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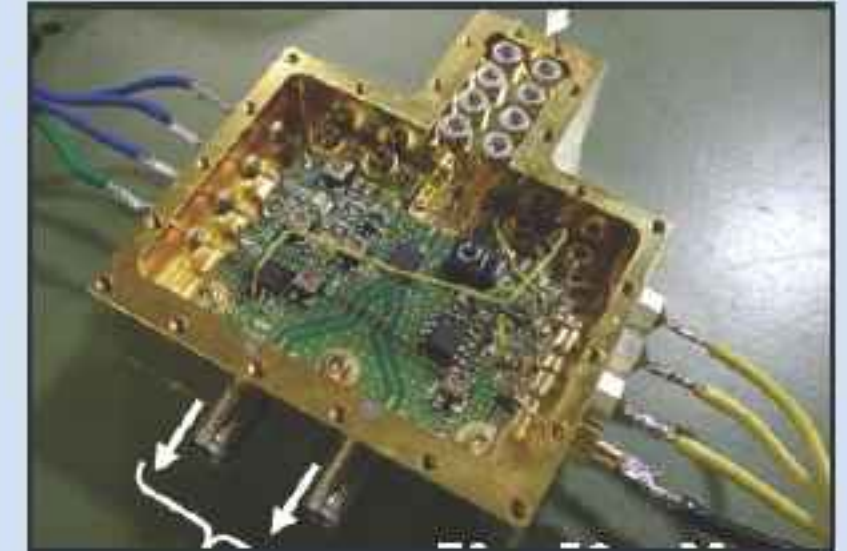
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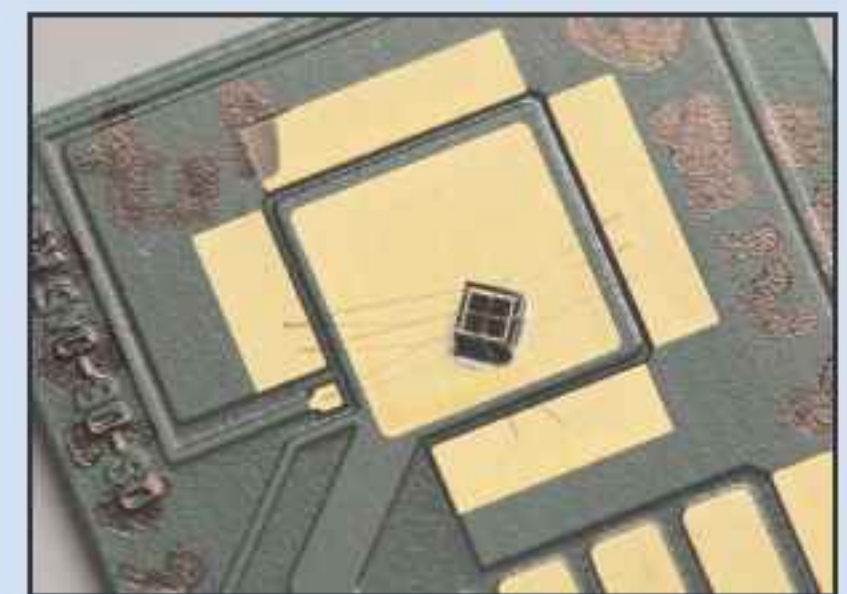
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**p20** Fujitsu's new impulse-radio RF receiver, which incorporates InP HEMT components.



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**Cover:** Osram Opto Semiconductors' new mini laser bars emit at wavelengths of 910–1020nm. Output and beam parameters have been matched so the light beam can be coupled more efficiently into a small fiber core diameter with a restricted acceptance angle. **p45**



# Making gains from energy efficiency

This issue includes market news (on pages 5–7) that highlights the strong growth in sectors of the LED market. The penetration of LED backlighting into LCD-TV panels is forecast by iSuppli to grow 13-fold from just 3% this year to 39% in 2013 (or from 438,000 units in 2008 to 90 million in 2013), driven by a shrinking of the price gap between white LEDs and incumbent cold-cathode fluorescent lamps (CCFLs) as well as adoption by LCD-TV makers including Korea's Samsung and LG. Correspondingly, the number of LEDs used in LCD backlights is forecast by DisplaySearch to more than quadruple from 8bn in 2008 to 34bn in 2012, becoming the largest LED market segment (at nearly 35%). Apart from benefiting established LED makers like Nichia and Toyota Gosei, it should also benefit other suppliers, including Samsung LED (formed in April) and Taiwanese display makers such as Chi Mei that have moved up the supply chain into making LEDs.

Another factor is the 'green' initiative to cut energy consumption, which is also driving what ElectroniCast forecasts to be annual growth of almost 31% in the LED market for solid-state lighting, from about \$338m in 2008 to nearly \$1.3bn in 2013 (see pages 38–42 for news on LEDs).

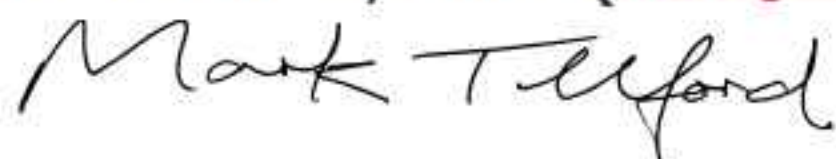
On pages 44–48 we report news from the LASER 2009 event in Munich, including launches of lasers by Opnext, JDSU, Osram and Oclaro (re-branding itself after its creation by April's Bookham–Avanex merger, followed by the acquisition of Newport Spectra Physics' high-power diode laser business). Like Oclaro (which has entered the eye-safe laser diode market), 3S Photonics has also continued to adapt its telecom-based technology to diversify into lasers for industrial applications, now boosted by new investment as well as French government funding for that purpose (see page 49).

On pages 13–25 we report news from the International Microwave Symposium. Apart from new GaAs products (including RFMD's first amplifiers operating above 20GHz), IMS 2009 also saw further launches and demonstrations of GaN device technology by Cree, Toshiba and Fujitsu (which reported the first 100W-class X-band amplifier with efficiency of more than 50%). In addition, RFMD unveiled its GaN foundry service, targeting applications that are largely complementary to rival TriQuint's GaN foundry (for lower-power, higher-frequency applications).

RFMD has also outlined its collaboration with the US National Renewable Energy Laboratory (NREL), which aims to commercialize and develop high-volume manufacturing of high-performance photovoltaic cells (in RFMD's main 6-inch GaAs production fab) — see page 63.

Meanwhile, concentrating photovoltaic (CPV) technology is continuing to establish itself, with Concentrix's systems at its 2MW plant in Spain now feeding the power grid with efficiencies of up to 23%, while CPV system maker SolFocus has closed its Series C funding round at \$77m (page 60). Furthermore, after setting an efficiency record of 28.3% for single-junction solar cells, UK-based QuantaSol has raised funds to develop a triple-junction variant of its strain-balanced quantum-well solar cells, which promise even greater efficiencies than current triple-junction technology (see page 57).

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#### Regular issues contain:

- news (funding, personnel, facilities, technology, applications and markets);
- feature articles (technology, markets, regional profiles);
- conference reports;
- event calendar and event previews;
- suppliers' directory.

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## PON grows 9% in Q1/2009, boosted by China build-outs, FiOS and Japan

Passive optical network (PON) equipment revenues grew 9% sequentially in first-quarter 2009, despite a weak global economy, according to the 'Access Quarterly Report' from market research firm Dell'Oro Group. Both Gigabit PONs (GPON) and Ethernet PONs (EPON) had robust sequential growth.

"It appears the weak economy has yet to have a major impact on existing PON projects as operators continue to hold to their strategy of increasing user bandwidth to create new revenue streams," says president Tam Dell'Oro. "PON revenue growth in the first quarter was higher than what we had expected due to rapidly increasing EPON build-outs in China,

strong GPON ONT [optical network unit] shipments for Verizon's FiOS service, and continued strong EPON demand in Japan," he adds.

Mitsubishi remained the leader in the overall PON market, benefiting from being the primary EPON supplier to NTT, Japan's largest service provider. Alcatel-Lucent recaptured the number two position, with higher GPON ONT shipments to Verizon. Huawei's nearly doubled its revenue share from last quarter and vaulted to the number three spot due to strong EPON shipments to China, as well as higher GPON shipments to customers in Europe and the Middle East, the report concludes.

[www.DellOro.com](http://www.DellOro.com)

## Mobile market fell 11.9% in Q1/2009

In first-quarter 2009, the worldwide mobile phone market shipped 35 million fewer units than a year ago, fulfilling an expected trend that will last throughout 2009, according to the report 'Mobile Devices Market Forecast Analysis' from ABI Research.

The mobile phone industry has long been characterized by its seasonal trends, where the first quarter always delivers a sequential decline after a busy holiday season. However, the drop this year was especially sharp, says ABI Research's practice director Kevin Burden. "The 255.6 million handsets shipped represented a 20% decline from Q4/2008, which was already a down quarter, and a nearly 12% decline from Q1/2008."

Shipment reductions are a new reality for the mobile phone market. "The industry and consumers have gone into protection mode," says Burden. "Protecting profitability has led handset manufacturers to produce less and to operators and

retail outlets holding smaller inventories," he adds. "Consumers are also realizing that many of the features they desire are already in the handset they currently use, and are willing to forego an upgrade until they have more confidence in their own futures."

The Asia/Pacific region, with handset volumes triple that of the next largest region, had been widely expected to feel more than a fair share of pain due its very troubled economic conditions. However, it posted a year-on-year decline of just 8%, which was a spot of encouragement. However, the Latin American market tempered any encouraging news with a reminder of how deeply the recession can cut. The region had a nearly 28% decline in shipments (the largest decline of any region), due in large part to the devaluation of its currencies leading to higher prices of imported mobile phones, ABI Research concludes.

[www.abiresearch.com](http://www.abiresearch.com)

### IN BRIEF

## Ultra low-cost handset surge in China & India to reach 300m by 2013

Ultra low-cost handsets (ULCH) — those selling for \$35 or less — will determine the success of operators and vendors in emerging markets, according to the report 'ULCH- A Key to Success for Vendors and Operators in Emerging Markets' from the Strategy Analytics Emerging Markets Communications Strategies service. More than half of the 300 million ULCH expected to be sold in 2013 will go to emerging markets, with China and India playing a crucial role in driving the growth.

Between 2007 and 2013, the ULCH share of global handset sales will triple, as operators try to attract new users. "Emerging markets have a huge untapped population," says report author Rahul Gupta, manager Emerging Markets. "But it's a population with limited spending power. A low-cost handset has to be part of the strategy of any operator or handset vendor trying to get a piece of this market," he adds.

"The most important issue for operators seeking to benefit from low-cost handset development is to choose suppliers who have global scale in purchasing, product design and brand," says Chris Ambrosio, executive director of the Strategy Analytics Global Wireless Practice.

The report also points out that low-cost alone is not sufficient; and the need to provide a limited set of rich applications (such as embedded gaming and FM radio), along with the expansion of distribution and service networks into rural areas, compounds the challenges that operators and device vendors have in developing ULCH offerings.

[www.strategyanalytics.com](http://www.strategyanalytics.com)



## LED replacement lamp market to grow at 107% to 2013

Although the market for LED replacement lamps is still in its early stages of development, conditions are right for it to accelerate in the next few years, with lamp revenues forecast to grow at a compound annual growth rate (CAGR) of 107% through 2013, according to Strategies Unlimited's report 'LED Replacement Lamps — Market Analysis and Forecast, 2009', which analyzes five LED-based lamp types designed to replace lamps: A-lamp and globes; PAR and R lamps; MR 16s; candelabra and decorative lamps; and linear fluorescent tubes.

Dramatic improvements in commercially available LED performance in recent years, as well as significant cost reduction, has made it feasible to design LED lamps to offer comparable lumen output and to compete with other established lighting technologies on the basis of cost of ownership, says the firm. The market is in a state of flux as utilities, energy-efficiency organizations and cus-

tomers look for optimum solutions that save energy, minimize the cost of ownership, and give acceptable quality of light. Customers are in the process of being educated about comparing the cost of ownership rather than the initial price of lamps.

Regulations in Europe will ban the 100W incandescent clear glass lamp starting in September, and will progressively ban all inefficient incandescent lamps by 2012 and all incandescent lamps by 2016. The Energy Information and Security Act of 2007 began the process of restricting the sale of inefficient lamps in the USA. By 2012, with a few exceptions, inefficient incandescent lamps cannot be sold.

Although awareness of these regulations in the marketplace is still weak, they will create market opportunities for LED replacement lamps, believes Strategies Unlimited. Recognizing the potential of LED technology to save energy, policy

makers have been supporting R&D on LED technology and helping its commercialization.

In the short term, while LED replacement lamps become a viable alternative, regulators are encouraging compact fluorescent lamps (CFLs). However, over the next five years the advantages of LED technology over CFL will be recognized, especially with respect to the quality of light, dimmability, controllability, lamp life, and environmental cost of ownership, says the market research firm. Some well-designed LED lamps already offer effective lumen efficacies that compete with CFLs.

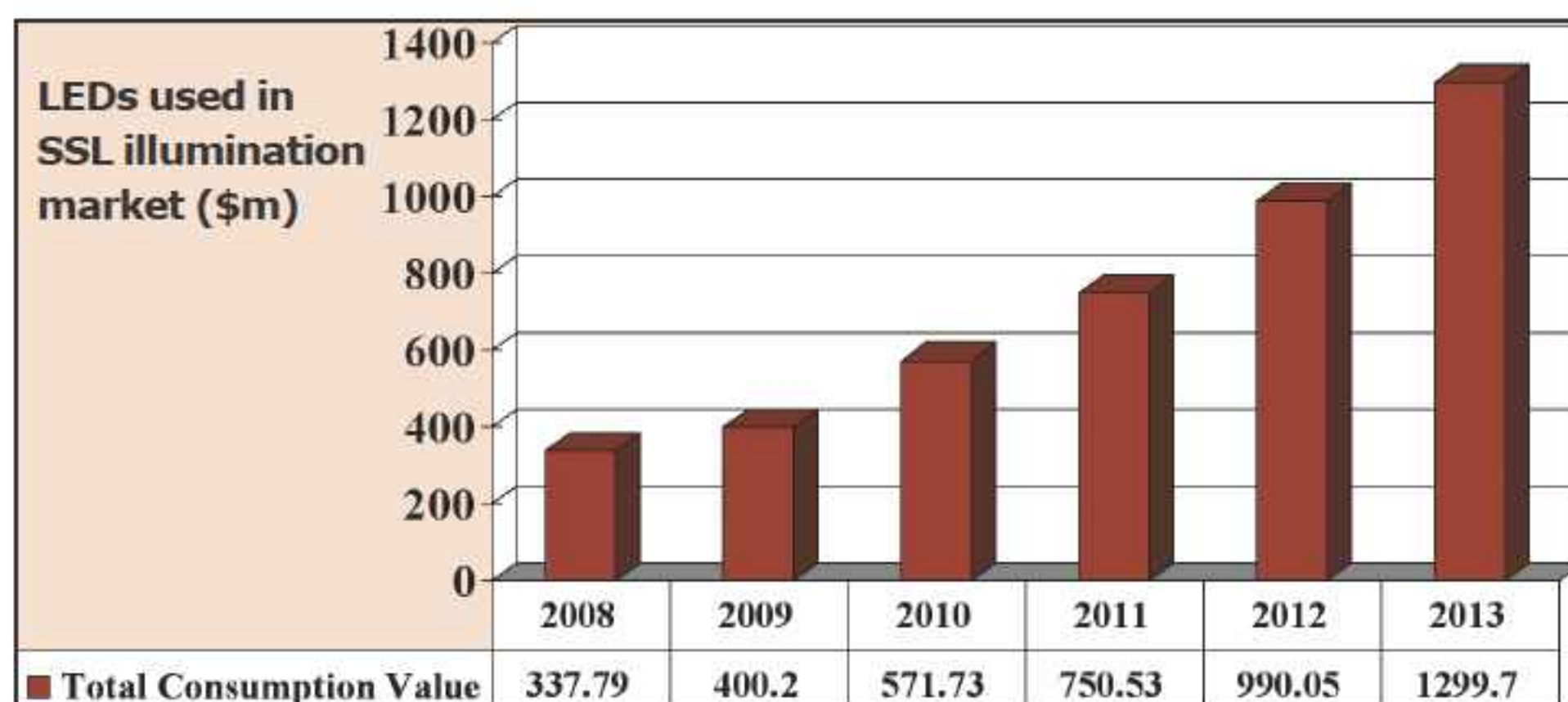
The commercial and industrial segments will embrace LEDs to control costs and save energy, forecasts Strategies Unlimited. The LED lamps will be used for directed light applications, in hard-to-reach places, and where the cost of replacement is very high.

[www.strategies-u.com](http://www.strategies-u.com)

## LED lighting market to grow at 30.9% to \$1.3bn in 2013

The global consumption of packaged LEDs in solid-state lighting (SSL) illumination rose from \$283.95m in 2007 to \$337.79m in 2008, and is forecasted to increase at an average annual growth rate of 30.9% to nearly \$1.3bn in 2013, according to a new report 'LEDs Used in Solid-State Lighting Illumination Global Market Forecast and Analysis (2008–2013)' from ElectroniCast Consultants. This is despite continually declining average prices partially offsetting the strong unit growth.

"The market for interior LED solid-state lighting in retail stores and food service is set to expand by a factor of over 15x in five years in the USA," says Stephen Montgomery, ElectroniCast's director of LED research projects. "Green-tech concerns, the excitement of integration possibilities of innovations, as well as the creation of more sophisticated lighting designs and aesthetic quality or effect, are only



a few of the market dynamics in this field," he adds. "However, the excitement of these possibilities will require a stronger sense of strategic market branding by the LED industry to counter consumer-level concerns of initial sticker-price shock."

In 2008, residential and commercial/government exterior lighting fixtures (landscaping, pool/fountain, buildings, bridges, architectural and other general lighting) applications represented an 85% share of LEDs

used in solid-state lighting illumination. The channel lettering lighting/light-box (signage) application represented a 9% share.

"High-brightness LED (HB-LED) concepts offering low voltage and operating with low running costs as well as enabling increased longevity with reduced maintenance costs are attractive strengths for LEDs versus the weaknesses of traditional forms of lighting," says Montgomery.

[www.electronicast.com](http://www.electronicast.com)



## LED-backlit LCD-TV penetration to grow 13-fold by 2013

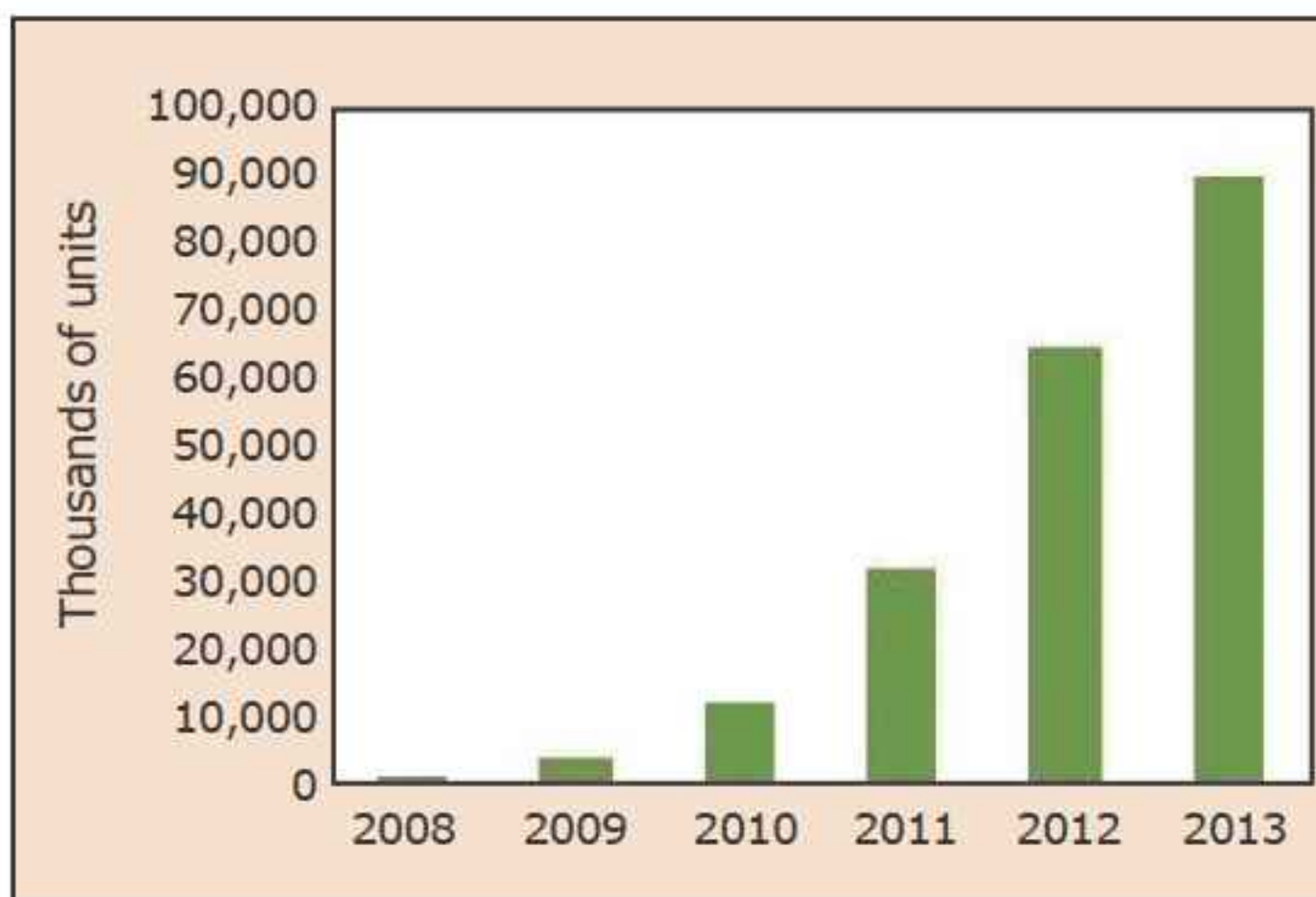
As prices of LCD panels that use LED backlights fall in the coming years, their use in televisions is set to explode, predicts market research firm iSuppli Corp.

Global shipments of LCD-TV panels with LED backlighting will rise from just 438,000 units in 2008 to 90 million units in 2013, says the firm. Penetration of LED-backlight technology in LCD-TV panels will grow 13-fold, from 3% in 2009 to 39% in 2013.

"The price gap between LEDs and the cold-cathode fluorescent lamps (CCFLs) traditionally used for LCD backlighting has narrowed due to the higher yield rate of LEDs, as well as the oversupply that resulted in a drastic price reduction for LEDs in the second half of 2008," says Sweta Dash, senior director, LCD research. "And with the advent of green technology, power savings and thinner form factors, more branded manufacturers are looking at LED-backlit LCD-TVs in 2009. These factors are spurring brand-name television manufacturers to adopt LED backlighting."

Branded TV makers have offered LED-based LCD-TVs for some years now without much success, mostly due to a higher price and larger cost differential between LED and CCFL products, says iSuppli. But there is renewed interest in LED-backlight-based LCD TVs with the use of white LEDs. Instead of focusing only on color gamut, picture quality and high-end RGB solutions, manufacturers are starting to concentrate more on thinner form factors and lower power consumption with the use of side-mounted white LED backlighting.

The lower price differential between CCFL and white LED solutions, combined with the lure of thin TVs, has led to an increasing adoption rate of LED-based TVs, says the market research firm. Branded manufacturers such as Samsung are also focusing on shifting a significant portion of their LCD-TV offerings to LED backlights.



Forecast global shipments of LCD-TV panels equipped with LED backlights (2008–2013).

For LCD-TVs, panel suppliers are offering products with 120Hz frame rates with edge-lit LED backlights to achieve thinner form factors, lower power consumption and mercury-free 'green' attributes. In some cases, the use of LED backlights can lead to power savings as high as 30–50%, says iSuppli. Thickness and weight savings can also be as high as 30–50%.

**Global shipments of LCD-TV panels with LED backlighting will rise from just 438,000 units in 2008 to 90 million units in 2013, says iSuppli. Penetration of LED-backlight technology in LCD-TV panels will grow 13-fold, from 3% in 2009 to 39% in 2013**

Owing much to the 'green' initiative in many countries, statutory requirements for lower-power TVs are expected in the next few years, and this may lead to faster adoption of LED backlights. Also, in a consumer survey in the April edition of iSuppli's US 'TV Consumer Preference Analysis', more than 50% of US consumers take into account the 'green initiative' factor when buying TVs.

However, because LEDs also are used for general lighting purposes, there has recently been some concern about LED chip supply. Furthermore, the LED backlight supply chain is still evolving, with varieties of solutions and many different suppliers that need to

be involved. Already, panel suppliers are either entering joint-venture partnerships or developing their own in-house LED solutions to streamline the value-chain process, reduce costs and gain better control over the supply, comments the market research firm.

New innovations and higher performance will speed the adoption of LEDs in TVs in the years to come. The price difference for LED versus CCFL TV systems may range from \$300 to \$700, depending on the size and type of LED used. However, the gap is expected to narrow in the future, and many branded TV manufacturers are planning new LED-based TV models with very aggressive prices in second-half 2009.

Given the current high price gap between CCFL- and LED-based LCD-TV sets and panels, panel suppliers are hoping to reduce the price difference to less than \$100 for 40/42-inch panels (compared to more than \$150 currently) and to less than \$150 for 46-inch panels.

With increasing importance being placed on lower power consumption and green initiatives, more stringent requirements for TVs are expected in the future. LED backlights will enable next-generation TVs to fulfill those requirements, concludes iSuppli.

[www.isuppli.com](http://www.isuppli.com)



## Backlight LEDs to grow from 8bn in '08 to 34bn in 2012

The number of LEDs used in TFT LCD backlights (in sizes ranging from 1" to more than 70") will rise more than 300% from 8bn in 2008 to 34bn in 2012, forecasts DisplaySearch in its report *Display LEDs: Lighting Up the Display World*.

A total of 70.8bn LEDs were shipped in 2008 (see table). In particular, there are two categories of LEDs used in display applications: active outdoor displays, which used 11bn LEDs (15% of the total), and LCD backlights, which consumed 8bn (11%). Within LCD backlight applications, five key types are adopting LEDs: small/medium, notebook PC, desktop monitors, industrial applications, and most notably TV. In the TFT LCD market, LEDs have been a hot topic especially due to their rapid adoption in notebook PC displays and their potential in LCD TV panels.

With the fast growth in LED outdoor displays and backlights, DisplaySearch forecasts that in 2012 display LEDs will claim a 34.7% share of the global 167bn unit LED market — including 24bn (14.7%) for active outdoor display and 34bn (22%) for LCD backlights — making display LEDs the largest market segment.

Low-current LEDs will be the mainstream type used in large-area LCD backlights, due to cost, thermal management and luminance efficiency requirements. In contrast, high-power LEDs, with a driving current higher than 350mA (more than 1W), are not well suited for LCD backlights due to thermal issues, and will mainly be used in general lighting applications that require high brightness.

Shipments of LED backlights for large-size (10"+) TFT LCDs will grow 25-fold from 2008 to more than 368m in 2012, forecasts DisplaySearch (Figure 1). Side-view LEDs enable slim design and dominate small/medium LCD backlights. In contrast, large-size (10"+) LCD backlights typically use top-view LEDs. With the increased penetration of LED backlights in notebook PCs and

increasingly TVs, top-view LED shipments will pass side-view in 2010.

The penetration rate of LED backlights in notebook PCs will reach 52% in 2009 and grow rapidly to 81% in 2010, forecasts DisplaySearch. In LCD TV, the penetration rate will ramp up from 3% (3.6 million units) in 2009 to 10% (15 million units) in 2010. Leading LCD TV brands including Samsung, Philips, Sharp, Sony, Toshiba, Vizio and LG are planning increased use of LED backlights starting in second-half 2009. A driving factor is the change in LED backlight structure from direct to edge light type, which reduces the cost premium over cold-cathode fluorescent lamp (CCFL) backlights. Finally, LED backlights in desktop monitors are expected to reach 31m units in 2012.

Eyeing the growing LED needs for their panels, nearly all panel makers are participating in the LED business through new LED firms or investments in existing manufacturers. DisplaySearch reckons that Nichia and Toyota Gosei will continue to dominate the market for blue and white LEDs for LCD backlights over the next three years due to their strong patent portfolios and customer relationships. However, Samsung LED, Stanley, Citizen, Showa Denko, Seoul Semiconductor

and Osram are targeting growth in LED backlights for LCD TVs. Finally, Taiwanese manufacturers such as Lite-On, Chi-Mei Lighting, Lighthouse and Everlight are entering the backlight market with low-cost structures.

The report also forecasts that LED revenues for outdoor displays will reach \$1bn in 2009 and grow to \$1.5bn in 2012. The use of LED outdoor displays in the 2008 Beijing Olympics provided international visibility, and such events will be a driving force for growth in the coming years, says DisplaySearch.

"LEDs will create new growth for the TFT LCD industry due to characteristics such as lowering power consumption, meeting green requirements, adding dimming capability, improving color performance, and enabling slim and light form factors for LCD panels and applications," notes Yoshio Tamura, VP of DisplaySearch and the component research team leader. "TFT LCDs also provide new vigor to the LED industry, as they open up broader applications requiring higher quality and more advanced technology... The interaction between the LCD and LED industries can be viewed as a key development in electronics in the coming decades," he adds.

[www.displaysearch.com](http://www.displaysearch.com)

### LED demand by application (millions of units).

Application	2007	2008	2009	2010	2011	2012
<b>Backlights</b>						
Notebook PC	127	532	3503	6230	8193	8873
Desktop monitor	0	5	145	585	1032	1789
LCD TV	16	150	1461	4890	10,525	15,102
Large others						
(inc industrial)	4	189	475	701	879	1114
Small/medium	6662	7253	6046	6768	7059	7244
<b>Backlights total</b>	<b>6809</b>	<b>8129</b>	<b>11,630</b>	<b>19,174</b>	<b>27,688</b>	<b>34,122</b>
Outdoor display	8755	10,947	11,584	12,941	16,809	24,481
Signal	1512	2125	2582	2925	3302	4991
Automotive	3665	4587	5371	6213	7582	10,681
Illumination	3606	4755	6148	7919	10,679	14,882
Others	44,314	40,245	38,491	46,716	51,504	77,854
<b>Total</b>	<b>68,662</b>	<b>70,788</b>	<b>75,806</b>	<b>95,887</b>	<b>117,564</b>	<b>167,011</b>



## Skyworks passes RFMD in power amplifier market share

RF Micro Devices of Greensboro, NC lost its lead in the power amplifier market to Skyworks Solutions Inc of Woburn, MA in 2008, according to a report from Strategy Analytics' RF & Wireless Component market research service, which explores changes in the handset and cellular device power amplifier (PA) market due to the economic slowdown and contraction in cellphone shipments, and what this means to PA suppliers in 2009 and beyond.

"The transition from the frenetic demand in the first half of 2008 to a severely depressed Q4 caught many PA suppliers off guard," says report author Christopher Taylor, director of the RF and Wireless Components service. The rapid growth of handsets has pushed the PA market to \$2bn per year, driving the fates of the two largest suppliers, Skyworks and RFMD, which are both depend-

ent on PAs for most of their revenues despite diversification efforts. Both firms and their competitors have invested heavily in new PA products and technologies to meet the demands of the cellphone OEMs for ever more bands, higher data rates and lower PA prices.

PAs for mid-priced handsets took the brunt of the slump, and so suppliers with a high share in PAs for low-cost handsets and PAs for higher-end 3G handsets fared better than suppliers with broad portfolios at all price and performance points. In particular, this helped suppliers of GPRS PAs and RFMD's W-CDMA PA competitors Skyworks, Avago Technologies of San Jose, CA and TriQuint Semiconductor Inc of Hillsboro, OR. "Both Skyworks and RFMD ended the year with close to one-third of the market, but Skyworks edged slightly ahead of RFMD," says Taylor.

However, in 2009 RFMD should regain its lost position at the top and, as the global economy and the market recover, RFMD, Skyworks and TriQuint stand to benefit the most from the trends in cellular devices, forecasts Strategy Analytics.

"Compound semiconductor-based PAs will continue as the enabling technology for the high-growth 3G and emerging 4G markets," says Asif Anwar, director of Strategy Analytics' GaAs and High Speed Semiconductor service. "However, silicon-based PAs have started to gain traction in low-cost 2G handsets, as underscored by the recent acquisition of CMOS PA supplier Axiom Micro Devices by Skyworks. This acquisition should help Skyworks to maintain share in the recession-resistant low-cost segment of the market," he reckons.

[www.strategyanalytics.com](http://www.strategyanalytics.com)

## Consumer broadband demand driving GaAs growth for satcom/VSAT

Long design cycles and pent-up demand driven by the consumer sector will allow the VSAT (very small aperture terminals) market to weather the current economic storm better than most communications markets, translating into steady demand for GaAs devices, concludes the Strategy Analytics GaAs and Compound Semiconductor Technologies (GaAs) service report 'GaAs Device Opportunities from the Satcom/VSAT Market: 2008-2013'.

GaAs technology is used extensively in VSAT satellite communications systems for both the space and ground segments of the market. Consequently, GaAs device demand will grow at a compound annual average growth rate (CAAGR) of more than 4% from 2008 to 2013, forecasts Strategy Analytics. Monolithic microwave integrated circuits (MMICs) will dominate the volume and represent 57% of total GaAs revenues in the sector.

"The VSAT industry has had to learn some tough lessons over the past decade, but the result is a model focused on value-added services which is now being augmented by growth prospects in the broadband access arena," notes Strategy Analytics' Asif Anwar. "Advances in technology and economies of scale have combined to increase data rates while simultaneously reducing prices, opening up the opportunities for satellite communications to compete against other wireless and wired broadband technologies. We believe the demand for broadband services will fuel the rollout of VSAT systems through 2013, creating steady demand for GaAs semiconductors," he adds. "The largest opportunities are for Ku- and Ka-band power amplifiers where, despite some threats from alternative technologies, GaAs will remain the dominant solution."

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## 802.11n grows as overall WLAN market shrinks 15% in Q1/09

In Q1/2009, the wireless local-area network (WLAN) market contracted more than 15% over the prior quarter, led by a sharp decline in the enterprise market, according to Dell'Oro Group. The SOHO WLAN market fared better than enterprise as sales of wireless routers, particularly 802.11n, buoyed the market.

"While 802.11n revenues increased in both the SOHO and enterprise WLAN segments in the first quarter, the sequential gain was more pronounced in the SOHO wireless router category," says WLAN research analyst Ben Kwan. "Users opted to pay higher prices for the higher performance of 802.11n wireless routers, propelling 802.11n sales to become the majority of the market. Strong retail brands, D-Link and NETGEAR, benefited the most from this increased demand," he adds.

Asia Pacific outperformed the total market due to growth in that region.

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## IN BRIEF

## Anadigics appoints VP of operations

GaAs-based broadband wireless and wireline communications component maker Anadigics Inc of Warren, NJ, USA has appointed Russ Wagner as vice president of operations.

Wagner joined Anadigics in September 2007,

when the firm acquired Fairchild Semiconductor's RF design team (where Wagner was general manager of Fairchild's



RF Power Group in Tyngsboro, MA).

With over 15 years of semiconductor industry experience, Wagner has held positions including:

- VP business & strategic development at Raytheon RF Components;
- VP finance & corporate development of Litton Systems Inc's Airtron Division; and
- chief financial officer, business unit general manager & board member at Laser Diode Inc.

At both Fairchild and Raytheon RF Components, Wagner was responsible for strategic and tactical management of operations, foundries, and world-class supply chain management.

Wagner achieved his B.S. degree from the University of Dayton and has pursued post-graduate work at University of Pennsylvania — Wharton, and the University of Chicago.

"Russ brings both extensive industry experience as well as a deep understanding of Anadigics' products and leading-edge technologies," says president & CEO Mario Rivas. "It's always positive to be able to promote from within the company... under his leadership we will accelerate the progress we have made to achieving operational excellence."

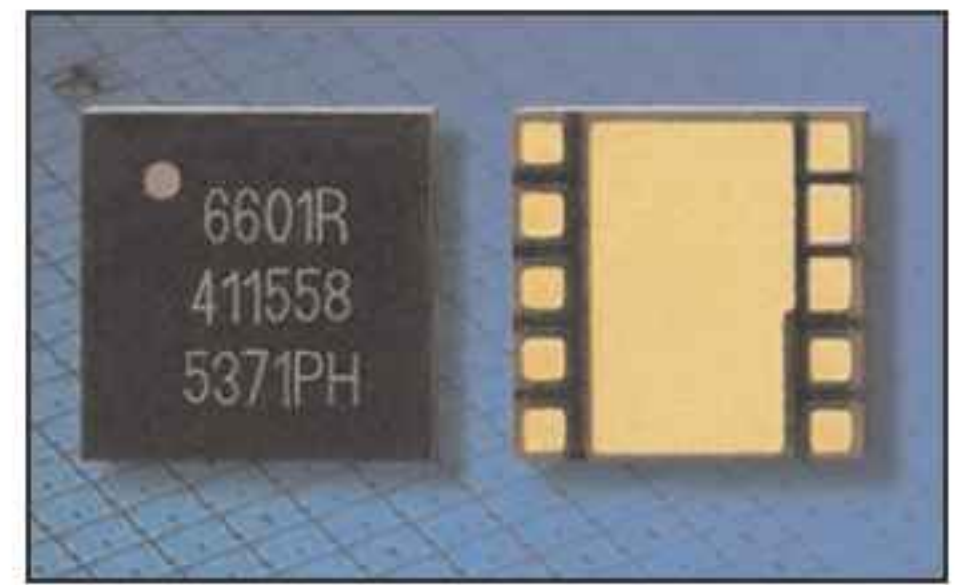
[www.anadigics.com](http://www.anadigics.com)

## WCDMA/HSPA PAs with daisy-chainable RF power couplers

Anadigics Inc of Warren, NJ, USA is sampling a family of WCDMA/HSPA power amplifiers (PAs) that incorporate daisy-chainable RF power couplers which enable simplified design of 3G handsets, data cards, modems and other types of UMTS subscriber devices. Volume production should start in Q3/2009.

Based on the firm's HELP3 technology (and, like all its WCDMA products, made using the firm's proprietary InGaP-Plus process), the new 3mm x3 mm integrated PAs are designed for 3G WCDMA/HSPA and HSPA+ mobile devices, and deliver both the high output power and linearity required by advanced 3G networks but with minimal battery current consumption, says the firm.

The RF coupler in each PA has typical 20dB directivity and 20dB coupling factor. Coupler input and output ports enable 'daisy-chain' RF designs, simplifying multiband 3G device board layouts. Each PA in the family is designed for optimized performance in a specific UMTS band:



The AWU6601 for UMTS2100 band 1.

- AWU6601 for UMTS2100 (band 1);
- AWU6602 for UMTS1900 (band 2);
- AWU6604 for UMTS1700 (bands 3, 4 & 9);
- AWU6605 for UMTS850 (bands 5 & 6); and
- AWU6608 for UMTS900 (band 8).

The new WCDMA power amplifiers suit 3G phones designed for single, dual, or multiple UMTS bands, says WCDMA/CDMA product line director Prasanth Perugupalli. "Their common footprint and built-in RF couplers give phone designers wider latitude in component placement and routing. In addition, the two-state logic simplifies phone calibration and shortens calibration time," he adds.

## Anadigics' PAs power LG's Arena handsets

Anadigics' AWT6224, AWT6321 and AWT6222 3G dual-band power amplifier (PA) modules are being used in LG Electronics' new Arena (KM900) multimedia touch-screen handsets for Europe, Asia and Central/South America.

The AWT6224 is a dual-band WCDMA/HSPA PA optimized for 3G connections in UMTS bands 1 and 8. The AWT6321 is a dual-band CDMA/EVDO PA designed for cell and PCS-band connections. The AWT6222 is a dual-band WCDMA/HSPA PA for 3G connections in UMTS bands 1 and 6.

The KM900 Arena provides tri-band GSM and 3G support, Wi-Fi and GPS connectivity, as well as Bluetooth and USB. Running on a new user interface called S-class,

it will be powered by a 1000mAh battery that should last for 300 hours of standby or 3 hours and 50 minutes of talk time. It also features mobile TV and a 5 megapixel built-in camera.

"Anadigics has been a long-standing, strategic supplier of RF front-end solutions to LG Electronics," says Dr Ali Khatibzadeh, Anadigics' senior VP & general manager, RF Products.

The firm says that its portfolio of 3G PAs enables OEMs to rapidly deliver multiple versions of a new platform to different operators worldwide. All three PA modules used in LG's Arena are available in identical 3mm x 5mm packages, reducing RF board area requirements and simplifying the layout.



## HRL receives Phase II COSMOS contract from DARPA

HRL Laboratories LLC of Malibu, CA, USA (a corporate R&D lab owned by The Boeing Company and General Motors) has received an 18-month Phase II contract from the US Defense Advanced Research Projects Agency (DARPA) to continue its work on the program Compound Semiconductor Materials on Silicon (COSMOS).

The goal of the DARPA/Air Force Research Laboratory program is to develop new methods to tightly integrate compound semiconductor technologies with complementary metal-oxide semiconductor (CMOS) circuits in order to achieve higher levels of circuit performance. The program targets high-dynamic-range (16 bit), high-bandwidth (500MHz), analog-to-digital conversion for challenging RF receiver applications, such as communications, radar and sensor systems.

After beginning in 2007 with an initial Phase I DARPA contract, last December at the IEEE's International

Electron Device Meeting (IEDM 2008) in San Francisco, HRL announced that it had successfully integrated silicon CMOS with indium phosphide double heterojunction bipolar transistors (DHBTs). The Phase I goal was to develop and demonstrate a viable process to integrate the two disparate materials silicon and InP which, when combined effectively, can dramatically improve linearity, dynamic range and bandwidth, according to HRL's COSMOS program manager Dr Ken Elliot.

"The new HRL technology also offers outstanding overlay accuracy, solves thermal expansion and stress issues, and maximizes connectivity between CMOS and InP transistors," Elliott adds. "No electrical degradation of the CMOS or InP HBT devices has been observed."

In addition, the integration process is fully compatible with the device and interconnect scaling needed for future technology generations, with the added benefits of a less costly

growth path and shorter time to market than potential alternative technologies, HRL reckons.

HRL says that the COSMOS technology could also represent the beginning of a paradigm shift for other materials and devices that should offer benefits if integrated with CMOS (e.g. enabling a more rapid development cycle for advanced systems-on-a-chip and emerging technologies). The development should result in higher bandwidth and lower-distortion signals for optical and RF communications.

Phase II of the program will focus on significantly improving both the yield and density of the heterogeneous interconnect process using HRL's 400GHz, 250nm InP HBT process combined with commercial 130nm CMOS. The program has a target of producing a 500MHz-bandwidth digital-to-analog converter with 13-bit dynamic range at the rated bandwidth.

[www.hrl.com](http://www.hrl.com)

## NXP boosts QUBIC4 BiCMOS technology with SiGe:C

NXP Semiconductors of Eindhoven, The Netherlands (formerly Philips Semiconductors) has extended the capability of its QUBIC4 BiCMOS silicon process technology, aiming to cost effectively deliver higher levels of integration and performance at high frequencies.

The firm claims that its existing QUBIC4 technology can speed the migration from GaAs components to silicon by enabling low-noise performance and IP availability (yielding improved voice, picture and data signal clarity with more bandwidth for two-way data transmission). In particular, QUBIC4 can help to speed satellite tracking and fix for GPS systems, improve base-station performance, enable e-metering utilities deployments as well as boosting WLAN, satellite and microwave radio applications.

Development of QUBIC4 BiCMOS has now resulted in three variants:

- QUBIC4+, which is silicon-based and suits applications up to 5GHz and medium-power amplification;
- QUBIC4X, the first SiGe:C variant, for devices operating typically at up to 30GHz and ultra-low-noise applications (e.g. GPS);
- QUBIC4Xi, the newest SiGe:C variant, which has an improved unity current gain cutoff frequency ( $f_T > 200\text{GHz}$ ) and a lower noise figure, suiting applications beyond 30GHz (e.g. VSAT and radar).

NXP says that the new variants of QUBIC4 now allow customers to incorporate more functionality into devices at a competitive cost and in less space, as well as enabling future generations of RF products such as low-noise amplifiers, medium-power amplifiers and LO generators (e.g. for applications in mobile phones and communications infrastructure equipment) to operate at a higher performance level.

"Consumers are continuously interacting with a growing number of mobile devices," says Stan Bruederle, research VP at market analyst firm Gartner. "However, as ever more data gets pushed down to these devices, the boundaries of performance and frequency are pressed to the limit," he adds. "The semiconductor industry is now enabling previously unachievable levels of RF integration and performance to ensure device manufacturers can capture emerging application markets."

"The RF market continues to be driven by consumer demands for greater levels of connectivity with mass-price cost structures," says John Croteau, VP analog mixed signal for NXP. "As a silicon-based technology with the performance of GaAs, QUBIC4 enables more robust, more integrated and more cost-effective solutions."

[www.nxp.com](http://www.nxp.com)



## Skyworks partners with energy providers to meet demand for smart meters for water, gas and electricity

Skyworks Solutions Inc of Woburn, MA, USA, which manufactures linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, says that it is partnering with several of the energy industry's top solution providers to meet the growing worldwide demand for smart water, gas and electric meter readers.

The strategic partnerships are enabling the firm to develop and ramp low-cost solutions for remote meter reading applications and smart grid technologies. Smart grids deliver power and energy from suppliers to consumers using digital technology, reducing utility and consumer costs while increasing system reliability. Governments

and utilities are actively promoting smart grids to address energy independence, global warming and emergency resilience issues, says Skyworks.

The firm's customers include Badger Meter, ESCO Technologies, Itron, Landis + Gyr Group, and Sensus. Each of these energy management providers are using Skyworks' front-end modules and linear products for their next-generation meters and advanced metering infrastructure (AMI) solutions.

"The energy management space has tremendous potential with several catalysts driving demand," says Liam K. Griffin, senior VP, sales & marketing. "The adoption of wireless technology provides a

compelling benefit to metering suppliers and utilities, and we are in the early stages of this global upgrade cycle," he adds. Skyworks is delivering a suite of customized analog solutions in support of the rapidly growing market.

Gartner expects more than 150 million smart meters to be installed worldwide in the next five years, with about 50% in North America – creating a cumulative semiconductor business of \$2bn by 2012. In the same December 2008 report, Gartner added that by 2012 consumers will be able to use personal communication devices (such as cellular phones) remotely to control the power consumption of electronics in their homes.

[www.skyworksinc.com](http://www.skyworksinc.com)

## Agilent process design kit provides MMIC design flow for TriQuint's TQPED E/D pHEMT process

Agilent Technologies of Santa Clara, CA, USA has made available a foundry-certified process design kit (PDK) to support the TQPED GaAs E/D (enhancement/depletion-mode) pHEMT process of TriQuint Semiconductor Inc of Hillsboro, OR.

Providing what is claimed to be the most complete MMIC design flow available using Agilent's Advanced Design System (ADS) platform, the new TQPED PDK completely renovates layout functions, adds many design automation and routing capabilities, and provides a MMIC toolbar personality to help streamline the MMIC design process. The PDK is available now from TriQuint.

One of the PDK's new capabilities is a TriQuint mailDRC function that can be launched automatically with the design embedded in an e-mail message. This allows users to easily and quickly obtain DRC results from TriQuint, through their Microsoft Outlook client, directly from Agilent's

Advanced Design System (ADS) environment without having to bother with translation steps. In addition, the PDK includes substrate definitions for Momentum (Agilent's integrated 3D planar EM simulator) to help decrease design cycle time.

"This PDK will make it easier than ever before to design low-noise amplifiers, power amplifiers and other integrated MMICs using the industry-leading TQPED E/D pHEMT process technology," says Glen Riley, VP & general manager of TriQuint's Commercial Foundry business unit.

"Given the popularity of the TriQuint TQPED process technology with our installed customer base, our continued collaboration with TriQuint is critical to providing future upgraded PDKs for TriQuint processes," says Jim McGillivray, VP & general manager of Agilent EEs of EDA. "Such upgrades will ensure that ADS users of TriQuint kits have a complete streamlined flow that supports the multiple EM

technologies integrated within ADS, like the Momentum tool," he adds. "Users will also be able to extract X-parameter models of their TriQuint designs either directly from ADS or through Agilent instrumentation, providing an accurate and complete unified behavioral modeling capability and further simplifying the design process."

ADS is an electronic design automation (EDA) software system that offers complete design integration for products such as cellular phones, wireless networking and GPS, radar and satellite communications systems, and high-speed digital serial links. ADS supports system and RF design engineers developing all types of RF designs, from simple to the most complex, from RF/microwave modules to integrated MMICs for communications and aerospace/defense applications.

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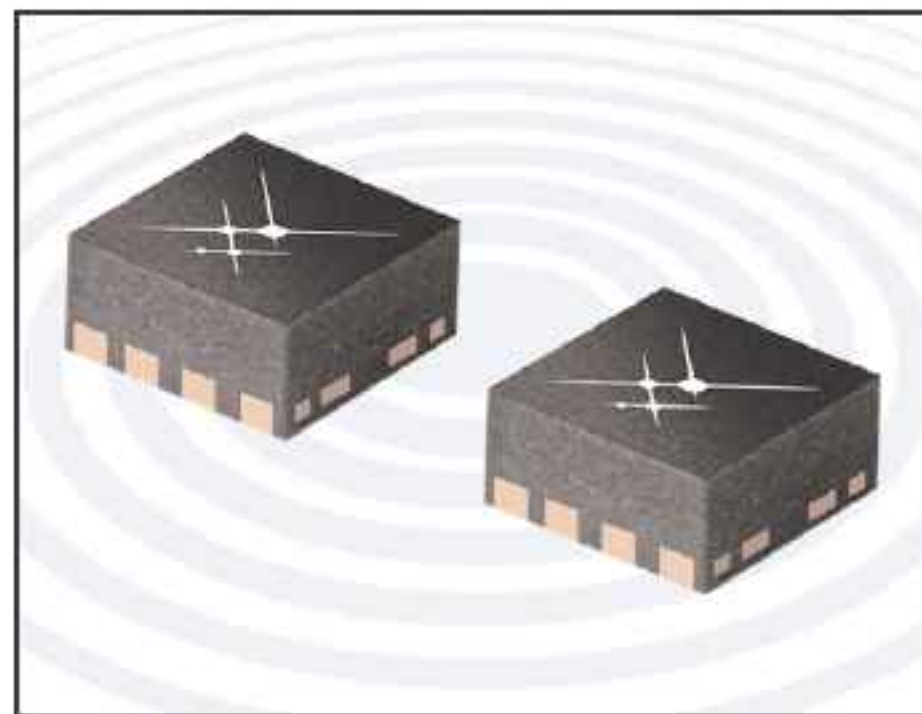
## Skyworks supplements to Linear Product portfolio with WLAN/WiFi power amplifier for HD video streaming and low-noise amplifier for high-performance receivers

At June's IEEE MTT-S International Microwave Symposium (IMS 2009) in Boston, Skyworks Solutions Inc of Woburn, MA, USA, which manufactures linear products, power amplifiers, front-end modules and radio solutions for handset and infrastructure equipment, launched two 2-stage, ultra-low-noise amplifiers (LNA) with high-linearity performance.

Fabricated using Skyworks' pHEMT process, the compact (2mm x 2mm) LNAs offer performance under 0.7dB while providing high-linearity amplification with OIP3 up to 35dBm. The SKY65037-360LF (operating at 0.7–1.2GHz) and the SKY65040-360LF (operating at 1.5–2.4GHz) have the flexibility of external tuning to set gain up to 25dB and supply current adjustment of 30–100mA. The quad flat no-lead (QFN) devices are lead (Pb)-free and restriction of hazardous substances (RoHS)-compliant.

The new LNAs serve demanding receiver applications including global positioning systems (GPS), satellite digital audio radio services, WCDMA and LTE (long-term evolution) infrastructure platforms, and ISM base-stations, repeaters and access points. Skyworks claims that its devices minimize system noise figure, improving receiver sensitivity and providing greater flexibility to meet a wide range of performance requirements.

"Today's new receiver specifications require low-noise-figure amplifiers with high-linearity amplification," says David C. Stasey, VP of analog components. "Our solutions meet these stringent parameters with a high degree of flexibility, balancing efficiency with power and linearity performance," he adds. "More importantly, these new solutions broaden our footprint into high-growth adjacent markets and further support Skyworks diversification strategy."

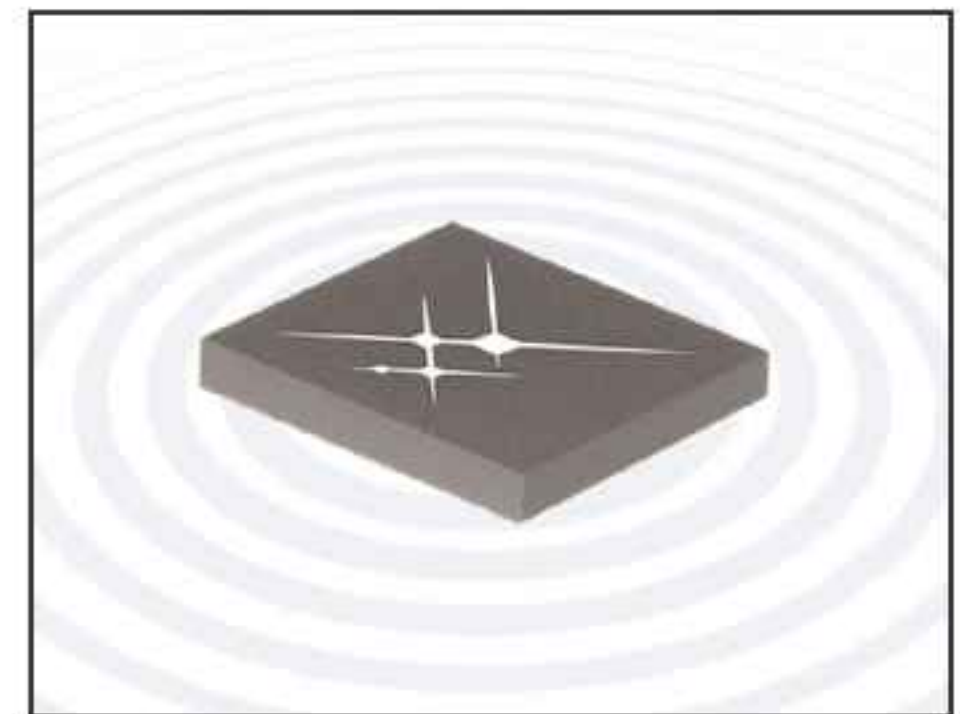


The 2mm x 2mm SKY65037-360LF and SKY65040-360LF LNAs.

Skyworks also announced the availability of samples of what it claims is the industry's highest-performance wireless local-area network (WLAN) and WiFi-certified power amplifier (PA) to meet demanding high-data-rate applications such as wireless high-definition (HD) video transmission. Volume production is scheduled to start in third-quarter 2009.

The SKY65137 is a microwave monolithic integrated circuit (MMIC) PA fabricated using Skyworks' indium gallium phosphide (InGaP) heterojunction bipolar transistor (HBT) technology. It is internally input-output matched in a 20-pin 6mm x 6mm multi-chip module (MCM) surface-mounted technology (SMT) package, enabling ease-of-use and faster time-to-market as well as higher performance, the firm claims. In addition, the SKY65137 delivers 24dBm linear output power at less than 2.5% error vector magnitude (EVM), enabling higher data rates at extended ranges.

The new SKY65137, along with other solutions in the product family, serve as a media gateway, allowing wireless access to an array of multimedia content from any room and replacing unwieldy cables currently required in the home. Additional applications include high-performance video gaming,



Skyworks' new SKY65137 MMIC power amplifier for WLAN/WiFi.

outdoor wide-range access points, and extended-range routers.

"Skyworks' new 5GHz solution increases the range and data rates of existing conventional WiFi gateways and clients, making it ideal for streaming video wirelessly in the home," says director of marketing Irene Song. "We are delighted to be at the forefront of powering a consolidated multimedia console that will allow consumers to wirelessly access their entire entertainment suite from any room."

Today's market is driving toward higher-performance, higher-data-rate wireless standards — particularly for video entertainment networking — which is driving the need for larger and faster data pipes. Channel bonding, which extends bandwidth by bonding two adjacent 20MHz channels into a single channel, can support this. Of the two WiFi frequency bands used currently, the 5GHz band (802.11a/n) supports many more channels than the 2.4GHz band (802.11b/g/n), making it more attractive to use for streaming video and other high data-rate applications. Besides 802.11a/n, additional 5GHz standards such as wireless home digital interface (WHDI) are being used to enable HD video transfer wirelessly in the home.

[www.skyworksinc.com](http://www.skyworksinc.com)

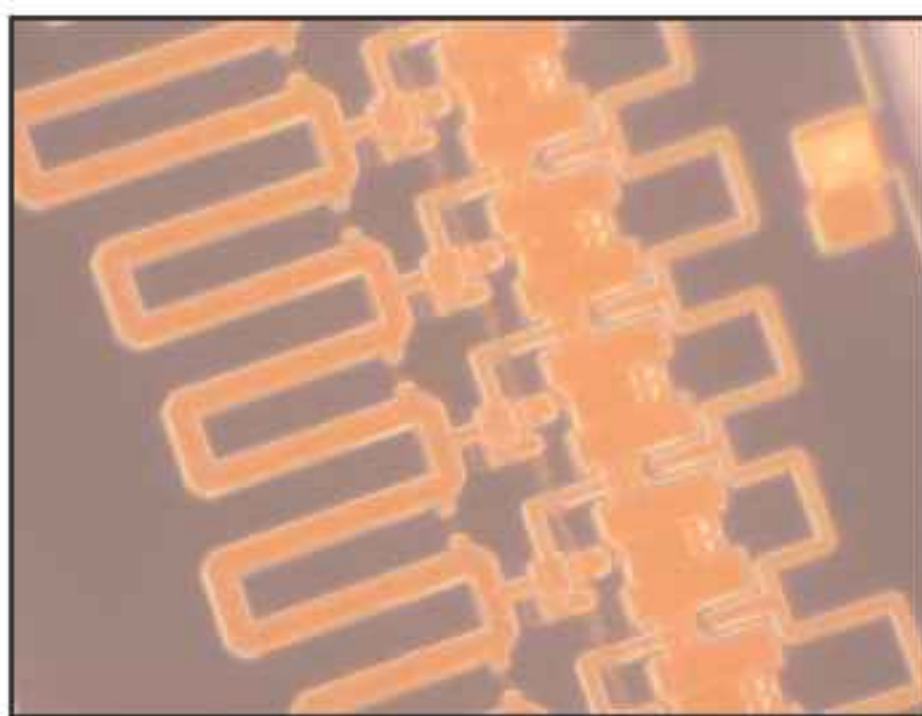


## GigOptix launches single-bias broadband power amplifiers

GigOptix Inc of Palo Alto, CA, USA, which designs optical modulators, drivers and transimpedance amplifier (TIA) ICs based on III-V materials, has extended its range of broadband amplifiers with the release of two new monolithic microwave integrated circuits (MMICs).

The iT2003 and iT2004 power amplifiers both offer an operating range of 2–20GHz and are designed for use in military and defense applications such as microwave amplifier assemblies.

Both are highly efficient broadband GaAs MMIC traveling-wave amplifiers with single-bias operation, which significantly eases design challenges by removing the need for a complex biasing network to manage the bias sequencing, says the firm. The iT2004 is designed for high-output-power applications, while the iT2003 supports medium-output-power applications.



Detail of GigOptix's iT2003 chip.

The iT2004 provides a saturated output power of 29dBm up to 7GHz and greater than 26dBm up to 20GHz. Average gain of 10dB with flatness of  $\pm 1$ dB is provided up to 20GHz. DC power consumption is as low as 3W and the input/output ports are AC coupled.

**The launch is just the first step GigOptix is taking to revitalize and strengthen our RF portfolio**

The iT2003 provides a saturated output power close to 27dBm up to 8GHz and greater than 25dBm up to 16GHz. Average gain is 15dB. DC power consumption is as low as 1.76W and the input/output ports are AC coupled.

"The launch of these two new products is just the first step GigOptix is taking to revitalize and strengthen our RF portfolio and to re-engage with customers in the RF field," says chief technology officer Andrea Betti-Berutto. "The iT2003 and iT2004 are following our RF products 'best in class' tradition by offering the best power efficiency of any single-bias broadband amplifier in the market," he claims.

Engineering samples of iT2003 and iT2004 die are available along with a test fixture. Packaged versions will be developed later this year.

[www.GigOptix.com](http://www.GigOptix.com)

## StratEdge launches new surface-mount package for VSAT, point-to-point, point-to-multipoint and WiMAX applications up to 30GHz Ka-band frequencies

At the International Microwave Symposium (IMS 2009) of the IEEE Microwave Theory and Techniques Society (MTT-S) in Boston in June, StratEdge of San Diego, CA, USA, which designs and produces packages for microwave, millimeter-wave and high-speed digital devices, launched its new high-frequency (DC–30GHz) SMX Series surface-mount package for applications such as test & measurement, VSAT, point-to-point, point-to-multipoint and WiMax.

The SMX 580495 is designed to provide good electrical transition performance for die up through the Ka-band frequency range. Transition loss is expected to be less than 0.5dB for frequencies up to 30GHz. The packages are made to provide wideband electrical performance

and incorporate copper composite bases for enhanced thermal dissipation. StratEdge says that these are true surface-mount packages that allow automated assembly and soldering for high-volume production of devices without sacrificing electrical and thermal performance. They are sealed with cup-shaped liquid crystal polymer lids with B-stage epoxy preforms or in conventionally hermetic configurations for military and aerospace applications.

The 580495 is a 10-lead design with six RF and four DC pins. The package incorporates a copper-composite base and Fe-Ni-Co leadframe attached to an alumina ceramic ring frame. The base is 0.278 inches x 0.315 inches and the cavity is 0.220 inches x 0.205 inches.

"Our new SMX package is the first of its kind — a completely hermetic, surface-mount solution for 30GHz applications," claims president & CEO Tim Going. The 580495 will be offered as a standard design, with samples and volume production quantities available in Q3/2009.

The SMX Series features surface-mount packages in various sizes and lead counts. With leads and base co-planar, SMX packages are designed for mounting directly on the circuit board, greatly reducing circuit board assembly costs. Such surface-mount packages can also simplify the circuit board layout as well as significantly reducing board design costs, adds StratEdge.

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## RFMD launches GaAs linear power amplifiers, broadband switches and high-frequency amplifiers

### RFMD launches high-efficiency linear PA for WiFi and WiMAX applications

At the IEEE MTT-S International Microwave Symposium (IMS 2009) in Boston, MA (9–11 June), RF Micro Devices Inc of Greensboro, NC, USA is introducing the RF5602, a 2GHz high-power, high-efficiency and high-linearity power amplifier (PA) designed for medium-power applications including consumer premises equipment (CPE) and access point (AP) applications for WiFi and WiMAX.

"RFMD's expanding product portfolio for WiFi and WiMAX applications provides global customers the breadth and flexibility they require to accommodate the rapidly growing demand for wireless connectivity," says Rohan Houlden, general manager of RFMD's Wireless Connectivity business unit. The firm says that the RF5602 delivers high output power while meeting requirements for linearity and low current consumption, easing implementation of traditional power supply, transmit efficiency and thermal performance concerns, Houlden adds.

Manufactured using RFMD's indium gallium phosphide (InGaP) heterojunction bipolar transistor (HBT) process technology, the RF5602 is optimized for use as the final RF amplifier in 802.16e/d and 802.11b/g/n applications. It is also applicable for 2.4GHz ISM-band applications, PCS communications systems, and WiBro 2.3–2.4GHz applications.

As well as providing strong linearity, the RF5602 delivers an error vector magnitude (EVM) of 2% at 26dBm output power (5.0V), 2% at 25dBm output power (4.2V), and 3% at 23.5dBm output power (3.3V).

Additional features of the RF5602 include integrated input power detector on die as well as 32–34dB of small-signal gain.

### High-isolation broadband switches added to multi-market product range

RFMD has expanded its RF component portfolio to include four new high-isolation broadband switches: the RF3021, RF3023, RF3024 and RF3025. Each of the symmetric single-pole, double-throw (SPDT) RF switches is designed to operate in multiple market segments, including cellular infrastructure, WiFi, WiMAX and antenna tuning applications for mobile devices.

RFMD's GaAs pseudomorphic high-electron-mobility transistor (pHEMT) technology enables the operating frequency band to be wider than other high-isolation switches, it is claimed (typically 6GHz versus 3.5GHz), while maintaining low insertion loss and high isolation. Also, each switch features an on-chip driver that enables a single voltage control line.

The RF3021 and RF3025 feature very high isolation and single-bit control. The RF3025 is an absorptive switch that features a 50Ω termination in the off-state. The RF3023 and RF3024 feature low insertion loss and moderate isolation, suiting general-purpose switching applications. The RF3021 and RF3025 are housed in a 16-pin 3mm x3mm QFN package, and the RF3023 and RF3024 in a 6-lead SC70 package.

Since RFMD's high-isolation broadband switches come in cost-effective plastic packages, compared to metal hermetic packages or in die form, pricing is up to 50% lower than competing switches, the firm claims: \$0.99 for the RF3021 and RF3025 and \$0.45 for the RF3023 and RF3024 (in volumes of 10,000).

Samples of the RF3021 and RF3025 were made available first, with samples of the RF3023 and RF3024 becoming available in July. RFMD expects volume shipments to start in the September quarter.

### RFMD expands family of packaged broadband high-frequency amplifiers for commercial, military and space applications

RFMD has added to its SUF family of products by making available samples of three new packaged broadband GaAs pHEMT high-frequency amplifiers that deliver what is claimed to be exceptional broadband frequency performance for commercial, military and space applications.

Available in small 3mm x 3mm QFN packages, the SUF-1033, -5033, and -8533 broadband amplifiers broaden the SUF family's performance range by offering multiple high-frequency gain blocks featuring small-signal gains of 10dB, 20dB and 15dB at the mid-band of their frequency ranges of DC–18GHz, 0.1–4GHz and DC–12GHz, respectively.

Each amplifier also features a single supply voltage (of 5V), low gain variation versus temperature, and 50Ω input/output match, promoting ease of design for global customers, it is claimed: customers across multiple markets can simplify their supply base by selecting amplifiers from a diverse portfolio.

The new family of SUF broadband amplifiers targets wideband gain blocks for military and space applications, high IP3 RF drivers, LO and IF mixer applications, and broadband test & instrumentation equipment, says Jeff Shealy, VP & general manager of RFMD's Defense and Power business unit.

The SUF-1033, -5033 and -8533 are packaged versions of die-level amplifiers launched by RFMD in second-half 2008. Supporting both die- and package-level products allows maximum flexibility for customers focused on multi-chip integration as well as radio board development, says RFMD.

RFMD expects product revenue in the September quarter.

[www.rfmd.com](http://www.rfmd.com)



## RFMD's first amplifiers above 20GHz; 35GHz distributed amplifiers precede 50GHz versions, then GaN HEMTs

RFMD has launched five new distributed amplifiers for broadband, high-frequency applications. The amplifiers operate at up to 35GHz and can support a wide range of high-frequency commercial, military and space applications.

Based on GaAs pHEMT technology, the SDA-1000 through 5000 series of distributed amplifiers range in operating frequency from DC-20GHz to DC-35GHz and represent RFMD's first amplifiers operating above 20GHz. Samples are available now, and product revenue is expected in the September quarter. Two follow-on amplifiers will extend the product family by delivering similar wideband high-frequency performance and noise figures but

at increased operating frequency of up to 40GHz and 50GHz.

The new family of distributed amplifiers has been designed specifically for high-frequency applications such as modulators, broadband test equipment, wideband gain blocks in military and space applications, and Mach-Zehnder modulator (MZM) laser drivers and clock drivers in fiber optics. "These new products deliver superior performance and provide a solid foundation for our broadband microwave amplifier product family," says Jeff Shealy, general manager of RFMD's Defense and Power business unit.

"We are also developing products with higher sensitivity, linearity and

multi-Watt power output exploiting advanced semiconductors like GaN and InP," says RFMD fellow Kevin Kobayashi. "Recently, we demonstrated as much as four times greater linearity and output power for GaN-based distributed amplifiers without compromising bandwidth or noise figure compared to our GaAs pHEMT products," he adds. "These will be attractive solutions for emerging applications and systems such as software-reconfigurable radios and 100 Gigabit Ethernet."

The performance of such GaN monolithic microwave integrated circuits (MMICs) was presented by Kobayashi at the Radio Frequency Integrated Circuits symposium during June's IMS 2009 event in Boston.

### WiFi portfolio expanded with switch and switch/LNA products

At June's IMS 2009, RFMD announced the expansion of its WiFi product portfolio to include samples of four new switch and switch/LNA products. The new family of front-end solutions is designed to address the need for high performance and continued size reductions in mobile WiFi applications, including cellular handsets, personal navigation devices (PNDs), digital cameras and MP3 players.

The RF5500, RF5501, RF5510 and RF5511 each contain a single-pole, three-throw (SP3T) switch designed to enable multi-path operation in the embedded segment of the WiFi, or WLAN, consumer electronics markets. The RF5501 and RF5511 also integrate a low-noise amplifier (LNA), providing reduced footprint area with low insertion loss for RF architectures requiring additional Rx gain.

RFMD is expanding its portfolio of

WiFi switch and switch/LNA products to address growing opportunities in WiFi-enabled mobile devices (with annual market growth expected to exceed 15% in 2010 and 2011), says Rohan Houlden, general manager of RFMD's Wireless Connectivity business unit. "This new family of products delivers a flexible, size-reduced solution to customers seeking to enhance the RF performance of 2.4GHz consumer and general market products."

## Broadband IC voltage control oscillators launched for military, satellite communications and industrial markets

RFMD has made available samples of the first product in its new family of broadband IC voltage control oscillator (VCOs). Targeting multiple RF markets, the RFVC1800 is a single-placement IC with integrated resonator and buffer amplifier.

"The highly integrated RFVC1800 draws upon RFMD's hybrid VCO design expertise to deliver a broadband, miniaturized MMIC VCO solution targeting performance-driven

RF requirements," says Jeff Shealy, VP & general manager of the Defense & Power business unit.

By integrating the buffer amplifier and resonator and providing a single 5V supply, the RFVC1800 reduces component count, streamlines engineering and promotes ease-of-use for global customers, says RFMD. Also, by delivering what is claimed to be excellent phase-noise performance and

broadband capabilities, it provides a highly integrated multi-purpose VCO that meets or exceeds stringent design requirements across multiple RF applications.

Manufactured using RFMD's GaAs HBT process and packaged in a small 4mm x 4mm QFN package, the RFVC1800 is optimized for use in radar, military communications, satcoms, test instrumentation and industrial/medical applications.

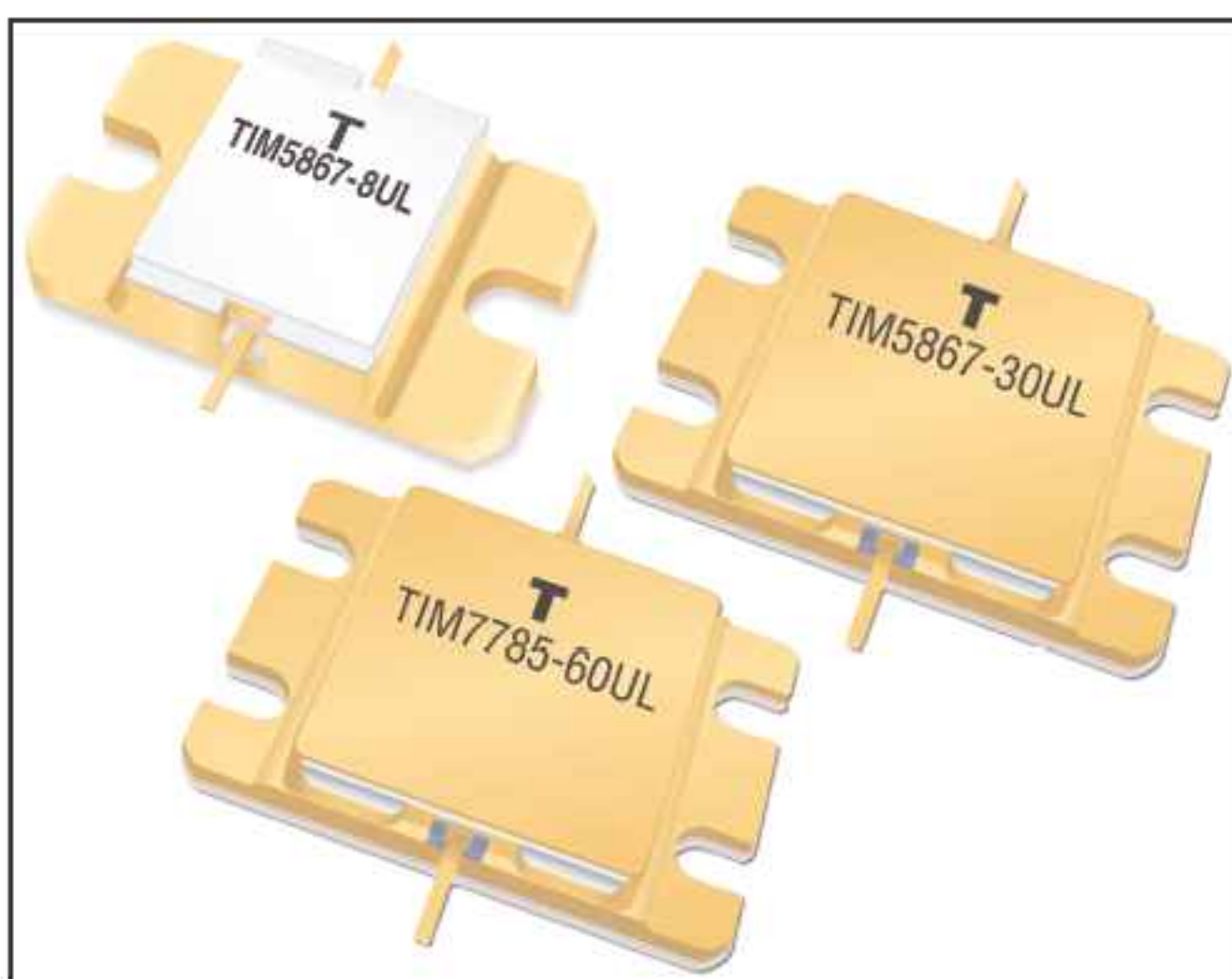


## Toshiba expands C-band GaAs FET lineup with PAs optimized for PAE in microwave digital radios and SSPAs

At the IEEE MTT-S International Microwave Symposium (IMS 2009) in Boston, Toshiba America Electronic Components Inc (TAEC) of Irvine, CA, USA and its parent company Toshiba Corp announced the expansion of its gallium arsenide field-effect transistor (GaAs FETs) lineup with samples of three new 24V devices optimized for enhanced power-added efficiency in microwave radios and solid-state power amplifiers (SSPAs).

Two new extended C-band GaAs FETs for microwave digital radios supporting point-to-point and point-to-multipoint terrestrial communications operate in the 5.85–6.75GHz range. The TIM5867-8UL has an output power at 1dB gain compression point of 8W (or 39.5dBm), linear gain of 10dB and power added efficiency of 36%. The TIM5867-30UL has an output power at 1dB gain compression point of 30W (45dBm), linear gain of 10dB, and power efficiency of 41%.

For satellite solid-state power amplifier (SSPA) applications, Toshiba has added the 60W TIM7785-60UL C-band GaAs FET



**Toshiba's C-band GaAs FETs for microwave digital radios and satellite solid-state power amplifiers.**

power amplifier, which operates in the 7.7–8.5GHz range and has an output power at the 1dB gain compression point of 48dBm, gain of 7.5dB and power efficiency of 36%.

"Toshiba has a broad power GaAs FET product family to support extended C-band, but many customers have asked us to upgrade the family using the latest process technology," says Hodayoun Ghani, business development manager,

Microwave, Logic and Small Signal Devices, in TAEC's Discrete business unit.

"High gain and high power added efficiency features will help designers build energy-efficient microwave radios," he adds.

"One of the design challenges with 7–8GHz SSPAs has traditionally been that they sometimes have a lower device gain compared to 5–6GHz parts, so designers

could not use the same lineup for 7–8GHz power amplifiers as they do for lower frequency amplifiers," says Ghani. The TIM7785-60UL offers 7.5dB of G1dB, which is a 1.5dB improvement over Toshiba's previous 60W product in that band. "The improved gain will help microwave designers reduce the number of parts in their overall system," he adds.

[www.toshiba.com/taec](http://www.toshiba.com/taec)

## High-gain, high-PAE X-band and Ku-band GaAs FETs for microwave radios and block up-converters

Toshiba has also expanded its GaAs FETs lineup with samples of three new power-added-efficiency enhanced GaAs FETs targeted at microwave radios and block up-converters (BUCs).

For microwave digital radios supporting point-to-point and point-to-multipoint terrestrial communications, the TIM1011-8ULA X-band GaAs FET operates at 10.7–11.7GHz, and has output power at the 1dB gain compression point of 8W (or 39.5dBm), linear gain of 9dB and power-added efficiency of 39%. Toshiba launched the similar TIM1011-8UL in 2008, but the new device is in a

2-11C1B package in order to support existing customers using legacy products.

For Ku-band, the TIM1213-8ULA (operating at 12.7–13.2GHz) is targeted at microwave radios for microwave links and the TIM1314-15UL (operating at 13.75–14.5GHz) is optimized for satellite block up-converter (BUCs) applications, for very small aperture terminals (VSAT) and solid-state power amplifiers (SSPAs). The TIM 1213-8ULA has output power at the 1dB gain compression point of 8W (or 39.5dBm), gain of 8dB and power efficiency of 35%. The TIM 1314-15 UL has

output power at the 1dB gain added compression point of 15W (or 42dBm), gain of 7dB and power added efficiency of 32%.

"Following the launch of our 'UL' power-added-efficiency enhanced 2W and 8W devices for X-band in 2008, Toshiba is expanding the product family with another X-band amplifier as well as two long-awaited devices in the Ku-band frequency range," says Ghani. "With energy-saving features associated with higher gain, we believe that these amplifiers will help our customers design more advanced telecommunication systems."



## Toshiba expands GaN HEMT family with PAs for C- and Ku-band satcom and X-band industrial applications

At the IEEE MTT-S International Microwave Symposium (IMS 2009), Toshiba America Electronic Components Inc (TAEC) of Irvine, CA, USA announced the addition of three new 24V GaN high-electron-mobility transistors (HEMTs) to its power amplifier product family.

The TGI 7785-120L, Toshiba's first commercial C-band GaN HEMT for satellite communication applications, operates at 7.7–8.5GHz with output power of 120W. Featuring output power of 51dBm with 44dBm input power, linear gain of 11dB and drain current of 10A, the device enables increased output power and helps to reduce size and weight in solid-state power amplifiers (SSPA) for satcom applications, says Toshiba.

"We believe this is the highest-output-power internally matched GaN HEMT in this band that is commercially available," says Hodayoun Ghani, business development manager Microwave, RF and Small Signal Devices in TAEC's Discrete business unit. "Its 120W output power is nowhere

near the limit of GaN technology, as we expect to be able to double or even quadruple this output power in the future."

Toshiba is also unveiling the extended Ku-band TGI1314-50L, which operates at 13.75–14.5GHz with output power of 50W. Featuring output power of 47dBm with 42dBm input power, linear gain of 8dB and drain current of 5A, targeted satcom applications include high-power solid-state power amplifiers (SSPA) and block up converters (BUC) for very small

aperture terminals (VSAT). Previously, in 2008, Toshiba launched the 14–14.5GHz Ku-band TGI1414-50L GaN HEMT for satcoms.

Toshiba's new X-band TGI1011-50-771

**Its 120W output power is nowhere near the limit of GaN technology, as we expect to be able to double or even quadruple this output power in the future**

GaN HEMT operates at 11.3–11.5GHz with output power of 50W. Featuring output power of 47dBm with 41dBm input power, linear gain of 9dB and drain current of 5A, targeted industrial applications include exciters for particle accelerators.

"Toshiba's first commercial GaN power amplifier has been in volume production since 2008 and this technology presents superior device performance such as high gain and efficiency in satcom and radar market," says Ghani.

"Toshiba is exploring new markets for this technology. Exciters for particle accelerators are a good example of non-telecommunication and non-radiolocation applications for these power amplifiers," he adds. "Toshiba will continue its efforts to develop additional GaN devices in other bands with higher output power."

Sample devices are available now, with mass production of the TGI7785-120L due in Q3/2009.

[www.toshiba.com/taec](http://www.toshiba.com/taec)

## TriQuint extends IQE's GaN HEMT epiwafer contract for Phase III of Wide-Bandgap Semiconductors program

IQE plc of Cardiff, Wales, UK says that its GaN epiwafer supply contract with semiconductor manufacturer TriQuint Semiconductor Inc of Hillsboro, OR, USA has been extended. IQE's New Jersey operation will continue to sub-contract to TriQuint, along with BAE Systems and Lockheed Martin.

The extension follows recent news that TriQuint has been awarded a US Army Research Laboratory (ARL) contract to lead Phase III of the R&D program Wide Bandgap Semiconductors for RF Applications (WBGs-RF). Funded by the US Defense Advanced Research Projects Agency (DARPA), the WBGs-RF program aims to develop new

high-power, high-efficiency GaN-based wideband amplifiers for defense and aerospace applications. TriQuint will use IQE's GaN-based high-electron-mobility transistor (HEMT) wafers to support product development for these applications.

"In Phase II, we developed a high performance, reliable GaN process with excellent reproducibility and high yield," says

**TriQuint has been awarded a US Army Research Laboratory (AFRL) contract to lead Phase III of the R&D program WBGs-RF**

TriQuint's Phase III program manager Cathy Lee. "We have enjoyed a close working relationship with IQE throughout Phase II of this program and this latest order is based on their solid support of us throughout that relationship," she adds.

"The continued relationship between IQE and TriQuint is a key demonstration of IQE's ability to provide world-class materials across a broad RF product portfolio, including emerging technologies such as GaN epitaxial wafers," says Alex Ceruzzi, VP & general manager of IQE's facility in Somerset, NJ.

[www.iqep.com](http://www.iqep.com)



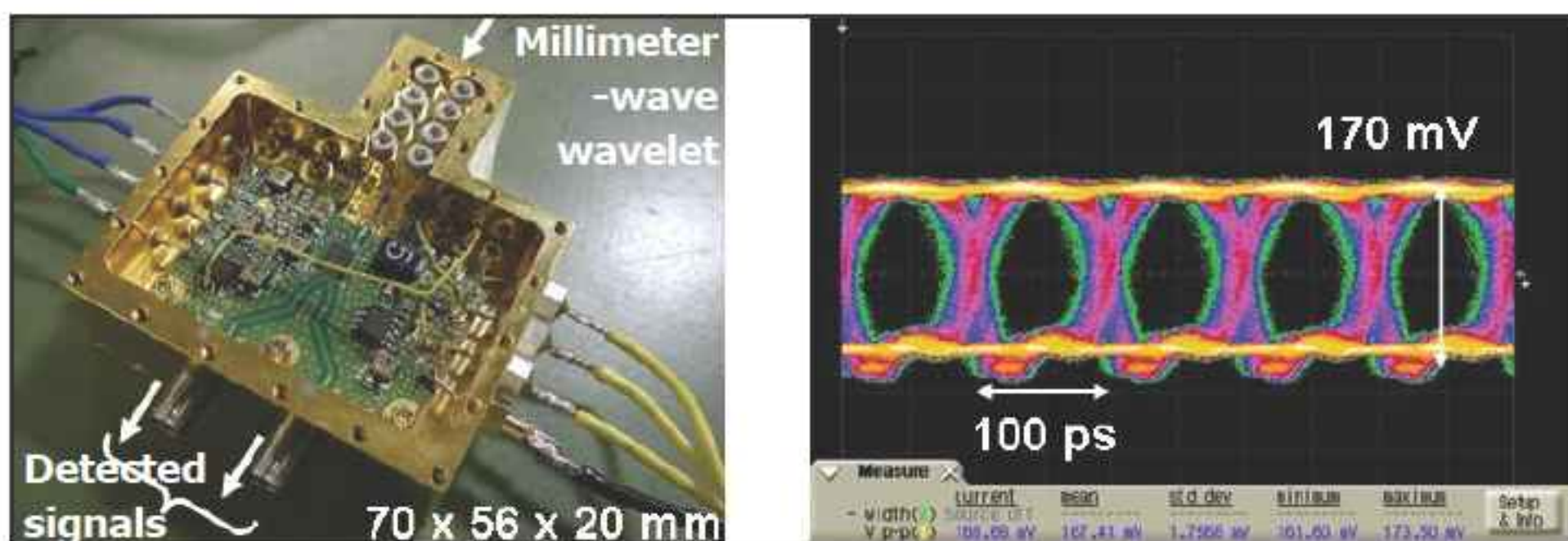
## InP HEMTs incorporated into impulse radio transceiver

At IMS 2009 Fujitsu Laboratories presented what is claimed to be the first impulse-radio-based high-capacity wireless transmission equipment using millimeter-band transmissions in the 70–100GHz band, resulting in throughput exceeding 10Gb/s. This work is part of the 'Research and Development Project for Expansion of Radio Spectrum Resources', sponsored by Japan's Ministry of Internal Affairs and Communications.

In an impulse radio transceiver, there is an RF transmitter (consisting of a short-pulse modulator, a filter, and a power amplifier) and an RF receiver (low-noise amplifier, detector, and limiting amplifier). Last year, Fujitsu developed the first RF transmitter (excluding the power amplifier) and subsequently began developing the transmission equipment (including an RF receiver intended for transmission testing). This has culminated in the new equipment (incorporating the power amplifier in the transmitter and the low-noise amplifier in the receiver).

For regions where it is difficult to lay fiber-optic trunk lines, wireless equipment that operates at 10Gb/s — on a par with fiber-optic cable — has been considered. For wireless transmissions at speeds exceeding 10Gb/s, it is best to use the 70–100GHz millimeter band, as it is relatively easy to secure wide swaths of bandwidth and is thus suitable for long-distance transmissions. However, equipment that operates at these high frequencies requires the use of multiple, single-purpose electronic components, resulting in a high parts count (with little progress on miniaturizing the equipment and reducing its cost).

An option for development is impulse radio, which involves generating a broadband pulse that varies over extremely short periods of time, and using filters to extract only the usable frequency component for transmission. This dispenses with the bulky oscillators and other components (such as mixers)



**New impulse-radio RF receiver (left) and measurement results of 10Gb/s-reception waveform (right) (y-axis: output voltage; x-axis: time).**

needed in conventional wireless transmission technologies, resulting in more compact and less costly millimeter-band transmission equipment. Fujitsu says that the new technology can be used as an alternative to fiber-optic trunk lines, as well as for a range of other applications, including indoor ultra-fast wireless local-area networks (WLAN) and high-resolution radar.

However, to send and receive millimeter-band pulse signals using an impulse radio, the following issues — which do not appear in conventional transmission methods — had to be overcome:

- On the receive side, waveform distortions — introduced into the signal by the wiring path from antenna to amplifier — must be reduced, and weak millimeter-band signals need faithful amplification.
- On the send side, the millimeter-band pulse signal sent from the transmitter has a propensity towards time variations. At the receiving end, this can lead to slippage on the determination of a millimeter-band pulse being a 0 or 1, resulting in faulty reception. The time variation hence needs to be minimized.

Fujitsu has hence developed the following technologies based on its InP high-electron-mobility transistors:

- Using InP HEMTs, which offer higher speeds and lower noise than GaAs HEMTs, a broadband, high-gain, low-noise amplifier was developed. This is connected to the receiving antenna by an interconnect that has the reverse transmission characteristics of the low-noise

amplifier, so that waveform distortions introduced by the interconnect cancel each other out, resulting in a signal waveform that is close to how it was received.

- The time variation in the sent signal is attributable to jitter in the timing of short-pulse generation in the modulator. In particular, generating a short pulse from a 10Gb/s data signal with significant timing jitter will make the time variation very conspicuous. Fujitsu used a new circuit for the InP HEMT short-pulse generator that generates a pulse based on a 10GHz clock signal, which has minimal jitter versus the 10Gb/s data signal, while referencing the 10Gb/s data signal.

Using these technologies, Fujitsu developed impulse-radio millimeter-band transmission equipment, including a baseband unit with a fiber-optic interface. The receiver had a sensitivity of 0.25μW and, along with the sensitivity needed for kilometer-class wireless transmissions, was demonstrated to achieve good received waveforms (see Figure). The transmitter held jitter on a 10Gb/s millimeter-band pulse signal to 0.3ps (a more than fivefold improvement over the stability achieved in 2008). Indoor transmission testing with a paired transmitter and receiver resulted in the world's first wireless transmissions to exceed 10Gb/s using impulse radio in the millimeter band.

Fujitsu will start field testing the technology with the aim of developing commercial systems by 2012.

<http://jp.fujitsu.com/group/labs/en>





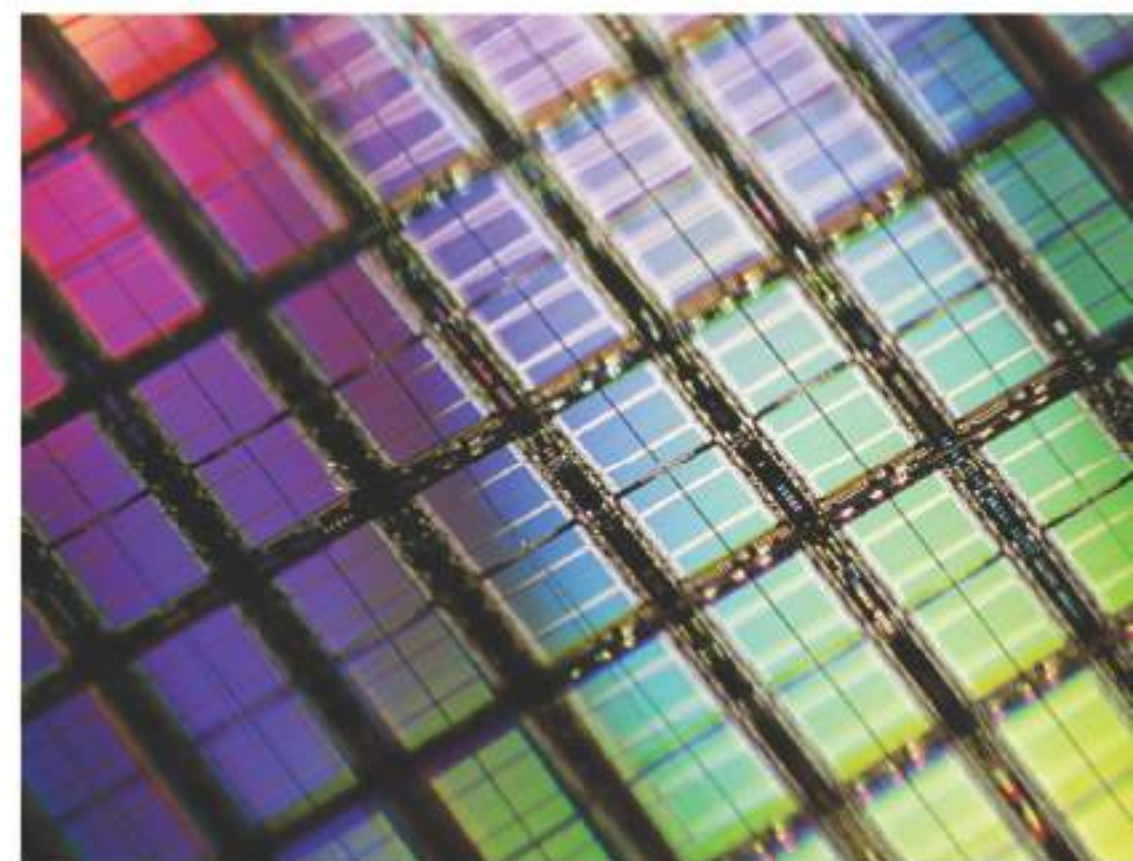
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# RFMD unveils GaN foundry services: main fab being used to offer fast cycle time for cost-sensitive high-power applications

At the IEEE MTT-S International Microwave Symposium (IMS 2009) in Boston (9–11 June), RF Micro Devices Inc of Greensboro, NC, USA has unveiled its new gallium nitride (GaN) Foundry Services business unit, which aims to supply high-reliability, high-performance, price-competitive GaN technology for multiple RF power markets.

RFMD says that the new business unit will leverage its experience with gallium arsenide (GaAs) manufacturing capacity and cycle times, as well as a range of new customer services, to drive shorter time-to-market and minimize time between initial wafer order and final delivery. The firm says that its GaN manufacturing is interchangeable with its GaAs manufacturing (taking place in its main 6-inch GaAs fab in Greensboro, which has the tooling for a 0.5 $\mu$ m process on 3-inch GaN-on-silicon carbide substrates) and benefits directly from the scale and expertise of its high-volume wafer fabrication capability.

The new business unit is providing GaN foundry customers access to RFMD's compound semiconductor technology and production facility and the benefits of its high-scale manufacturing, including reliability, uniformity, cycle time and quality, says Bob Van Buskirk, president of RFMD's Multi-Market Products Group. "RFMD GaN is a breakthrough technology that can change the RF power component industry as a result of its superior linearity, bandwidth and RF power density," he adds. "Additionally, RFMD GaN is a 'green' technology, enabling higher efficiencies than previously possible, thereby requiring less power consumption to achieve similar performance or superior performance at similar power consumption levels."

Rival RF component maker TriQuint Semiconductor Inc of Hillsboro, OR, USA rolled out its GaN foundry service last year. However, RFMD claims that its offering of GaN foundry services is distinctive because it operates the industry's largest GaAs fabrication plant and has supplied billions of high-reliability compound semiconductor RF components. By utilizing its existing, high-volume manufacturing assets, RFMD can deliver GaN technology with consistent reliability and increased uniformity. The firm reckons that its GaN cycle times through its fab (of just five weeks for prototype and shuttle lots) are typically 30–40% faster than its competition.

Also, compared to TriQuint's GaN (which is targeted at lower-power, higher-frequency applications), RFMD's GaN technology is targeted at high-power applications. Typical operating characteristics include operating voltages of 48V CW or 65V pulsed (due to a high breakdown voltage of 200V), a power density of 6–8W/mm, a unity current gain cutoff frequency of  $f_T = 11\text{GHz}$  and a maximum oscillation frequency of  $f_{max} = 18\text{GHz}$ , and a mean time to failure (MTTF) of more than 100 million hours at a channel operating temperature of 150°C.

RFMD also says that, by leveraging its knowledge of process mod-

els to accurately predict product performance, its Foundry Services business unit can lower customer development costs by reducing the number of prototype runs necessary to meet specifications. Applications expected to use GaN foundry include commercial and defense power applications such as wireless infrastructure, CATV line amplifiers, broadband communication, power amplifiers, and radar systems.

In addition, a Foundry Services support team is providing first-hand knowledge of customers' expectations and requirements, since it combines more than 50 years of foundry services experience (both as customers and suppliers).

**To minimize the total time from order entry to delivery, the support team has implemented a full set of services, including simulation models and business processes**

Also, to minimize the total time from order entry to delivery, the support team has implemented a full set of services, including simulation models that aim to enable a high probability of initial success and business processes that minimize queue time.

● At IMS 2009, RF Micro Devices also demonstrated its own GaN device products. RFMD's high-power, small-form-factor GaN transistors are capable of power output of more than 300W at 48V, covering 500MHz of bandwidth, and are targeted at pulsed applications such as S-band radar.

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## First 100W-class X-band amplifier with >50% efficiency

At June's IEEE MTT-S International Microwave Symposium (IMS 2009) in Boston, Fujitsu Laboratories Ltd of Kawasaki, Japan reported the development of a gallium nitride (GaN) high-electron-mobility transistor (HEMT) amplifier that it claims is the first 101W X-band (8–12GHz) high-output amplifier achieving record efficiency of 53%.

According to comparisons made by Fujitsu, this output is about four times greater than that generated by gallium arsenide (GaAs) HEMT amplifiers, allowing the transmission range to be extended by up to two-fold. Also, compared to GaAs HEMT X-band amplifiers with same-class output power, the new GaN HEMT amplifier can significantly reduce power dissipation.

Furthermore, using the amplifier in the C band (4–8GHz), Fujitsu has raised its own C-band GaN HEMT amplifier output power record from 320W (reported last October at the 2008 IEEE Compound Semiconductor IC Symposium in Monterey, CA) to 343W (outperforming GaAs-based amplifiers by a factor of seven, according to comparisons made by Fujitsu Labs), while maintaining the level of efficiency. Compared to conventional amplifiers using GaAs HEMTs, the GaN HEMT-based amplifier is therefore expected to extend the transmission range by 2.6-fold in the C band.

The C band is used mostly for fixed-point wireless and wireless access. The higher-resolution X-band is used for weather radar and aircraft control but, because it is prone to signal attenuation by rainfall, it needs high amplifier output and efficiency.

Previous high-output X-band amplifiers based on GaN HEMTs suffered from poor efficiency, and presented the following problems that need to be solved for practical implementation:

- To achieve high efficiency, the amplifier must have high gain, i.e. the performance of the transistor chip must be improved.
- Transistor chips in high-output

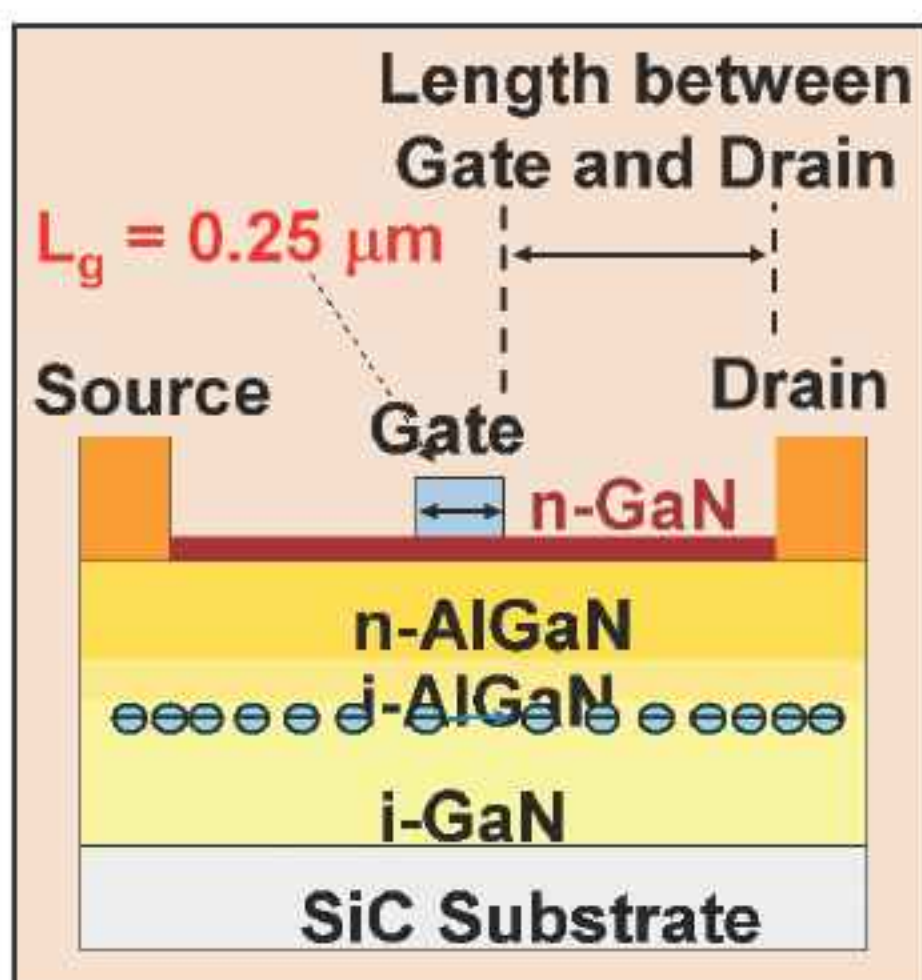


Figure 1: Fujitsu's new X-band GaN HEMT.

amplifiers consist of multiple transistors connected in parallel. If there is a single point of input and output, then a phase discrepancy can be caused between the signal passing down the center of the chip and the signal passing along its periphery due to the different signal path lengths. So, especially for higher frequencies, transistors are operating out of phase with each other, and the full benefit of each transistor cannot be realized. Eliminating this phase discrepancy is necessary to achieve high efficiency.

Fujitsu's new high-efficiency, high-output GaN HEMT amplifier for the X and C bands consists of two transistor chips. This design enables the inherent high-output performance of GaN HEMTs to come through even at high frequencies, and for them to operate with high efficiency, says Fujitsu. Benefits of the new

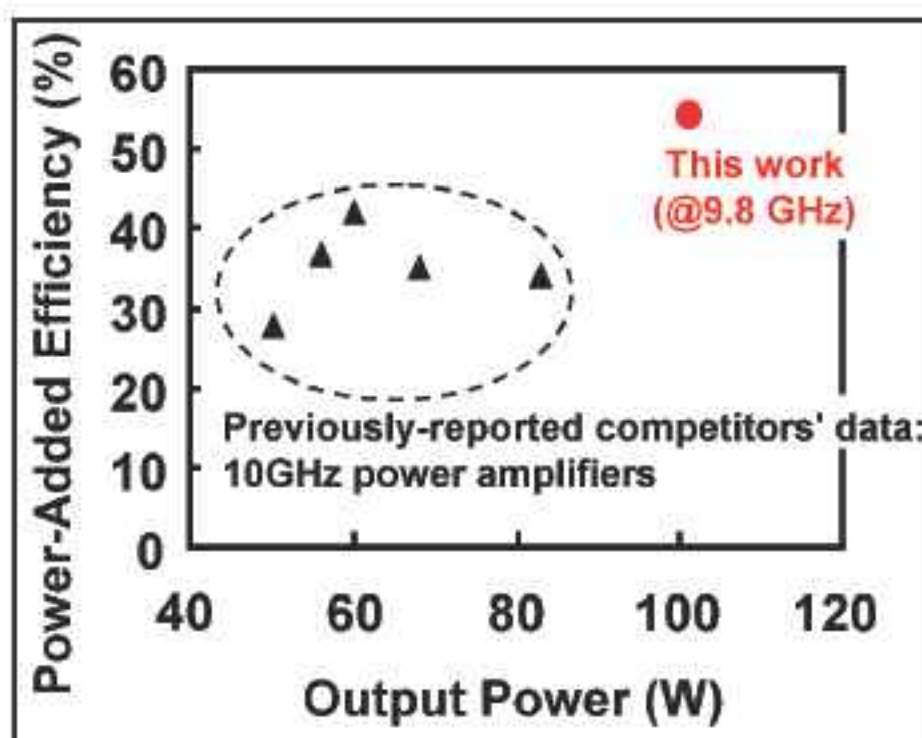


Figure 2. X-band amplifier performance (10GHz band).

amplifier include the following:

- To accommodate high frequencies, the gate length was reduced to 0.25μm and the gate-drain gap was optimized, resulting in a high-output transistor featuring good high-frequency characteristics and high breakdown voltage (Figure 1). This enables roughly ten-fold gain in the X band, reduces the resistive component, and raises efficiency.
- The manifold I/O path structure developed for the C-band GaN HEMT developed last year (which avoided phase discrepancies in the input signal) was further optimized for application to the X band. This eliminated phase discrepancies introduced to the input signal within the chip for the X band as well, enabling uniform performance for a GaN HEMT with high output power density and efficiency. Furthermore, by suppressing thermal interference between the two chips, the performance degradation caused by chip heating was also suppressed.

Efficiency is especially important for reducing the transmitter's power consumption. Compared to previously reported results, with equivalent output in the 10GHz band, efficiency was about 20% higher (see Figure 2), claims Fujitsu, contributing significantly to power savings.

Fujitsu says that the results for the new amplifiers raise the prospect of applying the technology to a wide range of applications that demand the combination of high-output and high-efficiency performance. This includes using them as alternatives to traveling-wave tube amplifiers (vacuum tubes commonly used for high-output-power microwave applications), which would enable the realization of smaller, light-weight, more energy-efficient and longer-lasting transmission systems used in weather and air-traffic control radars, satellite transmitters, and next-generation mobile-phone base-stations for wireless communications equipment.

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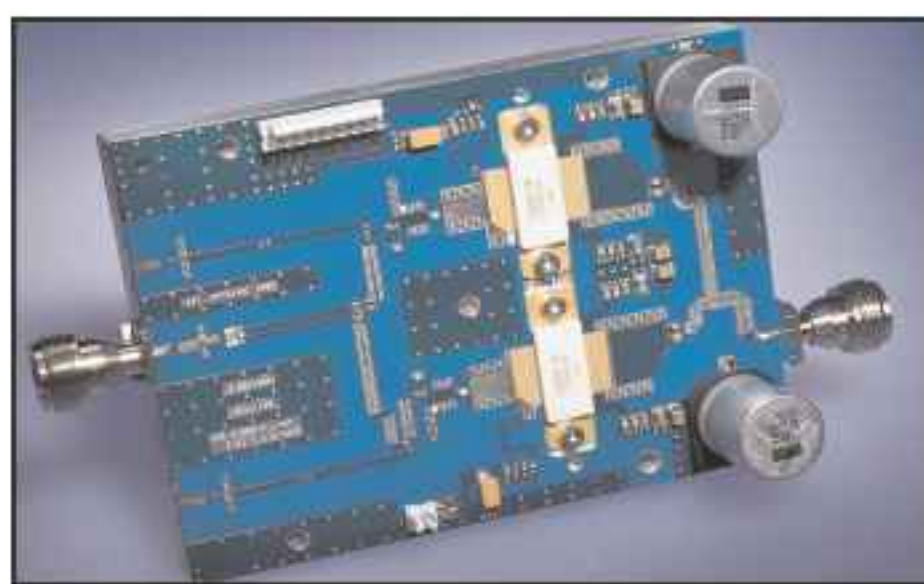


## Cree demonstrates 50%-efficient GaN HEMT-based Doherty amplifier with digital pre-distortion

At the 2009 IEEE/MTT-S International Microwave Symposium (IMS) in Boston, Cree Inc of Durham, NC, USA highlighted the performance of its growing line of commercial high-power RF transistors by demonstrating amplifiers that combine its latest 120W and 240W gallium nitride HEMTs linearized with Texas Instruments' GC5325, a single-chip wideband digital pre-distortion transmit processor, to enable improved power efficiency for wireless basestation applications. This includes the first public demonstration of a Doherty transistor amplifier with what is claimed to be a record efficiency of 50%.

The following amplifiers were demonstrated:

- a 50%-efficient 480W peak power Doherty amplifier (using the new CGH21240F pre-matched 240W GaN HEMT transistor) with greater than 80W average power under a W-CDMA (6.5dB peak/average) signal corrected to better than -50dBc ACLR (adjacent channel level ratio) covering well over the 2.11-2.17GHz UMTS band;
- a 42%-efficient 240W class A/B



Doherty amplifier using GaN HEMTs .

amplifier (using the CGH21240F transistor) with 40W average power under a W-CDMA (6.5dB peak/average) signal corrected to better than -50dBc ACLR covering the 1.8-2.3GHz operating bandwidth;

- a 35%-efficient 870MHz 120W class A/B amplifier (using the new CGH09120F transistor) with 20W average power under a two-carrier W-CDMA (7.5dB peak/average) signal corrected to better than -50dBc ACLR covering 25% instantaneous bandwidth - this same transistor has been demonstrated in other amplifier applications at 700-1800MHz, including DVB-H (digital video broadcast).

Texas Instruments' GC5325 combines a crest factor reduction block

(CFR) and a digital pre-distortion block (DPD) to improve power amplifier (PA) efficiencies. Also available is a system evaluation kit that includes the GC5325, a floating-point DSP, high-speed data converters and amplifiers, and clocking and RF components to allow easy demonstration of these efficiencies across various signals.

"We continue to demonstrate that our GaN HEMT transistors provide power, bandwidth, and efficiency not achievable with other technologies such as silicon and GaAs transistors," says Jim Milligan, director of RF and microwave products. "These demonstrations directly address the demand for higher-efficiency, broader-bandwidth HPAs [high power amplifiers] in the small form factors necessary for emerging remote radio head and microcell applications," he adds. "The marketing cooperation between Cree and Texas Instruments validates that high-efficiency performance coupled with excellent linearity and spectral mask compliance is possible with our current line of commercial products."

## Cree demos 120W and 180W high-efficiency GaN HEMT amplifiers

At IMS 2009, Cree demonstrated the CGH40120F and CGH40180PP, the newest members of its general-purpose broadband GaN HEMT transistor product family.

The demonstration amplifiers have high efficiency and high power under continuous-wave (CW) operation, with typical power-added efficiencies (PAE) of 70% at saturated powers of 120W for the CGH40120F and 180W for the CGH40180PP in class A/B demonstration amplifiers.

"A number of very-high-efficiency amplifier architectures, routinely used at lower frequencies for audio and UHF applications, are being realized at much higher RF and



Cree's CGH40120F GaN HEMT.

microwave frequencies using GaN transistors," says Jim Milligan, director

**Amplifiers have high efficiency and high power under CW operation**

of RF and microwave products. "Published research indicates greater than 80% PAE using Class D, E, F and J amplifier architectures, with Cree GaN HEMT transistors, at frequencies over 2GHz. More typical Class A/B operation can also offer exceptional efficiency, validated by the demonstrations," he adds. "Cree GaN transistors offer system designers a wide range of choices, supporting diverse application requirements."

Samples and fixtures are available through the distributor Digi-Key. Large-signal models for Agilent's ADS or AWR's MWO simulators are available from Cree. [www.cree.com](http://www.cree.com)



## IXYS expands 600V IGBTs with co-packaged SiC diode

At the PCIM (Power Control and Intelligent Motion) show in Nuremberg, Germany in mid-May, IXYS Corp of Milpitas, CA, USA and Biel, Switzerland said that it had expanded its family of 600V GenX3 insulated-gate bipolar transistors (IGBTs) to include a range with silicon carbide (SiC) co-pack diodes. For demanding applications like solar inverters and switch mode power supplies, the combination of the GenX3 IGBT and the extremely fast SiC diode creates a solution for applications where efficiency is the main design requirement, IXYS says.

The GenX3 platform is manufactured using IXYS' robust HDMOS IGBT process and is optimized in two speed classes. Both take advantage of IXYS' proven punch-through (PT) technology, which includes lower saturation voltage and lower energy losses, offering a viable option for improved switching applications in the 600V range.

The B3 range of GenX3 IGBTs is optimized for 20kHz hard switching applications, and the SiC diode combination will be essential for efficiency-critical applications at mid-range frequencies such as solar inverters, says IXYS. The C3 GenX3 IGBTs extends the range to higher frequencies and can facilitate what is claimed to be the fastest-switching IGBT on the market.

The devices are co-packed with high-performance, ultra-fast SiC diodes, which offer minimal switching losses due to the absence of reverse recovery charge ( $Q_{rr}$ ) in wide-bandgap technology, further extending the switching frequency limits of the IGBT. The square reverse bias safe operating area (RBSOA) featured in the 600V GenX3 IGBT improves the maximum clamped inductive load current, allowing the device to safely operate in snubberless, hard switching applications.

Products are offered in standard packages (TO-220 to TO-247) with collector current ratings of 30–60A, as well as in IXYS' ISOPLUS packaging, which provides high isolation capability (up to 2500V) and superior thermal performance, it is claimed. Initial device offerings include the

- IXGP30N60C3C1,
- IXGH36N60B3C1,
- IXGH48N60B3C1, and
- IXGH48N60C3C1.

"Several years ago we pioneered the combination of our IGBTs with GaAs power rectifiers," says Bradley Green, VP of international sales. "To further extend competitive advantage to our customers, the silicon content in these products can also be integrated in IXYS' high-reliability module packages to create higher power density, reduced parasitic inductances and customer-focused solutions," he adds.

[www.ixys.com](http://www.ixys.com)

## Cree launches Z-Rec 600V SiC power diodes

Cree Inc of Durham, NC, USA has announced the availability of its 600V silicon carbide (SiC) junction barrier Schottky (JBS) diodes.

The firm says that its new Z-Rec diodes provide improved device power efficiency and enhanced surge current capability, allowing system optimization for performance and cost in power conversion applications ranging from 250W to 1500W. Primarily used for boost diode applications in power factor correction (PFC) circuits, Z-Rec SiC JBS diodes, through their inherent lack of reverse-recovery currents, can reduce AC-DC power supply losses by up to 10% versus silicon fast-recovery diodes, it is reckoned.

Cree says that the zero reverse-recovery current of its SiC diodes has enabled switch-mode power supplies to reach and exceed ENERGY STAR, 80-plus certification levels. The new Z-Rec devices add to SiC diode power savings through

device junction capacitance values that are as much as 10% lower than Cree's first-generation devices, reducing switching losses and extending the power savings to systems operating at higher switching frequencies. Each new device, of a given current rating, maintains the low  $V_f$  (<1.8V) of previous Cree SiC diodes at rated current and temperature, so there is no compromise in conduction losses.

The ability to sustain repetitive and non-repetitive surge currents has long been a limitation when designing-in SiC JBS diodes, says Cree. Early-generation SiC diodes often required designers to choose a device with a higher-than-required current rating to assure robust and reliable operation under potential surge conditions. Cree says that its advances in SiC power device structures and design allow the Z-Rec diodes to provide optimal efficiency with use of the minimum

required current-rated device. Also, the performance and application cost advantages of the Z-Rec diode support 'green' energy efficiency in an expanding number of power supply designs for server, PCs, communications, industrial and consumer switch mode power supplies, the firm adds.

"SiC power diodes are rapidly becoming a standard component, replacing their silicon predecessors for applications in which efficiency, switching speed and reliability are prerequisites," says Dr Cengiz Balkas, VP & general manager, power and RF.

Z-Rec 600V devices are available in 2, 3, 4, 6, 8, 10 and 20 Amp ratings in TO-220-2, TO-220-2 fully molded (Full-Pack), TO-247-3, TO-252-2 (D-Pak), and TO-263-2 (D2Pak) packages. All devices are RoHS, REACH, and Halogen-Free compliant.

[www.cree.com/power](http://www.cree.com/power)



## Microsemi launches 20 new SiC-based power modules

Microsemi Corp of Irvine, CA, USA has made available samples of a new line of 20 silicon carbide-based power modules in standard dual-diode and full-bridge configurations, designed for a wide range of industrial applications.

"By integrating our SiC components into two very low-profile packaging options — the industry-standard SOT227 and our innovative SP1 — we enable customers to create very compact high-frequency systems with low parasitics," says Philippe Dupin, director of Power Module Products for Microsemi's Power Products Group in Bordeaux, France. "These 20 new SiC diode power modules allow our customers to improve their system designs beyond the capabilities of today's conventional power solutions," he adds.

Microsemi's new power module family takes advantage of SiC's superior performance at high operating temperatures for industrial, UPS, SMPS and motor drive applications. The family includes five standard dual-diode products in



Microsemi's SOT227 package, used to house five of the new dual-diode SiC modules.

SOT227 packages, a dual-diode product in an SP1 package and four single-phase bridge rectifiers in SP1 modules.

The SOT227-packaged modules feature current ratings of 20–60A and breakdown voltages of either 600V or 1200V, in either parallel or antiparallel configurations. The new modules can be used in phase-leg, common-anode or common-cathode implementations, and may be wired as a single diode at twice the current capability by connecting the



Microsemi's SP1 package, used to house a dual-diode SiC module and four single-phase bridge rectifiers.

package's two diodes in parallel.

For applications requiring a 90A current rating, Microsemi offers two SP1 products with dual, independent diodes at either the 600V or 1200V breakdown voltages.

Completing the family are eight single-phase bridge rectifiers packaged in SP1 modules with ratings of 10A, 20A, 30A or 40A, each at a voltage breakdown of either 600V or 1200V.

Prices are from \$36.89 to \$214.21 in quantities of 1000–5000.

## SiC diodes now standard on designated line of power modules

Microsemi has made silicon carbide (SiC) diode upgrades standard on a large selection of its existing portfolio of power modules for industrial, UPS (uninterruptible power supply), SMPS (switched-mode power supply) and motor drive applications.

While the substitution of SiC Schottky diodes for conventional fast recovery diodes (FREDs) is an option on all Microsemi power modules, the firm has selected the most frequently used offerings for standardization where high-temperature operation and temperature-independent switching behaviour are essential at elevated operating frequencies.

"By expanding our portfolio with these SiC-enhanced modules, Microsemi provides our customers

with a unique variety of standard modules to best suit their design needs," says Philippe Dupin, director of Power Module Products in Bordeaux, France. "The superior electrical characteristics of silicon carbide devices, in combination with Microsemi's innovative packaging, add to our ability to satisfy the needs of power system designers seeking to increase their power density, efficiency and system reliability with standard module solutions," he adds.

**SiC diodes have been implemented in packages with the lowest parasitics, low profile and very compact packages**

The modules now with standard SiC upgrades range from 500V to 1200V, mainly using MOSFET technology. A smaller number of IGBT (insulated-gate bipolar transistor) modules are also included. To optimize electrical performance, the SiC diodes have been implemented in packages with the lowest parasitics, low profile and very compact SOT227, SP1, SP3, SP4 and SP6 packages.

Electrical configurations that benefit from SiC diode technology vary from single switch to phase leg, full bridge, boost, dual boost, Buck and dual-Buck choppers.

Samples are available now. Prices range from \$13.78 up to \$246.08 in quantities of 1000–5000.

[www.microsemi.com](http://www.microsemi.com)



## Production-ready germanium-on-insulator wafers launched for high-performance devices

Epiwafer foundry and substrate maker IQE plc of Cardiff, Wales, UK has made available production-ready germanium-on-insulator (GeOI) engineered substrates for high-performance ICs and devices.

The firm says that engineers at its Cardiff-based silicon epitaxy facility have developed new manufacturing techniques to overcome long-standing challenges to produce GeOI material with very high crystalline quality.

The GeOI substrate will allow device designers to look beyond the performance constraints imposed by existing silicon technologies.

"This addition of high-mobility GeOI material for next-generation processor, memory, MEMS and solar applications, shows our commitment to ensuring that our customers maintain their competitive advantage through rapid access to leading-edge technology solutions,"

says Ali Hoy, sales & business development manager for IQE's electronics products.

GeOI development kits are available in 4" (100mm) and 6" (150mm) diameter wafer sizes. The new addition to IQE's product range was showcased at the SEMICON West show in San Francisco (14-16 July).

Later this year IQE will also make available 8" (200mm) GeOI wafers.

[www.iqep.com](http://www.iqep.com)

### IN BRIEF

#### IQE presents final-year graduate prizes at Bath University

IQE has sponsored a number of final-year prizes to engineering graduates as part of the graduation ceremony at the UK's University of Bath.

The winners were:

- Christopher Elsey, for the best final-year project in optoelectronics/optical communications;
- James Gilbert, for the best final-year project in the area of sensors; and
- Joe Kinrade, for the best examination result in optical devices and communications systems.

All prize winners achieved first-class M.Eng. degrees.

"IQE is honored and proud to be associated with the electronic and engineering department at the University of Bath," commented IQE's Chris Meadows on presenting the awards at the graduation ceremony. "The commitment and enthusiasm demonstrated by the entrants for these prizes is a clear sign that Britain can continue to build on its long heritage of producing world-class, high-calibre engineers."

[www.bath.ac.uk](http://www.bath.ac.uk)

## CEO regional winner of Ernst & Young's Entrepreneur Of The Year award

IQE's CEO Dr Drew Nelson OBE has been named a regional winner at Ernst & Young's London & South Entrepreneur Of The Year Awards.

Since Nelson co-founded IQE in 1988, the firm has grown from a single manufacturing operation in Cardiff to having six manufacturing sites in three continents.

Now in its 11th year in the UK, the awards encourage entrepreneurial activity among those with potential, and recognizes the contribution of people who inspire others with their vision, leadership and achievement. They celebrate those who are building and leading successful, growing and dynamic businesses, recognizing them through regional, national and global awards programs in more than 135 cities in 50 countries.

Nelson was one of 23 London and South regional winners who proceed to a national final in October, where 53 executives will compete for the title of Ernst & Young Overall UK Entrepreneur of the Year.

"The winners are all outstanding entrepreneurs who are growing market share and succeeding despite the worst economic conditions in living memory," said Ernst & Young partner Iain Wilkie. "These entrepreneurs and the businesses they lead will be in the vanguard in driving our economy out of recession."

"In these tough economic times, the entrepreneurial spirit is not only alive and well in the UK but is being widely acknowledged as the key attribute for driving the economy to prosperity in the years ahead," says Nelson.

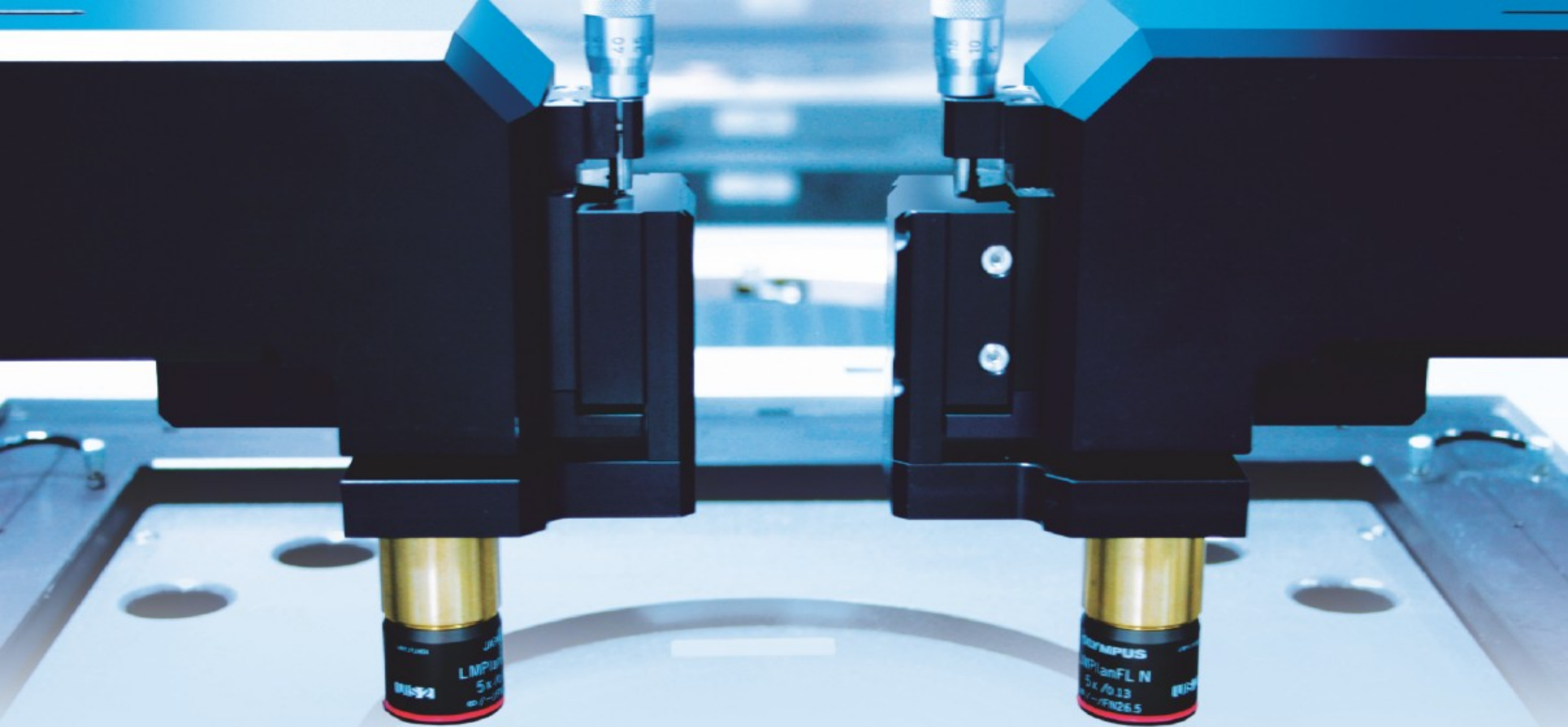
### Director of North American sales appointed

IQE has appointed Brian VanOrsdel as director of North American sales & strategic accounts for its optoelectronic product portfolio.

VanOrsdel has more than 20 years of sales management experience in optoelectronic and telecom technologies at firms such as Epitaxx and JDSU and, most recently, at Bookham Inc as strategic accounts manager.

He will be based in New York and be responsible for expanding IQE's business in the USA and Canada, offering epitaxial services in wafer applications using InP, InGaAs, GaAs, GaN, AlInGaAs, AlInGaP, InGaAsP, SiGe and silicon (made using MOCVD, MBE, and CVD growth technologies at IQE's manufacturing/epi-reactor sites in the US, UK, and Singapore).





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## Probing for high-volume 60–80GHz RFIC manufacturing

On 'Agilent Avenue' of the exhibition at June's IEEE MTT-S International Microwave Symposium (IMS 2009) in Boston, Cascade Microtech Inc of Beaverton, OR, USA launched two products that aim to streamline engineering and production testing of high-bandwidth, short-range RFIC devices for WirelessHD, automotive radar, and other 60GHz wireless applications.

According to ABI Research, 1 million wireless high-definition TVs will be installed worldwide by 2012, with double-digit growth rates. Also, Strategy Analytics reckons that over 2.3 million cars will be equipped with collision avoidance radar systems by 2011, requiring over 30 million radar sensors.

"Automotive radar and wireless multimedia applications will continue over the next two years to move from their embryonic stage into higher-volume growth applications," says Cascade's CEO Geoff Wild. "Cascade Microtech is unique in that it has a 25-year history of helping customers to precisely characterize and validate device functionality at both engineering and production test," he claims. "To achieve widespread deployment of

CMOS-based mmW RFICs in consumer applications at 80GHz and beyond, it requires a knowledgeable leader in very high-frequency high-volume probing," he adds.

"End-to-end solutions that speed the design and testing of WirelessHD devices are a direct result of ongoing collaborations between Agilent and Cascade Microtech," says Gregg Peters, VP & general manager of Agilent Technologies' Components Test Division. "Agilent recognizes Cascade Microtech as a key global channel partner."

Using a combination of Cascade Microtech's proprietary thin-film technology and coaxial probe technology from its Infinity Probe architecture, the 110GHz Unity-MW millimeter-wave RFIC engineering probe enables cost-effective precision characterization and testing of these multiple-port emerging technologies, says the firm. Using the same membrane technology, the Pyramid-MW 81GHz production probe card provides a robust production solution for shipping at-speed known-good-die (KGD) in high volume.

With 25 contacts per quadrant, the multi-contact Unity-MW probe

enables the connection of up to four 110GHz RF signals per quadrant for comprehensive and consistent testing of phased arrays. Using the production-proven Pyramid Probe photo-lithographically defined tip technology, Pyramid-MW is claimed to be the industry's only dedicated 81GHz probe card delivering repeatable, reliable measurements that ensure high-yield KGD can be shipped. Both the Unity-MW and the Pyramid-MW help to lower the cost of test with their robust, low-maintenance and documented probe tip cleaning regimes, the firm says.

With Cascade Microtech's unique web-based Unity-MW design capture tool and streamlined manufacturing process, users can submit required configurations for delivery in 1 week, starting 1 September. To ensure faster time-to-market, Unity-MW probes and Pyramid-MW probe cards are designed from a common database ensuring an efficient transition from engineering lab to volume production. For customers purchasing the Unity-MW, the non-recurring engineering (NRE) charges for developing a Pyramid-MW will be waived on the first Pyramid-MW order.

[www.cmicro.com](http://www.cmicro.com)

## On-wafer power device characterization extended for GaN and SiC

Cascade Microtech has announced a set of new probes and accessories for its Tesla on-wafer power device characterization system, making it fully compatible with the recently released Agilent B1505A power device analyzer. The combined solution offers an extended triaxial measurement range to accommodate low-noise probing of power devices up to 2000V.

The broad use of power semiconductors has created a pressing need to characterize power devices quickly and efficiently, the firm says. The Tesla on-wafer power device characterization system meets this challenge, it claims, reducing time-to-market for new power devices.

In particular, with emerging energy standards driving demand for efficient power use (creating a need for accurate power device characterization in automotive, mobile devices, transportation and power station manufacturing), there is a need to measure at increasing voltage and current levels for devices fabricated using wide-bandgap materials such as SiC and GaN.

Tesla offers what is claimed to be the highest voltage and current range for on-wafer measurements up to 2000V triax/3000V coax and 60A pulsed/20A continuous. It is hence said to be the first measurement system providing a complete on-wafer solution for over-temper-

ature, low-contact-resistance measurements of power semiconductors up to 60A and 3000V.

The new probes have specifically been designed to take full advantage of the performance of Agilent's B1505A power device analyzer, meeting the demands of more advanced device characterization.

"The Tesla system facilitates on-wafer C-V, IV and breakdown measurements, which in turn enables faster development cycles at an overall lower cost-of-test versus packaged test," says CEO Geoff Wild. It also allows users to realize the B1505A's full potential, with the maximum range of voltage, current and application compatibility.



## Accel-RF's latest SBIR award to boost in-situ GaN device measurement

Accel-RF Corp of San Diego, CA, USA, which produces accelerated life-test/burn-in test systems for RF devices, has been awarded an SBIR (small business innovation research) contract for Topic N08-164 in cooperation with the Naval Surface Warfare Center in Crane, IN.

"Over 15 years ago, the AARTS (Automatic Accelerated Reliability Test Set) product was developed through a successful SBIR project administered by NASA," says president & co-founder Roland Shaw. "We have significant experience with the SBIR process and this new concept is looking very promising for moving on to Phase II." Details of the project will be released if Accel-RF is awarded a Phase II contract.

"As intrinsic reliability is proven on lower-power GaN devices, the product evolution is moving toward

application of high-power MMICs, HEMT, and HFET devices that require significant advancements in reliability and performance characterization testing equipment," Shaw adds. "This new SBIR is in keeping with this trend."

Accel-RF has self-funded developments toward reliability testing of high-power devices, including a 200W per channel high-power reliability system, test platforms with RF- and DC-pulsing capabilities, as well as millimeter-wave reliability test systems for 30GHz and 60GHz device testing. Successful completion of this SBIR will add further in-situ measurement capability to the AARTS system platform, with direct benefits to compound semiconductor manufacturers and users, specifically the wide-bandgap initiative partners and tri-services component teams, says Accel-RF.

[www.accelrf.com](http://www.accelrf.com)

### IN BRIEF

#### Nextreme's Series B funding adds \$8m

Nextreme Thermal Solutions of Durham, NC, USA, which makes microscale thermal and power management products, has raised a further \$8m in Series B funding from corporate investors, bringing Series B to more than \$21m and total financing since its inception in 2004 to \$35m. The new funding will be used to expand Nextreme's presence and products for energy harvesting for micro and portable power along with solidifying its position for thermal management products in computing, consumer and mobile markets.

"The company is well positioned to execute its product development and sales plan over the next two years," says CEO Jesko von Windheim.

[www.nextreme.com](http://www.nextreme.com)

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## Veeco announces senior management changes

Epitaxial deposition, process, and metrology equipment maker Veeco Instruments Inc of Plainview NY, USA has announced changes to its senior management team.

Executive vice president & chief financial officer John (Jack) F. Rein Jr has announced his retirement, after more than 15 years with the firm. Veeco has retained a search firm to assist in recruiting a new CFO, with Rein assisting in the search and remaining in his role until a successor is named.

"Jack has been instrumental to Veeco's growth and success since our initial public offering in 1994, and he has been an invaluable member of our senior management team," says CEO John Peeler.

Peter Collingwood, VP & general manager for Europe, has been made senior VP, Worldwide Sales &



Collingwood (left) and Bruns (right).

Field Service Organization. He joined Veeco last October from JDSU, where he was regional VP of sales for Europe, Middle East and Africa for the Communications Test Division.

Dave Bruns has been appointed as senior VP & general manager of Veeco Solar Equipment. Bruns joined Veeco in 2000 through the acquisition of CVC, and has held roles in general management, marketing, operations and sales. He was VP & general manager of

the Asia-Pacific region (based in Singapore) since July 2007, and this January extended his field responsibilities to include North American Process Equipment as senior VP of sales & service. Prior to Veeco, Bruns worked for BOC Edwards in sales and service management roles.

"We have chosen to elevate two highly qualified individuals within Veeco to help guide our success in the future," says CEO Peeler. "Peter's experience spans nearly 20 years, with a proven track record of leading and developing highly successful sales and service teams," he adds. "Dave's deep background in general management, marketing, and sales make him ideally suited to spearhead the growth of our exciting solar business."

[www.veeco.com](http://www.veeco.com)

### IN BRIEF

#### Veeco co-sponsors award for MBE innovators

Veeco Instruments Inc (which manufactures MBE deposition systems and thermal deposition sources) is once again co-sponsoring the MBE Innovator Award in 2009 in conjunction with the North American Molecular Beam Epitaxy (NAMBE) organization.

Initiated in 2003, the award (consisting of a \$3000 honorarium and plaque) recognizes individuals whose innovations have significantly advanced MBE technology. It will be presented at the North American Conference on Molecular Beam Epitaxy (NAMBE 2009) at Princeton University, NJ (9-12 August).

NAMBE Advisory Committee Officials will select a winner, with the recipient receiving the award at the conference banquet.

[www.nambe2009.com/awards](http://www.nambe2009.com/awards)

## SUSS MicroTec streamlines its sales & support structure in Asia

SUSS MicroTec of Garching near Munich, Germany, which provides process and test solutions for microstructuring applications, has announced a new structure for sales in Asia based in Singapore.

The firm has consolidated its sales office in Bangkok, Thailand (which administered sales and service for lithography and wafer bonder equipment in Asia) and the former Singapore office of wafer-level engineering test solutions provider SUSS MicroTec Test Systems into a joint sales office in Singapore for the three product lines. It has also appointed ZMC Technologies as general sales representative for Malaysia, Singapore and Philippines.

SUSS MicroTec already has sales offices in Seoul (Korea), Shanghai (China), Yokohama (Japan) and Hsinchu (Taiwan). It now also operates two fully equipped application centres in Yokohama and Singapore and provides real-time after-sales support for both process and test

solutions to its Asian customers.

By appointing ZMC, SUSS MicroTec is streamlining its sales and service organization, providing customer support for all product lines. ZMC has already been representing the firm's test solutions for more than eight years and is now extending its services to sell and support SUSS MicroTec's lithography and wafer bonding systems.

"Within the global semiconductor and MEMS markets, customers demand new advanced processes requiring the one-source solutions offered by SUSS MicroTec. Streamlining our organization is therefore a logic step for us", says president & CEO Frank Averdung. "With our strengthened presence in Asia we are not only closer to our customers but also able to offer all our customers a high level of sales and applications support for our complete product portfolio," he adds.

[www.suss.com](http://www.suss.com)

[www.zmc.net](http://www.zmc.net)



## Riber wins orders for MBE reactors

Riber S.A. of Bezons, France, which manufactures molecular beam epitaxy (MBE) systems as well as evaporation sources and effusion cells, has announced the signing of several major orders with customers in France, Russia and Asia.

The FOTON (Optical Functions for TelecommunicationS) laboratory of France's INSA-Rennes (Institut National des Sciences Appliquées de Rennes) has ordered a new research system — a Riber LPCVD21 gas-source silicon epitaxy reactor. Bought with support from the French and European funds PONANT/FEDER (Fonds européen de développement régional), the system will be connected to an already installed Riber Compact21 and will enable the FOTON-INSA lab to increase its optoelectronic component research capabilities (particularly relating to light transmitters based on nano-structured gallium arsenide on silicon substrates).

Also, the International Tomography Center at the Russian Academy of Science's Siberian division in Novosibirsk has ordered a Compact21 reactor (the world's most popular MBE research system). The reactor will be set up by Dr A. Toropov and is to be dedicated to nano-technology applications for GaAs components.

Riber also notes that sales of evaporation sources for organic LEDs (OLEDs) are taking off, with the signing of a significant order from a major Asian manufacturer. Over the past few years, Riber has supplied deposition system makers and end users with effusion cells suitable for depositing OLED structures on large-size screens. First used in the production of small flat panels (mobile phones, radios, notebooks, etc), OLED technology is gradually diversifying with the production of flexible large-size flat panels and planar luminaires.

[www.riber.com](http://www.riber.com)

### IN BRIEF

#### AWSC to ship PAs for WiMAX at year-end

Taiwanese GaAs foundry Advanced Wireless Semiconductor Company (AWSC) expects to start shipping power amplifiers (PAs) for WiMAX base-stations in small volumes at the end of 2009.

AWSC is developing its InGaP HBT/PHEMT process to deploy into the WLAN and WiMAX markets. It is also transferring its 4-inch GaAs foundry production line to 6-inch in order to reduce costs and satisfy customer needs, said president Ching-Hua Wang.

AWSC is a strategic partner of leading PA supplier Skyworks, and on 1 June it was listed on Taiwan's over-the-counter (OTC) stock market.

[www.awsc.com.tw](http://www.awsc.com.tw)

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## IN BRIEF

## Fraunhofer ISE orders reactor for multi-junction PV development

Deposition equipment maker Aixtron AG of Herzogenrath, Germany says that in fourth-quarter 2008 the Fraunhofer Institute for Solar Energy Systems (ISE) in Freiburg, Germany ordered an AIX 2800G4-R MOCVD Planetary Reactor in 8x6-inch configuration (with automated wafer handler) for delivery in fourth-quarter 2009.

Funded by the Fraunhofer Society and the BMBF (German Federal Ministry of Education and Research), the new system will form the centerpiece of a program to develop and produce next-generation triple- and multi-junction solar cells in cooperation with industrial partners.

"We selected an Aixtron MOCVD system because of its high degree of flexibility and reproducibility that is achieved with the Planetary Reactor technology," says Dr Frank Dimroth, head of Fraunhofer ISE's III-V Epitaxy and Solar Cells group.

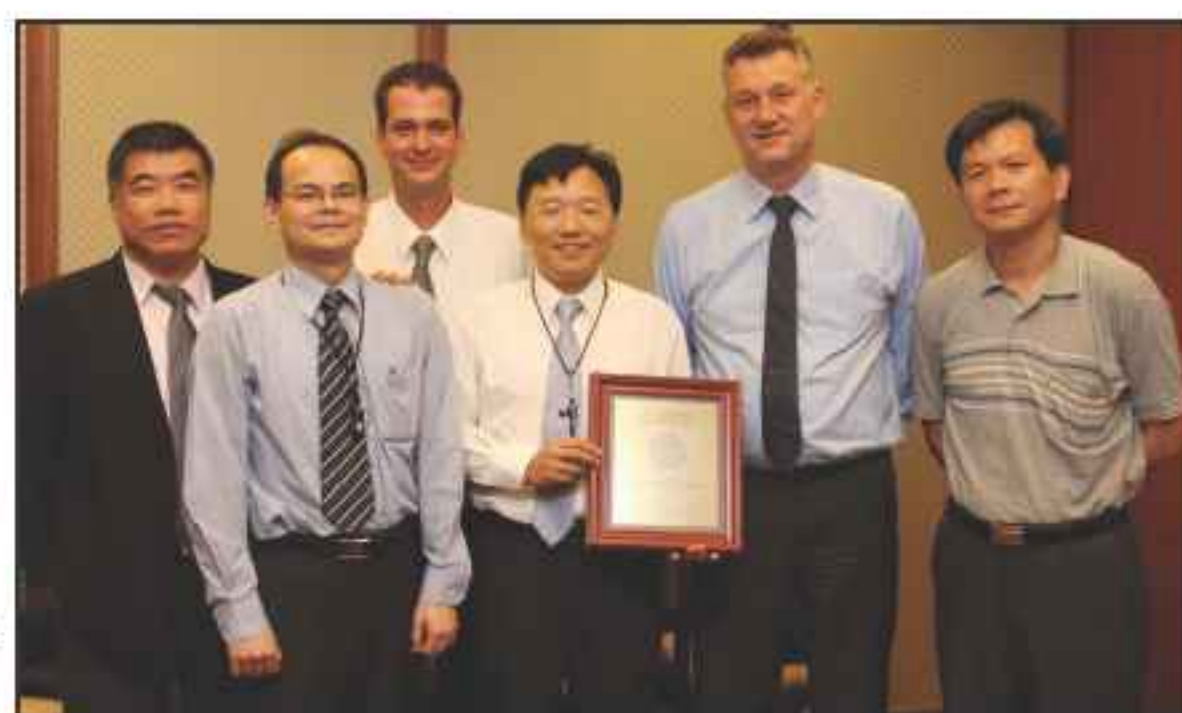
"Moreover, we can employ the system's wide process window for tuning our new process technology... The AIX 2800G4-R will incorporate advanced in-situ monitoring technologies and we will be able to change wafer configurations flexibly up to 8.5 inch," he adds. "I was impressed by the improvements which have been made in the reactor design compared to our current AIX 2600G3 system. The new Aixtron technology allows us to transfer our R&D processes up to high-volume mass-production, which is a prime target for our development project."

[www.ise.fhg.de](http://www.ise.fhg.de)  
[www.aixtron.com](http://www.aixtron.com)

## Epistar places multiple system order and celebrates its 150th Aixtron production reactor

In second-quarter 2009, LED chip-maker Epistar Corp of Hsinchu Science-based Industrial Park, Taiwan placed a further multiple system order for Aixtron MOCVD reactors. This latest order consists of CRIUS Close Coupled Showerhead (CCS) reactors and AIX 2800G4 HT Planetary Reactor systems (for delivery in 2009, starting in Q3) for the volume production of GaN-based LEDs.

In a separate ceremony in Taiwan recently, Aixtron's executive VP & chief operating officer Dr Bernd Schulte presented an award to Epistar's chairman Dr B.J. Lee to celebrate the 150 Aixtron systems bought in total by Epistar. "Our two companies have enjoyed a long-lasting relationship," says Lee. "We have great confidence in the technology and the service that they provide. This is the foundation



Epistar's chairman Dr B.J. Lee receiving an award from Aixtron's executive VP & chief operating officer Dr Bernd Schulte.

of our success for the efficient volume production of world-class ultra-high-brightness [UHB] LED products," he adds.

"Epistar has developed considerable expertise with the AIX 2600G3, producing some of the brightest AlInGaP LEDs in the market and has also developed extremely high-performance GaN products with the Aixtron nitride Planetary Reactor systems," says Schulte.

[www.epistar.com.tw](http://www.epistar.com.tw)

## Chinese Academy of Sciences orders MOCVD tool for lasers and LEDs

Aixtron says that in first-quarter 2009 the Institute of Semiconductors of The Chinese Academy of Sciences in Beijing, China ordered a Close Coupled Showerhead (CCS) 3x2 inch MOCVD system. The new tool will be shipped in third-quarter 2009 and used for R&D on semiconductor lasers and LEDs.

"The Institute has focussed on optoelectronic device development for some years now," says professor Zhu Hong Liang, project leader within the Key Laboratory of Semiconductor Materials Science. The new Aixtron MOCVD system will enable the institute to undertake a complete materials development

program, he adds. "Aixtron's MOCVD equipment is well-known for its reliability and its straightforward operation."

The Institute of Semiconductors was founded in 1960 to meet the needs of the 'National Twelve Years Plan of Scientific Development', where development of semiconductor science and technology was identified as one of 'The Four Urgent Measures'. Since then it has become one of the key bases for R&D on semiconductor science and technology in China. Today it has over 420 staff, including 64 professors and 66 associate professors.

[www.semi.ac.cn/semi/en](http://www.semi.ac.cn/semi/en)



## MOCVD reactor for Italian multi-junction PV research

Aixtron of Herzogenrath, Germany says that in December it received an order for an AIX 2800G4 Planetary Reactor (in 15x4"-wafer configuration) for delivery in fourth-quarter 2009 to CESI RICERCA S.p.A. of Milan, Italy, which on 29 April was renamed ERSE S.p.A. (Enea-Ricerca sul Sistema Elettrico S.p.A.).

CESI RICERCA was established by CESI at the end of 2005 to develop energy-related research activities (funded at both the national and international level) for the national electricity system. In particular, the firm has experience in III-V-based high-efficiency multi-junction (MJ) solar cells, from material growth through characterization to cell modeling and testing. It is also involved in research and demonstration of concentrating photovoltaic (CPV) systems, renewable energy hybrid systems for remote community electrification, and the integration of photovoltaics into buildings.

The AIX 2800G4 system will be used to develop multi-junction solar cells as an integral part of a pan-European collaboration, the five-year Apollon Project of the Seventh Framework Programme (which supports the transfer of new technologies to mass production). The aim of the project (which began last September) is the development and realization of MOCVD technology for highly efficient multi-junction solar cells, as well as the development of high-concentration point focus and dense array CPV systems based on monolithic and discrete multi-junction technologies. The project has a final target cost of €2/Watt-peak.

**We will also be able to easily tune the system for our new processes and materials... the testing of new hydride and MO sources**

"For this project we are developing triple-junction and multi-junction solar cells with new materials and so we needed an MOCVD system with sufficient flexibility," says Dr Gianluca Timò, Apollon project director at ERSE. The Aixtron Planetary Reactor design has a wide process window due to its new inlet geometry and reactor design, he adds. "We will also be able to easily tune the system for our new processes and materials... the testing of new hydride and metal-organic sources will be straightforward. Such features, together with the advanced in-situ monitoring technologies and flexible wafer configurations up to multiple 8.5", will ensure that our development program can investigate all possibilities smoothly and efficiently," Timò reckons.

[www.cesiricerca.it](http://www.cesiricerca.it)  
[www.apollon-eu.org](http://www.apollon-eu.org)  
[www.aixtron.com](http://www.aixtron.com)

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## Tegal ponders sale as revenue falls 74% year-on-year

Plasma etch and deposition system maker Tegal Corp of Petaluma, CA, USA has reported revenue for fiscal 2009 (to end March) of \$13.1m, down 60% on \$32.9m in fiscal 2008. This included fourth-quarter revenue of just \$1.9m, down 74% on \$7.4m a year ago and 58% on the prior quarter (although only back down to the \$2m of the quarter before that). This follows Tegal on 16 September completing the acquisition from Alcatel Micro Machining Systems (AMMS) and Alcatel Lucent of their deep reactive ion etch (DRIE) and plasma-enhanced chemical vapor deposition (PECVD) products and related intellectual property.

Gross margin has fallen from 42.6% to 39.8%, including just 26.3% in the fourth quarter (down on 50.6% a year ago). Compared to net income of \$18.1m in fiscal 2008, net loss was \$7.9m, including \$3.2m for the fourth quarter (compared to net income of \$15.2m a year ago). Cash balance fell from \$19.3m a year ago to \$12.7m at the end of fiscal Q3, but only fell to \$12.5m at the end of fiscal Q4. The firm stresses that it has no debt and few liabilities.

During the quarter, systems order backlog fell from \$2.8m to \$1.5m, although it has since risen to \$4.3m. Despite unprecedented market conditions, during the quarter Tegal secured system orders from two new customers (one in North America and one in Asia).

After the fiscal year end, the firm established the subsidiary Tegal

France, with offices in the Haute Savoie capital of Annecy, completing the transition of the DRIE products and related intellectual property for 3D packaging and MEMS (micro-electro-mechanical system) devices from France-based AMMS and Alcatel Lucent.

Tegal says that the development of its new-generation DRIE tool has reached completion, offering a solution for complex 3D interconnects using thru-silicon vias (TSVs), which the firm believes will further expand its stake in the MEMS market.

Also, Tegal has just received orders for a 110 DE/SE DRIE tool and for an SMT AlN (aluminum nitride) PVD system from two

**We cannot indefinitely withstand the impact of a protracted industry downturn and a deep global recession. It makes good business sense, therefore, to take early and decisive action to explore strategic alternatives**

research centers that are first-time customers: one in South East Asia for research in micro-systems, microfluidics and MEMS sensor applications, and one in North America for research on RF MEMS and piezoelectric sensors and actuators, respectively.

However, the firm says that revenue levels remain below breakeven, even after rigorous cost-cutting initiatives (including a 10% cut in staffing announced last November). Furthermore, visibility is extremely poor industry-wide, making forecasting difficult, it adds. These challenges have prompted the board of directors and management to explore all available strategic alternatives to optimize future opportunities. Tegal has therefore retained the services of Cowen and Company LLC to assist in this.

"Doing what is right for our shareholders and employees means making pragmatic decisions based on prevailing market conditions," says chairman, president & CEO Thomas Mika. "We cannot indefinitely withstand the impact of a protracted industry downturn and a deep global recession. It makes good business sense, therefore, to take early and decisive action to explore strategic alternatives, including the potential sale of the company as a going concern," he adds. "Our considerable intellectual property

**Our cash balance allows time for careful consideration**

assets and our healthy share of select high-growth markets strengthen our position, while our cash balance allows time for careful consideration of the best possible options."

[www.tegal.com](http://www.tegal.com)

## Tegal given cure period to comply with Nasdaq listing requirements

The NASDAQ Stock Market LLC has provided Tegal a period under the NASDAQ Listing Rules during which it can cure its existing deficiency.

This follows Tegal announcing that, as a result of the recent resignation of Edward A. Dohring from its board of directors, it no longer complies with NASDAQ's requirements, both on independent directors and on

audit committee composition, for continued listing as set forth in the NASDAQ Listing Rules 5606(b)(1) and 5605(c)(2)(A), respectively.

Under the NASDAQ Listing Rules, Tegal may regain compliance within a cure period up to the firm's next annual shareholders' meeting or 16 June 2010 (whichever comes first). Alternatively, if

the next annual shareholders' meeting is before 14 December 2009, then the firm must give evidence of compliance before that.

Tegal says that it intends to evaluate qualified candidates to fill the vacancy created by Dohring's resignation, with a goal of curing the deficiency before the cure period expires.



## Plasma Etch launches high-rate RIE version of plasma system

Plasma Etch Inc of Carson City, NV, USA has launched a high-rate reactive ion etching (RIE) version of its BT1 plasma system.

The BT1-RIE is suited to fast anisotropic removal of photo-resist, nitrides, oxides, polyimides and even diamond-like carbon (DLC) films, and is offered with a unique water-cooled RIE electrode for processing multiple substrates up to 1 foot square per load cycle.

The system uses a 1250W 13.56MHz RF power supply with automatic matching for high rate etching capability. Two mass flow controllers for two gases are provided as standard, with options for a total of up to four gas channels. The system is completely PLC controlled, using a color touch-screen display for user configuration setup and operation. Up to 20 complete process sequences can be stored

and dual steps can be programmed for automatic processing. Two-stage vacuum pumping is included, with blower packages optional for high throughput.

Applications include medical devices, solar cells, optics, printed-circuit boards, connectors, micro-electro-mechanical systems (MEMS), and wafer-level packaging.

[www.plasmaetch.com](http://www.plasmaetch.com)



Plasma Etch's BT1-RIE.

## Liverpool orders second OpAL tool for atomic layer deposition project

Etch and deposition equipment maker Oxford Instruments Plasma Technology (OIPT) has received a second order from Liverpool University for its OpAL Open Load atomic-layer deposition (ALD) tool. The first system was purchased as part of the research project 'Atomic layer deposition of hafnium-nitride and lanthanide nitrides' funded by the UK Engineering and Physical Sciences Research Council (EPSRC). The second was bought as part of a joint industry/government funding initiative. Liverpool is continuing to strengthen its links with industry via its collaboration with OIPT and SAFC Hitech.

"Our current OpAL system is being used to develop thermal ALD processes using ammonia and metal-organic precursors for the deposition of hafnium-nitride and lanthanide nitrides/oxynitrides;

these materials are of significant interest for gate stack applications in integrated circuits," says Dr Richard Potter of the Department of Engineering. "The OpAL shows plenty of scope for future expansions such as the plasma upgrade option and access ports for in-situ monitoring," he adds.

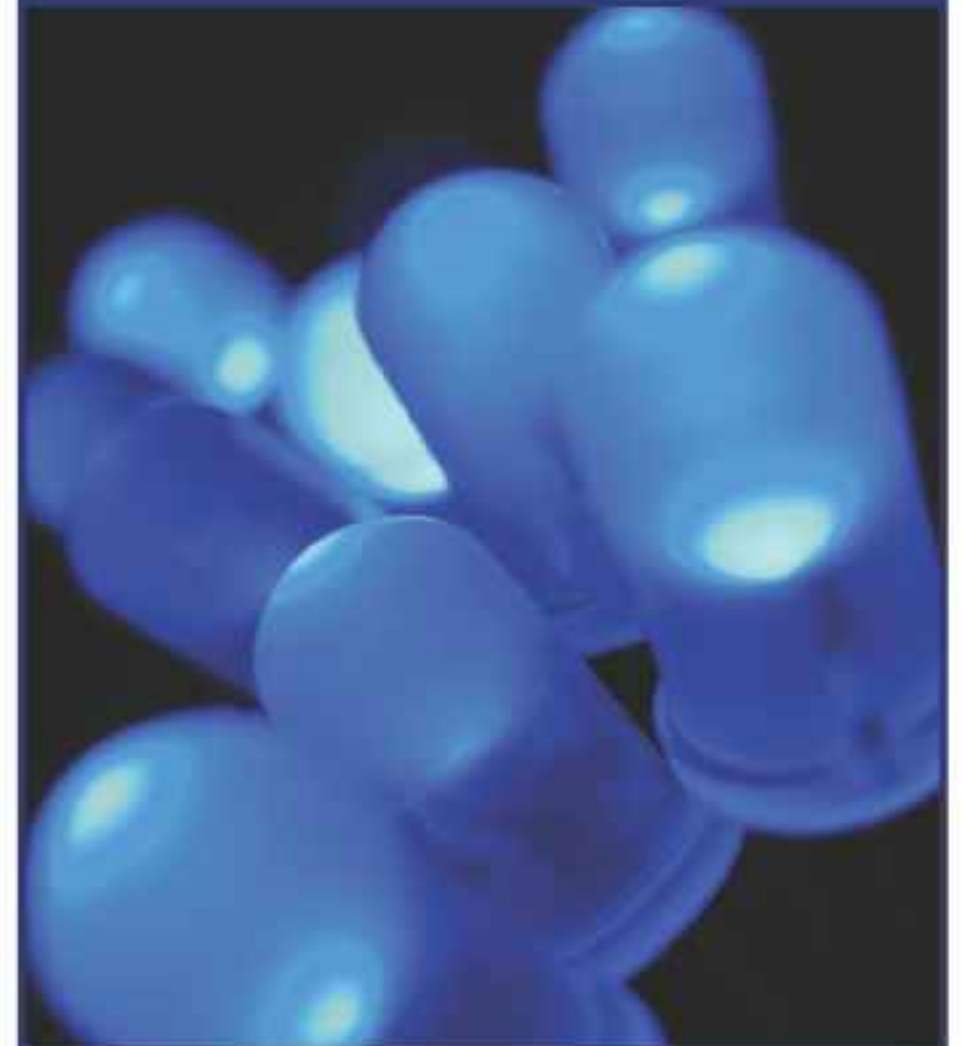
"This additional OpAL system expands our R&D opportunities with plasma," says professor Paul Chalker. "We chose the OpAL because of its flexibility and its well-established suitability for research applications both here and at other universities

running similar projects," he adds.

[www.oxford-instruments.com](http://www.oxford-instruments.com)

## Templates for Blue and UV LEDs

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## Showa Denko's 660nm red LED chips adopted at Japanese government's plant growth facility

Red-light-emitting (660nm-wavelength) aluminum gallium indium phosphide (AlGaInP) LED chips made by Tokyo-based chemical manufacturer Showa Denko K.K. (SDK) have been adopted by the Ministry of Economy, Trade and Industry (METI) at its fully controlled plant growth facility (which acts as a model for such facilities in Japan). The red 660nm wavelength is considered to be the optimum light for accelerating the growth of plants. SDK began selling samples of the LED chips in early April.

The plant growth facility was installed in the lobby of METI's annex building in Kasumigaseki, Tokyo in January to raise awareness of the importance of such facilities among consumers, enterprises, local governments, and other involved parties. In its initial stage, a combination of artificial light and sunlight was used. However, on 26 May it was fully renewed, focusing on artificial light



Lamps using red LED chips (which are best suited for plant growth), alongside fluorescent lamps.

(including LED, fluorescent, and sodium lamps) and featuring fully controlled temperature and humidity. The facility's LED lamps contain a total of about 800 red LED chips from SDK.

In recent years, facilities for growing vegetables in an environment of controlled lighting, temperature, humidity, CO<sub>2</sub> concentration and

nourishments have been attracting attention, because they ensure stable production regardless of season or location, as well as realizing multiple cropping. Furthermore, due to the controlled environment, fungicides or insecticides are not needed.

Under its 'Passion Extension' project (which follows its original 'Passion Project' of 2006–2008), SDK is expanding its ultra-

bright LED chip operation—consisting of AlGaInP red LED chips and indium-gallium-nitride (InGaN) blue/green LED chips—as a 'next-generation growth-driver' business. The firm says that it is preferentially allocating resources to these areas in an effort to further increase its corporate value.

[www.sdk.co.jp](http://www.sdk.co.jp)

## Seoul Semiconductor's Acriche LEDs provide illumination in Korea's National Palace Museum

FS Korea Networks Co Ltd has installed DELICIA lighting fixtures, incorporating Acriche AC-driven LEDs from LED maker Seoul Semiconductor Inc, for the main interior lighting in all galleries of Korea's National Palace Museum. Opened in November 2007, the National Palace Museum inside Gyeongbokgung Palace has 15 galleries on two floors above ground and one below ground.

Equipped with dimming control, the DELICIA lighting fixtures were chosen to protect the works of art and documents of the Joseon Dynasty, since LEDs are a safe source of high-quality lighting (without the emission of ultraviolet and infrared rays).



Interior lighting in the National Palace Museum of Korea

FS Korea Networks says that it will install further Acriche-based lighting fixtures in more galleries of the National Museum in the future.

As the use of LED lighting grows rapidly worldwide, orders for

Acriche (the world's first AC-driven LED) are rising sharply and may soon outstrip production without further expansion, says Seoul Semiconductor. "Even though Acriche is already being used in specialized lighting systems for museums and art

galleries, we are rapidly making it a global brand to serve a large and varied general-purpose illumination market," adds the firm.

[www.acriche.com](http://www.acriche.com)

[www.delicia.kr](http://www.delicia.kr)

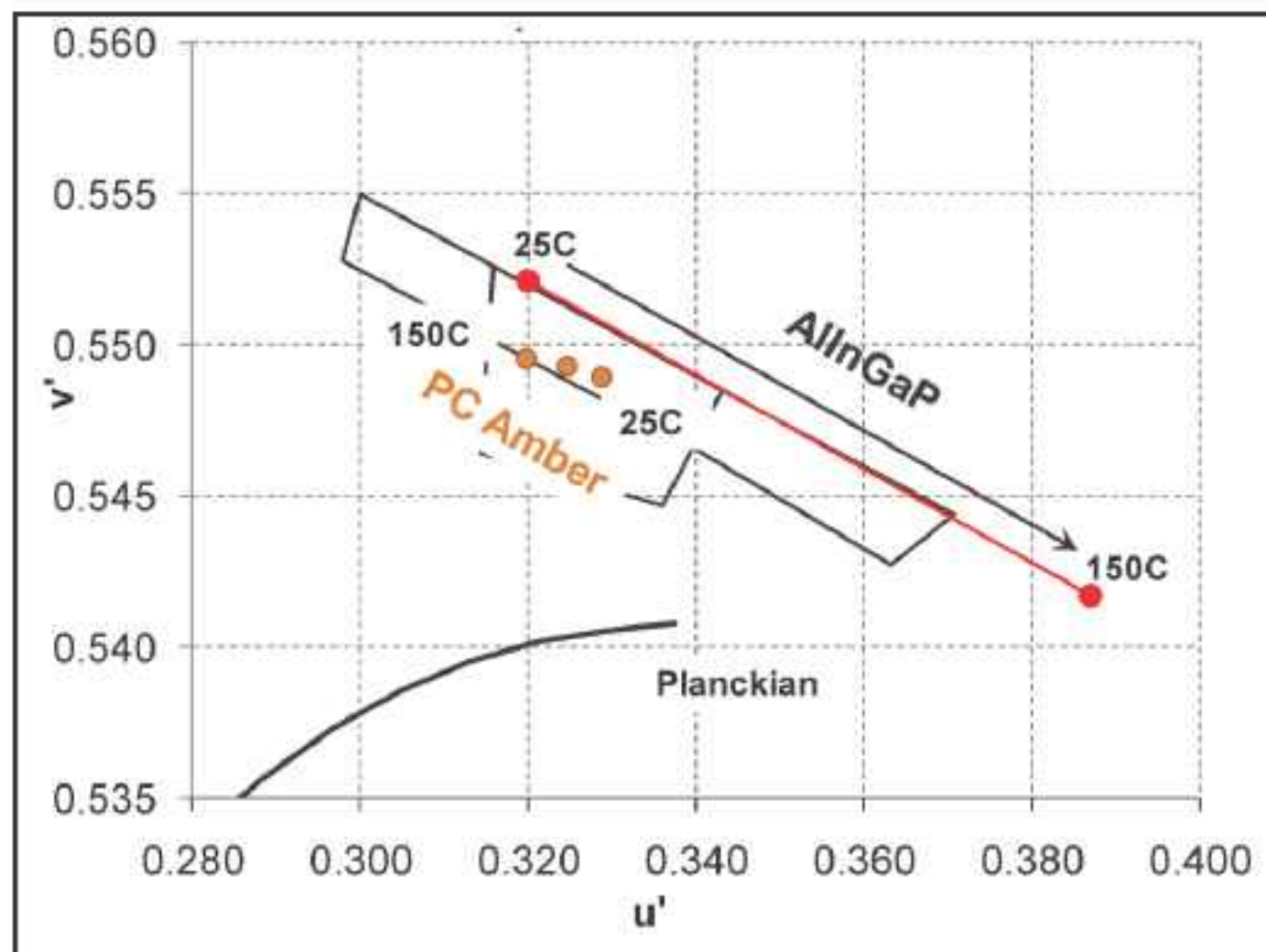


## Lumileds launches phosphor converted amber LED

Philips Lumileds of San Jose, CA, USA has made available the LUXEON Rebel phosphor converted amber (PC Amber) LED. The firm claims that its latest LUXEON Rebel LED yields 2–5 times more light output and dramatically less color shift compared to typical amber LEDs. The PC Amber delivers typical flux of 70 lumens at a drive current of 350mA, enabling solution and application providers to reduce the number of LEDs used, the cost per lumen, overall system costs, and to simplify the solution manufacturing process.

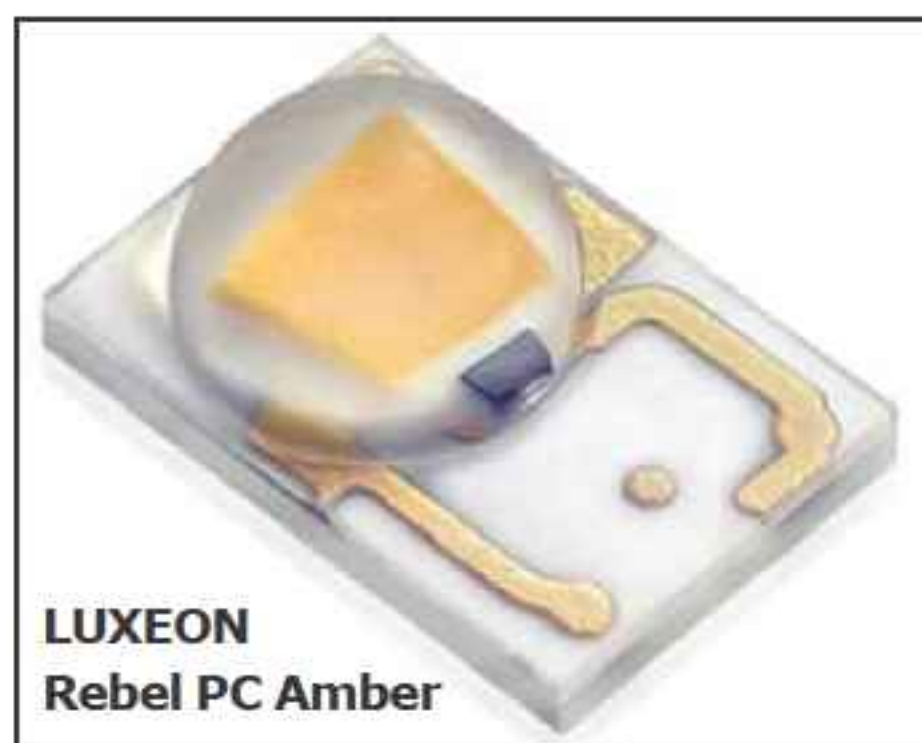
"The number and breadth of applications that require amber LEDs is tremendous," says Frank Harder, VP of product marketing, citing the automotive, entertainment, roadway, and signaling markets. "With better efficiency and more light output, LUXEON Rebel PC Amber makes it that much easier to reduce energy consumption with an environmentally friendly product," he adds.

Many applications have not switched from conventional incandescent lamps to LEDs because they did not produce enough light and



**Color shift with temperature: PC Amber vs AlInGaP LED.** of amber LEDs.

could not operate effectively at higher temperatures, says Lumileds.



With the PC Amber, yellow traffic signals can be converted, warning lights and beacons on vehicles and obstructions can be switched, and entertainment applications can adopt the new LEDs, the firm adds.

Automotive applications, such as those for braking and signaling, use significant numbers

With the PC Amber, manufacturers can use fewer LEDs and lower other component costs because of the improved light output and, in particular, the stable color over temperature, which has been problematic for many auto makers. Lumileds expects full automotive qualification later this year.

PC Amber LEDs are available through exclusive worldwide distributor Future Lighting Solutions (a division of Future Electronics).

[www.futurelightingsolutions.com](http://www.futurelightingsolutions.com)  
[www.philipslumileds.com](http://www.philipslumileds.com)

## Lumileds' LUXEON Rebels power LED security floodlights

Philips Lumileds says that its LUXEON Rebel LEDs are being used by intelligent lighting and sensor fixture manufacturer Steinel of Herzbrock-Clarholz, Germany to power its new XLed range of security floodlights, which use one-third of the energy consumed by conventional floodlights, it is claimed. The XLed is available as the XLed 25 (with 25 LUXEON Rebels for very high luminous flux and total power consumption of about 60W) and the more compact XLed 10 (with 10 LUXEON Rebels and total power consumption of about 25W).

To extend the energy-saving benefits of the LUXEON-based XLed fixtures, Steinel has incorporated a

wide-angle motion sensor for use in security applications. An electronic control unit switches the floodlight on instantly at full power when a human body is detected, but turns it off after a period of time or reduces light output to 10% of maximum, as decided by the user.

"The LUXEON Rebel LEDs are very temperature-resistant," says



**Steinel's XLed 25 floodlight, incorporating 25 LUXEON Rebel LEDs.**

Steinel's managing director Thomas Möller. "In product development we tested many different LEDs, and we found that the Philips Lumileds LEDs were the best for our application," he adds.

Lumileds says that its LUXEON Rebel white LEDs suit Steinel's XLed, where the requirement is for a bright and compact light source that delivers high efficacy and offers a long operating lifetime, remaining robust even in the most demanding operating conditions. XLed is designed to operate at full power for sustained periods and carries a warranty for an operating lifetime of 50,000 hours (45 years at three hours' use per day).

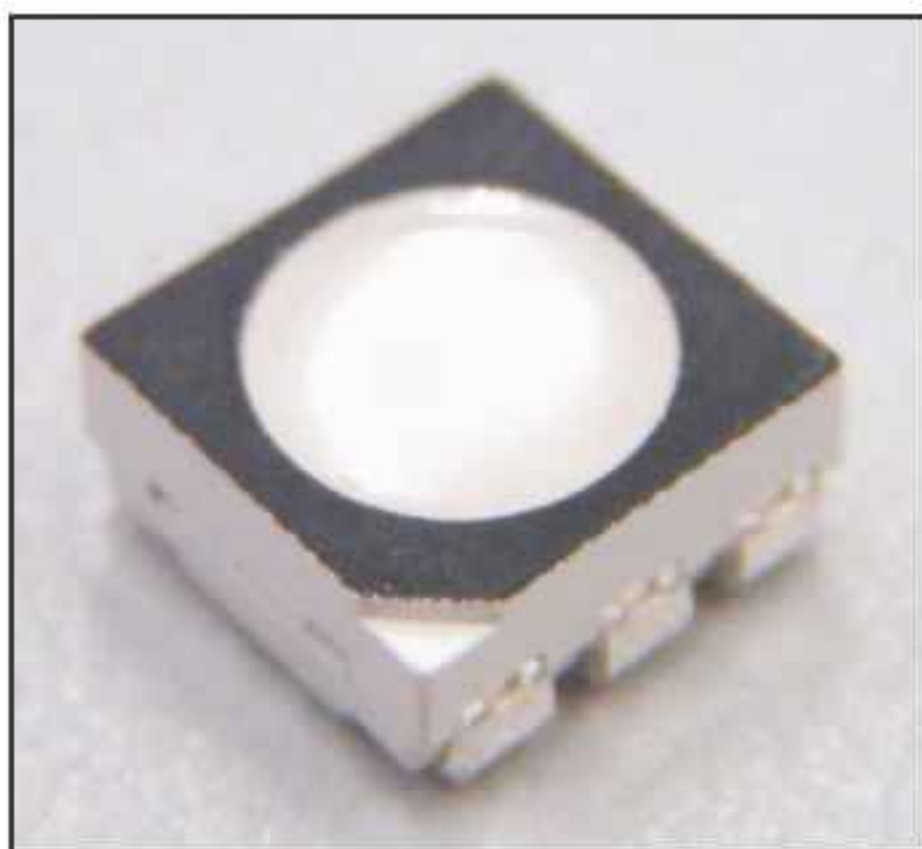
[www.steinel.de](http://www.steinel.de)



## Cree launches first IPx5-rated tri-color LED for displays

LED chip, lamp and lighting fixture maker Cree Inc of Durham, NC, USA has made available samples of what it claims is the first commercially available water-resistant, surface-mount, high-brightness LEDs for outdoor video screens. The RGB (red-green-blue) LED has an IPx5 rating, indicating that the LED is protected against low-pressure jets of water from all directions.

"We've developed a water-resistant, red-green-blue LED that can be used in indoor and outdoor video screen applications," says Paul Thieken, director of marketing, LED components. "Previously, LEDs had to be encapsulated to protect them from water. By incorporating encapsulation at the LED level, we can help our customers save time and money," he adds.



Cree's ScreenMaster CLV6A-FKB LED.

Cree worked on the LEDs with the display maker Displ'aire of Rohnert Park, CA, USA. "Cree's involvement started with us early in our development cycle, and they provided the support we needed to rapidly deploy our new technologies," says

the firm's CEO Leo Stearns. "Displ'aire portable, daylight-visible displays and the new water-resistant Cree LEDs are a perfect technology match for creating brighter, more efficient displays that can better stand up to the elements."

Cree's ScreenMaster CLV6A-FKB LED features a black face for improved contrast in full-color video screens, decorative lighting and amusement applications. It has a unique encapsulation resin with UV-inhibitors, minimizing the effects of long-term exposure to direct sunlight, which helps to improve the stability of the light output over the life of the LED. It also features a unique matched horizontal radiation pattern, enhancing color mixing and pixel-to-pixel color consistency.

[www.displaire.com](http://www.displaire.com)

### IN BRIEF

#### Third plant expands SemiLEDs' monthly capacity to 15m chips

SemiLEDs Corp of Boise, ID, USA has opened a third production plant in Hsin-Chu Science Park, Taiwan, bringing its capacity to 15 million 1mm x 1mm high-power LED chips per month by September.

SemiLEDs' chips are manufactured using a unique, proprietary 'metal vertical photon' (Mvp) process that provides a flexible copper alloy base, enabling what is claimed to be the industry's best thermal resistance (0.4°C/W) as well as providing optical and electrical advantages. Packaged LEDs typically output more than 110 lumens at 5000K and 350mA.

"Along with our ongoing collaboration with Aixtron on 6" wafers [announced at the end of April], this new facility will enhance our power LED capacity and allow us to stay ahead of ever increasing demand," says CEO Trung Doan.

[www.semileds.com](http://www.semileds.com)

## Blue LED pioneer wins Kyoto Prize

The Inamori Foundation says that Isamu Akasaki (a professor at both Nagoya University and Meijo University in Japan) is among the laureates of its annual Kyoto Prize, an international award celebrating its 25th anniversary that honors contributions to the "scientific, cultural and spiritual betterment of mankind".

The prize is presented on 10 November each year in three categories (Advanced Technology, Basic Sciences, and Arts and Philosophy).

For 2009, the Kyoto Prize in 'Advanced Technology' focuses on electronics. Akasaki, 80, will receive the award for pioneering work that led to the development of the blue LED.

After decades of research on gallium nitride, Akasaki created GaN-based positive-negative (p-n) junctions, making the blue LED practically possible. This stimulated research on blue LEDs, and served as the first step toward their eventual commercialization in the 1990s.

Applications now include displays for mobile electronic devices; large outdoor display equipment and sig-



nage; railway and road traffic signals; and vehicle lamps. Also, with the advent of blue semiconductor lasers, the capacity of optical

recording media such as Blu-ray discs has been increased.

The award citation also says that Akasaki's research has not only led to diverse new applications in electronic equipment but also offers promise for protecting the global environment as blue LEDs are adopted for energy-conserving general-purpose lighting.

During a week of ceremonies beginning 9 November in Kyoto, each laureate will be presented with a diploma, a 20-karat-gold Kyoto Prize medal, and a cash gift of 50m yen (about \$500,000) per prize category.

The laureates will also reconvene in San Diego, CA, USA on 20-22 April 2010 for the ninth annual Kyoto Prize Symposium.

[www.kyotoprize.org](http://www.kyotoprize.org)



## First US public community college halves lighting energy consumption as it joins Cree's LED University program

LED chip, lamp and lighting fixture maker Cree Inc of Durham, NC, USA says that Illinois' Joliet Junior College (JJC) is joining its LED University program.

Launched in April 2008, the LED University initiative is an international community of universities working to evaluate, deploy and promote the adoption of energy-efficient LEDs across their infrastructures (in areas such as offices, student housing, parking garages, walkways and streets). The aim is to save energy, protect the environment, reduce maintenance costs, and provide better light quality for improved visibility and safety. Joliet Junior College joins inaugural participant North Carolina State University as well as University of California at Santa Barbara, the University of Arkansas, Marquette University, the University of Notre Dame, University of California Davis,

the University of Miami, the University of Alaska at Anchorage, and Madison Area Technical College (MATC) in the USA, as well as Tianjin Polytechnic University in China.

Joliet Junior College officials recently renovated 12 restrooms on campus, replacing compact fluorescent and tube fluorescent fixtures with Cree's LR6 six-inch LED recessed lights. Energy consumption was reduced by 50%, from 3384W to 1692W. A total cost-of-ownership analysis by JJC shows an expected saving of more than \$53,000 over the estimated 25-year life span of the LED fixtures.

"We wanted to start with a single application as we evaluated the benefits of switching to LED lighting," says Patrick Van Duyne, JJC's director for facility services. "We anticipate that the drastically lowered maintenance costs, coupled with the reduction in energy usage,

means real savings; we no longer budget for disposal costs or for changing light bulbs frequently," he adds. "We plan to move forward with LED lighting in additional restroom renovations and other applications, like dining areas and parking lots."

"JJC energy officials have taken a practical approach to evaluating and deploying LED lighting, realizing significant energy and maintenance cost savings now, and anticipating larger savings as energy and labor costs are expected to rise over the next few years," says Cree LED programs manager Deb Lovig. "Although the initial evaluation was relatively small, cutting energy use in half and the potential to save close to \$53,000 produced the business case for expanding efforts."

[www.jjc.edu](http://www.jjc.edu)

[www.leduniversity.org](http://www.leduniversity.org)

## Cree's CEO discusses LED lighting with Obama

On 2 July, Cree's chairman & CEO Chuck Swoboda and seven other CEOs representing American companies at the forefront of energy-efficient technologies joined President Obama at the White House in a roundtable discussion on areas such as clean energy (including LED lighting) and the potential benefits to the US economy.

"It's men and women like these who will help lead us out of this recession and into a better future," said Obama afterwards. "My job — and our job as a government — is to do whatever we can to unleash the great generative powers of the American economy by encouraging their efforts. And when you hear the innovation that's taking place —



President Obama, with Cree CEO Swoboda at back, center.

**There are unprecedented opportunities for US companies like Cree to deliver innovative technologies and products to address our current energy challenges**

everything from LED lighting that can save a huge amount on energy costs to new concrete materials....that gets you excited about the future," he added.

"With President Obama's support and the current momentum surrounding energy efficiency and sustainability, there are unprecedented opportunities for US companies like Cree to deliver

innovative technologies and products to address our current energy challenges," said Swoboda. "22% of US electricity is used for lighting, and the widespread deployment of LED lighting can reduce this by more than 60%," he adds.

[www.cree.com](http://www.cree.com)



## projectiondesign, LG, BenQ & Coretronic use Luminus LEDs

At June's InfoComm 2009 in Orlando, Luminus Devices Inc of Billerica, MA, USA said that its PhlatLight LEDs are being used to provide illumination in several new projectors on show based on Texas Instruments' digital light processing (DLP) technology.

"Traditional lamp technologies are rapidly being replaced with environmentally friendly, more powerful LED light sources," said Stephane Belloguardo, director of product marketing, Projection Display business.

Luminus demonstrated the new Joybee mini projector from Taiwan's BenQ, costing \$499 for professionals, gamers and other mobile system users. Its PT-39 LED chipset is designed for projection systems that use micro-displays of size 0.4–0.55" with individual red, green and blue LEDs. "BenQ's mission is to continue developing compact projection systems that are ideal for numerous environments, such as home movies, gaming, meeting room demos



BenQ's new Joybee mini projector.

and for the on-the-go business professional," said BenQ America's marketing director Po Su.

projectiondesign of Fredrikstad, Norway (which provides DLP-based projectors for applications in professional, business, home cinema and eCinema markets) showcased its new FL32 series of high-end professional projector systems. "Through the use of PhlatLight LEDs we are able to satisfy the most demanding users' requirements for brightness, color, reliability and light-source life,"

said president & CEO Jørn Eriksen.

Korea's LG Electronics demonstrated its HS-200G. One of several new ultra-mobile projectors powered by PhlatLight LEDs (as well as the existing HS-102 pocket projector), it weighs less than 2 pounds and fits in the palm of a hand. Since PhlatLight LEDs can last up to 70,000 hours, they should not need replacement throughout the projector's lifetime.

The Texas Instruments DLP booth demonstrated a new DLP-based data projector from Coretronic (the world's largest DLP projector maker). The new projector is claimed to be the first of its kind to offer light output suitable for the classroom and boardroom.

"We are very pleased to see the increased adoption of Luminus PhlatLight LED technology across all projection system categories," commented Luminus' president & CEO Keith T. S. Ward.

[www.luminus.com](http://www.luminus.com)

## Luminus appoints general managers of lighting and UV businesses

Luminus Devices has recruited Doug Lawson as general manager of its ultraviolet (UV) business, responsible for developing new PhlatLight LED products for UV curing (e.g. for hardening paints, adhesives, varnishes, printing inks and polymer systems).

"He will be an invaluable asset to drive our diversified overall growth strategy," says president & CEO Keith T. S. Ward. "This is an exciting time for Luminus to penetrate the UV equipment market."

Prior to joining Luminus, Lawson was VP of marketing & business development at BTU International, responsible for growing its solar business. Previously, he was head of SD Lawson and Associates (a strategic consulting firm focused on product, market and business development strategies for technology firms) and has held senior positions with PRI Automation Inc and Digital Equipment Corp. Lawson

began his career as a process sustaining engineer at Intel Corp.

Luminus says that its PhlatLight LEDs suit UV curing applications, as irradiance levels are comparable to existing UV sources such as mercury lamps. LED-based UV curing offers long life and a reduction in system cost of ownership. It also cuts both electrical consumption and emissions. "The UV lighting market will contribute greatly to the firm's overall growth strategy," says Lawson.

Luminus has also recruited Peter Weller as general manager of its lighting business, responsible for all aspects of its activities across applications, engineering, product development, operations, finance, marketing and sales.

"Peter brings a strong track record of success in the general lighting industry in both domestic and global markets," says Ward. "He will play a critical role as Luminus continues

to broaden its reach in the general lighting space with our big-chip, high-performance PhlatLight LEDs."

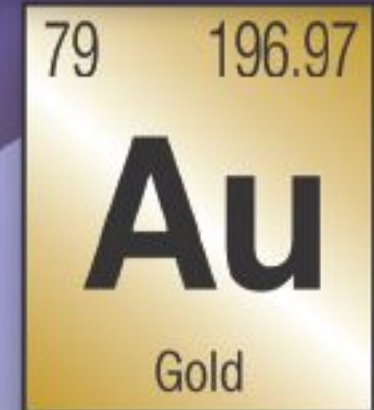
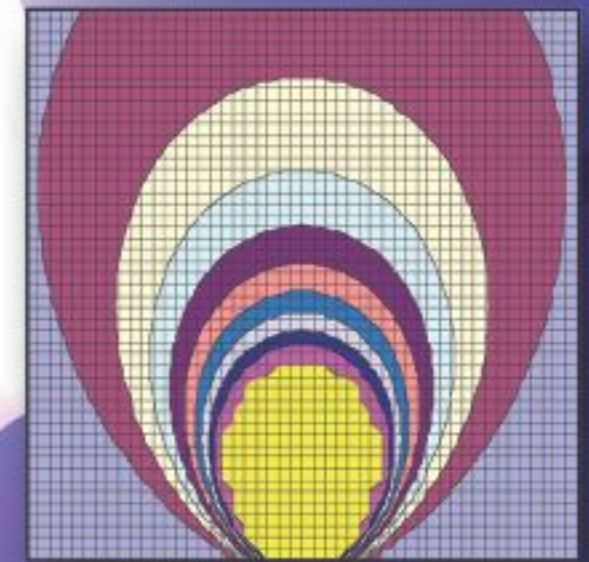
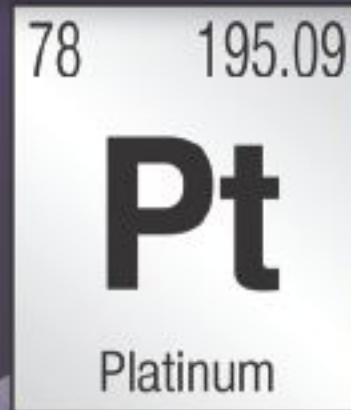
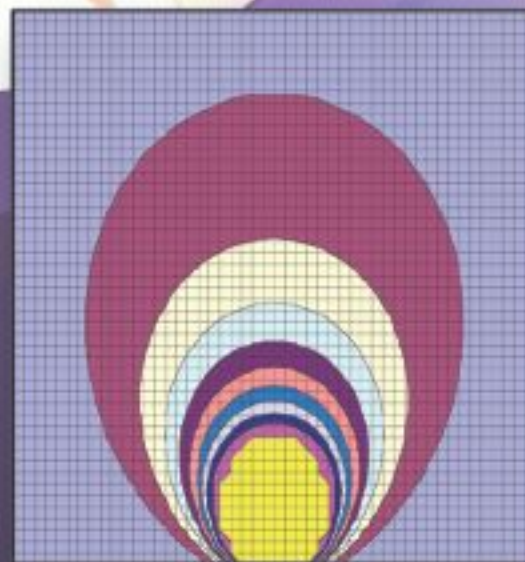
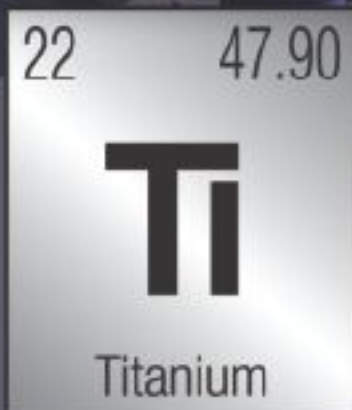
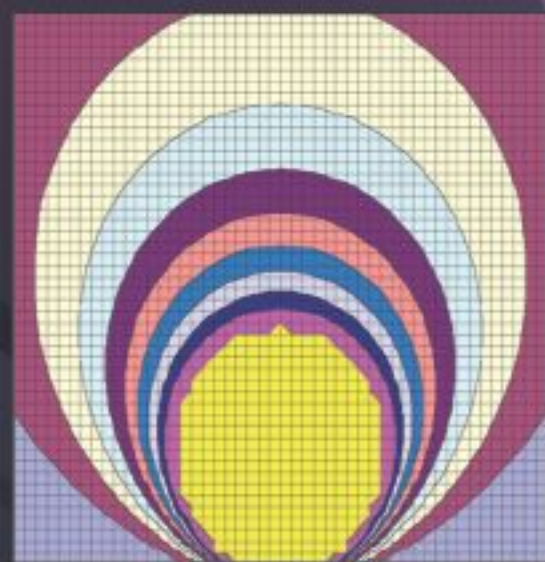
Weller joins from TCP Inc, where he was division & general manager of the ecoVation brand of compact fluorescent products. Previously, he held senior management posts at H.E. Williams Inc, Venture Lighting International and Osram Sylvania Inc. He also has experience as a lighting engineer with GTE Sylvania.

Weller will lead efforts to expand the use of PhlatLight LEDs in the general lighting industry (e.g. the architectural, entertainment, roadway and commercial segments).

"I look forward to expanding Luminus' reach into general lighting with our OEMs and distributors, customers, partners and the Luminus team as we deliver long-life, high-brightness LEDs to the market and enable new fixture designs for new and existing lighting applications," says Weller.



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## Opnext launches red laser diodes operable at 60°C

At the LASER World of Photonics 2009 event in Munich, Germany (15–18 June), optical component, module and subsystem maker Opnext Inc of Fremont, CA, USA introduced upgrades to its range of red laser diodes, resulting in higher-temperature-operation red laser diodes for use in industrial and medical sensor light sources and measurement equipment.

The HL6395/96MG and HL6397/98MG series offer what is claimed to be the world's highest-temperature operation (60°C) with output of 10 and 20mW in the 639nm wavelength band. The HL63101/102MG series offers tem-

perature operation of 60°C and what is claimed to be the world's lowest operating current with output of 5mW in the 637nm wavelength band. Both achievements were accomplished through a new development process that includes a new waveguide structure and optimized structure parameters. The active layer thickness and facet reflectivity result in a lower level of power consumption and extended battery-driven time, the firm says.

Opnext's new red laser diodes are suited to applications in laser levelers, distance meters, optical fiber checkers, as well as positioning sensors such as chip mounters.

"Our latest red laser diode is especially suited for applications with environmental restrictions due to temperature, such as coolers," says Tadayuki Kanno, who is senior vice president of the Device business unit. Systems that previously may have needed to use thermal management methodologies may now not need them, he adds.

Sample shipments began in June, with volume shipments due to begin in July for the HL6395/96MG and HL6397/98MG series and in August for the HL63101/63102MG series.

[www.opnext.com](http://www.opnext.com)

### IN BRIEF

#### Opnext receives Huawei's Technical Support Award

As part of its 2008 Supplier Performance Awards, Chinese telecom equipment vendor Huawei Technologies Corp Ltd has awarded optical component, module and subsystem maker Opnext Inc of Fremont, CA, USA its Year 2008 Technical Support Award. Opnext says that this reflects its strong history of customer relationships and builds on a long-standing tradition of customer support.

"Huawei's supplier appreciation awards represent our way of recognizing those suppliers who have proven to be an integral part of the Huawei supply chain team," says the firm. "Opnext has delivered technological expertise and quality products to support Huawei's business."

"Opnext is honored to be recognized by Huawei as its valued partner," says president & CEO Gilles Bouchard. "This award underscores and reinforces our dedication to raising the bar for service and technical excellence."

## JDSU launches industrial diode laser for automotive and electronic manufacturing applications

At June's LASER World of Photonics 2009 event in Munich, Germany, JDSU of Milpitas, CA, USA announced the availability of Industrial Diode Laser (IDL) 200 Series systems and modules, which aim to help end users and systems integrators improve the uptime of their instruments and lower their maintenance costs compared to using similar bar-based products.

The IDL 200 Series can be integrated into production tools designed exclusively for manufacturing processes including plastics welding in the automotive industry and selective soldering in the electronics industry.

The key is the implementation of single-emitter architecture based on JDSU's proven L4 diode lasers. Each diode laser emitter operates in parallel and is unaffected by thermal crosstalk that can damage other emitters and is common in competing technologies. The result is highly reliable operation over the life of products in even the most demanding operational environments, claims JDSU. In addition,

the firm's single-emitter-based products operate reliably under modulated conditions (pulsed on and off) without the lifetime limitations associated with competing bar-based technologies, it is claimed.

IDL 200 Series systems and modules also include multiple point monitoring of the individual output power of each diode emitter, ambient and internal system temperatures, various critical system voltages, and other key functions. Data is reported back to the operator through various ports, including analog, RS-232 and a front-mounted serial USB port. Health information can be monitored in real time and a regularly updated health log is available through the USB port for easy downloading and review.

[www.jdsu.com](http://www.jdsu.com)



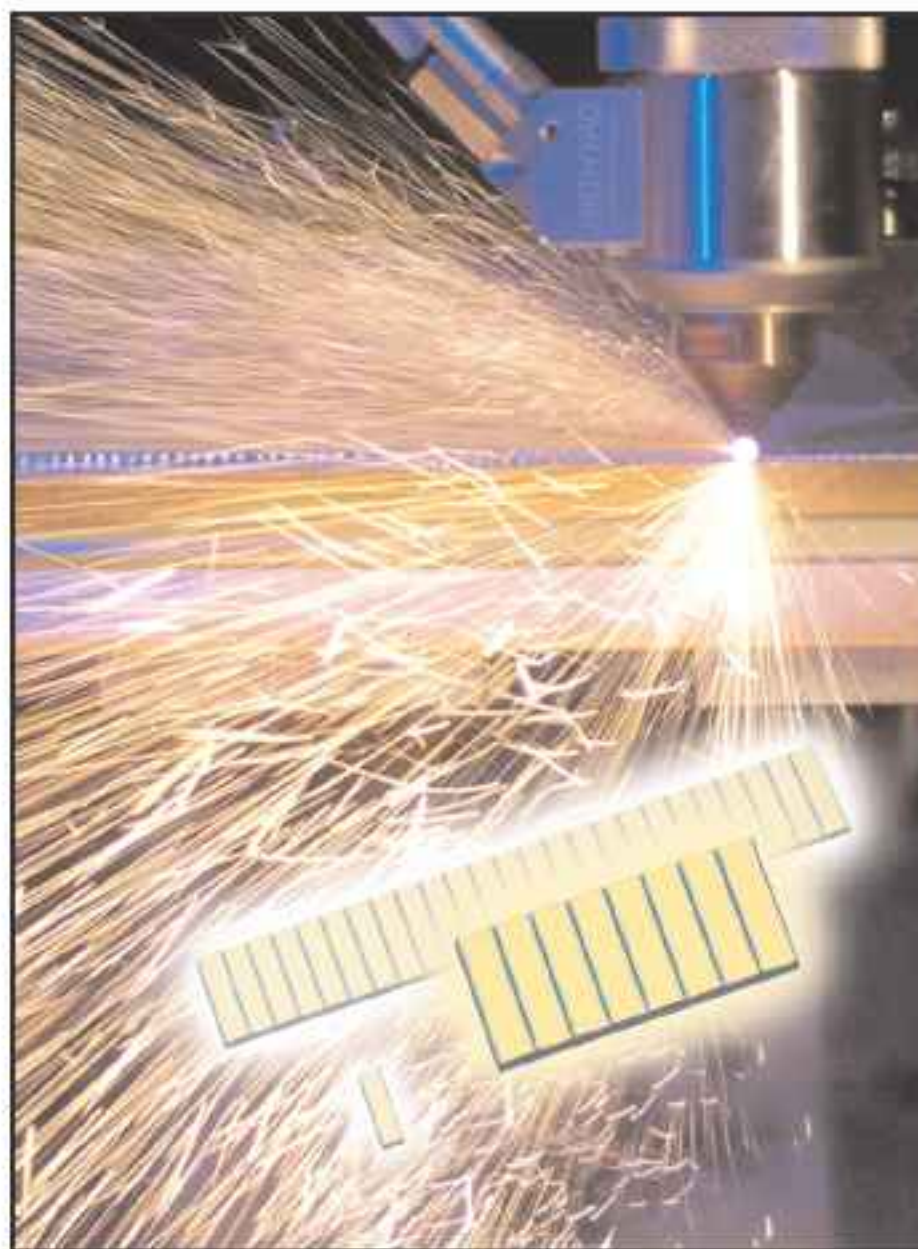
## Osram launches mini laser bars for more efficient fiber coupling

Osram Opto Semiconductors GmbH of Regensburg, Germany has made available samples of a new generation of mini laser bars (emitting at wavelengths of 910–1020nm) that have been optimized for fiber injection. Their output and beam parameters have been closely matched so that the light beam, which leaves the small laser aperture at a defined angle, can be coupled more efficiently into a small fiber core diameter with a restricted acceptance angle. Series production will start in early 2010.

The new laser bar's high brilliance (output power per unit area and solid angle, defining how much light can be efficiently injected into a glass fiber) has been achieved by the new VLOC (very large optical cavity) epitaxial structure and new proprietary mirror coating technology. "Our new mini bars have a high optical output and efficiency, which enables us to offer tailor-made solutions for cost-effective fiber-coupled laser diodes," says Dr Jörg Heerlein, head of laser product marketing.

Mini laser bars also combine the advantages of single emitters with those of classic 1cm bars. They are cost-effective, durable and, due to their small size, can be easily adapted to meet the requirements of different applications, says the firm. In contrast to conventional fiber-coupled diode laser systems, the new bar structures allow more cost-effective beam-forming concepts to be used for fiber coupling. The associated reduction in system costs is a major factor in making diode laser systems more attractive for direct material processing, particularly in comparison with alternative laser solutions, says Osram Opto.

The mini laser bars are available in various application-specific product families, with fill factors of 10–20% and typical efficiencies of up to 65%. In addition to pumping fiber lasers, they can also be used



Osram's new mini laser bars, optimized for fiber injection.

for direct micro-material processing, such as marking and micro-welding.

Their brilliance is exemplified by the SPL BF series, which has a fill factor of 10% and provides an output of 8W per emitter at an

**High brilliance has been achieved by the new VLOC epitaxial structure and proprietary mirror coating technology**

emitter width of 100µm, with a slow-axis divergence of <math><7^\circ</math> (the value applies to 95% output). The maximum output compatible with long life is about 12W per 100µm emitter. With five emit-

ters, the beam parameter product is 15mm x mrad. With the aid of simple optics, the light from several mini laser bars can be coupled into a fiber with a core diameter of 200µm and a numerical aperture (NA) of 0.22. Fiber output of more than 200W can hence be achieved. Depending on requirements, many further designs and specifications can also be produced on the basis of the new technology, adds the firm.

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## Oclaro enters eye-safe laser diode market

At LASER World of Photonics 2009 in Munich, Germany (15–18 June), optical component, module and subsystem maker Oclaro of San Jose, CA, USA said that it has entered the eye-safe wavelength market with long-wavelength laser diode single-emitter and bar products emitting at about 1.5 $\mu$ m, targeting applications in defense, material processing and medical markets.

Eye-safe standards are important in environments where there is a risk of exposure to laser light. Eye-safe lasers emit light at wavelengths above 14xx nm, as light in this range is largely absorbed by the cornea before reaching the more sensitive retina, which can be seriously damaged by just microseconds of exposure to high-power light at shorter wavelengths.

15xx and 14xx nm laser diode bar products deliver up to 30W continuous wave (CW) output power and are offered with a micro-channel or a passive Cu cooler configuration. The bars come with a fill factor of 30% and an emitter pitch of 500 $\mu$ m, suiting fiber-coupled and pump laser applications.

The single-emitter laser diodes emit 2W output power at 1470nm from a 90 $\mu$ m stripe and are available on a C-mount or in a 105 $\mu$ m fiber-coupled configuration. The fiber-coupled version is built on the proven Oclaro platform for single-emitter fiber-laser pump modules, enabling high-volume, scalable, and cost-effective manufacturing.

"Extension of our high-performance laser diode bar and single-emitter laser diodes into the long-wavelength range is an important step for Oclaro, addressing increased demand for eye-safe lasers, particularly in defense and medical markets," says product marketing director Karlheinz Gulden. "We have been able to deliver the high-power and high-reliability qualities with which Oclaro is associated at wavelengths that enhance eye safety, broadening the market appeal of our high-power laser diode portfolio," he adds.

### Oclaro expands single-emitter-based pump module portfolio

Oclaro also debuted new products from its expanded portfolio of single-emitter-based modules offering higher powers, new fiber core options and extended wavelength capabilities, targeted at fiber, direct-diode, and Nd:YAG laser systems for industrial, printing, medical, and defense markets.

The latest high-power multimode pump products include:

- The 25W fiber-laser pump module with 105 $\mu$ m, 0.15NA fiber, based on a new hermetically sealed, compact module platform.
- A multi-emitter prototype delivering 40W and more at 9xx nm from a 105 $\mu$ m, 0.15NA fiber, satisfying the increased power requirements of fiber-laser and direct system manufacturers.
- Modules delivering up to 30W at 808nm from 105 $\mu$ m- and 200 $\mu$ m-core fibers for Nd:YAG pumping and medical applications.
- 2W 105 $\mu$ m fiber modules at 793nm and 1470nm for eye-safe thulium fiber and direct-diode lasers for medical and defence applications.
- High-brightness multimode modules with 40 $\mu$ m or 50 $\mu$ m fiber, aimed at the computer-to-plate (CTP) pre-press printing market, delivering up to 2W at 830nm and up to 3W at 940nm.

"Combining our latest multimode laser diodes with our single- and multi-chip modules allows us to seamlessly upgrade to higher pump powers for our fiber-laser customers, and to offer different wavelengths, for applications such as Nd:YAG pumping and CTP printing," says product line manager Dominik Jaeggi. "We are developing scalable, flexible products that meet customer and application requirements, and will drive our growing presence in the high-power laser diode market," he adds.



### Oclaro launches 1064nm New Focus high-power laser for Raman spectroscopy

Oclaro has introduced a 1064nm capability to its portfolio of New Focus high-power SWL-7500 single-wavelength lasers for Raman spectroscopy.

The 1064nm variant of the SWL-7521 is designed to meet demand from users undertaking Raman spectroscopy, where longer wavelengths can help reduce the fluorescence background of the spectra. Oclaro says that its New Focus high-power laser portfolio offers narrow linewidth and long coherence length, which are crucial for industrial spectroscopic applications such as quality control, chemical analysis, and security.

The high-power laser is enabled by the gallium arsenide chips manufactured at the firm's plant in Zurich, Switzerland. The chip design also uses the same technology as Oclaro's terrestrial and submarine telecom amplifier and pump portfolios, including the 750mW ultra-high-power pump and the OceanBright submarine pump.

### Oclaro and Laserline demonstrate beam quality

Oclaro and laser system maker Laserline jointly unveiled what is claimed to be one of the industry's highest-beam-quality 4kW direct-diode laser systems, with product demonstrations on both the Oclaro and Laserline booths.

The 4kW system has a beam parameter product (BPP) of just 30mm x mrad, delivering a small spot size and unprecedented performance for a direct-diode system, it is claimed. The beam quality is enabled by Oclaro's 80W very high brightness (VHB) bar, allowing direct-diode systems to compete with solid-state and CO<sub>2</sub> laser systems on applications such as keyhole welding and sheet metal cutting.

"We have worked very closely with the Oclaro high-power laser team,"





**Laserline's LDF 4000-30 direct-diode laser system, which includes Oclaro's 80W very high brightness (VHB) laser bar.**

► says Laserline's managing director & co-founder Volker Krause.

"The VHB bar is excellently tailored to our application and Oclaro has the skills and the expertise to support the complex design process to capitalize on high powers and high efficiency from such small footprints," he adds.

Oclaro's 80W VHB laser bar offers up to four times the brightness of a typical 10mm laser bar and measures just 3.2mm in width. It supports direct industrial laser systems and enables fiber coupling without expensive beam transformation optics by delivering high output power and a narrow emitting area.

"Laserline consistently challenge us to deliver the highest-quality products that enable them to advance their laser systems and compete in new, high-value markets," says Oclaro's senior product line manager Christian Naumer. "Having played a key role in achieving this breakthrough level of beam quality, we continue to innovate to enable even higher performing products," Naumer adds.

[www.newfocus.com](http://www.newfocus.com)

## Oclaro extends laser diode bar range

At June's LASER World of Photonics 2009, optical component, module and subsystem maker Oclaro Inc of San Jose, CA, USA exhibited its extended portfolio of high-power laser diode bars, including the 100W 808nm bar, the 200W bar with new 1030 and 1070nm capability, and a new series of 150W bar products at 9xx nm and 10xx nm. The new products are aimed at directed energy, diode-pumped solid-state (DPSS) laser and multi-kilowatt direct-diode applications.

The new 200W bar — which is claimed to be the highest continuous wave (CW) power laser diode bar commercially available — has a wall-plug efficiency of 65% and is designed for single-sided cooling on a micro-channel cooler at a configuration allowing low pitch when stacking. Extending up to 1070nm adds two more colours to scale multi-kilowatt direct-diode systems by wavelength multiplexing, enabling direct laser system manufacturers to directly compete with fiber lasers and CO<sub>2</sub> lasers in material processing applications, the firm says.

The 808nm 100W bar on micro-channel has a wall-plug efficiency of 60% and a 50% fill factor to enable higher power output from a larger emitter area. For conduction cooling, a 60W 30% fill-factor version (launched at Photonics West 2009 in January) is also available. Here, the extended wavelength range also includes 793nm, important to eye-safe applications based on thulium laser systems.

Oclaro's 200W bars are targeted at high-end direct-diode system manufacturers, while the 150W bars offer an alternative for users who are not quite ready to handle drive currents in the 200A range, says senior product line manager Christian Naumer. "With our new 808nm products we are clearly targeting defence-related pumping and directed-energy applications as well as solar cell and flat-panel display processing applications."



**Oclaro's laser diode bar.**

Like all Oclaro high-power laser products, the front facet of the bar is protected against catastrophic optical damage (COD) by the Oclaro E2 mirror passivation process. Telecom-grade AuSn (gold tin) hard solder makes the product suitable for demanding industrial and defence applications in CW and hard-pulse operation mode.

Yves LeMaitre, executive VP & general manager of Oclaro's Advanced Photonic Solutions division, highlighted LASER 2009's importance for Oclaro launching its new brand. Oclaro was formed only in late April through a merger that combined the optical component expertise of Bookham Inc of San Jose, CA with the module and subsystem expertise of Avanex Corp of Fremont, CA to create what is claimed to be one of the largest suppliers of optical components, modules and subsystems to the long-haul and metro optical telecoms markets. Also, in early June Oclaro signed a definitive agreement to acquire the high-power laser diode business of Newport Spectra Physics in exchange for laser and photonic components supplier Newport Corp of Irvine, CA acquiring Oclaro Advanced Photonics Solutions division's New Focus business (which makes photonics products including tunable lasers, optoelectronics, high-resolution actuators, stable opto-mechanics, vacuum and ultra-clean solutions, and OEM-engineered solutions).

[www.oclaro.com](http://www.oclaro.com)

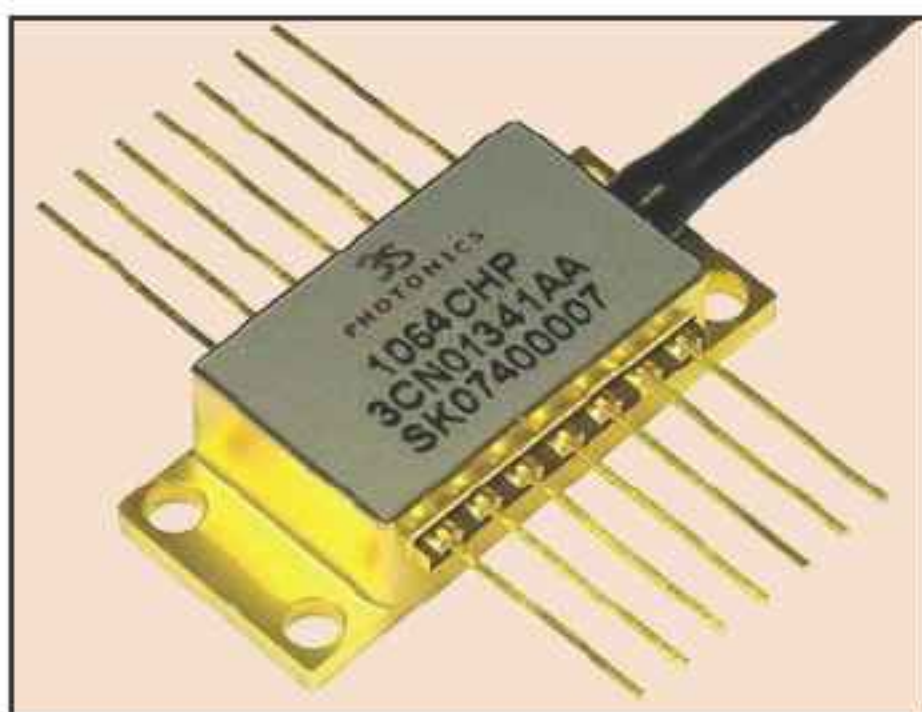


## 3S unveils 500mW 1064nm seed laser for fiber lasers

At the LASER World of Photonics 2009 event in Munich, Germany (15–18 June), 3S Photonics of Nozay, France, which manufactures laser chips, optical discrete modules and passive components for telecom networks, launched what it claims is the industry's most powerful CW and pulsed 1064nm cooled laser diode modules, to be used as seed lasers for fiber-laser applications.

Leveraging its technical expertise and its latest developments in telecoms, 3S is releasing two enhanced versions of its 1064 CHP Series laser diode modules (with operating wavelengths of 1050–1070nm), capable of delivering up to 500mW CW of optical power at 1000mA through single-mode fiber and intended for industrial applications:

- a CW version, with high PER values;
- a pulsed version, stabilized with a narrow-bandwidth fiber Bragg grating (FBG) in the polarization-maintaining



**3S' 1064 CHP Series laser module.**

single-mode fiber (PMF) pigtail.

The seed laser modules have been characterized at very high operating peak currents up to 1.7A with 1µs/500kHz pulses, and have proven their long-term reliability in pulsed-mode operation, says 3S. The low-profile hermetically sealed 14-pin butterfly package incorporates an ultra-high-power 1060nm single-mode laser diode including an internal thermo-electric cooler

(TEC), a thermistor and an InGaAs back-facet monitor photodiode.

"These new modules provide more than 30% extra power compared with current offers as well as a telecom-grade reliability level," says Yannick Bailly, VP of marketing & product management. "It represents a significant step forward for our customers involved in industrial laser markets, looking for increased output powers but also for more and more reliability," he adds.

The new 1064 CHP modules have already proven their long-term reliability through a dedicated 4000 hour life-test with an injection current of 1.2A and a heat sink temperature of up to 50°C. Thermal cycling, high-temperature storage and mechanical integrity tests have also been passed, says the firm. The mean time to failure (MTTF) exceeds 100,000 hours.

[www.3Sphotonics.com](http://www.3Sphotonics.com)

## Princeton Optronics wins US Navy contract to develop high-power blue VCSEL arrays for anti-submarine LIDAR

In June, Princeton Optronics Inc of Mercerville, NJ, USA, which develops high-power vertical-cavity surface-emitting lasers (VCSELs) and low-noise solid-state lasers, said that it has received a \$750,000 two-year US Navy Phase II SBIR (small business innovation research) contract to develop blue-laser arrays consisting of frequency-doubled high-power pulsed VCSELs.

The objective of the program 'High Power, High Repetition Rate, Pulsed, Blue Laser for ASW Purposes' is to develop compact, high-efficiency, short-pulsed (1–20ns) blue lasers (with energies of more than 10mJ per pulse) for Navy light detection and ranging (LIDAR) applications in airborne anti-submarine warfare, since existing lasers are bulky and low efficiency. The phase II contract follows completion of a phase I SBIR contract received last year that led to the

firm demonstrating a frequency-doubled high-energy pulsed blue laser array and studying its characteristics and means to deliver high power from the array.

Princeton Optronics has taken its near-infrared-emitting VCSEL technology and frequency-doubled the radiation using a nonlinear material (periodically poled lithium niobate) in the device's structure. The laser's output is single-mode, blue (480nm), monochromatic, and has a half-angle divergence of only 8mrad.

The lasers are constructed in two-dimensional arrays that can

currently emit up to 230W of optical power from a 4.7mm-diameter area. Single lasers emit up to 30mW each with an 8% wall-plug efficiency.

In phase II, Princeton Optronics aims to improve the power level and other characteristics and to make a large array to demonstrate a high-energy pulsed array that meets the Navy's specifications.

The firm says that high-power pulsed VCSELs also have applications in marking, materials processing, range finding and oceanography (with a market that could amount to many millions of dollars). Princeton Optronics adds that it has the manufacturing and marketing capabilities to commercialize the product, and aims to do so very soon after the completion of phase II of the SBIR.

[www.princetonoptronics.com](http://www.princetonoptronics.com)  
[www.navysbirprogram.com](http://www.navysbirprogram.com)

**The firm says high-power pulsed VCSELs also have applications in marking, materials processing, range finding and oceanography**



## 3S raises €13m as investors back French fund

3S Photonics of Nozay, France, which manufactures laser chips, optical discrete modules and passive components for telecom networks, has raised funds from France's Strategic Investment Fund (Fonds Stratégique d'Investissement, or FSI), Alto Invest and Midi Capital.

FSI was created on the initiative of President Nicolas Sarkozy in late November amid the financial crisis, endowed with €20bn, to help stabilize small-to-medium enterprise (SME) technology and defense firms that are deemed to be strategic. In May FSI promised to invest €10m (€5m of which has already been provided). Alto Invest is now contributing an additional €2.5m, while Midi Capital, which recently purchased a shareholding in 3S, is investing €450,000 more, making almost €13m in total.

3S Photonics was founded in 1994 as Alcatel Optronics S.A. (a subsidiary of the Alcatel group) and was acquired in 2003 by Avanex Corp of Fremont, CA, USA, becoming Avanex France S.A. In April 2007, it was bought by entrepreneur Alexandre Krivine (becoming chairman & CEO) and Didier Sauvage (former director of Avanex France) and renamed 3S Photonics.

The firm designs and makes both active optical components (incorporating GaAs and InP optoelectronic laser chips fabricated in-house at Nozay, France) as well as passive optical components based on fiber Bragg gratings, for use in discrete modules for high-speed telecom networks. 3S also provides foundry services using its related epitaxial and wafer processing capabilities.

Deep in debt in 2007, 3S has since recovered financial stability on the basis of its portfolio of existing products (optoelectronic components for long-distance submarine telecom networks, which have stringent requirements on reliability, with a 25-year guarantee). The firm has recruited 50 more staff and broadened out to new segments of the telecoms market, such as pump

modules for terrestrial applications or fiber-to-the-home (FTTH). Revenue in fiscal 2007/2008 (to end June 2008) was €27.9m. The firm currently employs almost 160 staff (between the plant in Nozay and sales departments in Marcoussis, France and London, UK) and uses subcontractors in Asia (supervised by a regional office in Thailand).

To diversify from its historical submarine telecom market, in June 2008 3S acquired a significant stake in Korean firm COSET Inc, which specializes in packaging (particularly the assembly of pump modules for terrestrial applications). This initial international expansion also allowed 3S to acquire (at a relatively low cost) technologies adapted to the optics industry outside the telecom market. Due to the new funds that have been raised, 3S says that it can now repeat this sort of activity and extend its operations further (e.g. into defence, industrial lasers and, most recently, medical applications). "Rather than bow our heads and suffer the international economic crisis, we decided to take advantage of the current situation, which lends itself particularly to mergers and acquisitions," adds Krivine. "We will seize any opportunities for external growth which appear in sectors with prospects of international consolidation." The aim is to fully exploit the plant in Nozay, and to consolidate the firm within France.

FSI's equity investment shows how closely 3S's aims — to diversify through external growth — match those of fund's to support innovative SMEs in order to boost the French economy's competitiveness. "The aim is to support the strategy of external growth into new markets for the company, a strategy that we considered coherent and promising", says FSI's chief operating officer Gilles Michel.

"We are very happy to welcome new shareholders... This involvement in our work is validation for

our strategy, emphasising and rewarding the high-technological potential of our teams," says 3S' chairman & CEO Alexandre Krivine. "Since buying the company in 2007 we have managed to fulfil all the commitments and deadlines we set for ourselves. We have achieved all our growth on the basis of our own funds," he adds. "Nowadays, in the light of the international context and although we are still unaffected by the crisis, our partners' capital contribution is extremely opportune and will act as an accelerant to growth." The new funds will enable 3S to speed up market diversification with the acquisition of shareholdings or the purchase of other firms, it adds.

The firm reckons that its resilience to the current situation is due to its position in niche markets with strong added value and in growth markets such as wavelength division multiplexing (WDM), as well as long-term projects and R&D partly funded by industrial partners.

3S says that its range of approved technologies for high-reliability applications, its staff's qualification and its state-of-the-art equipment have already secured it a place on several large-scale projects. Project 6\_POD (dedicated to developing photonic integrated circuits for broadband networks, and part of the SYSTEM@TIC PARIS-REGION competitive cluster), R&D projects with the DGA (General Delegation for Ordnance), France's EPOD (enhanced passive optical networks) project and the European counterpart ALPHA (both of which are concerned with FTTH). These constitute the basis for diversification, the firm says.

Nevertheless, in spite of the shift in projects and investments caused by the crisis, the prospects for submarine cable networks are still good, notes 3S, with market forecasts for cabling of about 50,000km for 2009, 70,000km for 2010 and 80,000km for 2011.

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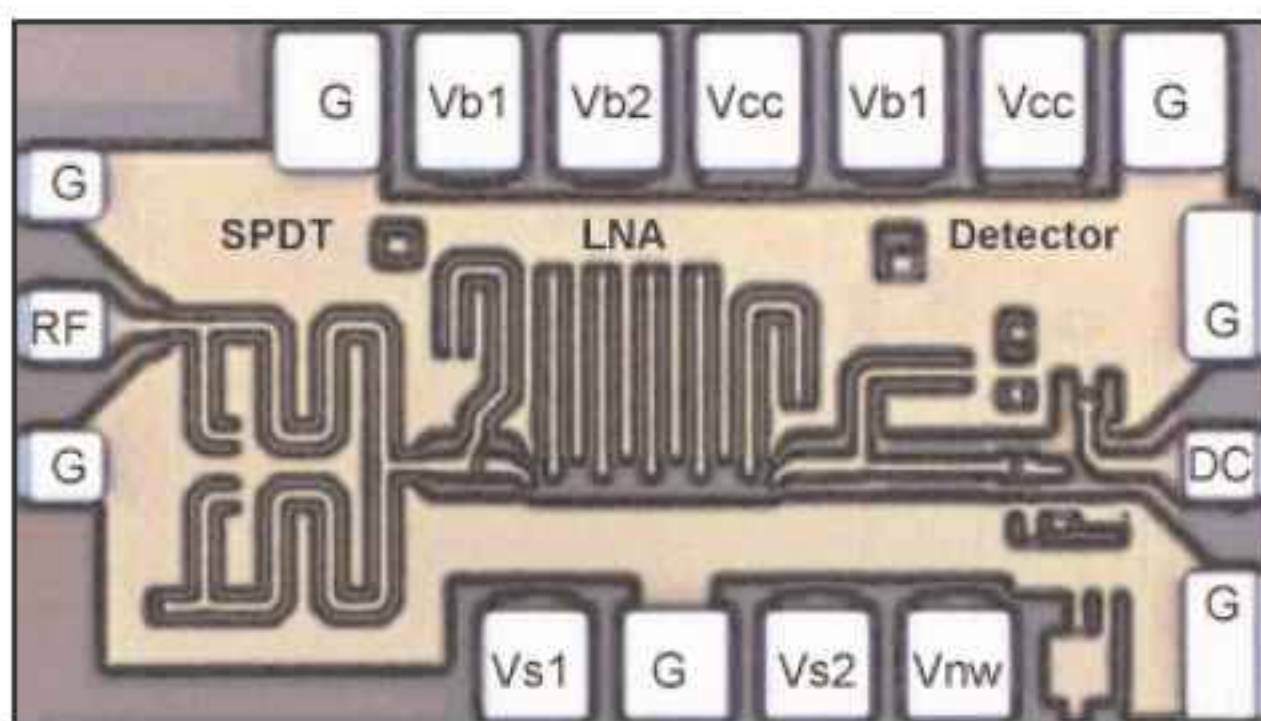


## UCSD demonstrates first W-band SiGe imaging chip

In a presentation selected as one of the best three student papers at the 2009 IEEE Radio Frequency Integrated Circuits Symposium in Boston, MA (7–9 June), researchers in University of California, San Diego's Jacobs School of Engineering reported what is claimed to be the first W-band silicon-germanium (SiGe) RFICs for passive millimeter-wave imaging. It is reckoned that this could lead to significantly cheaper imaging systems for identifying concealed weapons, for helping helicopters to land during dust storms, and for high-frequency data communications.

Passive millimeter-wave imaging systems operating in the W-band (140–220GHz) provide high spatial and temperature resolution while penetrating obscurants such as dust, fog, or clothing (since mm-wave radiation emitted from the human body and from objects under a person's clothing can pass through clothing largely or completely unaffected). In particular, imagers operating at such wavelengths can resolve images down to the millimeter scale, which is fine enough to identify small objects and separate items on a person's body. Using signal processing, scanners can assemble an image of a temperature map of a person's body that includes any objects beneath the clothing. "By the size of the signal we detect, we can tell the temperature of the signal we are looking at," explains project supervisor and electrical engineering professor Gabriel Rebeiz.

Existing passive mm-wave imaging systems use high-gain amplifiers based on gallium arsenide or indium phosphide followed by either a diode detector or a heterodyne mixer. The development in 2007 of low-noise, high-responsivity zero-bias diodes allowed unprecedented temperature resolution with only a 20dB-gain GaAs or InP pre-amplifier for passive imaging arrays. However, these diodes are not compatible with standard GaAs or InP



**W-band SiGe RFIC for passive mm-wave imaging.**

epitaxial layers needed for the low-noise amplifiers, necessitating a two-chip solution.

The new W-band millimeter-wave amplifier system works at the same frequency and follows the same underlying principles as the most advanced security imaging systems currently used in airports. However, the new RFIC is unique in using standard silicon technology. "Other systems are typically customized and very expensive," says first author and electrical engineering PhD student Jason May.

In contrast, due to recent advances in SiGe technologies, a low-cost system with high temperature resolution can be achieved. The low-noise W-band square-law detector was implemented in a commercial SiGe 0.12 $\mu$ m BiCMOS technology (IBM's 8HP process, with a unity-gain current cutoff frequency  $f_T$  of 200GHz). The detector occupies just 0.14mm<sup>2</sup> (including pads). This was integrated with a five-stage SiGe low-noise amplifier (LNA) to form a compact W-band passive imaging system. The LNA achieves a peak gain of 23dB and >20dB gain from 86–103GHz.

The combined LNA+detector measures just 0.26mm<sup>2</sup>. It achieves a peak responsivity of about 4000kV/W at 94GHz with a minimum noise-equivalent power (NEP) of 0.014pW/Hz<sup>1/2</sup> (compared to <1pW/Hz<sup>1/2</sup> targeted by previous GaAs- or InP-based systems), and consumes a current of 29mA from a 1.2V supply. The chip can achieve a temperature resolution of

0.3–0.4K (on a par with 0.2–0.5K for previous systems) with an integration time of 30ms and a bandwidth of about 20GHz.

"An imager with our chip could resolve images down to a millimeter scale, enabling us to identify very small objects that are on someone's body," said

Rebeiz. "A ceramic knife concealed against a person's leg, for instance, might appear one or half of one degree cooler than the rest of their body," says May. "We could then tell that something is there and we could exactly determine its shape," he adds.

"The technologies that we use are very inexpensive and reliable, so we should be able to bring the costs of those sorts of systems down, perhaps even to handheld scanners some day," says May. The researchers hence believe that such imagers, high-speed communications systems, and other applications that operate at millimeter-wave frequencies are poised to become increasingly prevalent and influential as the circuit technologies for integrating them with existing silicon technologies matures.

The researchers add that they are currently testing a chip that integrates the LNA+detector with a W-band SPDT switch and a 50 $\Omega$  reference resistor (for calibration purposes). The reflective  $\lambda/4$ -based SPDT has a measured 2.8dB insertion loss, 19dB isolation, and 84–102GHz matching bandwidth. Measured responsivities are about 2000kV/W at 94GHz.

Future designs will focus on removing the input noise from the bias network and increasing the LNA gain (to 30–33dB), targeting a 10-fold improvement in performance.

[www.rfic2009.org](http://www.rfic2009.org)

[www.jacobsschool.ucsd.edu](http://www.jacobsschool.ucsd.edu)



## API's annual revenue rises 28% despite last-quarter dip

For its fiscal 2009 (to end March), vertically integrated optoelectronics manufacturer Advanced Photonix Inc (API) of Ann Arbor, MI, USA has reported net sales of \$29.7m, up 28% on \$23.2m a year ago (led by the military, telecoms and industrial/non-destructive testing markets). "We are pleased with the results of our fiscal year, especially considering these tough economic times," says chairman & CEO Richard Kurtz.

Fiscal fourth-quarter sales were \$6.1m, up 16.7% on \$5.2m a year ago, led by military sales (up 79%). However, this was down 20% on fiscal Q3's \$7.6m.

Gross margin rose from 38% in fiscal 2008 to 44% (due mainly to higher revenues and product mix). In fiscal Q4 it was 38%, up from 34% a year ago but down on Q3's 43%.

Operating expenses were cut slightly from \$14.9m in fiscal 2008 to \$14.6m or, as a percentage of revenue, from 64.1% to just

49.2%. This demonstrates operating leverage inherent in the business model, the firm says.

On a non-GAAP basis, compared to a loss of \$2.4m in fiscal 2008, fiscal 2009 saw net income of \$550,000. However, the fourth quarter saw a net loss of \$884,000. This is cut from \$1.1m a year ago, but compares with net income of \$260,000 in fiscal Q3.

Compared to -\$2.8m for fiscal 2008, EBITDA (earnings before interest, taxes, depreciation, and amortization) was +\$1.6m. Fourth-quarter EBITDA has been improved from -\$1m a year ago to -\$603,000, but this compares with +\$590,000 in fiscal Q3. Cash and cash equivalents rose during the year from \$1.6m to \$2.6m.

"We are particularly proud to have reported significant revenue growth, non-GAAP earnings of \$0.02 per share, an improvement of \$0.13 per share, and growth in EBITDA of \$4.4m," says Kurtz.

"In these uncertain and difficult times, we are fortunate to have three product platforms that are all contributing to help meet our growth targets," he adds. Products include patented silicon, indium phosphide and gallium arsenide based APD, PIN, and FILTRODE photodetectors; high-speed optical receivers (HSOR); and the T-Ray 2000 and QA1000 THz terahertz instrumentation platforms.

"As our platform revenue mix changes next year, we expect to see ongoing improvement in revenues and EBITDA growth," adds Kurtz. "The start of our fiscal year will be slower, mainly due to the macroeconomic environment, but the growth of our HSOR and the stability of our other product platforms will support our growth plans and we remain cautiously optimistic that we can continue to grow despite the generally adverse economic conditions."

[www.advancedphotonix.com](http://www.advancedphotonix.com)

## Mitsubishi launches lower-power, wider-temperature-range 1.3µm TOSA for 10Gb/s transmission

Tokyo-based Mitsubishi Electric Corp is shipping samples (priced ¥20,000) of the FU-456RDF-9M2 1.3µm transmitter optical sub-assembly (TOSA) laser module for 10Gb/s optical transmission. The module complies with the two standards for optical transceivers—the XFP 10Gb/s small-form-factor pluggable module and the SFP+ enhanced 8.5 and 10Gb/s small-form-factor pluggable module—as well as the XMD MSA (10Gb/s miniature device multi-source agreement) standard for optical transmission devices.

Mitsubishi Electric says that carriers are rushing to expand metro-area fiber-optic communications networks in response to the recent increase in traffic due to the spread of ADSL, fiber-to-the-home (FTTH), and other high-speed, large-volume communication services for the residential market. Similarly, there is

growing demand to increase optical transmission capacity in high-speed storage-area networks (SANs), e.g. for transmitting music, images and other digital content, or for high-volume corporate databases.

In these networks, the mechanics and electronics in optical transceivers follow the XFP or SFP+ standards for 10Gb/s optical transceivers, while the mechanics and electronics in optical devices follow the XMD-MSA standard. With increasing demand for high-density mounting of optical transceivers to release internal heat from the devices, optical transceivers need to operate with lower power consumption and over a wider temperature range, says the firm.

The FU-456RDF-9M2 therefore incorporates a newly developed, distributed feedback laser diode (DFB-LD) that enables operation at -20°C to 95°C (a wider temperature

range than -5°C to 85°C for the previous FU-456RDF-8M2 TOSA). Despite this, the new model has the same compact package size (compliant with the XMD MSA).

Also, typically, TOSAs use a large amount of electricity to attain a fast enough response for 10Gb/s high-speed transmission. To reduce power consumption in optical transceivers, it is essential for DFB-LDs to operate at a lower current, says Mitsubishi Electric. At 25°C, the new, highly efficient DFB-LD can operate at 25mA (40% less than the previous model's 35mA). This should lead to lower power consumption in networks, says the firm.

Mitsubishi Electric aims to continue development to further increase the performance and output of the TOSA. The firm also plans to further expand its product lineup.

[www.mitsubishichips.com/Global](http://www.mitsubishichips.com/Global)



## IN BRIEF

**\$1.5m order for undersea optical modulator drivers**

GigOptix has received a \$1.46m purchase order for ultra-long-reach Mach-Zehnder modulator (MZM) drivers. The order, from a large European customer for undersea optical network cable drivers, will be delivered in second-half 2009.

"Despite the difficult market conditions, we see a continued healthy demand for our long-reach and ultra-long-reach drivers for terrestrial and undersea optical cable links greater than 500km," says Pdraig O'Mathuna, director of product marketing. "Our drivers, with integrated encoders for 10Gb/s RZ (return-to-zero) and RZ-DPSK (return-to-zero differential phase-shift-keying) modulation formats, are valued for their superior performance and offer the best jitter specifications in the market," he claims. "This new order brings our expected 2009 sales to this customer to more than \$3.5m."

[www.GigOptix.com](http://www.GigOptix.com)

**D-Lightsys optical transceivers to be used on Airbus A400M aircraft**

GigOptix and D-Lightsys of Rosny Sous Bois, near Paris, France, a Radiall Company that manufactures optical interconnects for severe environments, have received combined product certification from Airbus Military for its A-400M. This is said to be the first truly new military transport aircraft of its category designed in over 30 years (with twice the capacity and payload of the aircraft that it will replace).

Fiber-optic communications links are insensitive to electro-magnetic interference (EMI) and do not generate EMI, as well as guaranteeing huge available bandwidth. They are therefore being adopted in avionics systems to ensure the integrity and to allow extensibility of the aircraft's communication systems. In addition, replacing copper with fiber optics significantly reduces weight, contributing to improved fuel economy. D-Lightsys says that its parallel optical transceivers were selected by Airbus equipment manufacturers for the A-400M fuel control systems due to their small footprint and low-power capability.

The compact designs of GigOptix's HXR3401 TIA and HXT3101 VCSEL driver enable D-Lightsys to deliver highly integrated and mechanically robust optical transceivers with what is said to be the best power consumption on the market. The devices are built to withstand the severe environmental requirements of military and avionic applications and comply with AEEC/ARINC 804 transceiver specifications. Being protocol independent, they can be applied to Gigabit Ethernet, Fiber Channel, Infiniband, etc.

"D-Lightsys has been working closely with GigOptix to produce a superior system that will be resistant to the stresses of avionics," says D-Lightsys' CEO Mathias Pez. "Being certified for this advanced avionic application is another step forward for GigOptix which would not have been possible without our close partnership with D-Lightsys," adds Jörg Wieland, VP & general manager of subsidiary GigOptix-Helix in Zurich, Switzerland (which makes TIAs, limiting amplifiers and VCSEL drivers).

[www.d-lightsys.com](http://www.d-lightsys.com)

**USC professor joins GigOptix advisory board**

Alan Willner, professor of electrical engineering at the University of Southern California, has joined the advisory board of GigOptix Inc of Palo Alto, CA, USA, which designs optical modulators, drivers and transimpedance amplifier (TIA) ICs based on III-V materials. He has previously served on the scientific advisory boards of several small firms.

Willner has a Ph.D. in Electrical Engineering from Columbia University, and was a postdoctoral member of the technical staff at AT&T Bell Laboratories (Crawford Hill) and then a member of the technical staff at Bellcore. He currently conducts research in optical communications, optical signal processing, optical networks, fiber optics, and

optical device technologies.

Professional positions that Willner has held include president of the IEEE Photonics Society, co-chair of the Optical Society of America (OSA) Science and Engineering Council and general co-chair of the Conference of Lasers and Electro Optics (CLEO). He has also been editor-in-chief of technical publications including the IEEE/OSA Journal of Lightwave Technology (JLT), the IEEE Journal of Selected Topics in Quantum Electronics, and the OSA Optics Letters.



**Alan Willner.**

During his career, Willner has been honored with the Presidential Faculty Fellows Award from the White House, the David & Lucile Packard Foundation Fellowship in Science & Engineering, the IEEE Photonics Society Distinguished Lecturer Award, the OSA Leadership Award and the Fulbright Foundation Senior Scholar Award.

The technology being developed by GigOptix has the potential to resolve some of the major challenges facing optical communications, comments Willner.

"We look forward to a mutually rewarding collaboration," adds the firm's chief technology officer Andrea Betti-Berutto.

<http://csi.usc.edu/faculty/willner.html>



## GigOptix enables sub-1W for 120Gb/s parallel optics links

GigOptix says it has demonstrated error-free 10Gb/s optical links over 100m of multi-mode fiber (MMF) operating with less than 81mW per channel (8mW/Gb/s). These links used 'off the shelf' 850nm optoelectronic components and GigOptix's HXT/R4 series of multi-channel vertical-cavity surface-emitting laser (VCSEL) driver and receiver arrays with a single power supply. This should enable 12-channel links used in SNAP12, CXP, and for 100GBASE-SR10 standards to achieve sub-1W power dissipation.

Commercially available 12-channel parallel-optics modules operating at 6.25Gb/s per channel offer an aggregate bandwidth of 75Gb/s with power consumption of 53mW/Gb/s (about 300mW per channel). GigOptix's 10Gb/s solution offers 120Gb/s, and results demonstrate more than a six-fold improvement over the previous generations with a single power supply.

"Network demand continues to grow at a fast pace and parallel optics provides many benefits over traditional copper connections in broadband networks," says Daryl Inniss, VP & practice leader of Communications Component at market research firm Ovum. "Continuously driving down the energy per bit is key to accelerating the adoption in the enterprise

**Continuously driving down the energy per bit is key**

segment. GigOptix is setting a significant benchmark with these results," he adds.

This confirms the value of the 10Gb/s implementation with new technology concepts to reduce power, GigOptix says. "We also have more system optimization ideas which, we believe, can improve on these results with further cooperation with our customers," says Joerg Wieland,

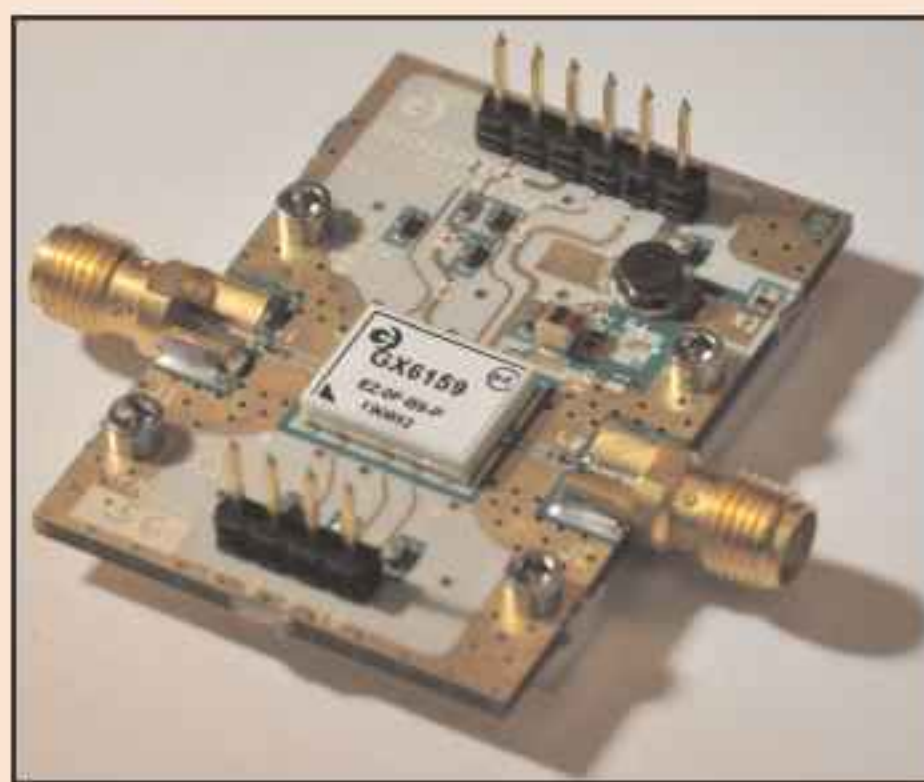
vice president & general manager of Zurich-based subsidiary GigOptix-Helix AG (which makes TIAs, limiting amplifiers and VCSEL drivers). "System integrators can now produce unprecedented power efficiency for high-density board-to-board interconnects for high-end servers and routers," he adds. "This new generation provides higher bandwidths and greatly reduces system power dissipation, which will enable data-center managers to save significantly on energy costs due to heat management."

The HXT/R4 family is designed for use in active optical cables (AOC), SNAP12 and QSFP (quad small-form-factor pluggable) optical modules while serving the fast-growing markets of high-performance computing optical interconnects, switch and router optical backplanes, and the new 40G and 100G Ethernet standards.

## GigOptix launches 12.5Gb/s NRZ modulator driver

GigOptix has made available samples (along with an evaluation board) of the GX6159, a high-voltage 12.5Gb/s NRZ/DPSK (nonreturn-to-zero differential phase-shift-keying) modulator driver for 10Gb/s long-haul and metro optical transponders that use lithium niobate (LN) Mach-Zehnder modulators (MZM) to encode data onto the fiber. The hybrid device consists of two wideband pHEMT amplifiers in a compact ceramic package and is footprint compatible with GigOptix's GX6155 LN driver.

Key features include: a 9V<sub>pp</sub> output amplitude with low power dissipation; pin castellation for improved soldering reliability verification at assembly & test; ceramic package compatible to common RoHS reflow temperatures; non-inverting polarity; and low RMS (root mean square) jitter degradation.



**GigOptix's GX6159 12.5Gb/s NRZ/DPSK Mach-Zehnder modulator driver for 10Gb/s transponders.**

The GX6159 augments GigOptix's driver portfolio by providing a solution that can drive the high voltages required not only for 10Gb/s DPSK (differential phase-shift keying) but also 40Gb/s DP-QPSK (dual-polarization quadrature phase-shift keying) transponders in a form factor that is compatible with lower-voltage

drivers such as the GX6155. Market research firm Ovum expects the 40Gb/s market "to grow 48% annually through 2013" and indicated that the 40Gb/s DP-QPSK market accounts for 45% of the overall 40Gb/s market.

"This higher-drive-voltage version of our popular LN modulator driver was requested by one of our customers, a leading European transponder maker," says GigOptix's vice president of marketing Julie Tipton. "The driver is well suited for a 40Gb/s DP-QPSK transponder which combines four 10Gb/s modulated signals to generate the 40Gb/s data stream," she adds. "A major benefit of this is that it brings a 40Gb/s capability over the existing 10Gb/s infrastructure, thus minimizing the cost for upgrade and making this technique attractive to service providers."

[www.GigOptix.com](http://www.GigOptix.com)



## Firecomms appoints sales reps for Midwest USA

Firecomms Ltd of Cork, Ireland has signed two representative agreements to promote and sell its plastic optical fiber (POF) transceivers and red vertical-cavity surface-emitting lasers (VCSELs) in the Midwest USA: with Electro Mark Inc in Minnesota, North Dakota, South Dakota, Western Wisconsin and Iowa; and with CC Electro in Indiana, Kentucky, Michigan, Ohio, and Pennsylvania.

Both firms specialize in customer-specific applications, and will market and sell Firecomms' full range of POF transceivers, which are being adopted by developers of equipment for the consumer electronics, industrial, and automotive networks.

"Electro Mark recognizes the tremendous opportunity for POF in the IPTV, industrial, medical, and automotive markets," says Electro Mark's president Bob Steffes.

"As a value-add proposition to our customers using plastic optical fiber from Mitsubishi International Corporation, CC Electro has enhanced our line card with the addition of Firecomms POF termination capabilities," says CC Electro's president Carol Cohen.

"Both Electro Mark and CC Electro bring reputations as established knowledgeable, full-service rep firms in the Midwest, with impressive histories of success with both OEM and distribution customers," says Lawrence Thorne, Firecomms' VP of sales & marketing for the Americas. "We look forward to teaming with these firms on customer applications in medical, the industrial, consumer and transportation industries," he adds.

According to market research by Information Gatekeepers, the POF market is estimated to be worth over \$1bn per year by the end of 2009.

[www.firecomms.com](http://www.firecomms.com)

[www.electromarkinc.com](http://www.electromarkinc.com)

## u2t buys GaAs optical modulator firm

u2t Photonics AG of Berlin, Germany, which manufactures indium phosphide-based ultra-high-speed photodetectors and receivers (up to 100GHz), has acquired the assets of a UK-based high-speed GaAs optical modulator business for an undisclosed sum.

GaAs modulator technology is seen as being key to the cost-effective deployment of 40 and 100Gb/s fiber-optic communication systems to meet the ever-increasing demands of global internet traffic.

Since GaAs can use 6-inch wafer processing capabilities, the process control that is available can be much better than that employed for the smaller wafer sizes normally employed for optoelectronic components used in optical communications applications, u2t says. This will in turn enable higher levels of monolithic integration in GaAs, helping to create the high-performance and cost-effective components that are required for the complex modulation schemes needed by 40 and 100Gb/s systems.

Founded in 1998 as a spin-off from Heinrich-Hertz-Institut in Berlin, u2t expects that the addition of the GaAs modulator business will add to its capabilities in 40 and 100Gb/s optical communication products, which are amongst the fastest-growing areas in the optical networking market.

With this acquisition, u2t gains access to GaAs-based optical components and adds another platform to its technology portfolio. u2t Photonics says that it will continue its close partnership with Heinrich-Hertz-Institut on components based on indium phosphide technology, enabling the exploitation of whichever material system is best suited for each application.

"We see very strong synergies with our existing 40 and 100Gb/s receiver products," says u2t's CEO Andreas Umbach. "It will allow us to enhance our offering by delivering high-performance yet cost-effective transmitter functionality."

[www.u2t.de](http://www.u2t.de)

## Infinera expands module plant

In early June, Infinera Corp of Sunnyvale, CA, USA opened a new, larger facility in Allentown, PA to accommodate the expansion of R&D and manufacturing in response to growing demand for its digital optical network systems.

At Allentown, Infinera designs and assembles optical modules — incorporating its own large-scale indium phosphide-based photonic integrated circuits (PICs) — which carry Internet traffic in long-haul and metro core optical networks.

The new facility encompasses 43,000ft<sup>2</sup> of office and manufacturing space and employs 84 staff.

At the opening, co-founder and chief marketing & strategy officer



Opening of Infinera's new Allentown plant, attended by US Congressman Charlie Dent.

Dr Dave Welch recounted Infinera's growth from a small start-up to now employing 960 staff, including more than 700 at its US facilities in Sunnyvale, CA, Allentown, PA, and Annapolis Junction, MD.

[www.infinera.com](http://www.infinera.com)



## Finisar launches first 150Gb/s parallel active optical cable

At the International Supercomputing Conference (ISC'09) in Hamburg, Germany (22–24 June), Finisar Corp of Sunnyvale, CA, USA, which makes fiber-optic communications components and subsystems as well as network test & measurement systems, demonstrated the C.wire active optical cable (AOC), a 150Gb/s optical link for storage, data center, and high-performance computing connectivity. Based on the industry-standard CXP form factor, the C.wire uses fiber-optic technology to transmit parallel high-speed data in 100+Gb/s applications such as InfiniBand, 100 Gigabit Ethernet (100GbE), and proprietary high-speed interconnections.

C.wire's product offerings include a 12x12.5Gb/s cable for proprietary interconnects and a 12x10Gb/s cable for InfiniBand 12xQDR and 100GbE applications.

With the increase in I/O bandwidth required by next-generation CPUs, protocols such as InfiniBand and Ethernet need very high-speed connectivity solutions for data center architectures, says Finisar. Aggregation switches, stacked switches and meshed network topologies need to deploy cabling solutions that are beyond the bandwidth and distance limitations available in copper.

Finisar claims that C.wire provides the smallest footprint of any cable solution available for applications requiring data throughput of 100Gb/s and beyond. It transmits parallel 12x12.5Gb/s data bi-directionally over a multimode fiber (MMF) ribbon cable. Low power, small bend radius and high density (Gb/s per mm<sup>3</sup>) suit connectivity for growing data centers and HPC clusters.

"C.wire will drive data center connectivity to new levels," says Alan Benner, senior technical staff member at IBM Corp and chair of the ElectroMechanical Working Group



Finisar's C.wire 150Gb/s parallel active optical cable.

for the InfiniBand Trade Association. "With InfiniBand QDR 40Gb/s server connectivity available today and 120Gb/s coming soon, we need solutions like Finisar's active optical cables to drive higher-density switches at lower power," he adds.

"With C.wire you can now get connections above 100Gb/s anywhere in the datacenter without worrying about whether you need copper or optics," says Karen Liu, vice president at Ovum RHK. "Aside from operation simplicity, Finisar's innovation

addresses these increasingly urgent issues as datacenters grow in both size and speed: power consumption, density and reach," she adds.

"As evidenced in recent analyst reports by IGI and Lightcounting, active optical cables are quickly becoming the next-generation interconnects of choice for high-speed datacenter and HPC connectivity," says Jan Meise, Finisar's director of strategic marketing. "C.wire represents the third member of Finisar's cable family and is a clear demonstration of our commitment to providing breakthrough cable technology that will ensure 100G computing connectivity as early as 2010."

[www.supercomp.de](http://www.supercomp.de)

## Finisar sees order pick-up

For its fiscal fourth-quarter (to end April 2009), Finisar Corp of Sunnyvale, CA, USA, which makes fiber-optic communications components and subsystems as well as network test & measurement systems, has reported revenue of \$116.7m, down 14.4% on \$136.4m last quarter and 3.6% on \$121m a year ago.

Network Test revenue was \$9.2m, down 10.4% on \$10.3m last quarter and 4.4% on \$9.6m a year ago.

Optics revenues fell to \$107.5m, down 14.8% on \$126.1m last quarter and 3.5% on \$111.4m a year ago (or 26.1%, excluding \$25.1m from the Optium merger on 29 August). In particular, products for 10–40Gb/s applications yielded \$40.6m, down 17.3% on \$49.1m last quarter but up 30.1% on \$31.2m a year ago, due mainly to Optium.

Gross margin has fallen from 32.9% a year ago and 30.2% last quarter to 25.4%.

On a non-GAAP basis, EBITDA was \$8.2m, down only \$3m on last quarter (despite the \$19.7m drop in revenue), reflecting the impact of operating cost synergies from the merger. During the quarter, cash and short-term investments (plus other long-term investments that can be readily converted into cash) rose from \$35.3m to \$37.2m.

"Based on order trends that have seen a marked improvement during the last several weeks,.. revenues for the upcoming first quarter should increase," says executive chairman Jerry Rawls.

Combined revenues have fallen by about \$58m (33%) since the record high for both firms just prior to the merger in the July quarter. "Yet, despite this decline in revenues, we continue to generate EBITDA in excess of our capital expenditure requirements as a result of synergies from the merger and the additional cost reductions that have been implemented," notes CEO Eitan Gertel.

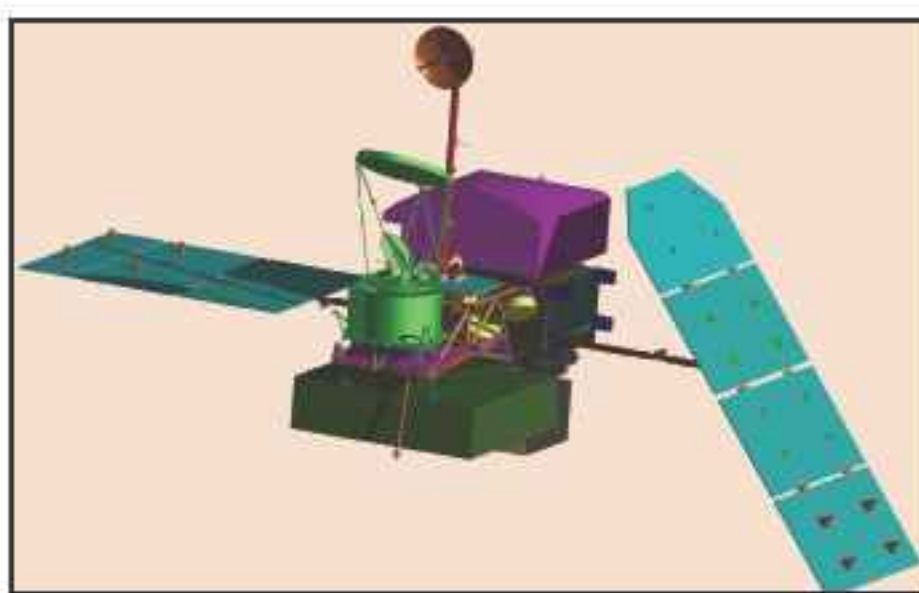
[www.finisar.com](http://www.finisar.com)



## NASA awards Emcore \$5m contract for PV panels for its Global Precipitation Measurement spacecraft

Emcore Corp of Albuquerque, NM, USA, which makes components and subsystems for the broadband, fiber-optic and solar power markets, has been awarded a \$5m contract to manufacture, test, and deliver panels for NASA's Global Precipitation Measurement (GPM) spacecraft, to be launched summer 2013. The contract will be managed by MEI Technologies Inc, a prime contractor for electrical systems engineering services at the NASA Goddard Space Flight Center (GSFC).

The GPM mission is one of the satellite-based earth science mis-



NASA's GPM spacecraft.

sions studying global precipitation, including rain, snow, and ice. The spacecraft's solar arrays will be powered by Emcore's latest-generation class ZTJ multi-junction solar

cells, which can provide power to interplanetary spacecrafts and earth orbiting satellites with a beginning-of-life (BOL) conversion efficiency of 30% and the option of a patented, onboard monolithic bypass diode.

"This award reaffirms Emcore's position as the leading solar panel supplier for space missions," says chief operating officer Christopher Larocca. Emcore claims to be the world's largest manufacturer of highly efficient radiation-hard solar cells for space power applications.

<http://gpm.gsfc.nasa.gov>

### IN BRIEF

#### Emcore wins \$5.7m AFRL PV contract

Emcore has been awarded a two-year, \$5.7m cost-plus fixed-fee contract from the US Air Force Research Laboratory at the Kirtland Air Force Base to develop high-efficiency photovoltaic solar cells for space applications, and to investigate advanced photovoltaic devices based on inverted metamorphic (IMM) structures.

The contract also includes a provision for a further \$3.4m over 12 months for IMM development once the base contract has been completed. Funding for the entire contract has been appropriated.

"We are pleased to be partnering up with AFRL to further develop Emcore's proprietary IMM photovoltaic technology," says chief operating officer Christopher Larocca. "This contract will allow Emcore to demonstrate industry-leading cell efficiency of 37%. This, combined with the lightweight and flexible properties of our cell, will enable significantly broader space and terrestrial photovoltaic applications."

[www.kirtland.af.mil](http://www.kirtland.af.mil)

## Emcore to provide solar power to New Mexico's largest electricity supplier

Emcore is to be the first participant in the distributed generation (DG) solar power program of PNM of Albuquerque, NM (New Mexico's largest electricity provider, serving about 497,000 customers statewide as well as selling electricity on the wholesale market).

This follows the signing of a formal 20-year agreement consisting of 114kW of solar power generated by second- and third-generation concentrator photovoltaics (CPV) systems installed onsite next to Emcore's corporate headquarters in Albuquerque. The power is fed to Emcore's buildings through a PNM-approved REC (renewable energy credit) meter. Although over 1MW of Emcore's CPV systems have been deployed across seven sites worldwide, this is the firm's first DG application.

"This is a significant milestone in advancing solar power applications for both Emcore and PNM," says Emcore's chief operating officer Christopher Larocca. "The DG program allows power to be generated close to the point of use and distributed without requiring a comprehensive transmission

infrastructure," he adds. Emcore's CPV systems are suited to such applications because of their cost competitiveness and high energy-conversion efficiency, he claims. "We look forward to pursuing additional distributed generation programs with PNM as well as other utility companies."

"Our large solar program announced earlier this year is just one of the many ways we're working to provide more environmentally friendly, renewable sources of electricity into our overall energy portfolio," says Sue Fullen, PNM's VP of marketing & customer service.

A commemoration event took place on 25 June at Emcore's headquarters, attended by PNM and local government officials.

[www.pnm.com](http://www.pnm.com)

[www.emcore.com](http://www.emcore.com)



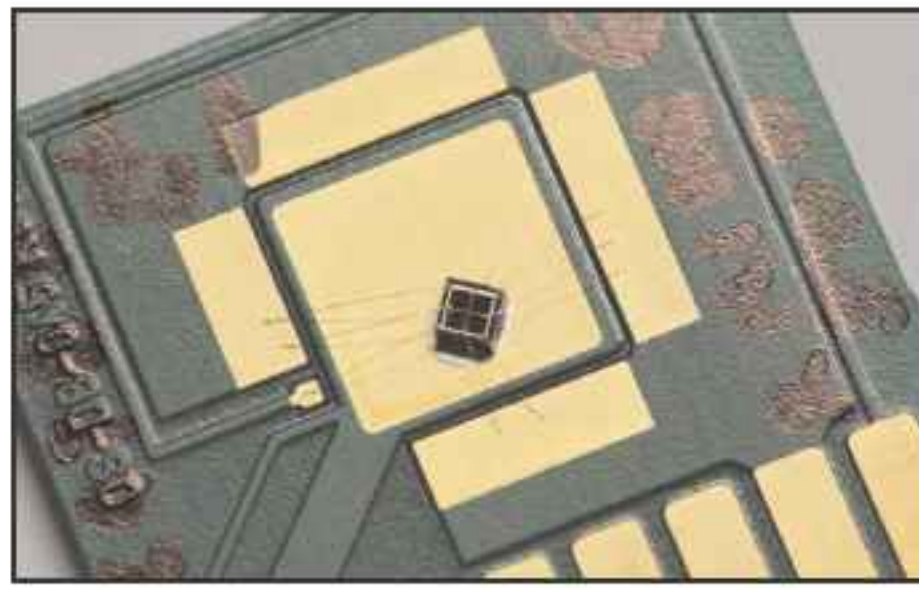
## QuantaSol raises \$2m in funding for triple-junction PV cells following 28.3% single-junction record

As part of an overall £1.975m funding round with Imperial Innovations, alternative energy investor Low Carbon Accelerator (LCA) has made a further investment of £1.175m in solar cell maker QuantaSol Ltd of Kingston-Upon-Thames, UK, which manufactures strain-balanced quantum-well solar cells.

LCA will invest in two tranches: £892,405 immediately, followed by a further £282,595 on the achievement of certain milestones. LCA has also converted an outstanding £400,000 loan into QuantaSol equity.

Following completion of the round, LCA will have invested a total of £2.375m and raised its stake in the firm from 25.6% to 41.4% of the equity on a fully diluted basis.

QuantaSol was spun off from Imperial College London, UK in June 2007 and is developing third-generation III-V-based solar cells for use by concentrating photovoltaic



QuantaSol's new solar cell (black) sitting on a larger chip.

(CPV) system makers. The firm says that its approach combines several nanostructures, of two or more different alloys, in order to obtain synthetic crystals that overcome the problems associated existing solar cell designs. The structure also greatly enhances the photovoltaic conversion efficiency, it is claimed.

The firm has already delivered a single-junction cell, manufactured on a commercial production line, with a record efficiency of 28.3%

at a concentration of greater than 500 suns, as tested independently by Fraunhofer Institute for Solar Energy Systems (FhG-ISE) in Freiburg, Germany. "This is the first time that anyone has successfully combined high efficiency with ease of manufacture, historically a bug-bear of the solar cell industry," claims CEO Kevin Arthur. In June Imperial College featured a QuantaSol device as part of its presence at the Royal Society Summer Exhibition in London.

QuantaSol says that it will now concentrate on cutting the cost of ownership of solar energy by moving to multi-junction devices. Specifically, the new funding will be used to develop its first commercial triple-junction cell. "We're now gearing up to provide multi-junction cells of even higher efficiencies as early as Q1/2010," adds Arthur.

[www.quantasol.com](http://www.quantasol.com)

## CPV plant feeds grid with record 23% AC efficiency

Concentrix Solar GmbH of Freiburg, Germany has confirmed that, on clear days and under normal field operating conditions, demonstration system efficiencies of 23% AC have been measured consistently for its entire 2MW Casaquemada commercial concentrator photovoltaic (CPV) power plant at the Solúcar Complex in Sanlúcar la Mayor, near Seville, Spain (which it operates together with Spanish investment partner and solar plant developer Abengoa Solar).

Concentrix was founded in 2005 as a spin-off of Freiburg's Fraunhofer Institute for Solar Energy Systems (ISE), and initially achieved the record 23% efficiency in May 2008 for a 5.4kW demonstration system at Abengoa's test site in Seville. "It is possible to reach these high efficiencies also in a larger installation and not only for a single test system," says chief technology officer Dr



Andreas Gombert. "At an efficiency of 23%, our concentrator systems produce almost exactly double the electrical power yield of conventional PV power plants," he adds. Typical silicon modules achieve 13-14%.

The plant's solar tracking systems have been installed with both conventional silicon modules and

**It is possible to reach these high efficiencies also in a larger installation and not only for a single test system**

CPV modules, making it one of the first combination power plants of this kind. Concentrix's CPV systems provide 100kW (5%) of the 2MW of installed power.

Casaquemada's 19 x 5.75kW trackers use first-generation FLATCON modules (commercially available since September 2008), which have a power output of 48W. In the meantime, Concentrix has produced the newer and more efficient CX-75 generation of FLATCON modules, which have a power of 75W and achieve an average efficiency of 27.2%. The firm produces its new modules using a fully automated production line with an annual capacity of 25MW (inaugurated last December). The building and infrastructure are designed in such a way that production capacity can quickly be increased to 100MW, says Concentrix.

[www.concentrix-solar.de](http://www.concentrix-solar.de)



## OPEL and BETASOL complete first 110kW phase of Spanish high-concentration photovoltaic installation

OPEL International Inc of Shelton, CT, USA and Toronto, Canada, which makes high-concentration photovoltaic (HCPV) panels (as well as both roof- and ground-based dual- and single-axis solar trackers for mounting them), and its Spanish partner BETASOL, which builds utility-grade solar farm installations for subsequent sale to investor groups, have completed the first 110kW phase of a four-phase 440kW solar farm in the Spanish province of Tarragona. This represents one of the first commercial-grade HCPV installations supplying electricity to the power grid and generating revenue in Spain.

Last December, OPEL began shipping its Mk-I HCPV panels mounted on dual-axis trackers. The balance of the installation is expected to be completed in third-quarter 2009, after which the project will supply power to more than 350 households.



OPEL's Mk-I HCPV panel.

"This installation has attracted great interest of potential customers in both Europe and Africa," says OPEL's CEO Robert Pico. "Our partnership with OPEL using its HCPV panels greatly improved

the system's efficiency, thus making the rate of return provided by the Spanish feed-in tariff structure even more attractive to investors," adds BETASOL's managing director Jesus Cabetas.

"OPEL's Mk-I HCPV panel design is a cost-competitive solution concentrating light from the sun more than 500 times on to very high-efficiency multi-junction solar cells," says OPEL's VP of marketing Frank Middleton. "This product has conversion efficiencies up to twice those of silicon solar panels and more than three times that of thin-film solar panels, making it an optimum solution, especially in sunny climates such as the Mediterranean basin and the South Western USA."

OPEL will report on progress as it completes the other phases of the project.

[www.opelinc.com](http://www.opelinc.com)

## OPEL appoints director of Asian business development, paving the way for worldwide expansion

OPEL has appointed Steven Lam as director of Asian Business Development. He will focus on the expanding the solar markets of China, South Korea, Malaysia and Thailand by building OPEL's footprint in sales, marketing and operations for the region.

Lam will be based in Shelton and will spend significant periods of time in Asia to handle OPEL's current customer base and to develop growth strategies for the region.

"The decision to build staff in Asia reinforces OPEL's commitment to establishing a market presence in all regions of the world," says CEO Robert Pico. "We see the Asian countries broadening their deployment of solar electric power generation as a result of the many solar incentives recently put in place in the region," he adds.

"We also look to Asia to contribute to OPEL's manufacturing process."

Lam has more than 30 years of integrated systems and semiconductor experience in general management, sales, marketing, and product engineering. His expertise includes formulating product strategy, new product concepts, product business plans and development, as well as launching new products to market and customer management.

**The decision to build staff in Asia reinforces OPEL's commitment to establishing a market presence in all regions of the world**

Lam has worked for ITT, Honeywell and Teradyne. He has also worked for TranSwitch Corp for over 20 years in senior sales, marketing, and engineering roles (most recently as director of Asian sales).

He holds both Bachelor of Science and Master of Science degrees in Electrical Engineering from Northeastern University and a Master of Business Administration degree from the University of New Haven.

"Steve has extensive experience developing Asian markets and he will play an important role in broadening OPEL's business in the Asian market," says Frank Middleton, VP of marketing. "OPEL can increase its responsiveness to customers in the region and develop relevant growth plans for its solar business in the Far East," he adds.







































































































