ISSN: 1863-5598

ZKZ 64717
03-10

Bodo´s Power Systems®

Electronics in Motion and Conversion

March 2010

CONCEPT
INTELLIGENT POWER ELECTRONICS

SCALE-2 Low Cost Driver Cores

The two new cores **2SC0108T** and **2SC0435T** are re-defining the standard for 1700 V IGBT drivers. Thanks to consistent integration, a sensational price/performance ratio has been achieved. For as little as **US$20 respectively US$30** for 10k items, drivers are available that offer not only reliable separation and UL-compliant design but also the precise timing that is characteristic of the SCALE-2 driver family. Typical applications are wind power and solar installations, industrial drives as well as power supply equipment of all kinds.

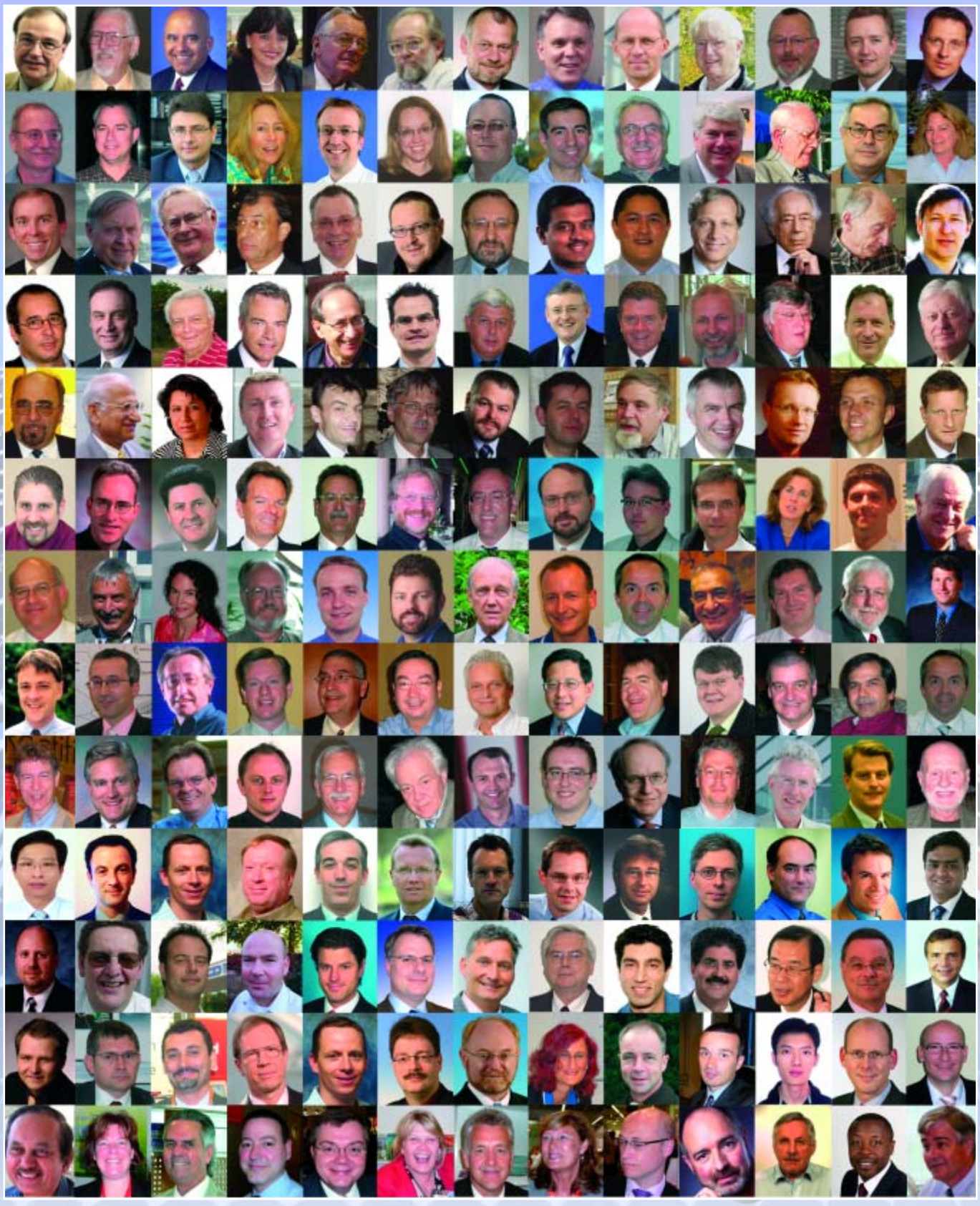
Features

- Safe isolation to IEC 60664-1
- 8 A or 35 A gate drive current
- 2x1 W or 2x4 W output power
- +15 V/-10 V gate voltage
- Up to 100 kHz switching frequency
- 80 ns delay time
- ±8 ns jitter
- Integrated DC/DC converter
- Power supply monitoring
- Short-circuit protection
- Embedded paralleling capability
- Superior EMC (dv/dt > 75 V/ns)

CT-Concept Technologie AG, Renferstrasse 15, CH-2504 Biel, Switzerland, Phone +41-32-344 47 47

www.IGBT-Driver.com

The Gallery



CUSTOMIZING YOUR PROJECTS

GvA Power Electronics

Welcome to the House of Competence.

GvA is your expert in individual problem solutions for all sectors of power electronics – state of the art know how and profound experience as an engineering service provider, manufacturer and distributor.

Consulting – Design & Development – Production – Distribution

GvA Leistungselektronik GmbH | Boehringer Straße 10 - 12 | D-68307 Mannheim
Phone +49 (0) 621/7 89 92-0 | www.gva-leistungselektronik.de | info@gva-leistungselektronik.de

Bodo´s Power Systems®

A Media
Katzbek 17a
D-24235 Laboe, Germany
Phone: +49 4343 42 17 90
Fax: +49 4343 42 17 89
editor@bodospower.com
www.bodospower.com

Publishing Editor
Bodo Arlt, *Dipl.-Ing.*
editor@bodospower.com

Creative Direction & Production
Repro Studio Peschke
Repro.Peschke@t-online.de

Free Subscription to qualified readers

Bodo´s Power Systems
is available for the following subscription charges:
Annual charge (12 issues) is 150 €
world wide
Single issue is 18 €
subscription@bodospower.com

circulation ASC audit since 09/2008

Printing by:
Central-Druck Trost GmbH & Co
Heusenstamm, Germany

Events

Embedded World,
Nuremberg Ger March 3 -5
www.embedded-world.de

EMC, Düsseldorf/Ger,
March.9–11 www.mesago.de

CIPS 2010, Nuremberg, Ger,
March 16-18
www.cips-conference.de

New Energy Husum, Ger,
March 18-21 www.new-energy.com

Digital Power Forum Europe
Nuremberg Ger April 6-7
www.dpfeurope.darnell.com

Battery University
Aschaffenburg
Ger April 13-15
http://www.batteryuniversity.eu

PEMD Brighton UK
April 19- 23
www.theiet.org/pemd

PCIM Europe
Nuremberg Ger.
May 4-6 www.mesago.de

How Green is our Mind?

It is nice to get feedback from engineers who share and circulate literature in their laboratory. When I was a young engineer a route slip was attached to magazines for us to sign once we'd reviewed them. Reading the same material encouraged discussion. There were up to ten people in our group using trade magazines as a source of new information and other design groups worked the same way. It's good to see that the willingness to share resources is still there. The requests I get from all over the world to supply an extra hard copy for the central library prove to me that print still has a strong value to engineers.

Many readers, on the other hand, go to the web and download the .pdf's they need and still others want only to receive the e-newsletter. The variety of methods used for accessing the information in my publication shows that the adaptation of working habits towards electronic media is slowly progressing.

This means that readership calculations should recognize a multiplication factor over circulation numbers alone, but this has yet to be defined. Whatever the numbers, I am happy and proud to serve the industry. My network of contacts, built through decades of working in the power electronic industry, ensures that new and useful information quickly finds its way into the magazine - the Gallery represents just the tip of the iceberg for using the space available. I have to thank all of my friends and supporters and especially ones not yet pictured in the Gallery. I try my best to keep up with all of you.

We have a number of strong shows coming up in Europe. APEC just took place in California and we are looking forward to the PCIM in Nuremberg as the next big measure of progress. This year brings with it expectations for a better economy than in 2009.

I am seeing some strong, positive impulses in the industry but am still concerned about the banks returning to their Las Vegas gambling mode, paying high incentives to trading people and encouraging unwarranted risk-taking while governments and our taxes are still being counted upon for unforeseen outcomes. Bank management could use a basic course in mathematics to calculate simple risks. If engineers calculated risks for transportation systems the way bankers calculate for some investments, we would be faced with a lot of fatalities and well-deserved criticism.

My Green Power Tip for March:
Share technical publications in your company, laboratory, university or other places where it makes sense and help conserve resources used in the printing process. We have only one world to live in and our children will benefit from us being careful with resources.

See you at the CIPS and New Energy conferences.

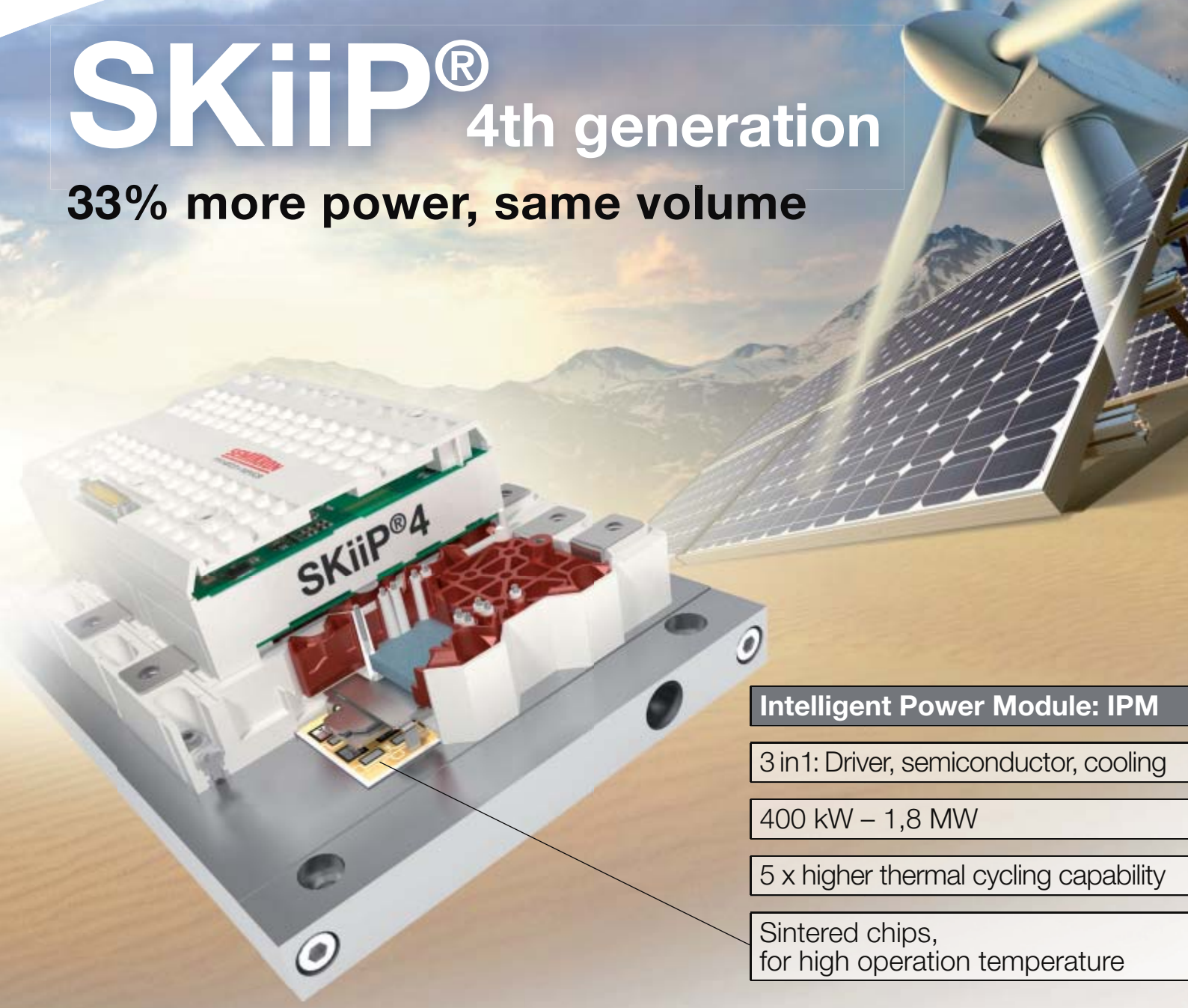
Best regards

Bodo

SEMIKRON
innovation + service

SKiiP® 4th generation

33% more power, same volume



Intelligent Power Module: IPM

- 3 in1: Driver, semiconductor, cooling
- 400 kW – 1,8 MW
- 5 x higher thermal cycling capability
- Sintered chips, for high operation temperature

SKiiP® Technology

SINTER Technology

Most powerful IPM on the market

1800A

2400A

3600A

I_{mrs} [A]	SKiiP®3	SKiiP®4	More power
1200V	750A	1030A	**37%**
1700V	775A	1030A	**33%**

Calculation prerequisites:
V_{dc}=650V, V_{out}=400V, f_{SW}=5kHz, cosφ=0,85, T_a=40°C, 150% OL, f_{out}=2 - 50Hz, 4 half bridges in parallel, same heat-sink

Australia +61 3-85 61 56 00 ■ **Belgium** +32 23 00 07 93 ■ **Brasil** +55 11-41 86 95 00 ■ **Cesko** +420 37 80 51 400 ■ **China** +852 34 26 33 66 ■ **Danmark** +45 58 10 35 56 ■ **Deutschland** +49 911-65 59-0
■ **España** +34 9 36 33 58 90 ■ **France** +33 1-30 86 80 00 ■ **India** +91 222 76 28 600 ■ **Italia** +39 06-9 11 42 41 ■ **Japan** +81 68 95 13 96 ■ **Korea** +82 32-3 46 28 30 ■ **Mexico** +52 55-53 00 11 51 ■ **Nederland** +31 55-5 29 52 95
■ **Österreich** +43 1-58 63 65 80 ■ **Polska** +48 22-6 15 79 84 ■ **Russia** +7 38 33 55 58 69 ■ **Schweiz** +41 44-9 14 13 33 ■ **Slovensko** +421 3 37 97 03 05 ■ **Suid-Afrika** +27 12-3 45 60 60 ■ **Suomi** +358 9-7 74 38 80
■ **Sverige** +46 8-59 4768 50 ■ **Türkiye** +90 21 6-688 32 88 ■ **United Kingdom** +44 19 92-58 46 77 ■ **USA** +1 603-8 83 81 02

sales.skd@semikron.com **www.semikron.com**

Intelligent IGBT Drivers from HY-LINE Power Components

CT-Concept Technologie AG has appointed HY-LINE Power Components as its Authorized Distributor for Germany and Austria. CONCEPT, a Swiss manufacturer with more than 20 years experience in the development and production of efficient high-quality driver stages for power semiconductor modules, will be represented by power electronics specialist HY-LINE Power Components in Germany and Austria with immediate effect. The technical competence of HY-LINE Power Components in sales of IGBT modules will now be complemented by CONCEPT's know-how in driver stages. Power electronics companies can now obtain driver stages and power modules from a single source, via HY-LINE Power Components, and can simultaneously rely on reliable technical support.

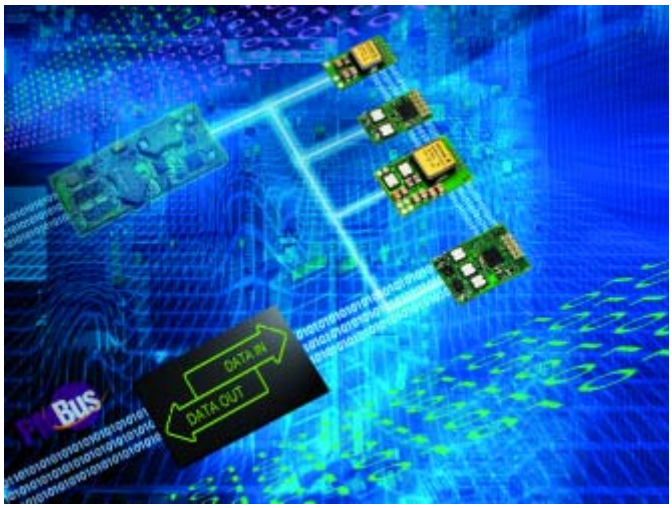
Power electronics developers appreciate IGBTs for their simple MOSFET-like driving and their ruggedness due to their bipolar output stage. However, although IGBTs have also simplified the design of converters and motor controllers, the configuration of an optimal driver stage is still a science in itself: in-house developments usually prove to be less efficient, need more space and cost more than a ready-to-use module from IGBT driver specialist CONCEPT into which years of experience in dealing with high gate capacitances and potential differences have flowed.

CONCEPT offers both mechanically and electrically matched driver stages on individual power modules (plug & play drivers), as well as driver stages freely dimensionable by developers (driver cores) in reverse voltages ranging from 600 V to 6.5 kV with driver powers of up to 20 W and switching frequencies up to 500 kHz. All these drivers are based on the proven SCALE ASIC technology.

CT-Concept Technologie AG is a privately owned Swiss company founded in 1986. CONCEPT is worldwide technology and market leader in the sector of IGBT drivers for mid to high powers and winner of several technology and innovation prizes.

www.hy-line.de/power

Worldwide Agreement on Digital Power Technology



In a worldwide agreement, Ericsson Power Modules has been granted a license on a patent portfolio for digital power technology (DPT) from Power-One. The non-exclusive license agreement provides Ericsson Power Modules with access to Power-One's portfolio of DPT patents for incorporation in Power Modules award winning series of 3E digitally controlled point-of-load devices.

Digital power management enables OEM's and data centres, including websites, to run more efficiently. As the number of point-of-load (POL) on boards continues to increase, and data centres utilize more power from the grid, the need for digital power management solutions intensifies. The use of digital control technology actually reduces cost while increasing performance, leading to the digital power market being one of the fastest growing markets in power management.

www.power-one.com

EBV Elektronik to Launch its Own Semiconductors, EBVchips

With immediate effect, EBV Elektronik, an Avnet (NYSE: AVT) company and the leading specialist in EMEA semiconductor distribution is offering via EBVchips a brand-new additional service in which it collaborates with customers to design its own semiconductors. EBVchips are produced by EBV's manufacturers and distributed exclusively by EBV.

For the first time in the history of the semiconductor industry, one distributor is now providing even small and mediumsized companies with access to specially customized products featuring state-of-the-art technology with the best price/performance ratio!

"With EBVchips, we now represent the interface between many thousands of customers and the manufacturer", explains Slobodan Puljarevic, President and CEO of EBV Elektronik. "This takes semiconductor distribution to a whole new level. 2009 was the 'Darwin year' of the semiconductor industry. Anyone who carries on as before and fails to reach the next evolutionary stage with the products and services they offer will find things very difficult in the long run."

www.ebv.com

25th European Photovolataic and 5th World Conference

The 5th World Conference on Photovoltaic Energy Conversion (WCPEC-5) will bring together the three most important global scientific and strategic PV Conferences: the 25th European Photovoltaic Solar Energy Conference and Exhibition, the 36th US IEEE Photovoltaic Specialists Conference and the 20th Asia/Pacific PV Science and Engineering Conference.

Dr. Giovanni Federigo De Santi, Joint Research Centre, European Commission, will be the Conference General Chairman of the 25th EU PVSEC and 5th World Conference on Photovoltaic Energy Conversion

This unique PV solar gathering will constitute the world's leading science-to-science, business-to-business and science-to industry forum for the global PV Solar sector. This joint event of the global PV community will take place in Valencia, Spain, from 6-10 September 2010 (Conference: 6-10 September 2010 - Exhibition: 6-9 September 2010).

www.photovoltaic-conference.com

Winner at the Shell Springboard Regional Finals in Manchester

It is a great pleasure to announce that Himag Solutions was a winner at the Shell Springboard regional finals in Manchester this week, winning an award of £40,000, ahead of 160 entrants. The Shell Springboard Award supports innovative Small and Medium sized Enterprises with products that help combat climate change, and Himag Solutions' efficient planar transformers caught the judges' eye, especially our applications in solar power and hybrid/electric vehicles. Himag Solutions has now been put forward to the UK finals in March, where we shall compete to be named as the overall UK winner against four other regional winners.

This award comes only five months after Himag Solutions won a Research Grant of £157k from the South West Regional Development Agency. The grant is 60% funding towards a research project focused on a new generation of lightweight, high performance, high efficiency planar transformers for the renewable energy, hybrid automotive, aerospace, defence and mass passenger transit industries. Both of these awards demonstrate the commitment to innovation in this sector and we are confident that this will provide you with even better products in the future.

Himag Solutions will be exhibiting at PCIM (Nuremberg, 4th-6th May, Booth 333).

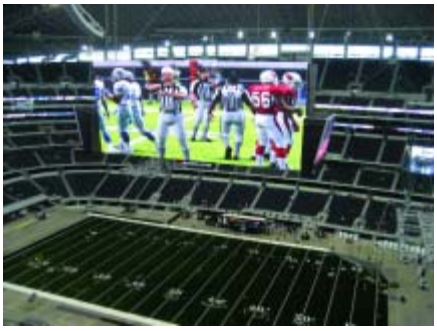
www.shellspringboard.org/news/63

www.himag.co.uk

Giant Video Displays Powered by 22,000 Supplies

There has been a lot of TV coverage recently concerning the Dallas Cowboys giant video displays at their new stadium in Arlington, Texas. The $40m, four-sided, high-definition Diamond Vision video board, which is built by Mitsubishi Electric, uses 22,000 TDK-Lambda power supplies to light the 25 million Light Emitting Diodes (LEDs) needed to create the image on the screen.

As part of the team's move from their previous home in Irving, the recently opened $1.1bn stadium sports a retractable roof from which the world's largest HDTV screens hang. The four panels, which together weigh 600 metric tons (600,000kg), are suspended



approximately 30 metres above midfield. The sideline panel stretches from one 20-yard line to the other and measures 21.76 x 48.32m; it has just been recognised by the Guinness Book of Records as the world's largest High Definition (HD) video screen.

Another record breaker, this time recognised as the world's highest resolution LED display, is located in the New York Yankee Stadium. Here 8,590 power supplies are used to power the eight and a half million LEDs used to render the image onto the screen. "Like the Dallas Cowboys displays," says a spokesman, "TDK-Lambda power supplies were selected for their long-term reliability and quality."

www.emea.tdk-lambda.com

Launch of Next Generation Company Website

UltraVolt Inc. announced the completion of its next generation company website. Twelve years after its advent, the brand new www.ultravolt.com has arrived.
The site has undergone a major transformation. Navigation is vastly improved to make information easier to find, product browsing is cleaner and more thorough, and the site's aesthetics are dramatically heightened with the inclusion of stunning graphics. Users can search for products three ways: drilling down by category to the appropriate model, searching by specification, or, if they already know our products, simply selecting the

product Series name from the appropriate category on the Products page. Most importantly, a new dynamic product search by specification is available, which includes a comparison feature to help engineers find the best unit for their application a little faster.
Other improvements include a new Events calendar outlining UltraVolt's presence at tradeshows and other events around the world and a Careers section detailing employment opportunities within the company. Even more improvements are planned for later this year.

www.ultravolt.com

New Energy Husum Records Massive Growth Figures

New Energy 2010 will be Europe's biggest Small Wind Turbine Show.

Results have shown that the Husum organisers' decision to focus on small wind turbines last year showed they were on the right track, as small wind turbines are now very much in trend in the regenerative energy sector. With over 45 small wind turbine companies already registered, New Energy Husum 2010 is already Europe's biggest trade fair for small wind turbines.
Husum's New Energy trade fair, which with around 16,000 visitors last year – well over half of which were trade visitors – making it one of the best visited events in the renewable energy sector, announces an increase in exhibition space of over fifty percent for the exhibition in March 2010.
Innovations from all areas of the renewable energy sector will be shown in three large exhibition halls and the open-air section, with the exhibition space totalling 10,500 square metres.

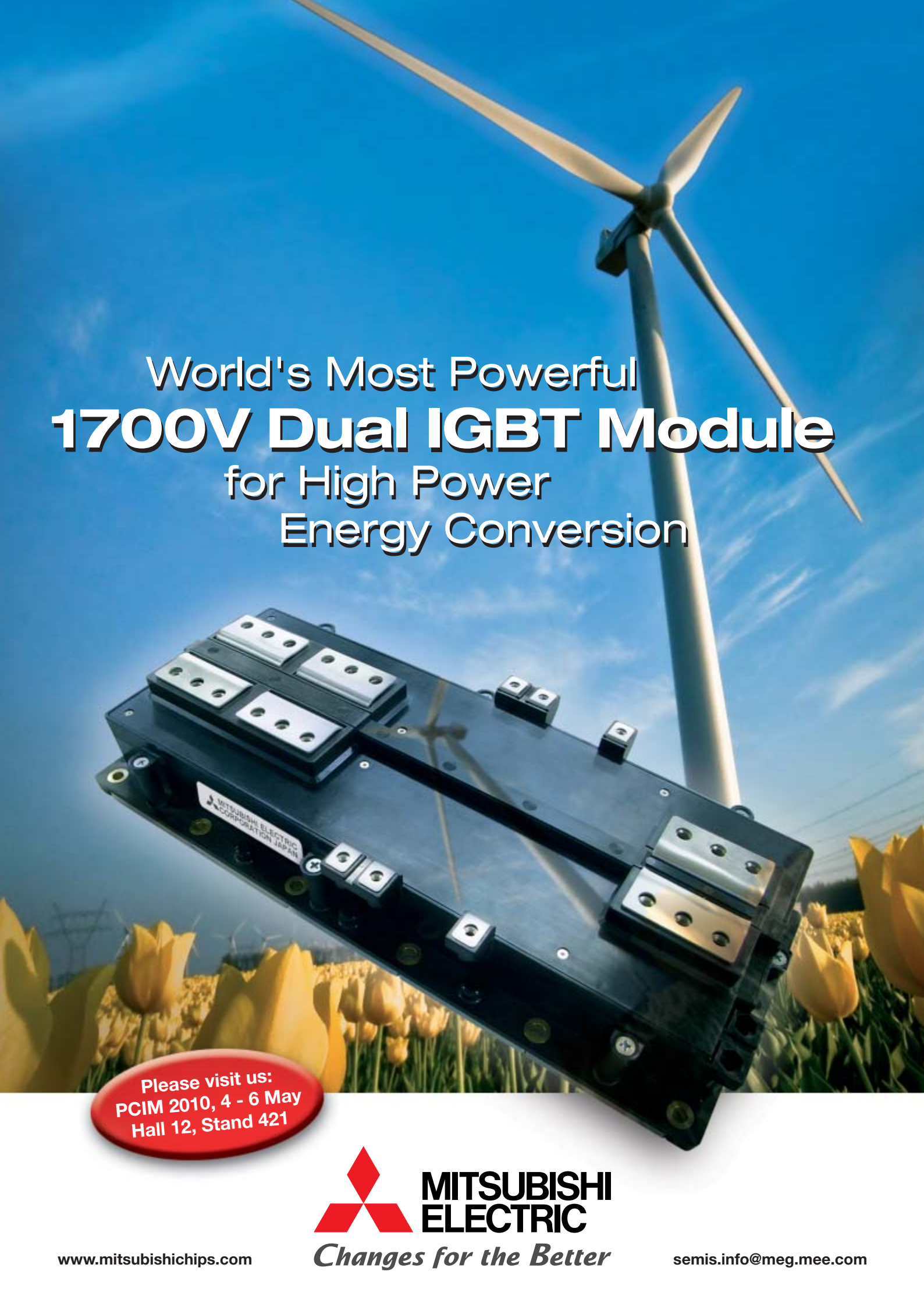
www.new-energy.de

Availability of Indium and Gallium

"Long term, both indium and gallium will be available with intermittent price volatility." Claire Mikolajczak, Director Metals and Chemicals, Indium Corporation.
The hessian GPS Technologies GmbH and the Indium Corporation created together an article about the extraction and availability of Inidium and Gallium.

Overall an appropriate Indium- and Gallium delivery capacity at a continuous availability is looking forward to you.
Expert more about the Indium and Gallium extraction, as well as theire worldwide availability.

www.gps-technologies.de/materialien.html


World's Most Powerful
1700V Dual IGBT Module
for High Power
Energy Conversion
Please visit us:
PCIM 2010, 4 - 6 May
Hall 12, Stand 421
MITSUBISHI ELECTRIC
Changes for the Better
www.mitsubishichips.com
semis.info@meg.mee.com

AS9100 Certification Renewal

Datatronics Romoland, Inc., a global leader in advanced custom magnetic component technologies for military, medical and other mission-critical applications, today announces the renewal of its AS9100 Certification.

Datatronics Romoland's General Manager Mark Robinson said,"Datatronics Romoland understands the need to deliver the highest quality magnetic components to our customers whose vehicles, equipment and systems must meet the most rigorous quality, performance and reliability standards. The renewal of our AS9100 Certification represents Datatronics Romoland's commitment to producing mission-critical magnetic components for advanced electronics applications operating in the most demanding environments."

AS9100 is the aerospace industry's recog-

nized standard for quality management systems (QMS). The AS9100 Rev B, which was published in 2004, incorporates the ISO 9001:2000 standard as well as additional requirements for the aerospace industry. Datatronics Romoland is a world leader in transformers and inductors for equipment supporting a wide range of aerospace, avionics, military, medical and telecommunications applications. The company designs and manufactures custom and standard off-the-shelf magnetic components including power inductors, RF magnetics, switching transformers, telecom and high-voltage transformers, LAN modules/filters, and fine-wire magnetics. Datatronics Romoland is qualified to some of the industry's most demanding standards in addition to AS9100, including: MIL-PRF-27, MIL-PRF-21038, MIL-STD-981, NASA Space Station Approved, ISO 9001:2000 and J-STD-001. Magnetic components from Datatronic Romoland are widely recognized for their robust design, including ultra fine wire winding and expertise in inductors and transformers for surface mount medical and space applications.

www.datatronicsromoland.com

Intersolar will be known as Intersolar Europe

On June 9, 2010, Intersolar, the world's largest solar technology trade fair, will once again get underway in Munich. The trade fair, previously known as "Intersolar", will this year take place under the new name "Intersolar Europe". The change of name reflects the continuing internationalization of the trade fair, which is now represented in many locations around the world. The newly titled international solar technology trade fair has already set a new record for exhibition space. Just under six months before the trade fair is due to begin, 90 percent of the planned exhibition space of 120,000 square meters, spread across eleven halls, has been booked up. This means last year's total has already been surpassed. Around 1,500 exhibitors are expected to attend the event at the New Munich Trade Fair Center in June.

On June 9, 2010, Intersolar Europe will open its doors in Munich. Intersolar, the world's leading trade fair, is now represented in North America, India and China, as well as in Europe. Intersolar Europe is the largest of the four events. 90 percent of the planned exhibition space of 120,000 square meters, spread across eleven halls, has already been booked up. This represents a further increase on last year's total, which itself had risen by 37 percent on the previous year to 104,000 square meters across nine halls. Exhibitor numbers will also surpass last year's total. Around 1,500 exhibitors from around the world will be presenting their products and services at the New Munich Trade Fair Center in June, and the number of registered exhibitors has already exceeded expectations. The organizers are also optimistic as far as visitor numbers are concerned, and are expecting over 60,000 visitors from all over the world to attend the 2010 event. Last year, 50 percent of exhibitors and 39 percent of visitors to the exhibition grounds of the New Munich Trade Fair Center came from outside Germany.

www.intersolar.de

More Wind Power Capacity Installed Last Year in the EU than any other Technology

More new wind power capacity was installed in the EU in 2009 than any other electricity-generating technology, new statistics published by the European Wind Energy Association (EWEA) reveal. 39% of all new capacity installed in 2009 was wind power, followed by gas (26%) and solar photovoltaics (16%). Europe decommissioned more coal and nuclear capacity than it installed in 2009. Taken together, renewable energy technologies account for 61% of new power generating capacity in 2009.

Investment in new European wind farms in 2009 reached €13 billion, including €1.5 billion offshore. 10,163 MW of wind power capacity was installed across the European Union – a 23% increase compared to 2008 installations – made up of 9,581 MW onshore (up 21% from last year) and 582 MW offshore (up 56% from last year).

2009 is the second year running that more wind power capacity has been installed than any other electricity-generating technology, and wind's share of newly installed capacity increased from 35% in 2008 to 39% in 2009. It is also the second year running that renewable energies have accounted for the majority of new investments.

The countries with the biggest share of new capacity installed in 2009 were Spain (24% - 2459 MW), followed by Germany (19% - 1917 MW), Italy (11% - 1114 MW), France (11% - 1088 MW) and the UK (10% - 1077 MW).

Wind power's total capacity in the European Union has now reached 74,767 MW, up from 64,719 MW by the end of 2008 with Germany remaining the EU country with the largest installed capacity, followed by Spain, Italy, France and the UK.

The wind capacity installed by the end of 2009 will in a normal year produce 163 TWh of electricity, meeting 4.8% of total EU power demand [1].

To download the pdf with the full analysis of the data please go:

www.ewea.org/fileadmin/emag/statistics/2009generalstats

Dual-PACK IGBTs

We never sell a product alone
It always comes with Quality

Voltage & current range

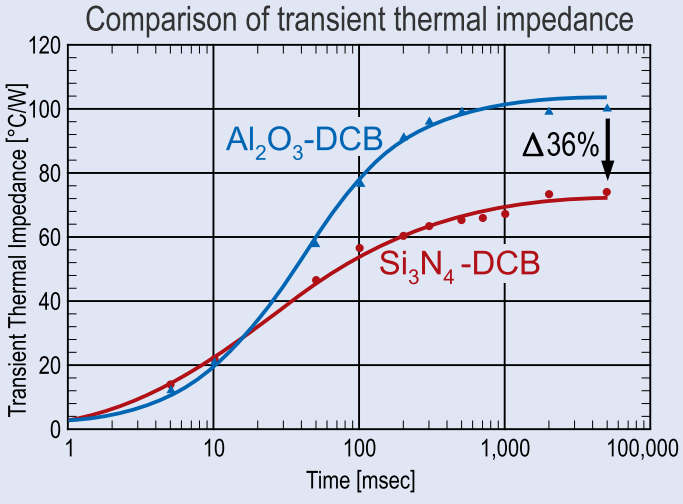
I_c	1200V	1700V
225A	●	●
300A	●	●
450A	●	●
600A	●	

SiN-DCB & thicker Cu pattern

Lower thermal impedance
Higher bending strength & fracture toughness

Higher thermal cycling capability
Higher reliability

- $T_{j\,(op)}$ = 150°C continuous operation
- $T_{j\,(max)}$ = 175°C
- New solder material for higher reliability
- Low switching losses & low over voltage spike



FUJI ELECTRIC
Power Semiconductors
e-Front runners

Fuji Electric Europe GmbH
Goethering 58 · 63067 Offenbach am Main · Germany
Fon +49 (0)69 - 66 90 29 0 · Fax +49 (0)69 - 66 90 29 56
semi-info@fujielectric.de . www.fujielectric.de

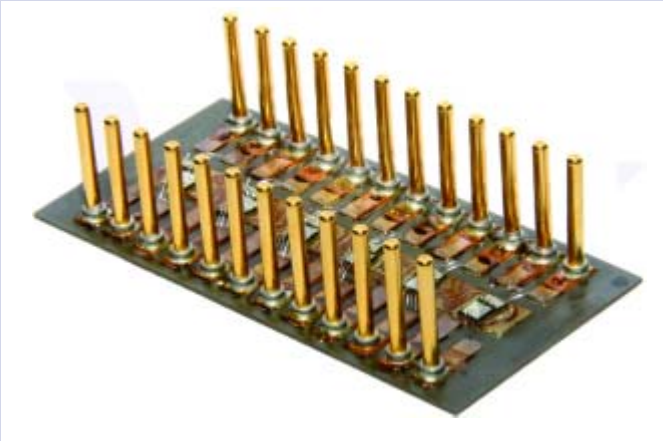
SiC Power Modules for High Power Applications

TranSiC has successfully completed a three year development project supported by Vinnova and Energimyndigheten (the Swedish Energy Agency). The project consisted of three parties: TranSiC AB, KTH School of ICT and Acreo AB all located in Kista Sweden.

The project's aim is to design and manufacture devices and modules to enable energy efficient and compact power electronic systems. The goal of the project was to verify the device designs for the proposed technology platforms, in particular switching power designs has been reached. Typical applications for these devices and modules are found in Hybrid Electrical Vehicles.

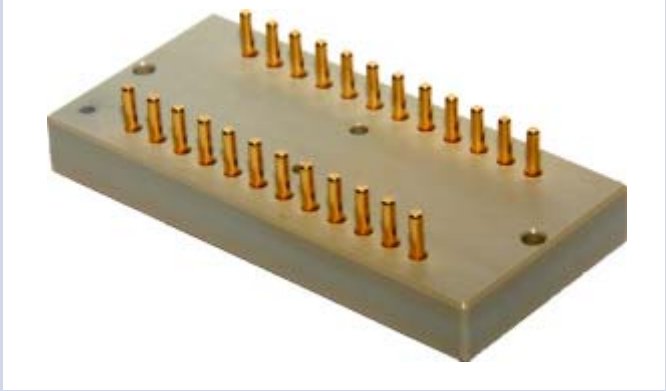
The results of the project include a state of the art 1200V SiC power module, consisting of six BitSiC power transistors and six diodes. The module exhibits state of the art performance with on state losses of 1.15 V at 100 A and room temperature. At an elevated temperature of 150°C, the TranSiC power module exhibits low losses of 1.75 V at 100 A. Specific on-resistance of the module is at a very competitive 3.1 mÙcm2 at room temperature.

"These results prove that TranSiC has the necessary competence and capability to design and manufacture SiC devices and modules with very high performances. With very low losses at high voltage ratings, SiC bipolar transistors have a good opportunity of becoming a standard solution in high power applications" says Mats Reimark CEO of Transic in reflection of the presented results.



The packaging and interior of the power module that TranSiC designed and manufactured within the realm of this development project

TranSiC is a world leading developer and manufacturer of Bipolar Power Transistors (BJT) in Silicon Carbide (SiC). Through solid experience in design, development and process innovation, TranSiC develops state-of-the-art power transistors to meet the highest standards of power control in hybrid vehicles, solar energy inverters, drilling equipment, avionics actuators and other demanding applications for power electronics. TranSiC was founded in 2005. Investors include Industrifonden, Volvo Technology Transfer AB and Midroc New Technology AB.



By creatively exploiting the inherently superior qualities of the Silicon Carbide, TranSiC achieves to realize compact high voltage SiC power transistors that offer the highest levels of efficiency yet suitable for operations at very high temperature levels up to 250°C.

The high temperature capabilities are typically required for applications within the Oil & Gas and Avionics Industry. TranSiC's power transistors offer unique performances when integrated in high temperature power electronics in these very demanding applications.

The superior qualities of TranSiC's silicon carbide power transistors include low conduction losses, low switching losses and high blocking voltage. They are therefore ideal to be used in many switched power applications requiring high efficiency operation. Examples of such applications include hybrid vehicles, photovoltaic inverters, power factor correctors and motor drives, among others.

As a pioneer in the field of refining Silicon Carbide for high performance Bipolar Power Transistors, TranSiC has demonstrated an impressive track record of recent advances. The future of Power Transistors in Silicon Carbide looks bright!

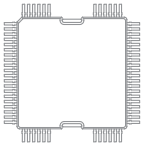
www.transic.com

innovation

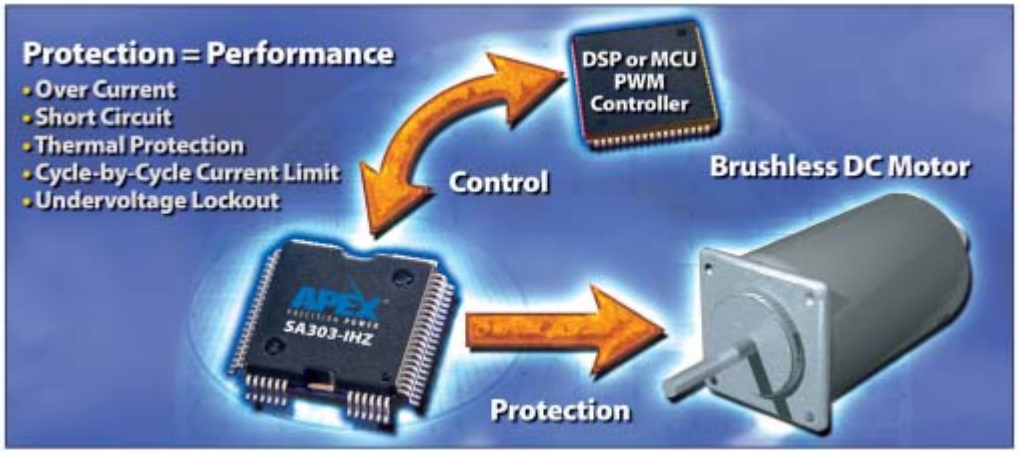
APEX PRECISION POWER

Product Innovation from Cirrus Logic

64-PIN QFP, PACKAGE STYLE HQ
JEDEC MO-188



(actual footprint)



3 A, Three-Phase Motor Driver IC Uses Protection Features to Deliver Performance Gains

The SA303-IHZ is a pulse width modulation (PWM) motor driver IC designed to protect brushless motors from operational hazards such as over current, under voltage and over temperature. This newest addition to the Apex Precision Power® product family can generate performance gains in the overall motor control circuitry by eliminating motor shutdown and re-starts. For example, should an over-temperature or short circuit occur, the SA303-IHZ will not shutdown the outputs but instead allows the system to continue running while it signals the external controller to take corrective action. In most cases, the processor can correct the condition by utilizing software to remedy the external interrupt.

APPLICATIONS

- Motor Drives – Industrial Controls
  - Factory Automation
  - Robotics
- Motor Drives – Office Equipment
  - Copiers, Fax Machines
  - Vending Machines
- Motor Drives – Aerospace, Military
  - Positioning Control
  - Aircraft Seating

	Model	Motor Interface	Output Current	Supply Voltage Operation
NEW	SA303-IHZ	Brushless DC Motor	3 A continuous 10 A Peak	10 V to 60 V Single Supply
	SA306-IHZ	Brushless DC Motor	5 A continuous 17 A PEAK	< 9 V to 60 V Single Supply
	SA306A-FHZ	Brushless DC Motor	8 A continuous 17 A PEAK	< 9 V to 60 V Single Supply
NEW	SA53-IHZ	Brush DC Motor	3 A continuous 10 A Peak	10 V to 60 V Single Supply
	SA57-IHZ	Brush DC Motor	5 A continuous 17 A PEAK	< 9 V to 60 V Single Supply
	SA57A-FHZ	Brush DC Motor	8 A continuous 17 A PEAK	< 9 V to 60 V Single Supply

NORTH AMERICA
+1 800-625-4084

ASIA PACIFIC
+852 2376-0801

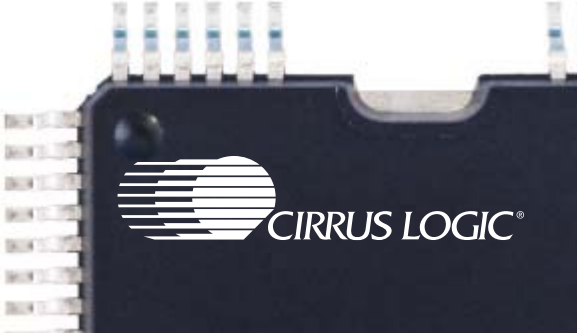
JAPAN
+81 (3) 5226-7757

EUROPE/UK
+44 (0) 1628-891-300

DOWNLOAD A COPY OF THE CIRRUS LOGIC V15 APEX PRECISIO POWER® PRODUCT DATA BOOK AT WWW.CIRRUS.COM/303BPS

For product selection assistance or technical support with Apex Precision Power products please contact apex.support@cirrus.com.

LEARN MORE AT
www.cirrus.com



Social Media & Building Brand Recognition

It's All About Quality, Not Quantity

By Sandra Iris Eilenstein, ITPR Information-Travels Public Relations, Munich, Germany

The electronics industry is all about innovation. Business dictates the need to meet the demands of buyers and, even more importantly, to anticipate their needs and design requirements before marketplace demand for their products accelerates. It's essential that engineers keep current on new products and developments, and print media has traditionally played a very important role in delivering this information. Much like the age-old adage about whether a tree that falls unobserved in the forest really makes a noise since no one hears it, we can question whether there is any real value in the most fantastic innovation if no one knows anything about it. Communicating with current and potential customers never goes out of style.

Before the advent and evolution of an Internet that was accessible to the masses, information was generally delivered either verbally in person or on paper in writing. In business-to-business communications, press releases, technical articles or white papers were, and still are, written for the technical community. Managers and executives expressed their opinions, visions and expert predictions in by-lined commentaries and interviews. Press conferences, round-tables, media briefings and presentations at industry events continue to offer a platform for direct and personal contact with editors, customers and partners. Roughly fifteen years ago both the media and the corporate world began using the Internet as a new channel for publishing information and communicating with their audiences. At first, bandwidth limitations relegated the type of content on the Internet to online versions of brochures and other printed materials. Only in the last five years or so has the bandwidth problem been overcome, effectively making Web 2.0 applications possible.

The term Web 2.0 was first used prolifically in 2004 and basically describes the web as a dynamic and decentralized platform where users can collaborate and share information that they themselves create. Examples include blogs, forums and video-sharing or social-networking websites. Social media are applications that take the next step and support the creation and sharing of user-generated content (USG), transforming users from content consumers to content producers. And the most recent addition, the social networking and microblogging service Twitter, has companies and communicators around the world scrambling to create strategies for leveraging these virtual communities to their advantage.

Social media communities are not always full of chatty and misinformed gossip, but they often are. Frequently, the only control mechanism for ensuring any level of accuracy and credibility for the information on these sites are the comments or rebuttals of other users on the site. Also, the anonymity of users in many social networks brings with it an intrinsic lack of accountability. User-generated content is, unfortunately, seldom reliable or thoroughly-researched information. Rather it has simply been passed along or "re-tweeted" without validation. For this reason alone it will never provide any real competition to professional journalism or scientific research.

What platforms such as Twitter, Facebook, MySpace and You Tube can undoubtedly offer businesses is a potentially huge audience of many millions of people around the globe. Although there are examples of companies that have successfully used these platforms to promote themselves to their audiences, friends and followers, no expert has yet been able to prove a direct correlation between financial performance and an increased investment in social media initiatives. Keeping this in mind, it is worth considering social media as an additional channel for encouraging brand engagement and creating buzz, but it can't be the only initiative. Nor can it replace long-established and proven techniques for creating recognition and brand value.

Building a brand, garnering respect and maintaining a serious and authentic image in the electronics business world is a process and not a project. It's important to develop first-class documentation on the company, its products and services that give both a macro and a micro level of detail, depending on who the intended audience is. Excellent photography and graphical imagery help customers visualize and understand complex concepts and greatly enhance the chance of getting published in print media. It might sound elementary, but providing the contact information for company representatives is imperative and often overlooked. Finally, and most importantly, it is critical that we do not underestimate the human factor and the value of real, as opposed to virtual, relationships. The best communication takes place one-to-one when the parties enjoy a relationship built on trust and authenticity. This is as valid in business communications as it is in our personal lives. As with friends, it's the quality and not the quantity that counts.

It may be true that the only thing constant is change, but some things are revolutionary, others are simply progress and some are nice to have. It'll take a few years before we know how to best categorize social media and its influence on business communications.

www.information-travels.com

CONCEPT
INTELLIGENT POWER ELECTRONICS

Natural match!

SAMPLES AVAILABLE!

2SP0320

2SP0320 is the ultimate driver platform for PrimePACK™ IGBT modules. As a member of the CONCEPT Plug-and-play driver family, it satisfies the requirements for optimized electrical performance and noise immunity. Shortest design cycles are achieved without compromising overall system efficiency in any way. Specifically adapted drivers are available for all module types. A direct paralleling option allows integrated inverter design covering all power ratings. Finally, the highly integrated SCALE-2 chipset reduces the component count by 80% compared to conventional solutions, thus significantly increasing reliability and reducing cost. The drivers are available with electrical and fiberoptic interfaces.

PrimePACK™ is a trademark of Infineon Technologies AG, Munich

Features

- +15V/-10V gate voltage
- 3W output power
- 20A gate current
- 80ns delay time
- Direct and half-bridge mode
- Parallel operation
- Integrated DC/DC converter
- Electrical isolation for 1700V IGBTs
- Power supply monitoring
- Short-circuit protection
- Fast failure feedback
- Superior EMC

CT-Concept Technologie AG, Renferstrasse 15, CH-2504 Biel, Switzerland, Phone +41-32-344 47 47

www.IGBT-Driver.com

Now is the Time for Strategic Thinking and Action at European Level

By Thomas Harder, ECPE

We are experiencing changing times from the carbon era to the age of solar power, and from an energy consuming society to an energy efficiency society.

The European Union's ambitious climate goals for the reduction of energy consumption and CO2 emissions cannot be achieved without the extensive use of power electronics. After all, power electronics enables:

- the efficient feeding-in of wind and solar power to the grid,
- the stabilisation of the power grids while the share of fluctuating renewable energies is increasing,
- highly efficient variable speed motor drives,
- energy efficient and low emission mobility with electric and hybrid vehicles,
- energy-saving lighting technology and
- the efficient energy recovery.

Power electronics is key to energy efficiency and power electronics is an enabler for the increased use of renewable energies. The power electronics community is aware of this, but what about the world outside our community: politicians, stakeholders, decision makers, officials in Brussels and the management of the big industry players? Yes, the situation has improved in the last years. We started the European Power Electronics Research Network ECPE seven years ago with the mission statement to create awareness. I remember, for example, my first visit in the German research ministry. We had to explain that power electronics is not defined by MegaWatts but by the basic functionality to convert electrical energy according to the needs of the load in the most efficient way by the use of power semiconductors, and to control the flow of electrical energy. They listened politely but when we asked for a research funding programme in our area we received the feedback that they are not interested in technology topics. We should come back when we have a vision on the future of power electronics.

A lot has happened in the meantime, initiatives started by the Power Electronics Network on the one hand, but also megatrends in society moving power electronics more into the focus. ECPE started the dialogue with the European Commission on energy efficiency - the role of power electronics with a well-recognised Brussels workshop summarised in a position paper. We launched the ECPE initiative on power electronics research roadmaps and the European E4U Project on ´Electronics Enabling Efficient Energy Usage´ in the ECs 7th Framework Programme. We are working on our power electronics vision of a more electric world where sustainable electrical energy forms the basis of the energy supply.

For the megatopics in society I have to mention e-mobility where power electronics is a key technology on the vehicle side as well as on the grid side. However, public interest is focussing on energy storage technology only. Another example is the smart grid with the key challenge to create an electricity infrastructure based on renewables where power electronics is vital for the energy feed-in to the grid as well as for the efficient grid operation including low-loss energy transmission. However, the European and national research programmes solely address the role of information and communication technologies (ICT) in the smart grids.

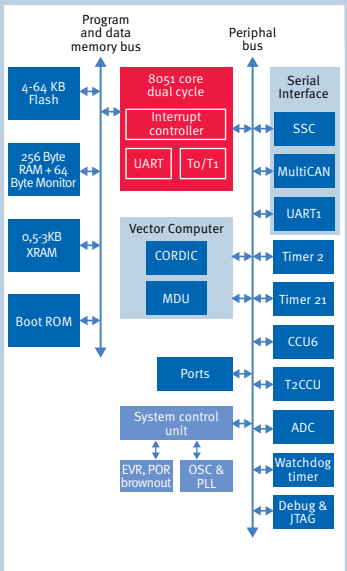
There are also positive milestones to be mentioned. Last year, the German Research Ministry (BMBF) started a programme on power electronics to improve energy efficiency addressing exactly the topics where power electronics can contribute.
But there is still a long way to go on our way towards a common vision. Therefore, ECPE European Center for Power Electronics has initiated a European Technology and Innovation Platform ´Electronics for Energy Efficiency and Sustainability (EEESy)´ to demonstrate the potential to improve energy efficiency by using innovative power electronics and to identify future research needs. This is not a misprint, we call it electronics. Power electronics still does not sell! To be clear we add a subtitle ´the strategic research initiative for efficient electric power conversion´. Today, we have 36 official technology platforms registered in Brussels e.g. for smart system integration, smart grids, photovoltaics and wind energy. However, as a cross-functional technology power electronics is not adequately represented in these existing platforms. Based on the results of the European E4U Project (www.E4Efficiency.eu) and the ECPE Roadmap Programme, the Technology Platform will set up a Strategic Research Agenda for Europe, identifying future research needs in power electronics in its key applications. In the next step, the impact of future innovations on efficiency and sustainability will be deduced and quantified.

To achieve awareness and acceptance of power electronics as a key technology to solve energy-related challenges, and to find our place in the European research funding system, a clear positioning of power electronics as a key enabler within energy and ICT fields and programmes is necessary.

www.ecpe.org

Highest Real-time Performance at Lowest Cost

XC800: Highly integrated and cost-effective 8-bit microcontrollers



XC800 architechture

INFINEON'S HIGH-PERFORMANCE XC800 family of 8-bit MCUs combines an 8051 core and powerful autonomous on-chip peripherals. The high-quality MCUs are well-suited for a wide range of applications like motor control with field oriented control (FOC), power factor correction (PFC) and networking in industrial and building automation systems.

- Flash sizes from 4 KB to 64 KB and pin counts from 20-pin to 64-pin
- Programmable 16Bit vector computer (e.g. for FOC)
- Extended temperature ranges up to 140°C
- Integrated oscillator, voltage regulator, EEPROM and supervisory circuitry

A COMPLETE TOOL CHAIN spans from free SW development environment, starter kits, USB evaluation kits to application kits providing an entire reference design. The new auto-code generator DAvE Drive for drive applications can be downloaded for XC800.

[www.infineon.com/xc800]

Interview about Power Supply Technology

with Matt McKenzie, President of CUI Inc

By Bodo Arlt, Editor BPS

Bodo Arlt: How did CUI start and what was the vision?

Matt McKenzie: CUI was started by my father, Jim McKenzie, in 1989. It was originally started as a joint venture with a Japanese firm called Stack Electronics. Stack is a manufacturer of high end probes for the oscilloscope industry. CUI was created to serve as an outlet for these products in the U.S. Our customers, who loved how we did business, asked us to become their supplier for other components. So we took on the task, developed our engineering presence, added strategic manufacturing relationships in Asia and started to make our move.

Bodo Arlt: What future end markets will drive CUI for technology development?

Matt McKenzie: CUI has made a big investment into digital power. We see this market (still in its infancy) as a significant opportunity for our growth in the future. As we target tier 2's and below with a module solution, we believe that this will drive the platform switch to digital faster than a tier 1. In turn we are developing a product roadmap that will keep us on the front edge of this technology.

There is also the big buzz around green initiatives. CUI sees that the solid state lighting market is probably the biggest area for us to make a move in offering a green power supply solution to a market that is being driven by the switch to a more efficient lighting solution. Our market studies show that this area will have almost exponential compound growth over the next few years as suppliers work towards product definition and solid supply chain stability.

Along with the green push, CUI has always made it a priority to stay on the leading edge of the governmental requirements for external adapters. We are always working to provide the highest level of energy efficient compliant products to the marketplace.

Bodo Arlt: What are the technologies that CUI can offer for innovation leadership?

Matt McKenzie: As I stated before, we are making a strong push into digital power. We believe we will offer the best solution for a digital point-of-load module on the market. We have partnered with Powervation and believe that their IC has the best feature-set that will allow the most broadly based adaptation of the technology.

We are also working on some IP development that will potentially allow us to have massive efficiency gains in many platforms. We believe that we will need to drive an entire portfolio of products that offer an efficiency gain on a full scale platform level, from the wall to the IC.

Bodo Arlt: What makes CUI different from other Power Supply manufactures?

Matt McKenzie: Outside of our broad and unique product offering, the difference is relationship. We work to create partners instead of just transactional interactions. Our goal is to work with companies that will become long-term partners to solve problems together for many years.

Bodo Arlt: Can you tell us about the range of your technology and some of its features?

Matt McKenzie: CUI offers a large range of power supply products. Our goal is to be able to offer a solution from the wall to the IC. We have everything from 2.5 kW industrial AC-DC power supplies to 1 W non isolated DC-DC converters. We also offer a great range of industrial DC-DC converters that were developed for rugged environments.

Bodo Arlt: How much is CUI involved in the end customer's applications?

Matt McKenzie: That depends on the customer and the technology. Some demand a higher level of integration between us and the customer. For instance, a digital and platform level solution would require a large amount of support both from an executive level, to sell the value of the platform, as well as engineering support needed to train and implement a switch of that magnitude. A customer looking for a cost down on a 5 W power supply will usually just send a purchaser to our company and we will look to create value on price and delivery.

Matt McKenzie Biography
Matt McKenzie is President of CUI Inc. Prior to serving as President he managed CUI's V-Infinity power product line. He holds an MBA from George Fox University, Portland, Ore.

Bodo Arlt: How much is CUI involved in commodity applications using the advantage of your expertise and technology to support low cost volume products?

Matt McKenzie: Standard wall plug and desktop power supplies represent a significant percentage of our annual sales. In this market we are most competitive and offer the best value to the smaller OEM's. Usually, there is a lot of commodity pull through business as well in this world. We have a lot of "total solution" business where we start with the power supply and follow with the mating connectors or other board level components.

Bodo Arlt: What do you see as your core competencies?

Matt McKenzie: Again, we are a truly relational company. So many times in our industry the relationships are mostly transactional. We seek to change this with support, respect, and a different take on how people and partners should be valued on a day to day basis.

Our other core competency is flexibility. We can move quickly, and adapt to customer needs. In addition, we are transitioning our company immensely as our goal is to be an industry leader in technology and engineering support.

Bodo Arlt: Who are your competitors you believe will stimulate the race for leadership?

Matt McKenzie: That depends on the type of product as we are pretty diversified in our product offering. We believe strongly that, in power, the move to digital will be significant. This is why we have decided to make a move to be a module supplier. I believe that the competition will be healthy for the market. This is exactly what has been missing from the market in order to drive digital as a platform in power. Texas Instruments, Ericsson, Power-One, and the like are going to drive us to become a stronger company.

Bodo Arlt: How was the name CUI selected?
Matt McKenzie: Originally our company was named Components Unlimited Inc. Our customers started to abbreviate it. It caught on, so we branded it. Over time, it has become a solid brand.

Bodo Arlt: Thank you Mr. McKenzie for the time. We look forward to a successful future for the technology innovations at CUI.

www.cui.com

Electronics Industry Digest

By Aubrey Dunford, Europartners

GENERAL

As a result of the worst economic recession in more than six decades, electronics systems sales worldwide are projected to fall 11 percent in 2009 to $ 1.11 billion from a record-high $ 1.24 billion in 2008, so IC Insights. The electronics equipment market is forecast to rebound in 2010 with the total value of systems shipments growing 7 percent to $1.19 billion.

SEMICONDUCTORS

Worldwide sales of semiconductors rose to $ 22.6 billion in November, a 3.7 percent increase from October, so the SIA. Sales were 8.5 percent higher than November 2008. For the first time in 2009, worldwide semiconductor sales in November were in positive territory compared to one year ago. Headquartered near Munich in Erding, Germany, LFoundry, an analog/mixed signal silicon foundry with a 200 mm production line providing access to manufacturing services down to analog 0.15 micron CMOS technologies, has entered into an exclusivity agreement with Atmel for the purchase of Atmel's wafer fabrication operation in Rousset, France.

NEC Electronics Europe has announced the formal opening of its recently enhanced motor control lab facilities at its offices in Milton Keynes, UK. The lab is fully equipped to develop, test and demonstrate hardware and software solutions based on NEC Electronics' latest 8-, 16and 32-bit motor control ASSPs.

Maxim Integrated Products is to establish a new international business operation in Dublin, with the creation of 50 staff initially, rising to over 100 by 2012, so IDA Ireland. Maxim's new international business, financial, and technical customer services centre in Dublin will serve the EMEA region, along with parts of Asia.

Analog Devices has completed operational improvements to lower cost and achieve greater wafer fabrication efficiencies for its proprietary analog, mixed-signal, and MEMS manufacturing process technologies. The improvements tare concerning plants in Wilmington, Massachusetts, and Limerick, Ireland.

Infineon Technologies has settled a patent infringement lawsuit with Fairchild Semiconductor. The patents in the suit and counter suit consisted of fourteen patents related to super-junction power transistors along with trench power MOSFETs and IGBT power transistors.

PASSIVE COMPONENTS

Bel Fuse has agreed to acquire Cinch Connectors from Safran, a French industrial group, for $ 39 M. Headquartered in Lombard, Illinois and with manufacturing facilities in Vinita, Oklahoma, Reynosa, Mexico and Worksop, England, Cinch had revenue for 2009 of approximately $ 60 M. Cinch manufactures a broad range of interconnect products for customers in the military and aerospace, high-performance computing, telecom/datacom, and transportation markets. Bel's products include magnetics (discrete components, power transformers), modules (DC-DC converters, integrated analog front end modules and custom designs), circuit protection and interconnect devices (passive jacks, plugs and cable assemblies).

OTHER COMPONENTS

Sharp, STMicroelectronics and Enel Green Power have signed a joint venture agreement for the production of thin-film solar cells in Italy. They will start the production of thin-film solar cells from the beginning of 2011, by utilizing the existing facility of ST in Catania Province, Sicily Region, Italy. The thin-film solar cell plant will start operation with an initial annual production capacity of 160MW, which is scheduled to be expanded to an annual production capacity of 480MW in the future.

LG Electronics announced the launch of a new business initiative with the unveiling of a solar cell production line in Gumi, about 200 kilometres southeast of Seoul. The production line will enable LG to manufacture approximately half a million solar modules a year with a total capacity of 120-megawatts (MW). The line, which will produce silicon wafer-based crystalline solar cells, will begin production this month.

OM Group, a specialty chemicals and advanced materials company, has signed a definitive agreement to purchase EaglePicher Technologies for $ 171.9 M. EaglePicher produces batteries, battery management systems and energetic devices for the defense, aerospace and medical industries.

The price of copper has reached a 16-month high with strike action looming at two copper mines in Chile, so BBC News. Copper is on course for an annual rise of about 140 percent -its biggest in more than 30 years. At the beginning of January, copper on the London Metal Exchange traded above $ 7,300 a tonne -its highest level since September 2008.

DISTRIBUTION

Acal announces the completion of its acquisition of BFI-Optilas for a consideration of € 10 M payable in cash and 2 million Acal ordinary shares. The acquisition, which was announced on 29 October, represents a key step in Acal's stated strategy of specialization.

MSC Vertriebs has signed a distribution agreement with Cree, a market leader in LED lighting, to increase the sale of Cree LED components in Germany, Austria, Switzerland, Benelux and France.

Avnet Electronics Marketing EMEA has extended its pan-European franchise agreement with Maxim Integrated Products, a manufacturer of analog components. The agreement is an extension of the existing relationship, which now allows both Avnet distributors, Silica and Avnet Memec, to cover sales and support in the Republic of Ireland.

Supplier of DC/DC power modules for distributed power architectures, Ericsson Power Modules has extended its distribution agreement with Mouser Electronics to include the EMEA regions.

This is the comprehensive power related extract from the « Electronics Industry Digest », the successor of The Lennox Report. For a full subscription of the report contact: eid@europartners.eu.com or by fax 44/1494 563503.

www.europartners.eu.com

Third-generation digital control technology has arrived.

Digital power controllers have reached price parity with analog.

Where is the only place that all of the important developments will be showcased and discussed?

Darnell's

Digital Power Europe

April, 2010

dpfeurope.darnell.com

Digital Power in Europe

By Linnea Brush, Senior Research Analyst, Darnell Group

Europe continues to be on the "forefront" of digital power on many levels, and these trends will be highlighted at Darnell Group's upcoming Digital Power Europe (DPE) Forum, to be held in Nuremberg, Germany, on April 6-8, 2010. ROAL, Ericsson, Analog Devices and iWatt are just some of the companies that will be presenting papers on the latest developments using digital power control technologies.

Digital power management is no longer an "emerging" technology. End users specify their power requirements, and they don't care how the power supply is designed, as long as they get the features they want. Digital control is increasingly the best way to achieve energy efficiency, for instance, which is what many customers focus on. Costs have come down relative to analog solutions, and digital power enables both current and future functionality.

Major strides are still being made in the design and use of digital control, however. These developments are leading to new partnerships, such as the recent worldwide agreement where Ericsson Power Modules has been granted a license on a patent portfolio for digital power technology (DPT) from Power-One. The non-exclusive license agreement provides Ericsson Power Modules with access to Power-One's portfolio of DPT patents for incorporation into Power Modules' series of 3E digitally controlled point-of-load (POL) devices.

The internal design of Ericsson's 3E POL regulators uses digital power control techniques, and some of the optional user implementations of these products are able to benefit from the utilization of system-level digital power and energy management approaches. While these products can be successfully applied using the same techniques as conventional, fully analog POL regulators, it is beneficial for customers to have access, through a PMBus™ interface, to critical information such as load condition, temperature, voltage, current delivered, and other parameters, making it possible to monitor the distributed energy down to the processor level. The addition of Power-One's digital power technology patents to existing and future products will extend the range of operation for customers, including fully programming and monitoring single or an array of digitally controlled POL devices with functions such as sequencing, voltage setting, dynamic commands to shift-load and many others.

For new designs of power converters, energy efficiency is a key parameter, according to Analog Devices. At DPE, the company will discuss new possibilities for designing high-efficiency power converters, including the programming of the power stage circuit, the set-up of protective measures, the government of heavy/light load mode by enabling/disabling of synchronous rectifiers, by using phase shedding options, as well as digital current sharing.

Many of these developments are being enabled by advances in power semiconductor technology. For example, STMicroelectronics has given designers new options using its ultra-efficient MDmesh™ V power MOSFETs, with a new device in the industry-standard TO-247 size package that delivers what the company claims to be "the industry's lowest on-state resistance for 650V MOSFETs." ST's MDmesh V technology delivers "the lowest on-state resistance per unit area compared to conventional MOSFETs and competing super-junction devices."

Benefits of this low-loss performance include increased efficiency, higher power density and lower operating temperatures, leading to better reliability in applications such as PC and server power supplies, solar-power converters, welding power supplies and UPS equipment, where conduction loss has a major influence over efficiency. While emphasizing ultra-low on-state resistance, the devices also achieve low switching losses, thereby enabling an overall efficiency boost across a wide range of applications and operating conditions.

Telecommunications rectifiers have always been considered a good opportunity for digital power management and control. ROAL will present a case study at DPE of a high-power, dc-dc isolated telecom front-end employing mixed digital/analog control techniques and digital management. The main advantages of digital control and analog control will be discussed, along with why they were selected. The paper will also show the main functions and benefits of implemented digital management, presented in real product architectures. Test data will be provided on 3kW dc-dc front-ends.

This approach of using both digital and analog control is also used by Maxim Integrated Products, which introduced the MAX16064, a fully integrated, highly accurate (+/-0.3%), quad-channel, digital power-supply controller. The MAX16064 offers a PMBus interface for programming, sequencing, monitoring, and margining power supplies. The MAX16064 can be connected to up to four all-analog low-cost power supplies to create a fully programmable, highly accurate, digital power-management solution, according to the company.

Using the existing analog power-management solutions, Maxim says the device provides "unequaled control and monitoring capabilities that were previously only available in all-digital power supplies." The MAX16064 digital controller is designed for high-performance, high-reliability systems with multiple power supplies. Applications include servers, storage devices, switches, base stations, routers, and networking equipment.

Emerging applications are also taking advantage of digital power technology. In fact, iWatt claims that digital power is contributing to the adoption of light-emitting diode (LED) lamps. LED light bulbs are well-known for their energy-savings, low-power consumption, and long life expectancy. They are a good candidate for replacing incandescent bulbs, according to iWatt. The adoption of LED light bulbs, however, will require that they operate seamlessly with or without

existing wall dimmers and the existing wiring structure, along with cost. The thousand types of existing wall dimmers were designed for incandescent lamps, and it has been a challenge for LED lamps to operate seamlessly with them. iWatt's advanced digital power control technology can work with any type of dimmers, and adjust the LED luminaries accordingly. It provides a low-cost, high-efficiency and reliable solution to enable a "plug and play" LED lamp in the incandescent socket.

The weak links in the overall lifetime of the LED luminaries are the electrolytic capacitors and the opto-coupler when used for isolation. iWatt's primary side regulated digital PWM controller takes a big leap towards increasing LED luminaries' lifetime by eliminating the opto-coupler. In addition, +5% LED current regulation over line, load and temperature variations can be maintained for constant brightness and flicker-free operation. The efficiency of the power driver is another key parameter. iWatt's digital power technology incorporates a valley mode switching and proprietary adaptive digital control algorithm that adjusts the switching frequency relative to line voltage. The efficiency can be up to 90%.

The handheld device market did not start out as an "early adopter" segment for digital control, but it has become one. Semtech's SC195 highly integrated 500mA synchronous buck regulator has the tiny size and output flexibility needed for low-voltage, point-of-load regulation, as well as mobile device applications. The company says that the product "gives our customers an excellent solution for critical power regulation – one that fits into designs where board space, high efficiency, low-power standby operation, flexibility, reduced inventory overhead, reliability and performance are necessary."

The 1.5 x 1.5mm (0.6mm max. height) SC195 operates from inputs of 2.9V to 5.5V and provides 15 pin-programmable output voltages from 0.8V to 3.3V, covering all the typical core and I/O voltage rails with one device. The 3.5MHz PWM operation balances high efficiency (up to 94%) and fast transient response with small external components.

To set the output voltage, the SC195 utilizes four digital programming pins to eliminate external feedback components, thereby saving space, increasing reliability and eliminating the inventory overhead of stocking individual fixed output voltage regulators for each different load. In applications such as graphics or other processors where voltage levels change on the fly, the programming pins can be driven from the host controller to dynamically position the output voltage level.

These are just some of the new digital control products and developments that are changing the power supply landscape. Keeping up with these trends is no longer an option – it is necessary for power supply companies to compete in a rapidly evolving business climate. Digital Power Europe is the only conference venue that focuses on digital power management and control trends in Europe, while providing a global context for decision-making. See you there!

http://www.darnell.com

http://dpfeurope.darnell.com

High Voltage Power Electronics Market and Technology Trends

By Brice Le Gouic, Yole Développement

With deep understanding of these application markets, Yole Développement provides a detailed analysis for each of them on the technical developments provided by the leading companies, the architectures of inverter units. The company details market data of macro market (wind turbine installed base, shipments of vessels and trains, and number of existing power installations for electricity T&D) and market metrics of related power devices and modules (Silicon IGBTs, thyristors, diodes and future SiC devices). This report also includes market estimation of silicon wafers and SiC substrates penetration.

Market trends

More importantly, power devices for application markets >1.7kV like wind power converters, electricity transportation and distribution (T&D), rail traction and ship & vessel propulsion correspond to high added-value businesses.

"It is sure that their total 2010 expected market size of $405 million (including power devices and power modules) is small compared to lower voltage markets, but they remain very dynamic and offer the potential of high margins", explains Brice Le Gouic, Market & Technology Analyst at Yole Développement.

These market developments are primarily driven by energy saving considerations and green technology developments. They are actively supported – e.g. electricity T&D – by several governments and leading companies are working to improve their technology.

As such, IGBTs, thyristors (GTOs and IGCTs) and diodes will get access to more and more technological improvements like transition to 8" wafer platforms and use of silicon carbide (SiC) materials among others.

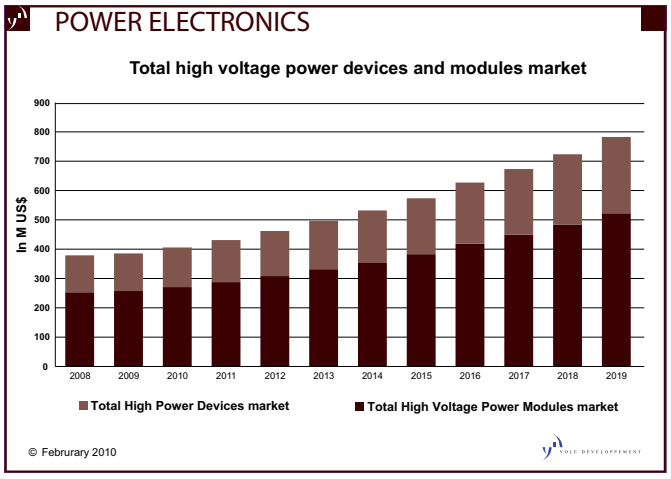


Figure 1:Total high Voltage Power Devices and Modules Market

However, the long time period of order contracts, the low volume production they imply and the issues to increase voltage to use SiC-based components induce quite light competition between the well-established players of those markets.

Market metrics

Total market for high power devices and modules (including IGBTs, thyristors and diodes) was $390 million in 2009 and is expected to ramp up to more than $570 million by 2015.

Rail traction will contribute more than 65% of this value because of the high level of production it represents and the number of inverter units per locomotive.

Electricity T&D will benefit from the strongest CAGR between 2010 and 2015: 11.1%. Indeed, Yole Développement expects plenty of work to be realized for HDVC transportation, and ABB to provide an important contribution to HVDC light architecture by making IGBTs.

Wind turbine converters have not suffered so much from the 2009 crisis, and their growth is expected to be the second strongest, with 2010 – 2015 CAGR of more than 9%.

Finally, ship and vessel markets have been impacted unevenly in 2009. Military vessels have kept on growing – relatively to the long time period of ship manufacturing – whereas passenger yachts acquired for private use have drastically decreased. As a consequence, Yole Développement estimates the global IGBT module market for ships and vessels to resume in 2013 and reach $26 million by 2015.

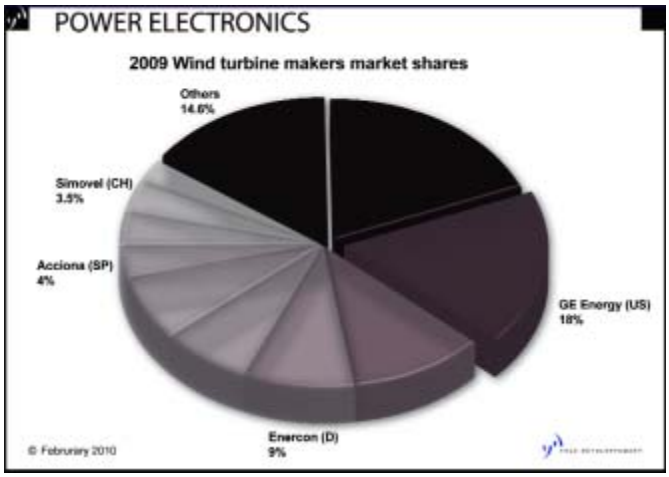


Figure 2:Power electronics, a daily challenge for many industries, according Yole Déve-loppement's analysis

Power electronics represent a daily challenge in several systems today (photovoltaic inver-ters, hybrid electric and electric vehicles, cameras, white goods…) from a market point of view, but also from a technology development aspect.

Plenty of companies are pushing R&D efforts hard in order to provide the most cost-effective, efficient and reliable materials, devices and systems. And some more “hidden” applications, like the over-1.7kV segment described in this report benefit from those efforts.

The 4 following segments have been investigated in Yole Développement’s analysis: wind turbine converters, electricity T&D, rail traction and ships and vessels.

High Voltage Power Electronics Market & Technology Trends Report.
Catalogue price: Euros 3,990 ; Publication date: Feb. 2010
For special offers and price in dollars, please contact David Jourdan (jourdan@yole.fr or +33 472 83 01 90).

Yole Développement is a market research and strategy consulting company. From tech-nologies to markets, we help our clients develop their business. Our commitment is to facili-tate market access for innovative devices, equipment, substrates and materials.

Founded in 1998, Yole Développement has strong leadership worldwide in the following fields: MEMS, Compound Semiconductors, Power Electronics, substrates, equipments & materi-als device manufacturing and 3D IC packaging & TSV related applications.

With 20 consultants, Yole Développement is working worldwide with the key industrial com-panies, R&D institutes and investors to help them understand the markets and technology trends. Yole considers the complete value chain in its analysis, including materials and capital equipment business, device manufacturers and system manufacturers and users of the technology.

In addition to our consulting and reports, Yole Développement maintains a daily news portal - www.i-micronews.com, publishes a free bi-weekly magazine: Micronews; and 3 free quar-terly magazines: MEMS Trends, 3D Packaging and PV Manufacturing.

www.yole.fr

High Power Dual Pack with High Reliability

Mechanical design of a converter will become much easier

The PrimePACK™ housing could become the new cost-effective standard for 2 in1-packages, which provides many mechanical, thermal and electrical advantages.

By Peter Dietrich and Thomas Heinzel, Fuji Electric Europe GmbH and Dr. Masahito Otsuki, Fuji Electric Systems Co. Ltd.

Until now high power modules (HPM) in the well-known standard-housings rated for 1200A to 3600A at 1200V or 1700V with footprint 130*140 [mm] or 190*140 [mm] were only available in single switch configuration.
In other standard housings like 62mm-package, EconoDUAL™ or SEMIX3®-package with 1200V blocking voltage the maximum available rating is 600A from Fuji Electric.
With standard packages, up to now the gap has been filled out only by using the 130*140 [mm] HPM for 600A, 800A or 1200A with two separated switches. But in this case, it could only be used as a pair of arm when they were externally connected by separate bus bars. Of course, the connection of upper and lower arm is less inductive when this is provided inside the module itself. Furthermore, the mechanical design of a converter unit will become much easier and more cost efficient. Therefore many suppliers' specific solutions have been introduced to the market without multiple source alternatives for customers.
But now the new PrimePACK™ housing could become the new cost-effective standard for 2in1-packages, which provides many other mechanical, thermal and electrical advantages to be presented in this article.

Mechanical properties

Figure 1: Mechanical dimensions

The PrimePACK™ is available in two different package sizes, called PP2 and PP3 see figure 1. PP3 is longer than PP2 and has got two DC-link terminals. As one can see from the front of the module the first terminal pairs are at the same position, both in the PP2 and in the PP3. Therefore it is possible to use different converter power ratings with the same mechanical design. According to the conventional high power modules the module height is 38mm.

The advantage of the slim shape is the easy parallel arrangement e.g. three modules for the widely used 2-level voltage source inverter. On the lower section at the front, a gate drive board can be mounted to drive upper arm and lower arm without being covered by a bus bar. The DC-terminals in the rear are free for the connection to the DC-link. It is possible to use a 3-layer bus bar for an AC and DC connection to cover all terminals. On the other hand, using a 2-layer bus bar would leave the AC-terminal free for separated connection. In any case, the specific configuration of each component does not mechanically affect the other one. Therefore, mounting, designing and maintenance are much easier and more cost-efficient. In addition, the reliably and mechanically stable connections are ensured by using M8 screws to fix the DC-link-bus bar respectively the phase output. For the gate drive board M4 screws guarantee a safe connection even under very rough conditions.

INTERNAL STRUCTURE

Ultrasonic welding

One of the challenges for the new package was to enhance the power density without having compromises or disadvantages, especially regarding reliability and size. It is clear that parts conducting high currents will heat up even when copper and/or aluminum are used to achieve low electrical resistance.

Table 1 shows from thermal, electrical and mechanical points of view that copper has the best properties for internal wiring. But until now the most effective way to join the terminals with the DCB (Direct copper bonded) substrate has been solder technique. Ultrasonic welding technology has been regularly used for aluminum.

Using solder material has got several difficulties: First of all it is a compound of different materials which can age chemically. Even worse cracks caused by thermal cycling due to mismatching expansion coefficients increase thermal resistance dramatically. Another weak spot is the 5 times lower mechanical strength of the solder material in comparison to copper.

Material	Electric resistance $[10^{-8}\Omega m]$	Strength $\left[N/mm^2\right]$	Thermal conductivity $W/m*K$
Aluminum	2,5	60	240
Copper	1,5	325	390
Solder (thin)	11,5	50	68

Table 1: Material properties of the metal used for IGBT module circuit

The challenges were done by developing new technologies which makes it possible to have ultrasonic welding of copper without any additional joining material like solder. This allows a direct connection of the internal bus bars to the DCB's copper foil. This is shown in figure 2.

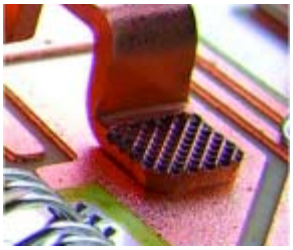


Figure 2: Copper terminal joint to DCB circuit by ultrasonic welding

Ultra sonic welding significantly improves the terminal joint reliability and vibration strength. Figure 3 shows a cross section of an ultrasonic welding joint after 300 passive thermal cycles of -40°C to 150°C without significant degradation of the mechanical strength.

Figure 3: Cross section of ultrasonic welding area after 300 thermal cycles (-40°C to 150°C)

The advantages of the welding process are clearly visible and can also be proven numerically. Figure 4 shows a comparison of tensile strength of the new welding method and a conventional solder joint before and after 300 thermal cycles. The pulling force for measuring the strength capability was applied in vertical direction.

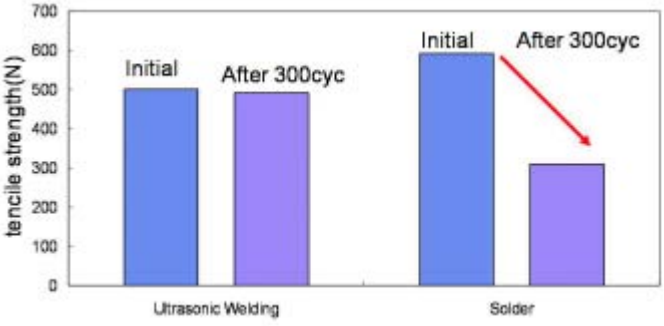


Figure 4: Relationship between Strength of terminal joint area and thermal cycling test

In fact, the new welding process provides improved mechanical strength and higher thermal cycling capability, even with increased current density.

Solder material under the DCB

The thermal cycling capability depends very much on the weakest link in the chain of layer connections. This means that the thermal cycling capabilities of the IGBT-module have to be improved not only for a particular part, but for the entire structure of the module. The thermal stress is mainly caused by shearing forces, which occur due to different thermal expansion coefficients of different materials. These shear forces can cause cracks in the solder layer and these increase the thermal resistance.

As a result, Fuji Electric improved the thermal cycling capability by a better matching of CTE (coefficient of thermal expansion) and by improving the interfaces of the different layers.

In IGBT modules, the biggest CTE mismatch can be found between the insulation ceramic substrate of the DCB and the copper base plate. The relating material properties are shown in table 2.

Fuji Electric did a lot of investigations to improve the reliability of solder join between copper base plat and DCB.

	Thermal conductivity [W/m*K]	Required thickness [mm]	CTE (coefficient of thermal expansion) [10^{-6}/K]
Al_2O_3	18-25	0,25-0,38	7,1
Si_3N_4	70-90	0,32	3,4
AlN	170	0,635	4,6
Copper (base)	390	3	16,8

Table 2: Material properties of available ceramic and copper

Tin-Silver (Sn-Ag) is the most widely used RoHS-compliant solder. It is able to withstand 100 cycles of the common passive thermal cycling test (-40°C (1h) ~ RT (0.5h) ~ +150°C (1h)) as an accelerated aging test.

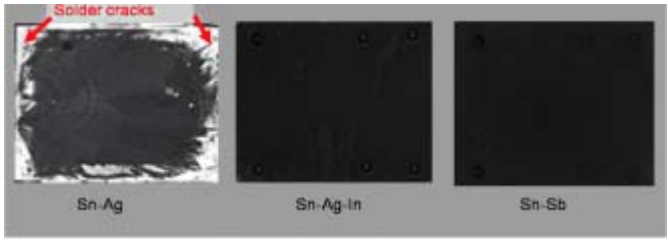


Figure 5: Comparison of crack areas between Sn-Ag solder, Sn-Ag-In-solder and Sn-Sb solder between Si3N4-DCB and copper base plate after 300 thermal cycles.

However, it is not able to withstand 300 thermal cycles like shown in the left SAT (Scanning Acoustic Tomography) picture of <<figure 5>>. Therefore Fuji Electric has introduced in 2002 RoHS compliant solder material containing Indium (In) for industrial application. In addition Fuji Electric has developed Tin-Antimony (Sn-Sb) solder material for automotive applications back in 2005. The record of <<figure5>> proofs that both solder materials are able to withstand 300 cycles under the same test conditions. The reason for the higher thermal cycle capability is, that the structures of Sn-Ag-In and Sn-Sb solder do not change on thermal impact. Therefore, the mechanical strength does not decrease relevantly. Sn-Sb has a higher melting point than Sn-Ag-In, which allows the assumption, that it also has a higher reliability. The respective tests are still going on.

For the first time Sn-Sb will be introduced for industrial applications in Fuji Electric's PrimePACK™ modules to increase again reliability for lead-free industrial products.

THERMAL FEATURES

Optimization in the chip arrangement

Beside to the performance (losses) of the silicon chip, the thermal behaviour of the module is the most relevant factor for the module rating. Mostly thermal cross coupling effects with the neighbouring IGBTs or diodes at smaller current ratings can be neglected. This rule does not apply in the same way for modules with higher current density like the PrimePACK™ module from Fuji Electric. Here, cross coupling effects have to be taken into account to reduce the impact on the chips, which are used in parallel for one arm. Therefore, upper and lower arm chips are arranged along the module length to reduce thermal coupling as much as possible. The resulting uniform temperature distribution shown in <<figure 6>> prevents occurrence of unnecessary hot spots.

Additionally, IGBTs are arranged alternately with the respective anti-parallel diodes see <<figure 6>>. This is especially advantageous when the absolute value of the power correction factor cos(φ) is high, i. e. near +1. Then load is concentrated more on the IGBTs than on the diodes.

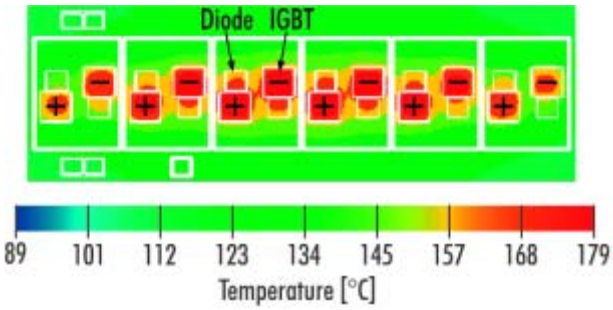


Figure 6: FEM simulation of thermal behaviour

Thermal contact to heat sink

All these thermal improvements can only become effective, if the resulting heat losses can be transferred well to the cooling system. From the thermal conductive point of view, thermal grease is a multiple worse than the other used materials like copper, solder and isolation ceramic. Thermal grease, even thinly applied, is a real bottleneck in the thermal network. To alleviate this effect, the base-plate is fixed by 10 respectively 14 M6-screws depending on the package size. The screws have a very short distance of 39mm in lengthways direction and 73mm across to achieve a well distributed pressure. The quality of the contact is given by the spreading behaviour of the thermal grease see <<figure 7>>.

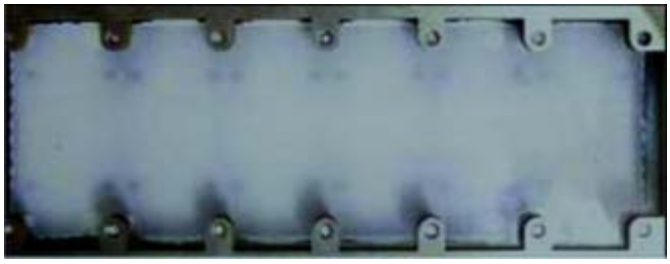


Figure 7: spreading behavior after tighten up the screws

Figure 7 shows a module mounted on a glass block after the screws were tightened with 3,5Nm.The result shows a good spreading of the thermal grease, even for the long copper base of the PP3. Of course, to get such a good result the thermal grease was applied via a metal stencil mask. 2,1g HTC01K was used in total for the PP3 with a 40% open ratio stencil mask pattern to achieve target thickness of the thermal grease of 50µm as an extreme demonstration.

Electric characteristics

Output power capability of the semiconductor depends on low power losses, the highest possible junction temperature and thermal impedance. The enhanced 6th-generation IGBT was used with improved trench-gate and field-stop-technology, enabling continuous operating junction temperatures of 150°C and a maximum temperature of 175°C.

The power losses, on the other hand, are reduced among others by a thin chip structure resulting in lower on-resistance. The output characteristic of the IGBT 1000A 1700V is shown in figure 8a and the corresponding FWD is shown in <<figure 8b>>.

For Fuji Electric's PrimePACK™ module the 1200V V-IGBT-silicones are installed to achieve softer switching behaviour and a higher voltage safety margin. The 1700V V-Series die however is thicker and does not need any adaption to achieve softer switching.

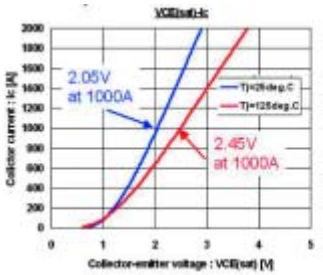


Figure 8a: Output characteristics of IGBT

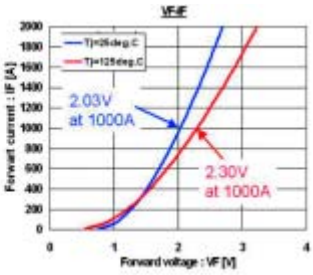


Figure 8b: Output characteristics of FWD

The improvement of the V-series' switching speed is related to the possibilities of higher surge voltages at turn-off caused by the energy stored in the stray inductance. Therefore efforts must be taken from both, module producer and converter manufacturer, to keep this as low as possible.

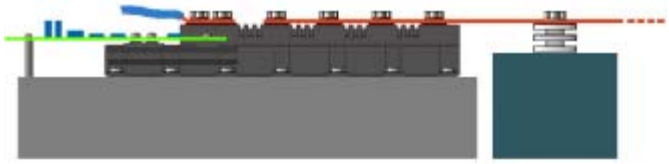


Figure 9: PP3 mounted and connected

Low inductance can be achieved by short, parallel and closely arranged bus-bars.

Fuji Electric's PrimePACK™ module features a design where the DC-link capacitors can be connected directly and with relatively short bus bars.

However, the rule is valid, that with a uniform and symmetric bus bar layout a lower stray inductance can be achieved. Therefore the terminals for the DC-link connections of the longer PrimePack™ module called PP3, alternate between positive side and negative side like shown in <<figure 10>>.

Figure 10: Alternation internal PN-Bus bar

The fact, that ultra low internal inductance was achieved for PP3 is proven by measurement. The corresponding theoretical equivalent circuit is shown in <<figure 11>>.

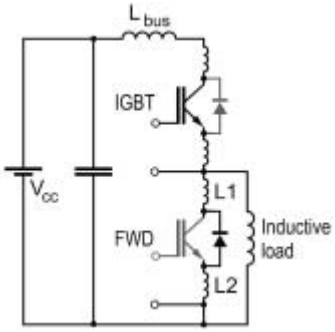


Figure 11 equivalent circuit and theoretical switching waveform

The experimental result is given in <<figure 12>>. It shows that according to formula $L_\sigma = L_1 + L_2 = \Delta V \frac{dt}{di}$ the stray inductance L_σ of one arm is about 5nH.

This means that the total stray inductance of the PP3 (upper and lower arm) is about 10nH and of the PP2 (because fewer DCBs in parallel) is about 18nH. In fact this is an excellent result in comparison to Fuji Electric's 2in1 High Power Module which has 21nH per switch without external wiring. This itself is a very good result and a unique value in the market for this housing.

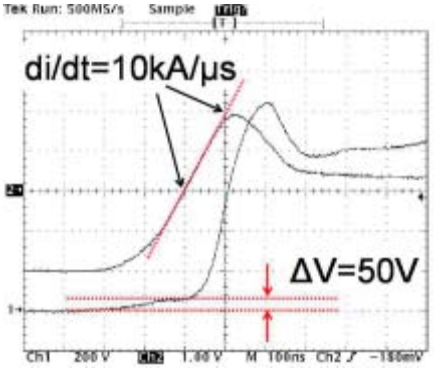


Figure 12: experimental result of internal inductance measurement (500A rep. 200V per division on y-axis, 100ns per division on x-axis)

Switching behaviour

The switching behaviour is a result of chip characteristic and package design.

Turn-off and turn-on waveform

A measured turn-off waveform of 1700V 1000A module is presented in figure 13. The measurement conditions are as following: DC-Voltage Vcc=900V, collector current Ic=1000A, gate voltage VGE=±15V, junction temperature Tj=125°C, gate resistance to turn off Rg(off)=0,17Ω

To assure switching performance for all applications, an extreme small resistance was chosen to achieve $\frac{dv}{dt} = 4250 \frac{V}{\mu s}$. The turn-off waveform is continuously and has no inflexion points.

Under same conditions, with exceptions of gate resistance, the turn-on wave form can be seen in <<figure 14>>. The gate resistance was adapted to Rg=0,17 Ω

Even under harsh conditions the switching behaviour still looks controllable. The maximum current gradient is $\frac{di}{dt} = 8750 \frac{A}{\mu s}$.

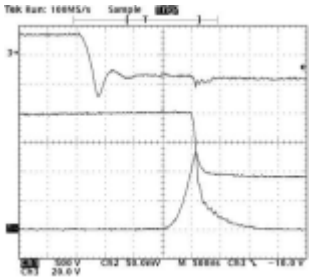


Figure 13: Turn off wave form of PP3 1700V 1000A (250A rep. 500V per division on y-axis, 500ns per division on x-axis)

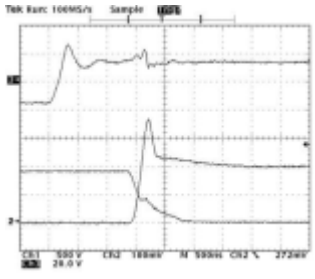


Figure 14: Turn on wave form of PP3 1700V 1000A (500A rep. 500V per division on y-axis, 500ns per division on x-axis)

Short circuit test

The module passed a short circuit test of 10µs with DC-link voltage of Vcc=1000V. The respective waveform can be seen in <<figure 15>>. The collector current arises to saturation, which corresponds to 4 to 4.5 times rated current. After 10µs a proper turn-off of the IGBT can be seen. The voltage does not exceed its maximum.

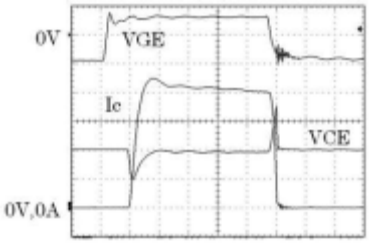


Figure 15: 10µs short circuit test (500V rep. 1000A per division on y-axis, 2µs per division on x-axis)

Applications

The presented module is easy to design in, has very good thermal and electrical performance and the reliability feature is promising a long product life-time. Therefore, this module fits to every application where one of these features in combination with high power density is needed. This could obviously be traction converters, even with copper base plate, but it would also fit to wind mills or big solar converters, all with a product life time longer than 20 years.

Product line up

The product line up is shown in table 3. These products will be available soon.

Package	V_{CES} [V]	I_C Rating [A]	Type name	$V_{CE(sat)}$ *) [V]	V_F *) [V]
Prime PACK 2™ 	1200V	450	2MBi 450VXA-120	1.70	1.75
		600	2MBi 600VXA-120		
		900	2MBi 900VXA-120		
	1700V	450	2MBi 450VXA-170	2.00	1.85
		650	2MBi 650VXA-170		
Prime PACK 3™ 	1200V	1400	2MBi 1400VXB-120	1.70	1.75
	1700V	1000	2MBi 1000VXB-170	2.00	1.85

Common features: *) Conditions: I_C=I_F=Rating Current; T_j=25°C

$T_{j(max)}$= 175°C | $T_{j(op)}$ = 150°C | V_{ISO} = 4.0kV, 1min | CTI > 600 | Base plate: Copper | DCB: Al_2O_3

Table 3: Product line up

References

[1] Y.Nishimura, etc, The relationship between IGBT module structure and reliability
Fuji Electric Systems, Semiconductors Development Group, Matsumoto, Japan,

[2] Y.Nishimura, etc, Development of ultrasonic welding for IGBT module structure
Fuji Electric Systems, Semiconductors Development Group, Matsumoto, Japan,

Semi-info@fujielectric.de

International Exhibition
& Conference for

POWER ELECTRONICS
INTELLIGENT MOTION
POWER QUALITY

4 – 6 May 2010
Exhibition Centre Nuremberg

Powerful

This is the right place for you!

Mesago PCIM GmbH – +49(0)711 61946-56 – pcim@mesago.com

A Better Shade of Green

A Simple yet Versatile Dimming-Ballast Solution for Low-Energy Lighting

EU-wide legislation promoting use of Compact Fluorescent lamps (CFLs) in place of incandescent bulbs could save as much as 1.2 million tonnes of greenhouse gas emissions per year, according to the European Efficient Residential Lighting Initiative (EnERLIn).

By Andre Tjokrorahardjo, Applications Engineer, Lighting Systems and Applications, International Rectifier

Lamp dimming is also known to be effective in saving energy, but CFLs have historically been unable to operate with the phase-cut (triac-based) dimmers most commonly installed in house and commercial premises. To maximise the energy-saving benefits of CFLs, ballasts compatible with phase-cut dimmers are required. However, these must be delivered at extremely low cost, and must also be consistent with the established form factors for incandescent-replacement CFL units.

Bright Ideas for Dimming

International Rectifier's IRS2530D DIM8™ is an example of this new type of dimming-ballast control IC. This device leverages high-voltage technology and advanced ballast-design IP allowing the high-side and low-side half-bridge drivers, and closed-loop lamp current dimming control to be fabricated on the same chip as the functions to control preheat, ignition and dimming. Half-bridge voltage-sensing circuitry for protection is also built in. This enables a higher level of integration than other triac-dimmable ballast ICs, leading to lower parts count and lower costs.

In addition, the DC-dimming reference input and AC lamp current feedback are combined so that a single pin can be used for dimming. This allows the IC to be delivered in a compact and low-cost 8-pin package.

The device can control analogue or digital dimming for CFL or linear fluorescent lamps. Moreover, with minimal modifications to the external output components the IC can also be used to dim LEDs, thereby presenting a versatile solution that will realise additional cost advantages through economies of scale.

Phase-Cut Dimmer Interface

Phase-cut dimmers are built using triacs, which are fired once in each half cycle at a phase angle corresponding to the desired dimming level. After firing, the triac will conduct for as long as the current remains in excess of the device's holding current. These dimmers work very well with a resistive load such as an incandescent light bulb as the triac conducts continuously from firing until very close to the end of the half-cycle. In contrast, traditional CFL ballast, without power factor correction, operates from a DC level provided by a storage capacitor. Current is drawn from the mains near the peak of the mains voltage, to charge the storage capacitor, but not during the remainder of the mains half-cycle. Hence the traditional ballast prevents proper conduction of the dimmer triac, resulting in severe flickering of the lamp.

Figure 1 shows the schematic of a triac-dimmable CFL ballast using the IRS2530D, suitable for driving a single 15W spiral CFL from an AC line input. Capacitors C2, C3, C4 and C5 interface with the triac in the dimmer, allowing the ballast to maintain triac conduction until almost the end of the mains half-cycle. In addition, there is circuitry that detects the firing angle of the triac and adjusts DC reference voltage to set the lamp current.

The voltage waveform at the junction of D1 and D4 is equivalent to the output voltage of the dimmer. This approximates to a phase-cut sine wave with a DC offset such that the negative peak is at ground. This is reduced by the voltage divider network of R2 and R3 which is then fed into D5 and D6. Only the signal representing the positive half-cycle of the mains is left at the anode of D6. The filter of R4 and C6 converts this to a DC level. Because the minimum dimming level occurs at a point where the dimmer is still capable of providing enough output for the ballast to operate, this voltage will never actually be zero. The DC level is further reduced with the voltage divider network of R5 and R6, and used as the DC dimming reference voltage.

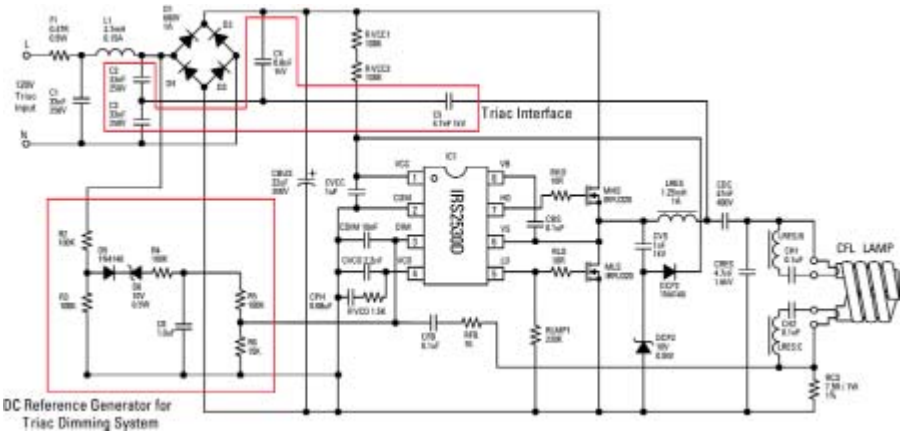


Figure 1: Triac-dimmable CFL ballast

The AC lamp current is sensed by the resistor RCS, and the resulting AC voltage is coupled with the DC dimming reference voltage. This DC + AC signal is then fed into the DIM pin of IRS2530D. The dimming control loop of the IRS2530D regulates the amplitude of the lamp current by continuously adjusting the frequency of the half-bridge switching circuit. In this way, the dimming control circuit keeps the AC lamp current peak-to-peak amplitude regulated to the desired value at all firing angle of the dimmer.

Analogue and Digital Dimming

Because of the simplicity of its dimming control method, the IRS2530D can be easily utilised for other dimming systems, including analogue and digital techniques (figure 2). The ballast designer needs to determine how to generate the proper DC voltage reference from the dimming control method being used.

Typical analogue dimmers include 1-10VDC dimmers, three-wire phase control, and dimmers controlled by photo-sensor, motion-sensor or wireless infrared. In these, the DC reference voltage is typically set using a voltage divider network. A low reference voltage is desirable, to limit power losses in the current-sense resistor. On the other hand, setting the voltage too low can incur noise problems at the lower dimming levels.

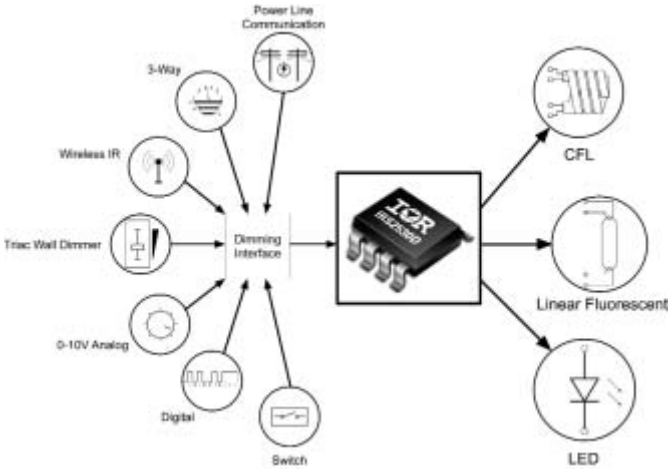


Figure 2: Support for multiple dimming techniques and low-energy lighting technologies

Digital dimming delivers advantages including simplified wiring and precise control of the dimming level, as well as the potential for two-way communication. Logarithmic control of the dimming level is possible, which produces apparently linear dimming since the human eye is much more sensitive to lower light levels than high levels. The most prominent digital dimming method is the open-standard two-wire Digital Addressable Lighting Interface (DALI).

A DALI dimming ballast designed around the IRS2530D requires a microcontroller to communicate with the digital protocols. The microcontroller is used to interpret the data from the digital control, and generates the square-wave signal with fixed frequency but varying duty-cycle which corresponds to the desired dimming level.

Dimmable LED Driver Using the IRS2530D

The IRS2530D can also be used to control and dim the current of LED, using a resonant-mode circuit architecture similar to that of a dimming CFL ballast. An example of an off-line LED driver schematic using the IRS2530D is shown in Figure 3. Unlike a fluorescent lamp, an LED requires constant current control and does not need to be preheated or ignited. With this in mind, a modified output stage is used. This replaces the preheat/ignition tank circuit with a series L-C-LED configuration and a full-bridge rectifier to convert the resulting square-wave AC output to a positive full-wave rectified voltage.

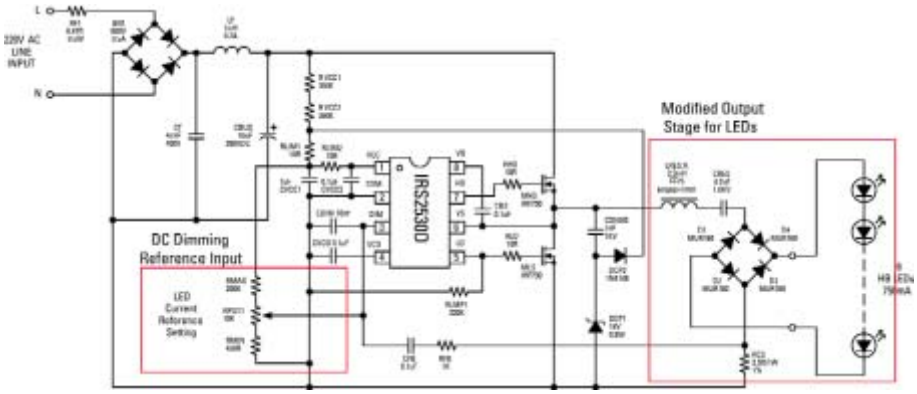


Figure 3: Dimmable LED driver using IRS2530D

The AC current sensing is still performed by the current-sensing resistor (RCS). This gives a direct AC measurement of the full-wave rectified LED current amplitude. This AC signal is then coupled with the DC voltage from the current reference setting onto the DIM pin of the IRS2530D.

The dimming control loop of the IRS2530D regulates the amplitude of the LED current by continuously adjusting the frequency of the half-bridge switching circuit such that the nominal r.m.s LED current is maintained within the manufacturer's specifications. When the DC reference voltage is decreased for dimming, the switching frequency is increased to decrease the gain of the resonant circuit and thus decrease the LED current. This control scheme keeps the LED current constant over line, load and temperature variations for any given dimming reference input.

The IRS2530D's dimming control loop allows the circuit to be scaled to any number of LEDs in series. In order to work with LEDs with different current rating, the current-sense resistor and the DC reference setting need to be adjusted accordingly.

Conclusion: Solution for Lower-Energy Lighting

The IRS2530D can also be used in dimming ballasts for standard fluorescent tubes. A number of reference designs with evaluation hardware are available, including a 1-10VDC analogue dimmer, a quad-level switch dimmer, and a three-way dimmer for CFL replacement of double-filament incandescent bulbs; these are widely adopted in the US. Each of the reference designs can also be adapted for LED dimming, helping to maximise the environmental benefits of today's most commonly used low-energy lighting technologies.

www.irf.com

A New Mitigation Strategy for Failures in Metallized Polypropylene Capacitors

Providing protection against catastrophic failures by rendering the capacitor electrically open

Metallized film capacitors utilizing polypropylene dielectric have become the component of choice in critical applications because of their low dielectric loss and superior breakdown voltage strength. There are some concerns that in certain applications metallized polypropylene capacitors can fail in a manner such that the failure poses a hazard to the equipment and personnel. Fuseac™ is a thermal fuse technology designed to protect against common capacitor failure modes in high power AC and DC applications. FuseacTM technology will deploy upon sensing a temperature beyond its preset limit and electrically disconnect, providing protection against catastrophic failures by rendering the capacitor electrically open.

By Joseph Bond, Operations and Engineering Manager, Electronic Concepts, Inc.

Metallized polypropylene dielectric for capacitors is fabricated by vapor depositing an aluminum or zinc-aluminum metal electrode to a polypropylene substrate that serves as the dielectric. This structural profile promotes self-healing at a fault by vaporizing the electrode at the point of the fault. Older technology film-foil capacitors using heavy foil electrodes in the windings would fail as a short but the foil was too thick to vaporize and the failure could not be reversed.

Metallized electrodes do not fail as a permanent short. At the failure point there is a momentary short where the energy stored in the capacitor creates a short-duration high current which causes the metal at the fault point to vaporize. Although this can prolong the life of the metallized polypropylene device, certain precautions must be taken to assure that the device does not destroy itself after multiple self-healing cycles.

Film-foil capacitors which fail as a dead short can be protected with fuses or current sensors to alert the user of a high current condition. However in metallized polypropylene devices many self-heal cycles can result in excessive leakage currents and increased power losses. Metallized polypropylene capacitors fail differently depending on whether the application is in a DC or an AC circuit.
DC applications with excessive self-heal cycles will exhibit an increased geometric center or “hot spot” temperature which decreases the breakdown voltage of the dielectric.
n AC applications the low resistance short due to self-healing will vary from a few ohms to a few hundred ohms. (New capacitors exhibit a resistance in the micro-ohm to the milliohm range.) This higher ESR contributes to higher I^2R generated heat. As core temperature increases, the dielectric strength of the capacitor is weakened which leads to further dielectric breakdown.
Failures in both DC and AC applications are thermally generated. Since the failure in AC applications is more likely to result in combustion (as opposed to an open circuit in DC circuits), and combustion failures have been observed with less than10% increase in line current, a method to monitor the core temperature of the capacitor for “hot spots” was needed so that the device can be electrically removed from the circuit before combustion occurs.

Failures in Metallized Polypropylene Capacitors
Failures in metallized film capacitors can be triggered by excessive total line frequency and PWM current above rating; excessive AC voltage above rating; transient voltage spikes above the dielectric withstanding voltage (DWV) rating; ambient temperatures in excess of 85OC; terminal connection problems relative to shock or vibration; exceeding packaging environmental conditions including moisture; excessive clearings or corona induced from an uncontrolled event. Conventional AC capacitor protection considerations include current sensing controls such as electrical fuses, management of voltage overrun conditions, heat management including ambient control (fan/cooling), thermal sensing on the body of the capacitor, and capacitor placement/location, e.g., isolation from heat sources. These are issues associated with these types of protection.

In AC circuits using metallized film capacitors protected by electrical fuses, dielectric flaws, stressed by one of the aforementioned events, can create internal momentary current spikes as partial discharges generate self-healing. The capacitor remains functional in the circuit through self healing and the electrical fuse remains closed which can lead to catastrophic failure. External thermal sensing attempts

include monitoring the temperature difference between the "hot spot" and the external case. The external case temperature can be markedly lower than the internal hot spot, depending on the diffusion of heat through the dielectric and case (independent of ambient). The rate of heat transfer from the "hot spot" to the external case is often too slow to detect a critical condition and physical placement of the capacitor relative to ambient cooling can affect a case-mounted sensor. ECI's thermally activated electrical disconnect, known as FuseacTM, deploys an internal thermal fuse that is triggered by temperature. Advantages of this type of thermal fuse include failure detection and disconnect before a fire condition. FuseacTM also allows a rigid connection to the unit with no mounting restrictions. Other advantages include enclosed dry construction (no oil or electrolyte), no case ruptures during disconnect, smaller size, lighter weight and cost effectiveness. Compare these advantages to a mechanical disconnect capacitor construction with a break away connection triggered by gas build up within the case. Mounting for mechanical disconnect devices requires flexible connecting lines, sufficient space for expansion above the connections, and is restricted to a vertical orientation. Gasses created during self-healing create intentional case deformation to disconnect the capacitor. Potential rupture of the package can result in oil leakage and system contamination. FuseacTM is a marked improvement over conventional mitigation strategies and directly addresses these critical application and reliability issues.

Fuseac™

Fuseac™ is a thermal fuse technology designed to protect against catastrophic capacitor failure potential resulting from common capacitor failure modes in high power AC and DC applications. Fuseac™ technology will deploy upon sensing a temperature beyond its preset limit and electrically disconnect, providing protection against catastrophic failures by rendering the capacitor electrically open. ECI's UL certified 5MPF series AC capacitors employ Fuseac™ technology at 300, 600 and 900vac ratings for inverter output filtering. Fuseac™ can be incorporated, on request, in a host of Electronic Concepts, Inc. products, especially for designs needing added overheating protection.

Figure 1: FuseacTM technology for inverter output filtering

Quality and Reliability

Self-healing metallized polypropylene capacitors fail due to avalanche breakdown caused by multiple self-healing events as temperature increases. Incorporating Fuseac™ in the capacitor will safeguard against these catastrophic temperature-generated failures, but additional measures are also taken during the manufacturing process to characterize potential failures in the metallized film. Some of these safeguards include:

- At incoming inspection of the dielectric film both voltage fault tests and avalanche tests are employed to assure film integrity.
- To assure clearing events are minimized, an overvoltage potential in excess of the rated DWV voltage is applied during capacitor production.

While these measures significantly improve product reliability, they cannot prevent clearings due to voltage transients or excessive temperature excursions during the product application. An additional means is required within the device to assure the safety of both equipment and personnel. This is accomplished by incorporating Fuseac™ in the polypropylene film capacitor. Unlike mechanical safety mechanisms described earlier, Fuseac™ disables the capacitor before it reaches combustible temperatures, thus offering an additional safety margin in critical applications.

Conclusion

Polypropylene film capacitors offer many advantages in large power applications. Their physical size and higher bandwidth make them highly suitable as a preferred alternative to other technologies. Process controls and monitoring contribute to their reliable field performance. The addition of Fuseac™ temperature protection makes them even more desirable for applications where high reliability, circuit protection and isolation are imperative.

www.fuseac.com

Right Technologies for Solar Converters

There are a wide number of topologies used

Energy produced from renewable sources is becoming an important contribution to the world's total energy demand and will increase in the next decades.

Solar photovoltaic technology represents one of the promising energy resources due to its low impact on the environment and its high reliability. This solar inverter has been equipped with ST's MDmesh and Silicon Carbide (SiC) devices in order to evaluate STMicroelectronics´ new green technologies.

By Gaetano Belverde and Giuseppe Sorrentino, Senior Application Engineers, STMicroelectronics

Every photovoltaic (PV) system consists of a module array and an inverter.

The inverter module is mandatory on all grid-connected applications in order to amplify the low DC voltage generated by the module to the higher AC level required by the grid.

If several modules are connected in series, it could not be necessary to include the amplification but in any case a maximum power point tracking (MPPT) function is required.

This prototype has a wide input voltage operation from 200V to 400V, and 3 KW of maximum power output, since it is intended for rooftop applications.

The total efficiency must be at least 97%, and a MPPT function is implemented in order for push panels to work at their best efficiency. In fact the PV Module (or modules if connected in series) changes its maximum power point continually during the normal operation due to the variances in solar radiation because of shade or weather.

Solar power systems and inverters

There are a wide number of topologies used to design the converters used for solar power systems, but there are two main classifications:
1) Grid connected
2) Stand alone

Grid connected systems are typically isolated residential PV panels or collections of panels, called 'farms,' connected to a central power facility maintained by a private or public company. Therefore, the energy produced from these photovoltaic modules during the day can be consumed or used immediately on the main grid. These systems do not require storage batteries or any backup system to store the energy, because the main grid will continue to supply energy at night or when the sun isn't shining.

Stand alone inverters are used on a system typically far from a municipal or public power grid. These systems use a battery, or bank of batteries, to store the energy produced during the day by the panels, in order to have a supply of energy during the night or when solar irradiation is low.

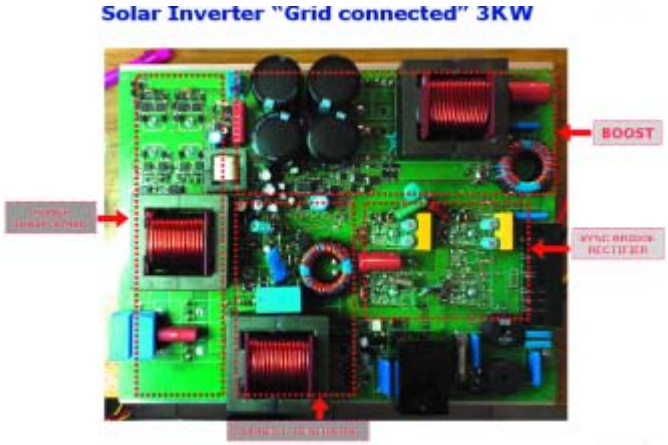


Figure 1: Grid connected solar converter prototype

Grid connected inverters are generally more complex than the "stand alone" because they must synchronize with the grid sinusoid and supply the current within the same phase. However, the first stages of design are quite the same on both types of inverters.

Traditionally, solar systems used to implement a single, shared, inverter for all panels. This system is called "centralized." The trend now is toward the "string inverter" - each panel is equipped with its own low power and high performance inverter.

Each of the afore-mentioned inverters can be realized following two different approaches in respect to the frequency operation. If low frequency is used, generally 100 Hz, very slow devices can be used, but because of that, very heavy transformer and bulk capacitor are necessary. Generally, newer designs adopt high frequency operation in order to minimize the inverter dimensions, weight, and performance.

It is worth mentioning here that we have performed the tests in our example on a 3 KW grid connected inverter, but the same benefits can be obtained in each type of inverter previously mentioned.

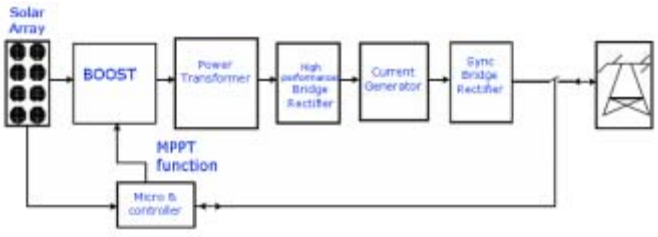


Figure 2: Grid connected solar converter block diagram

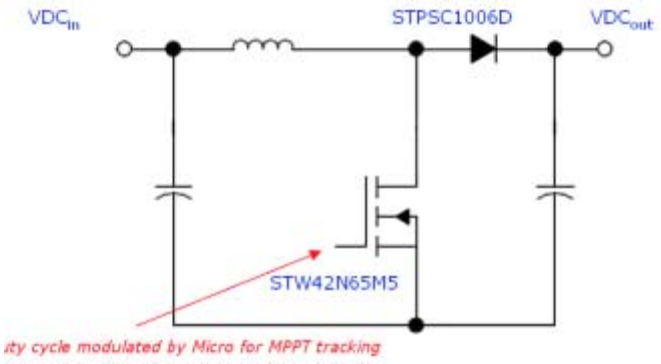


Figure 3: Grid connected solar converter, BOOST stage

Grid connected inverter

In order to validate new technologies, a solar inverter prototype was developed and equipped with ST MDmesh and SiC devices.

Figure 1 is a photo showing the full converter prototype. The block diagram is shown in Figure 2, and block by block details are show in Figures 3,4,5, and 6. Please note that instead of the 1200V switches generally used on this kind of converter, the new approach and topologies of each stage allow the use of a 650V Power MDmesh.

The first stage, called the “BOOST” stage, is common to most solar inverters and power factor converters (PFC). A converter used as a front-end between PV panels and inverter, it is used to amplify the panel voltage into a DC BUS from 400V to 500V for 3 KW output power.

The BUS voltage should be lower than 450V in order to permit the use of 450V capacitors, typically less expensive than 500V ones. In order to limit the peak value of the current on both the MOSFET and the diode, this BOOST works in continuous current mode operation so the MOSFET is turned on during the recovery time of the diode. The BOOST is driven from a microcontroller in order to implement the MPPT.

The second stage is “Power Transformer” as shown in Figure 4. This is used to provide a galvanic insulation between the panels and the grid. This block is not mandatory in some countries but is generally used for safety reasons. Its frequency operation is about 100 KHz in

order to minimize the transformer size. The MOSFETs are connected in a typical Bridge configuration, and the devices work on a modified Zero Voltage Switching (ZVS) modulation in order to minimize the switching losses. The bus voltage is 450V typical value, and the frequency operation is pushed around 100 KHz, also done in order to minimize the size of the transformer.

The "High performance bridge rectifier" stage is used to rectify the alternative voltage coming from the "power transformer." It is composed of four SiC diodes connected like a Graetz bridge, as shown the right side of Figure 4. These diodes are able to work at very high dI/dt - typically more than 1000A/µs. The operating frequency is the same as the "power transformer" stage, about 100 KHz.

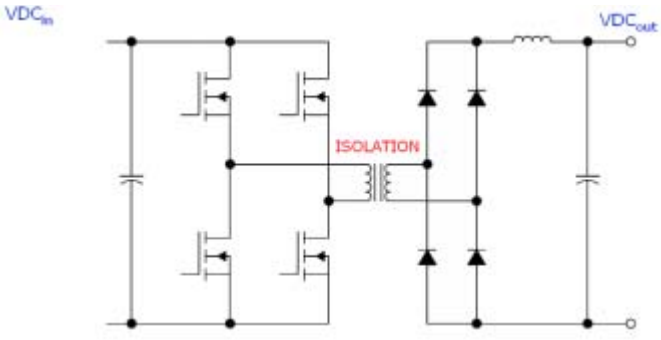


Figure 4: Grid connected solar converter, power transformer and rectification stages

The "Current generator" stage is used to provide and regulate the power generated from solar panels onto the grid. It consists of a typical buck topology composed by an MDmesh V MOSFET and a SiC diode as shown in Figure 5. The operating frequency is about 100 KHz, and the drive signal is modulated in order to follow the 100 Hz of the grid.

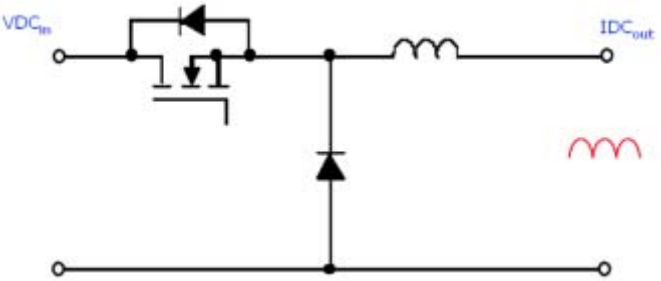


Figure 5: Grid connected solar converter, BUCK current generator stage

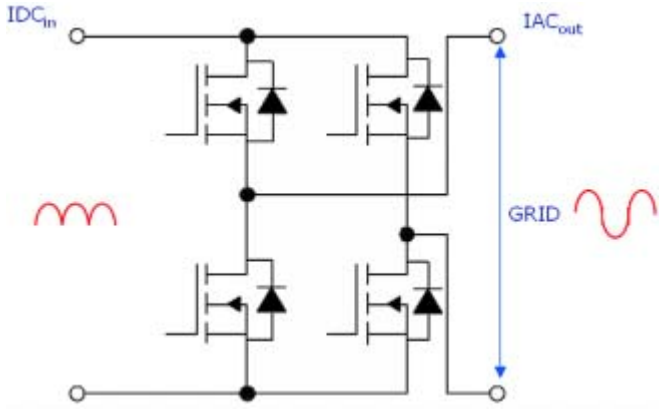


Figure 6: Grid connected solar converter, 100 Hz Bridge sync rectifier stage

The last stage is the "Sync bridge rectifier." This is a simple Graetz bridge used to rectify the grid and allow the "Current generator" to introduce the power to the grid during the full sinusoid. It is composed of four MOSFETs specially driven and used as synchronous rectifiers (illustrated in Figure 6).

Thanks to this solution a single switch, made with STW42N65M5, or STW77N65M5 650V MOSFETs, current generator can be adopted. Currently, most solutions adopt a bridge and half bridge current generator topology instead of single switch. Those solutions are able to follow the grid voltage on a full sinusoid but the 600-650V MOSFETs cannot be used due to their low breakdown voltage. In fact, in that case the MOSFETs must be able to manage at least 700V on the bus voltage (double maximum peak to peak grid voltage +- 338V).

Due to the circuit solutions adopted on this proposed new inverter design, 650V MDmesh V MOSFETs can be safely used (STW42N65M5 or STW77N65M5). Using MDmesh combined with 600V SiC diodes (STPSC1006D) allows us to increase the frequency operation and work at high dI/dt, from 800A/µs up to 2KA/µs and more. Being able to operate at a high frequency translates into being able to use the smallest transformer, and magnetic, and even smaller, capacitors.

Measurements on BOOST stage

Although MDmesh MOSFETs and SiC diodes are used on every stage of the inverter, the following results came from the inverter front-end stage called the BOOST stage.
This stage has been used as a case study to validate the performances of the new fastest MOSFETs and diodes available in the market.
The BOOST basic configuration is very similar to other applications like a traditional single switch PFC, as shown in Figure 3, but in this case, the input voltage is continuous rather than pulsed.
Efficiency has been measured in the worst conditions, which means at the lower input voltage, so that at full load the input current is the highest possible.

Figure 7 shows the efficiency versus output power, @ VDC in=200V and gate Ron=8.2Ohm.
With 8.2Ohm, we achieved a dI/dt of 1400A/µs during the turn-on, which grants good noise immunity and low EMI irradiation.
Figure 8 shows the detailed BOOST signals during the turn-on @ Vin=200V, Vout=450V, Pout=1700W.

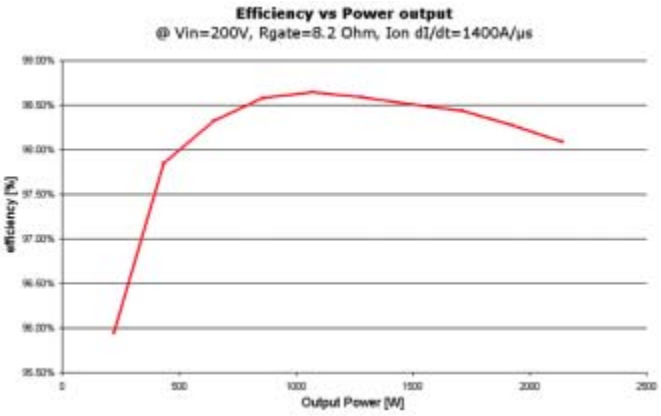


Figure 7: Efficiency vs. power output on BOOST stage @ Rg=8.2 Ohm and dI/dt=1400W

Please note the peak current on the trace in black (about 22A). This is due to the SiC capacitance discharge @ high dI/dt=1400A/µs. The step on the drain voltage (trace in red) is due to the parasites' inductance of the board. The trace in violet represents the energy losses during the turn-on.

SiC technology vs silicon one

By using very fast MOSFETs, the use of very fast diodes is necessary in order to prevent failures. Unfortunately, due to the relatively slow recovery of silicon diodes, even ultra fast silicon diodes, they could not be used on this project.

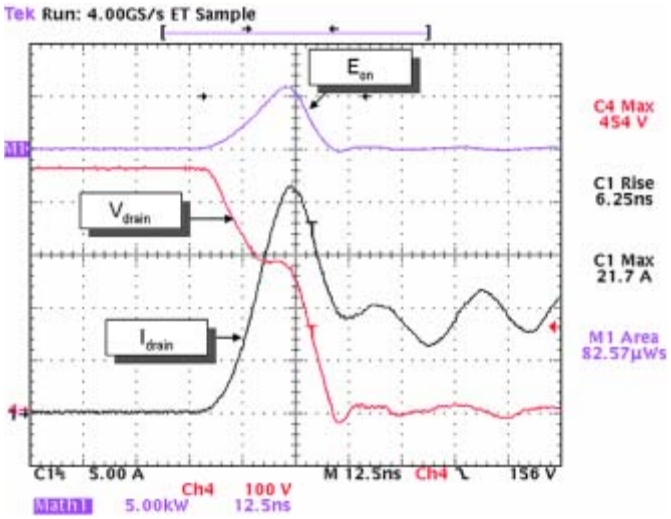


Figure 8: Turn-on waveform on BOOST stage @ Pout=1700W, Vin=200V

In order to meet these new requirements, ST has developed and introduced a new family of diodes using the new silicon carbide technology. Silicon Carbide diodes are virtually free of recovery current, even if, due to the charge and discharge of the parasitic capacitance, a peak current is still present during the commutation. But that peak value is very low compared to a silicon diode using the same forward and breakdown voltage.

These devices are the best choice for the high-end solar application where performance is the primary target.

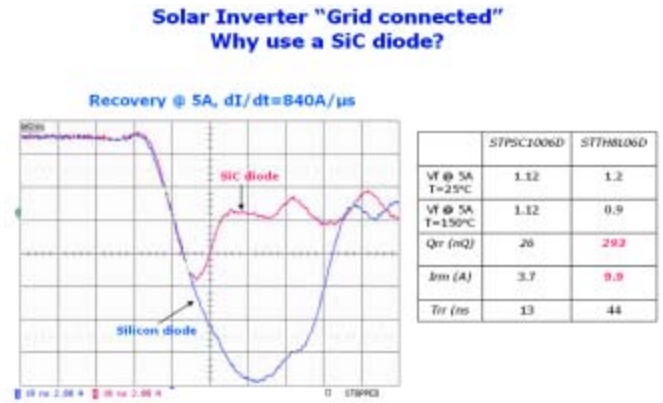


Figure 9: Silicon vs SiC diode comparison @ If=5A, dI/dt=840A/µs

A comparison between SiC and silicon diodes has been performed in a side by side test between a silicon ultra-fast diode and a SiC with the same forward parameters and using a dI/dt=800A/µs.

The table in Figure 9 provides the results of this comparison.

Figure 9 shows the recovery @ If= 5A. This clearly shows that the silicon diode has ten times a higher Qrr and more than 3 times the Irm than the SiC diodes.

This higher peak current triggers an immediate failure of the MOSFET if it is used on the converter prototype.

In other words, silicon diodes cannot be used on this kind of design in which the dI/dt is very high, from 800Aµs up to 2000Aµs.

www.st.com

Pulse-Width Modulated Fan Controllers for Automotive Applications

PWM controllers for fan motors can also offer many benefits

There are two areas inside the motor vehicle which require fans to facilitating cooling. These are the engine compartment, where primarily the engine cooling system needs to be cooled, and the passenger compartment for the HVAC system.

By Eric Hustedt, Jim Tompkins, and Peter Sommerfeld, Electronic Motion Systems

The fans for both of these applications are typically brushed DC motors, which need controllers to regulate their speed. This then allows different levels of ventilation which in turn allows control of cooling.

There are three "traditional" methods of controlling the speed of fans in a motor vehicle.
- Shunt resistors
- Series/parallel configuration
- Linear controllers

The shunt resistor method simply switches various resistors in series with the fan to slow the fan down, this is simply dissipating the extra power in the resistor, since that power has to come from the engine you can see this is a waste of fuel! The power wasted can easily exceed 100W for a 400W fan. As well as the inefficiencies, there is a limited speed selection range.

The series parallel configuration, while not being as inefficient as the shunt method, only gives two speeds, full power or under ¼ power due to the load characteristics of a fan motor.

The Linear Controller uses a transistor as a variable resistor to be able to continuously adjust fan motor speed. This still has the disadvantage of dissipating power in the variable resistor and wasting fuel.

Pulse-Width Modulated Control

Pulse-Width Modulation (PWM) for motor control is a method of changing the effective voltage and therefore the current a motor is supplied with. This is done by turning a switch on and off at a high speed (e.g. around 20kHz) and varying the "on" time to attain the required motor speed. As long as the switching speed is fast enough (technically, much greater than the overall time constant of the motor), the load does not see the difference between the equivalent DC voltage and the PWM voltage (see Figure 1). PWM does have significant reductions in power loss in the switch, which increases efficiency of the motor controller. The reason for this is explained in the following paragraph.

Since in a PWM system the switch is either "on" and carrying current with most of the voltage dropping across the load and almost no voltage dropping across the switch, or "off" with full voltage dropping

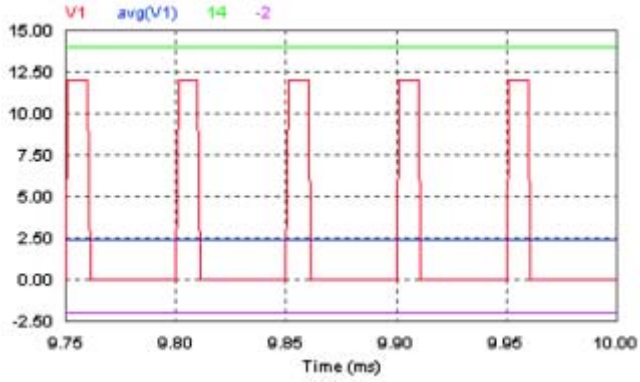


Figure 1: PWM with 20% duty cycle (20% on, 80 % off) and the corresponding PWM voltage and average voltage

across the switch but no current flowing, it means there is never the condition for significant power dissipation where both voltage and current need to be present simultaneously. Figure 2 shows a Field-Effect Transistor (FET) being used to switch a load of 1 Ohm on and off. The resistance of the FET, the RDS, can be varied from very high resistance (off-state) to very low resistance (on-state). If the FET is turned off, the voltage will drop entirely across the FET, but because of no current flowing through FET and load, there will be no power dissipation. If the FET is turned on (RDSon typically mOhm) most of the voltage will drop across the load since its resistance is typically much higher than the RDSon of the FET. If the FET were to be turned on sufficiently to allow half of the voltage to drop across the

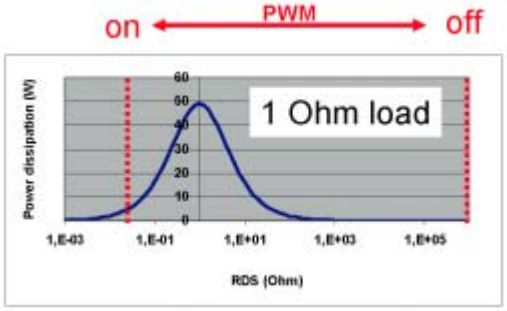


Figure 2: Power dissipation in a switch (FET) between off (RDS = high) and on-state (RDS = RDSon = low)

load, the RDS would need to be the same value as the resistance of the load.

This however would lead to a very high power dissipation as shown with the peak in Figure 2. To avoid this PWM control toggles between on-state and off state of the FET such that for a certain duty cycle (ratio between on time and toggle period) the desired average voltage drops across the load. This then is realized at greatly reduced levels of power dissipation.

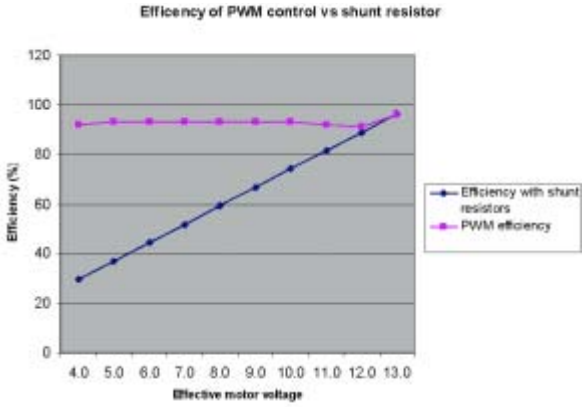


Figure 3: Efficiencies of a PWM fan controller compared with a shunt resistor controller (relays)

Figure 3 shows the efficiencies of a PWM control compared with standard resistor control for a fan motor. The corresponding power losses are shown in Figure 4.

The power dissipated will impact the fuel efficiency of a motor vehicle. This fuel can be saved by controlling fan motors through PWM.

Additional functionality offered by PWM control
PWM controllers for fan motors can also offer many other benefits by the ability of including certain functionality, e.g.:

- Efficient continuously variable speed control of the fan motor.
- Stall detection and protection in case of a locked rotor.
- Constant speed regulation.
- In-rush current limit or “soft start”.

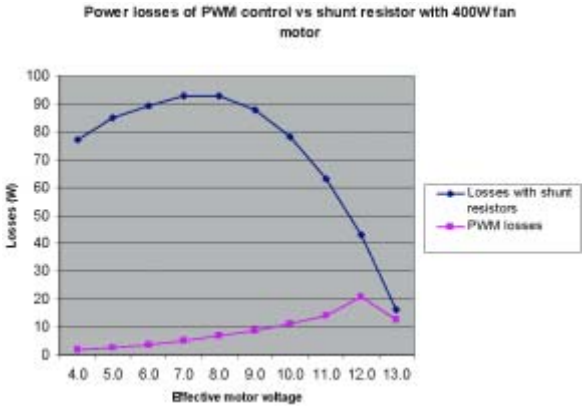


Figure 4: Power losses of a PWM fan controller compared with a shunt resistor controller (relays)

Continuously variable speed control
Since the fan controller is not limited by either fixed resistors or series/parallel switching, it can run the fans at any desired speed. Although linear controllers can do this as well, PWM controllers can do this at almost no power dissipation.

For engine cooling this means that the vehicle ECU can set the fan speed as required by the cooling system and can thus regulate the temperature more accurately improving engine performance.

In HVAC applications it means that the speed is not limited by fixed steps, and the controller can change the speed slowly reducing noise impact.

Stall detection
A PWM control unit can have advanced stall detection algorithms built into the software. The unit can detect both a stalled and an over loaded motor at various speed settings.

Should the fan be blocked or jammed for some reason this feature protects the fan against further damage or even fire, reduces the load on the vehicle electrical system and allows the fan to recover out of a temporary blockage like ice build up.

Speed regulation
In cabin fan applications it is desirable to prevent the fan motor speed changing with vehicle engine speed. This is caused by the variation of the battery voltage with changing alternator output. In traditional shunt resistor control a variation of the battery voltage causes a change in the fan speed in the cabin. This is most noticeable when coming to a stop (engine idle).

PWM fan controllers for HVAC applications can detect the change in voltage and modify their output accordingly. This means at all but full power settings the fan speed does not change with battery voltage. This control is not possible at full speed because the fan is then directly connected to the battery and the controller therefore cannot hold the speed when the battery voltage drops.

In-rush current limit

Figure 5: EMS Engine Fan Controller Package

All motors when starting draw far more current than at their steady state running speed. This can be in excess of 3 times normal current draw!

This puts an unecessary load on the vehicle electrical system, it can cause lights to dim momentarily, the alternator to over compensate etc. Large fluctuations in the load current on the alternator can also cause voltage spikes. This is not desirable for the vehicle electrical system!

PWM Fan Controller can provide a soft start and a soft increase function, meaning that at any increase in speed, either from zero or a low speed, the controller actively prevents large currents being drawn from the battery.

Fan Controller packaging
The engine fan controller is located at the shroud of the front cooling module of the vehicle. It requires battery voltage and ground as supply inputs and a control input, which is used to set the speed it should control the fan motor to. This set-point is usually communicated to the fan controller by the engine management system. Its 2-pole output goes to the fan motor, which is also located at the shroud.

Figure 6: EMS HVAC Fan Controller Package

The engine fan controller housing has a motor and vehicle connector integrated. An insert-molded lead-frame forms the contact leads in the connector shrouds and connects to the PCB inside the housing. The PCB holds the microcontroller, the power stage along with all the peripheral circuitry. The PCB is heat-sunk by attaching it via thermal adhesive to an aluminium heatsink, which is over-molded into the housing. A lid seals the housing cavity and protects the circuitry.

The HVAC fan controller is located in one of the air-ducts of the cabin cooling system. The input and output requirements are similar to the engine fan controller.

The motor output and power and signal input connectors sit directly on the controller PCB, which holds the microcontroller, the power stage along with all the peripheral circuitry. The PCB is heat-sunk by attaching it via thermal adhesive to the aluminium heatsink, which is cooled by the air-flow in the HVAC duct. A plastic housing place on top of the PCB/heat-sink assembly protects the circuitry.

Conclusion
Fan controllers using pulse width modulation, greatly reduce the power loss and therefore increase fuel efficiency. This technology is now proven and validated for automotive application and has been used on production programs , both for engine fan cooling and HVAC fan cooling.

www.ElectronicMotionSystems.com

International fair for the use of renewable energy sources

18 – 21 March 2010 · Husum

Look ahead, think ahead!
new energy husum – the most visited renewable energy fair, including Europe's biggest small wind turbine show.

American Wind Energy Association

German WindEnergy Association (BWE)

WWEA World Wind Energy Association

new energy husum

www.new-energy.de

Maximizing Energy Efficiency in Power over Ethernet PSE Design

Efficient port controller combined with power management can result in power savings

Clause 33 of IEEE 802.3 is the standard for delivering power over Ethernet (PoE). As specified in this standard, up to 15.4 Watts can be delivered to a powered device (PD) over all cable types. IEEE 802.3at, a new extension commonly known as "PoE+", has recently been ratified by the IEEE. PoE+ supports power levels up to 30 W per port from the power sourcing equipment (PSE) over most cable types. In the IEEE standard, the PSE is responsible for providing and controlling the power to the PD connected to the other end of the cable.

By John Gammel, Quentin Stephenson and Phil Callahan, Silicon Labs

While both of the PoE and PoE+ power levels are somewhat modest, it is common to have as many as 48 ports in a PSE system and multiple PSE systems in an enterprise network. A total installation might have hundreds of PSE ports on a PoE-enabled Ethernet switch or midspan providing power to VoIP phones, wireless access points, security cameras, point of sale (POS) terminals, and other network devices. With this large multiplying factor, the power provided by the PSE easily can be in the kilowatt range and higher. Significant power and system costs can be saved by using a power-efficient PSE controller and carefully managing the power supply.

The Power Controller

Power loss associated with a power controller arises primarily from:

- Quiescent power consumption (power taken from the power supply that is not delivered to the load)
- I^2R losses associated with the current sense resistor and the series power FET
- Any other components in the power path (such as the series diode that is associated with the commonly used "AC disconnect" method).

The table 1 summarizes the maximum high-voltage current, the maximum series resistance and total per port power loss at a load of 350 mA for representative 4-port PSE controllers.

PSE Controller	Quiescent Vee current (max) for 4 ports	Series resistance	Total per port power at Vee=50 V and 350 mA load
Competitor A	5 mA	External 0.5 Ω sense R and 0.2 Ω FET	148 mW
Competitor B	4 mA	External 0.33 Ω sense R and 0.2 Ω FET	115 mW
Competitor C	14 mA	Internal 1.8 Ω	395 mW
Si3452	4 mA *	Internal 0.6 Ω	124 mW

* Averaged between all ports on and all ports off

Table 1: Maximum high-voltage current, the maximum series resistance and total per port power loss at a load of 350 mA for representative 4-port PSE controllers

Disconnect Method

- The disconnect method refers to the algorithm used to discontinue power to a given PD. The IEEE standards specify two methods of disconnect sensing:DC disconnect involves sensing the current flow and disconnecting power when the current drops below 10 mA. Accurately sensing this low-level current can be difficult, given system noise floor and high frequency noise pick up due to parasitic inductances in the measurement path.
- AC disconnect involves injecting a few milliamps of ac current into the PoE circuit with a series diode and disconnecting the PD when the diode reverse biases. AC disconnect is potentially more accurate than dc disconnect, but the typical 0.6 V series diode drop plus the ac current source adds approximately 400 mW of dissipation at 350 mA port current. This negative impact to overall efficiency makes ac disconnect highly undesirable for maximizing a PSE system's energy efficiency.

The Si3452 PoE controller from Silicon Labs uses a proprietary and fully interoperable "dV/dt disconnect" method that is both efficient and accurate. This methodology briefly places the FET into a very low current limit mode during disconnect sensing. If the PD is not disconnected, the FET current limit is switched to the normal current limit and there is a small change in port voltage for a short time (hence, the name dV/dt disconnect). The dV/dt (or lack thereof for a true disconnect) is detected, allowing for accurate disconnect event sensing but with none of the wasted power associated with ac disconnect.

Power Management

Delivering up to 30 W per port, a high port count PoE+ PSE system requires a very large power supply to deliver maximum power to all ports. For example, a 24-port system requires a 720 W power supply. For this reason, power supply management becomes very critical.

Most PoE controllers provide port current monitoring for disconnect, as well as port current limiting to guard against short circuits and overloads. While some PoE controllers provide programmable overload current thresholds, the Si3452 can be programmed in a mode in which the overload threshold is self-adjusted based on the PD classification result. This feature is referred to as "per port power management." This methodology enables the total system power supply to be dynamically managed for optimal power savings.

The IEEE standards specify a mechanism to classify the PD within a range of 4 W maximum (class 1), 7 W maximum (class 2), 15.4 W maximum (class 3); or for PoE+, 30 W maximum (class 4). As an option, the PD can communicate with the PSE through the Ethernet LLDP layer for dynamic power management. In general, this type of power management is grant-based (see upper half of figure 1). For grant-based power management, power is granted to ports when it is available and denied to ports when full system power has been allocated, typically based on a priority scheme.

While classification and LLDP provide important information, it is common for a given PD to draw less than the maximum power it has requested. Another method of power management is consumption-based (see lower half of Figure 1). Here, power consumption is monitored, and additional ports are granted power if sufficient power is available (based on actual consumption) and allowing reserve for peaks. The individual port current monitoring of advanced PSE controllers, such as the Si3452, can be used to determine the power consumption of each port, thus avoiding the need for a power supply current monitor.

Figure 2 shows a complete power management-enabled PSE system that combines all of these features. The system is enabled by the Si3452 and its companion Power Manager software development kit (SDK).

Using this approach, it is reasonable to select a power supply that has only 25 percent of the capacity required to power all ports at full power. For example, a 180 W supply could be used instead of a 720 W supply for a 24-port PoE+ system. In rare cases where the power supply would run out of power, midspan power injectors or PD auxiliary supplies could be used to make up the deficit. This much smaller power supply reduces cost and increases system efficiency because of the lower power losses generated by the smaller supply. It is estimated that, at a given power level, a 180 W power supply would result in a power savings of 10 W versus a 720 W power supply. For a 24-port system, this results in a per port power savings of more than 400 mW.

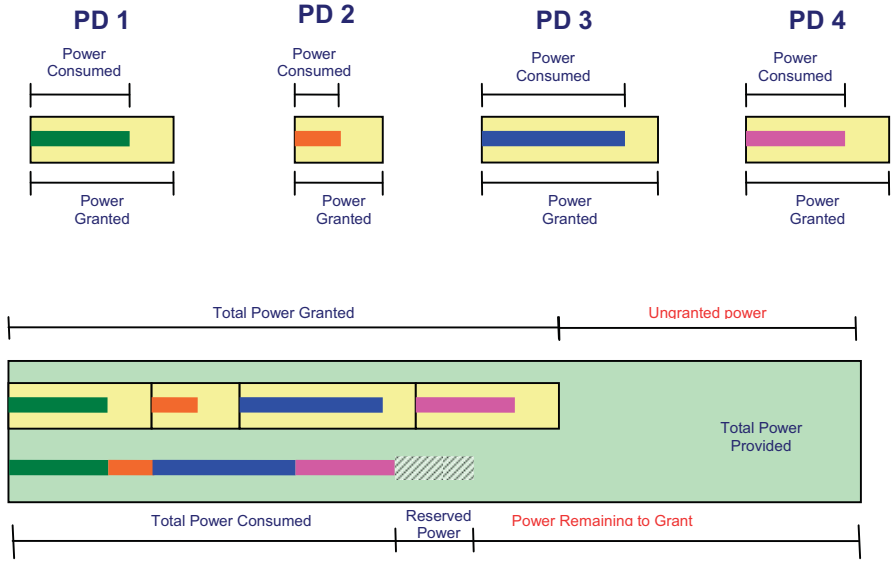


Figure 1: Granted and Consumed Power

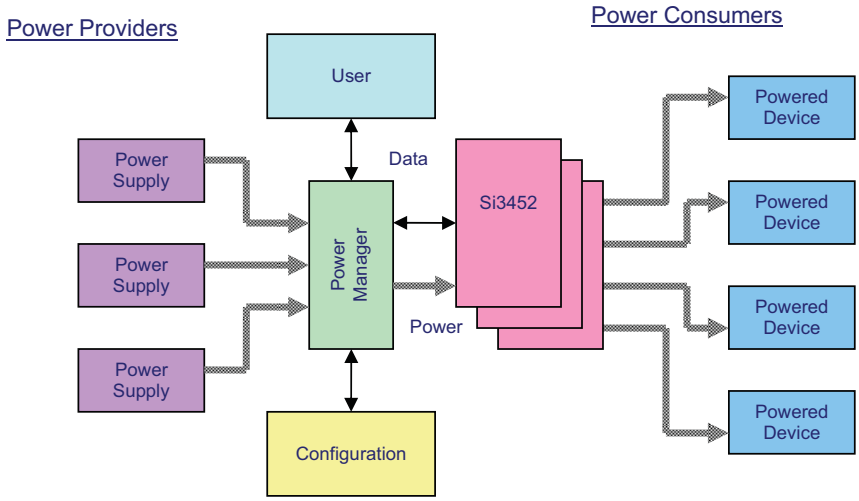


Figure 2. A complete PSE power management solution

	Possible per port savings	5-year savings for a 24-port system at $0.06/kWhour
Low PSE port controller quiescent power and series resistance	250 mW at 350mA – more at higher current level for low resistance controllers	$15.75
Use of dV/dt disconnect	400 mW	$25.20
Efficient power management	400 mW	$25.20 plus the lower cost of the smaller power supply
Total savings	**1050 mW**	**More than $100 (USD) including the power supply cost savings**

Table 2: Power and cost savings enabled by efficient PSE design and power supply utilization

Summary

The table 2 summarizes the power and cost savings enabled by efficient PSE design and power supply utilization.

Using an efficient port controller, such as the Si3452 device, combined with intelligent power management can result in substantial system power savings and reduced system cost.

www.siliconlabs.com

Blackfin BF50x Processors for Converged Digital Signal and Control Processing

Breakthrough in Price/Performance

Analog Devices' Blackfin® processors for converged digital signal and control processing applications deliver exceptional processing performance at low price points, enabling system designers to build innovative features into their existing products, create new products, and successfully enter new markets.

By Anders Norlin Frederiksen, Industrial Marketing Manager, Analog Devices, Inc.

Complemented by a rich ecosystem of development tools, applications and third-party support, ADI Blackfin processors continue to gain popularity among domain experts and designers seeking to create differentiating product value in a competitive marketplace.

ADI's new Blackfin BF50x series processors are optimized for a wide range of price/performance-sensitive applications, including applications previously serviced by high-end (32/64 bit) microcontrollers (MCUs). Designers facing a choice between incorporating DSPs and/or MCUs in their systems can utilize Blackfin BF50x processors to run the complex algorithms and execute the system control tasks they require to realize their design objectives – without compromising on processor cost. With performance headroom to spare, designers needn't be experts in DSP programming to take advantage of Blackfin-caliber performance today.

Figure 1: Blackfin BF50x series processors

Blackfin BF50x Series Processors Ensure Greater Development Agility

Blackfin BF50x processors deliver unmatched price/performance, providing up to 400MHz of processing performance at a price point where 150-200MHz clock speeds have been the norm. This performance profile extends high-performance digital signal processing capabilities to a broader range of applications, many of which previously required designers to implement algorithms in hand optimized C code, and in some cases assembly code, in order to run the application with the performance limitations of the processor or MCU.

Designers can leverage Blackfin BF50x's ample performance headroom to utilize advanced visual programming software, which helps designers shorten development cycles and reduce design complexity. These easy-to-use programming tools enable designers to evaluate concepts, develop and validate algorithms, map parallel, deterministic tasks, and tune parameters in real-time before committing to a hardware prototype. With the flexibility to model, simulate, and deploy systems utilizing user-friendly visual programming tools, design teams are empowered to make the best use of their resources and accelerate time to market.

Reduce Development Complexity with Visual Programming

Visual programming tools can preclude the need for specialized DSP programming experience, providing system designers with an abstracted design interface that handles low-level code generation in the background. Built-in abstractions liberate the designer from the strict modeling style guides that are required by general-purpose languages, allowing design objects to be represented with a high degree of efficiency.

Designers programming DSPs using traditional text-based languages such as assembly or C spend much of their time performing tasks that require multiple steps to make small changes. With visual programming tools, they can reduce iterative design cycles and overall development time. Commercially available model-based programming products can also provide support for Analog Devices' VisualDSP++® integrated development and debug environment (IDDE) to ensure end-to-end development simplicity spanning executable specification, design with simulation, embedded code generation, debugging, and code verification. The integration of these capabilities helps to reduce or eliminate errors associated with hand coding, and can incorporate system-level test bench capabilities, which eliminates the need for a different set of software tools for verification.

Efficient Algorithm Development and Implementation
Higher performing DSPs can run a greater number of algorithm cycles and process more sophisticated algorithms in a fixed amount of time. Blackfin BF50x's superior performance profile and ample on chip memory (4MB executable flash) equips designers to achieve greater system functionality and precision through the use of more advanced algorithms.

For solar energy inverter applications, for example, sophisticated algorithms can enable inverters to convert variable DC output into 'clean' current and regulate power flow into the commercial electrical grid and/or local electrical networks fed by residential and municipal photovoltaic (PV) cell arrays. Maximum power point tracking (MPPT) algorithms maximize the amount of energy that can be extracted from individual and/or serial-connected solar panels, and designers typically employ multiple MPPT algorithms to accommodate a range of environmental variables. Blackfin BF50x processors provide the superior signal processing performance to execute complex MPPT algorithms, ensuring ultra efficient energy extraction in inverter applications for which comparably-priced, lesser-performing processors and MCUs would be inadequate.

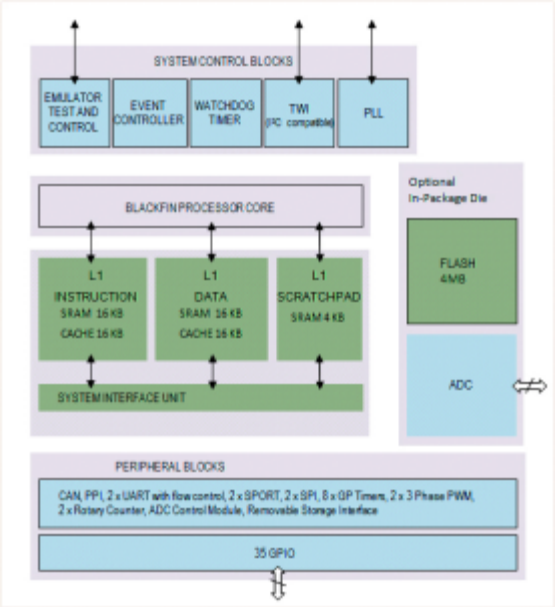


Figure 2: Block diagram of functions

For motor control applications, the ability to process complex algorithms assures dynamic control that adapts to real-time variations in system behavior to yield smoother performance and reduced power consumption. Consider a sensorless field-oriented control (FOC) algorithm, which can enable variable-speed control of permanent magnet synchronous motors (PMSMs) to yield greater energy efficiency and eliminate the need for speed and position sensors within the motor (sensorless vector control). Utilizing advanced, Blackfin BF50x-hosted modeling algorithms to accurately determine rotor shaft position and speed, designers can eliminate the need for position/speed sensors to realize smaller form factors, reduced costs and greater system reliability.

Best of Both Worlds – Algorithm Optimization with Visual Programming
Algorithms such as the aforementioned sensorless FOC algorithms can be readily developed, manipulated and validated with the aid of visual programming tools. Variables such as vectors, scalars and matrices are accounted for and correlated, freeing an algorithm developer from having to declare variables or create iterative loops to implement operations of this nature. Visual programming tools typically manage a host of automated mathematical functions that would allow the designer to focus on the top-level sensorless FOC algorithm, rather than re-implementing operations centric to sine or cosine flux. These tools facilitate hierarchical design so that complex functions can be structured and presented in a manner that is intuitive to the designer and easy for other members of a design team to understand, while offering visualization options that can include 2-D/3-D plotting, as well as animated graphics.

These automated capabilities don't preclude designers from manipulating the lower-level code, or porting existing code to the visual programming environment. As many designers maintain and reuse a stable of highly optimized, manually coded algorithms, most visual programming environments accommodate the integration and continued refinement of existing C code. In this way, visual software tools provide designers with a flexible, unified development environment via which they can tune and reuse code, and port designs to multiple platforms – all of which helps to shorten development cycles for subsequent design initiatives.

ADI Blackfin Fixed-Point Digital Signal Processors
Analog Devices' 16/32-bit fixed-point Blackfin digital signal processors are designed specifically to meet the computational demands and power constraints of today's embedded industrial, automotive, audio, video and consumer electronics applications. Blackfin processors deliver breakthrough performance and power efficiency with a RISC programming model, combining advanced signal processing functionality with the ease-of-use attributes found in general-purpose microcontrollers. This combination of processing attributes enables Blackfin processors to perform equally well in both signal processing and control processing applications - in many cases eliminating the requirement for separate heterogeneous processors. This capability greatly simplifies both the hardware and software design implementation tasks.

Comprehensive Development and Support Ecosystem
Analog Devices software and hardware development tools are designed to provide easier and more robust methods for engineers to develop and optimize systems, simplifying product development processes and reducing time to market. The Blackfin processor family leverages familiar development tools including the VisualDSP++® integrated development and debug environment (IDDE) and the EZ-Kit Lite® evaluation and application prototyping platform. A rich third-party software support network further enables developers to design more intelligent and efficient solutions for the industrial market.

For more information about ADI's full portfolio of digital signal processors, software, development tools and support, visit:

www.analog.com

Maximise Resonant Converter Efficiency in Flat-Panel Displays with Self-Timed Synchronous Rectification

Switching losses are negligible as the synchronous MOSFETs switch on and off very close to the zero current point

Flat-panel LCD displays have rendered CRT-based TVs and computer monitors obsolete, with today's consumers vying for the largest screen area, best picture quality, and slimmest profile that manufacturers can offer.

By Yong Ang, Senior Applications Engineer, Diodes Incorporated

A key sub-system in the race for the display slimness that's clearly so attractive is the power supply, which invariably uses a switch-mode topology. Of the topologies that suit offline conversion power levels of typically 100 - 600 Watts, resonant switch-mode converters are attracting increasing attention from product designers. Able to exploit high switching frequencies, resonant converters shrink the size of the supply's magnetics and filter components while achieving high conversion efficiencies with minimal EMC issues—at build costs that compete with other topologies.

Yet timing issues make it difficult to substitute efficient synchronous rectification for conventional and relatively lossy secondary-side diode rectifiers within a typical resonant converter. A new self-timing approach overcomes this issue, and helps flat-panel display manufacturers to meet minimum efficiency standards that the US leads with its Energy Star program and that other authorities are following.

Zero-voltage switching is key

A universal-input offline supply for a flat-screen LCD typically comprises an input rectification stage followed by an active power-factor correction circuit that attenuates power-supply harmonics to meet IEC61000-3-2 requirements for electromagnetic compatibility. Most often, a boost regulator generates a high-voltage DC bus level of around 400V. It's then necessary to downconvert this voltage as efficiently as possible to the low voltages that suit the display's subsystems. Efficiency becomes ever more significant with increasing screen size, with a typical LCD TV application requiring three main output levels that can be derived from multiple secondaries wound around a common transformer core.

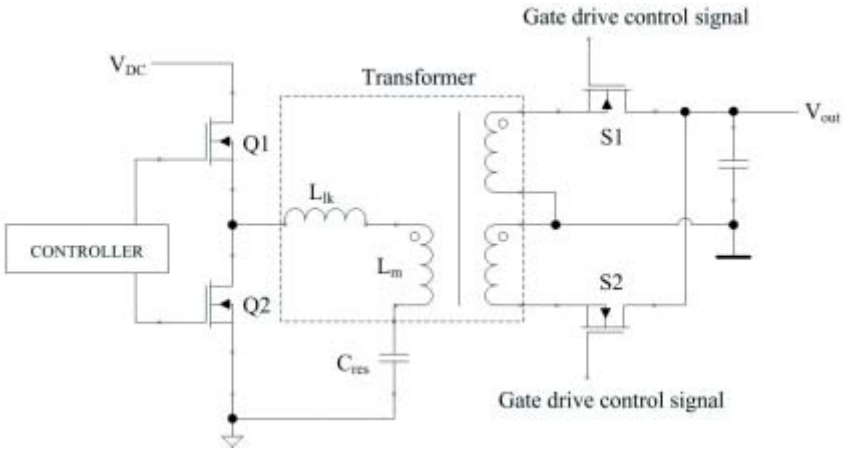


Figure 1 – Resonant LLC converter with centre-tap secondary winding

Of the available resonant converter topologies, the most attractive option for downconverting the high-voltage DC bus uses the LLC arrangement that figure 1 outlines. Here, the controller regulates the supply's output by modulating the drive signals to the primary-side MOSFETs Q1 and Q2. These switches drive the tank circuit that results from the transformer's magnetising inductance Lm and its leakage inductance Llk reacting with resonant-mode capacitor Cres.

A key advantage of this topology is its use of zero-voltage "soft" switching for Q1 and Q2, which greatly reduces the peak currents and edge losses that hamper traditional hard-switching topologies. As a result, this soft-switching approach improves efficiency and reduces heat generation and stress within the switching elements. It also minimises EMC generation that the sinusoidal nature of tank-circuit currents and voltages further constrains. This attribute is especially welcome in display applications, where noise can severely compromise picture quality because the power-factor correction circuit provides a pre-regulated DC supply, it's possible to optimise the resonant converter to operate close to the series resonant tank frequency at the nominal DC input voltage. It's then possible to regulate the output voltage over a wide load variation with narrow

changes in switching frequency. As the load level approaches zero, the converter's frequency reaches its maximum before entering a pulse-skipping mode that minimises power consumption.

Increasing efficiency with synchronous rectification

Yet in a typical LLC converter, the secondary-side rectifiers are almost invariably Schottky diodes that have relatively large forward voltages. It's therefore desirable to replace these lossy elements with MOSFETs configured as synchronous rectifiers (S1 and S2 in figure 1).

Precise gate-drive control is essential for synchronous rectification, with two control schemes being possible. The first synchronises the gate-drive signals for the secondary-side MOSFET rectifiers with the primary-side MOSFET's gate drive using pulse transformers. But for LLC resonant converters that operate over a wide load range, this method has difficulty in producing secondary gate-drive signals that are usable over the full operating envelope. Because the converter operates above its resonant frequency under light load conditions, the output rectifier currents become discontinuous and phase differences exist between the resonant tank voltages and currents. The resulting timing mismatch causes reactive power flow between the output and the power transformer due to the output capacitor discharging during the discontinuous rectification interval, causing inefficiencies that limit this scheme to resonant converters that operate over a relatively narrow load range.

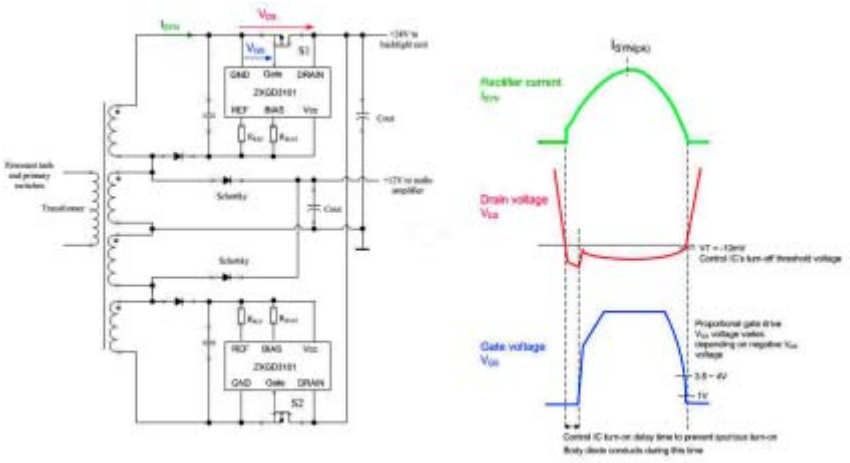


Figure 2 – Drain voltage sensing synchronous controller with analogue gate drive for resonant converter.

An alternative scheme employs signals derived from the secondary side to drive the synchronous MOSFETs. The basic idea relies on sensing the current through the MOSFET rectifiers to derive these drive signals, conventionally using a current-sense transformer and analogue comparator to switch each MOSFET in response to the current flowing through each device. Issues include high component count and the timing delay that the comparator introduces. Figure 2 shows a lossless drain-voltage sensing technique that takes advantage of IC design techniques to overcome these problems, improving conversion efficiency while reduc-

ing system cost by dispensing with the current-sense transformer and discrete comparator.

Drain voltage sensing synchronous control IC

The ZXGD3101 integrates the voltage-detection circuitry, comparator, and MOSFET gate-driver stages to implement a drain-voltage-sensing synchronous controller. As figure 2 shows, the voltage between the chip's GND and DRAIN pins is proportional to the current flowing through the resistance that the MOSFET's source-drain channel presents. Each MOSFET structure also intrinsically includes a forward-biased body diode in parallel with the source-drain terminals. This diode starts to conduct when current in the rectifier starts to flow, generating a negative voltage at the drain pin. Upon detecting this voltage, the controller turns the MOSFET on.

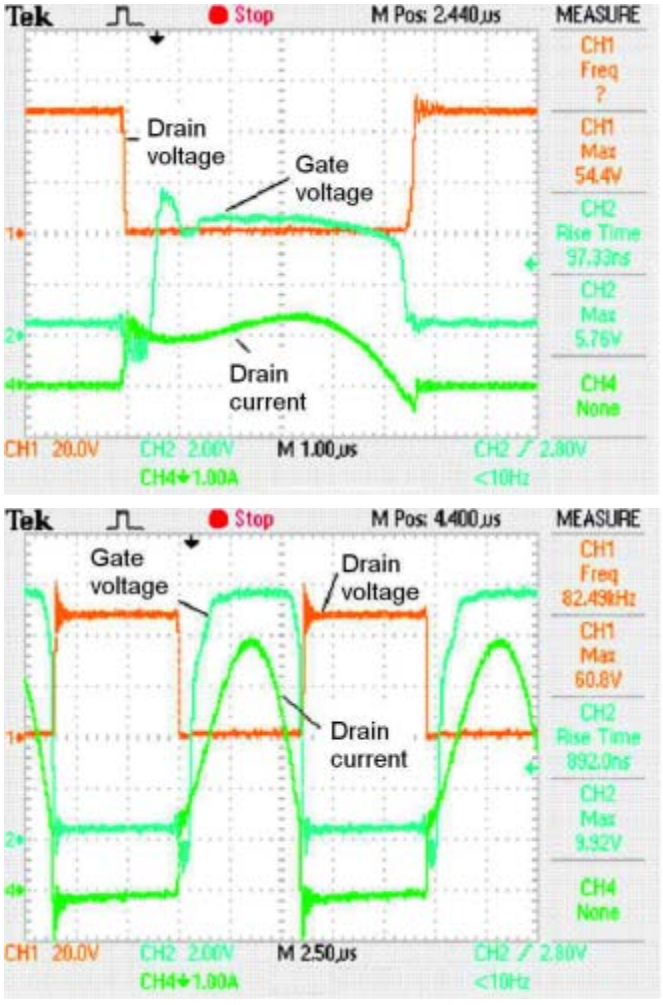


Figure 3 – Synchronous rectifier control waveforms in resonant converter (a) 25% load and (b) full load

At the end of the conduction cycle, efficiency considerations make it imperative to switch the MOSFET off as closely as possible to the zero-current point, and without allowing any reverse current flow. By comparing the drain voltage with a negative threshold voltage and pulling the MOSFET's gate-drive voltage down when the drain voltage is more positive than this threshold value, the controller guarantees to switch the MOSFET off at the optimum time.

An interesting feature of the controller's implementation is its use of an analogue signal to control the MOSFET's gate, rather than the digital high voltage that traditional gate drivers use to enhance the MOSFET throughout its conduction period. The device's proportional gate-drive approach reflects the fact that in a resonant converter, the load current is sinusoidal and losses reach their maximum at the peak drain current point.

Figure 3A shows the controller quickly ramping up the gate voltage as the drain current level rises to around 25% of nominal load capacity, fully enhancing the MOSFET to minimise its on-resistance while it carries significant current. The controller then gradually ramps down the gate-drive voltage in response to falling load current. This adaptive reduction in gate-drive voltage lowers the level of gate charge in the MOSFET, minimising switching power losses while speeding the device's turn-off to prevent reverse current flow. Figure 3B shows a cycle at full output loading, when the gate-drive voltage takes on a more rectangular shape to minimise the conduction losses that dominate due to the MOSFET's on resistance.

Lowering thermal stresses in backlight supplies—example

A representative LCD TV power supply might provide +24V for the screen's backlight, +12V for the audio amplifier, and +5V for analogue and digital circuitry. The +12V and +5V supplies are low current rails that can use Schottky-diode rectifiers without significant compromises. But at full brightness, a 32" screen needs around 144W for the backlight, rising to about 264W for a 42" display. These levels respectively equate to about 6A and 11A that challenge the Schottky rectification approach, with each diode dissipating around 1.275W at 6A and 3.12W at 11A. Heatsinks then become essential to manage heat dispersal, which the sealed nature of TV supplies further complicates.

Compared with the relatively static power dissipation of Schottky diode rectifiers, the drain-voltage-sensing synchronous rectification technique is more complex to analyse. Assuming that the resonant tank circuit filters the harmonics of the input voltage under full load conditions, the RMS drain current of each MOSFET is around 3.33A for a 6A output. Because the controller only turns on the rectifier when it detects conduction within the MOSFET's body diode, there is a theoretical efficiency loss due to the delay in gate activation time that becomes more significant with rises in switching frequency.

In practice, the switching losses are negligible as the synchronous MOSFETs switch on and off very close to the zero current point. As a result—and taking into account body-diode and MOSFET channel losses for a converter switching at 80kHz—each power device's dissipation is about 192mW for a representative 100V part with 9mÙ on-resistance. This means that each MOSFET can safely operate with a junction temperature of just 92ºC within an ambient temperature of 80ºC. The same MOSFET dissipates approximately 935mW at the 11A level that a 42" display requires. Assuming a surface-mount D2PAK footprint that uses the PCB's copper for heat dispersal, the device still operates reliably with a 29.5ºC junction temperature rise.

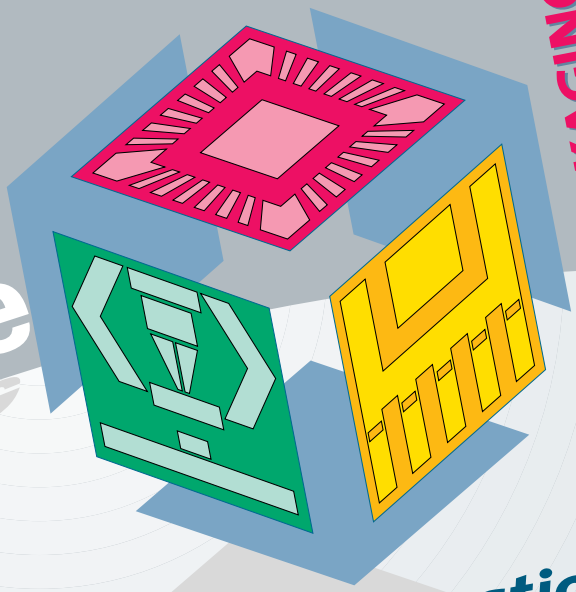
As well as slimming the assembly and its bill-of-materials, power-supply build costs fall yet further because dispensing with through-hole heatsinks allows manufacture to become a one-stage assembly process.

Reference 1: Ang, Yong: "Synchronous rectifier reduces conduction loss in LLC resonant power supplies", application note AN69, March 2009, Diodes Incorporated,

www.diodes.com

smt-exhibition.com

The place to be!



SMT HYBRID PACKAGING

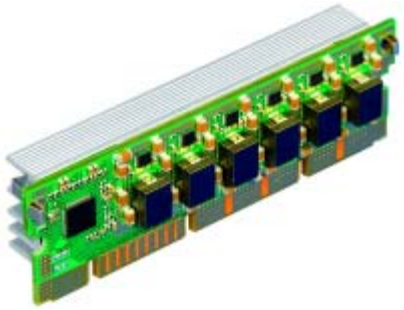
System Integration in Micro Electronics

Exhibition & Conference Nuremberg 8–10 June 2010

Organizer: Mesago Messe Frankfurt GmbH, Rotebuehlstrasse 83–85, D-70178 Stuttgart, Tel. +49 711 61946-79, Fax +49 711 61946-93, smt@mesago.com

High Performance Voltage Regulator Modules

FDK Corporation, a global electronic component and battery manufacturer, introduced the VR Series of voltage regulator modules (VRM) with the announcement of the FPVR12CR50130PA dc-dc converter. Designed to meet the power needs of high end microprocessors and related devices in servers, workstations, supercomputers and storage, the VR Series converters are compatible with the Intel® VRM 11.1 specification. The FPVR12CR50130PA is the first product in this series and delivers up to 130 Amperes (A) of continuous output current with minimal derating and high efficiency.



The FPVR12CR50130PA converter operates from an 11.04Vdc to 12.60Vdc input, and provides an 8-bit VID programmable output voltage in the range of 0.50Vdc to 1.60Vdc. Benchmarked at an output voltage of 1.35Vdc, it delivers the full rated continuous output current of 130A with no derating up to 40 degrees Celsius with 400LFM (2m/s) airflow, at an efficiency of 87%. To minimize capacitance needs, it has a power train comprising six interleaved phases, with an effective switching frequency of 2.4MHz.

The FPVR12CR50130PA is offered in a 3.780 x 0.728 in (96.0 x 18.5mm) card edge package, with a height of 1.177 in (29.9mm). The low profile makes it suitable for applications with rack heights down to 1U, while occupying a footprint of only 2.8 in2 (18cm2). Standard features include remote ON/OFF, over-current and over-temperature protection, and a light load mode to improve efficiency at low output current.

www.fdk.com

Most Energy Efficient 1MBd Digital Optocoupler

Avago Technologies announced the industry's most energy efficient 1MBd digital optocoupler. Avago's compact low power ACPL-M50L single channel optocoupler, which operates on approximately 80 percent less drive current than today's standard 1MBd digital optocouplers, targets designers of communication interfaces, microcontroller system interfaces, switching power supplies, and digital isolation for A/D, D/A conversion applications.

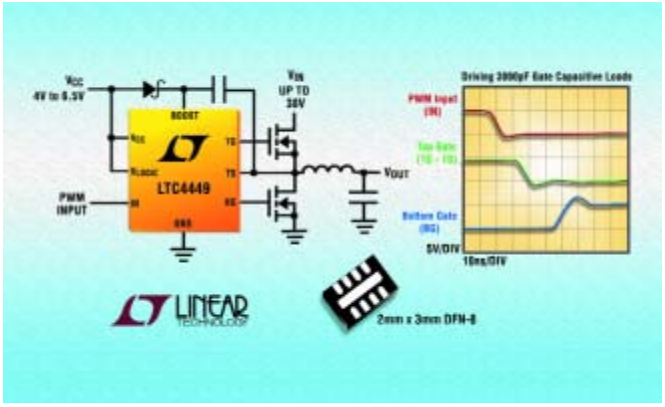
The ACPL-M50L provides superior high voltage performance over the lifetime of the product while meeting safe insulation requirements for reinforced applications. Available in a small outline-5 (SO-5) package size, Avago's ACPL-M50L high speed digital optocoupler supports a wide supply voltage range from 2.7 to 24-volts and is driven by low forward drive current (IF > 3mA) with a high current transfer ratio (CTR > 80 percent min.) to allow direct drive from a microcontroller without the need to add a buffer chip.

Separate connections for the photodiode bias and output transistor collector of the ACPL-M50L increases its speed up to a hundred times over that of a conventional phototransistor by reducing the base-collector capacitance. Additionally, this optocoupler operates over a wide temperature range from -40 to +105 degrees-C making it ideal for use in harsh industrial environments.

www.avagotech.com

High Speed Synchronous N-Channel MOSFET Driver

Linear Technology Corporation introduces the LTC4449, a high speed synchronous MOSFET driver designed to drive upper and lower power N-channel MOSFETs in a synchronous rectified converter topology. This driver, combined with one of Linear Technology's DC/DC controllers and power FETs forms a complete high efficiency synchronous regulator that can be used as a step-down or step-up DC/DC converter.



The LTC4449 drives both upper and lower MOSFET gates over a range of 4V to 6.5V and operates from a supply voltage up to 38V. This powerful driver can sink up to 4.5A and source up to 3.2A, making it ideal for driving high gate capacitance and high current MOSFETs. It can also drive multiple MOSFETs in parallel for higher current applications. The fast 8ns rise time, 7ns fall time of the top MOSFET and 7ns rise time, 4ns fall time of the bottom MOSFET, when driving a 3,000pF load, minimize switching losses. Adaptive shoot-through protection is integrated to prevent the upper and lower MOSFETs from conducting simultaneously while minimizing dead time. The LTC4449 features a 3-state pulse with modulation (PWM) input for power stage control and shutdown that is compatible with all multiphase controllers employing a 3-state output feature. In addition, the LTC4449 has a separate supply for the input logic to match the signal swing of the controller IC, as well as an undervoltage lockout circuit on both the driver and logic supplies.

www.linear.com

Scan Drivers Minimize Panel Cost in LCD HDTVs

Maxim introduced the MAX17120/MAX17121, triple/dual, high-voltage, level-shifting scan drivers for TFT panels with integrated gate logic. These devices minimize panel cost in LCD TVs by integrating all logic required to implement a high-performance scan-driver system. Each scan driver has two channels that switch complementarily.

Their outputs swing from +40V to -30V and can swiftly drive capacitive loads. In order to save power, these complementary outputs share the charge of their capacitive load before they change states. These devices are well suited for driving large- (MAX17120) and regular-sized (MAX17121) HDTV LCD panels.

The MAX17120 is available in a 5mm x 5mm, 32-pin TQFN package, and the MAX17121 is available in a 4mm x 4mm, 24-pin TQFN; both packages have a maximum thickness of 0.8mm for ultra-thin LCD panels. Prices start at $0.70 (1000-up, FOB USA).

www.maxim-ic.com

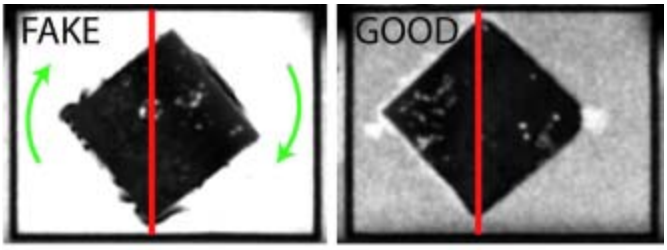
Sonoscan Expands Counterfeit Identification Menu

SonoLab®, the applications laboratory division of Sonoscan, has recently developed analytical techniques that bring to 25 the number of acoustically detectable features and characteristics used to separate counterfeit plastic IC packages from genuine packages.

"The increase in useful tools is the result of our growing base of experience in separating counterfeit components from genuine parts – often within a mixed lot shipment," said SonoLab manager Ray Thomas. "Our laboratories are seeing more questionable parts because the industry has become much more interested in weeding out counterfeit parts. Ideally, engineers have known genuine parts to which they can compare incoming parts."

Identifying a counterfeit component may be straightforward, but is often more complex. Part of the problem is that counterfeiters are becoming more skilled at making their knock-offs resemble genuine components. Using a greater number of acoustic techniques increases the confidence factor when separating genuine parts from fake parts. Measuring two or three parameters may suggest that a part is genuine or fake, but having a menu of 25 items on hand makes it much easier to make clear distinctions.

In this acoustic image of two D-PAKs, the diamond shape is the die, attached to its rectangular substrate. In the counterfeit D-PAK at left,



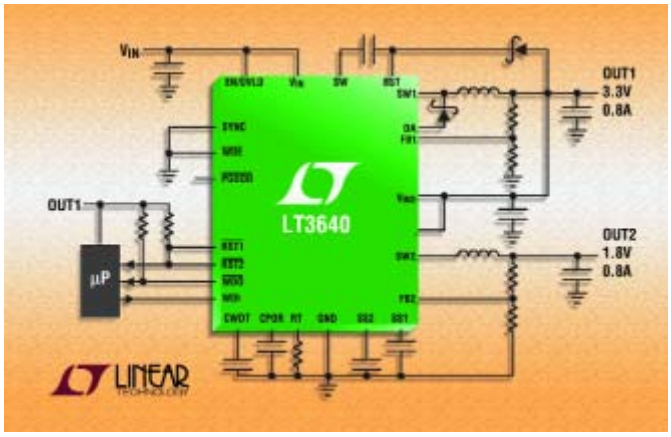
the die is rotated (arrows) out of its correct position. It is also closer to the lower edge of the substrate than the good die at right. The die in genuine D-PAK at right is properly centered and aligned, thus indicating that the counterfeit part was manufactured by a different vendor or a different process. In addition, the mold compound shows measurable variation between the two packages.

For more information, contact SonoLab manager Ray Thomas at 847 437-6400 x 245.

www.sonoscan.com

2MHz Dual Channel Step-Down Regulator with Power-On Reset

Linear Technology Corporation announced the LT3640, a dual channel, current mode step-down switching regulator with a power-on reset and watchdog timer. Its 4V to 35V input voltage range with 55V transient ride through makes it ideal for load dump and cold crank conditions commonly found in automotive applications. The LT3640 uses a unique dual channel design with a high input voltage (4VIN to 35VIN, 55VIN transient) nonsynchronous channel that delivers 1.1A of output current, combined with a lower input voltage (2.5VIN to 5.5VIN) synchronous channel that provides up to 0.9A of continuous output current. Although the part allows separate inputs for each channel, most applications will use the output of the high voltage channel to power the lower voltage channel, offering dual outputs while optimizing efficiency and switching frequency. For example, using a nominal 12V input and a 2MHz switching frequency, the LT3640 can deliver a 3.3V output at 600mA with 85% efficiency via its high voltage channel and a 1.8V output at 800mA with 87% secondary conversion efficiency via its lower voltage channel.



The integrated microprocessor supervisor functions support high reliability applications such as automotive electronic control units. The LT3640 includes one power-on reset timer for each channel and one common watchdog timer. The reset and watchdog timeout periods are independently adjustable using external capacitors. Tight accuracy specifications and glitch immunity ensure reliable reset operation of a system without false triggering. The LT3640 implements a windowed watchdog timer monitoring falling edges at its watchdog input pin that are grouped too close together or too far apart.

www.linear.com

Capacitors Provide 3,000-Hour Ripple Load Life

Providing power electronics design engineers with capacitors that combine proven high ripple current performance and economical pricing, Cornell Dubilier recently introduced two new snap-in aluminum electrolytic capacitor series with extended voltage rating up to 450Vdc. Designated the Type SLP (105°C) and SLPX (85°C) series, the capacitors are targeted for next generation switching power supplies, DC filtering circuits in inverters and motor drive applications.

"These new snap-in aluminum electrolytics provide a wide range of capacitance values and voltage ratings with exceptional ripple current life-test capabilities," said Jim Navarro, product manager at Cornell Dubilier.

"Their combination of reliable performance and best value pricing make them ideal for a wide range of power electronics applications."

Both the Type SLP and Type SLPX capacitors are available in diameters from 22 to 35 mm and lengths from 25 to 50 mm, with 10 mm spacing snap-in leads. Standard capacitance values for the Type SLP Series range from 47 to 56,000 µF, tolerance ±20%, with voltages from 10 to 450 Vdc. Standard capacitance values for the Type SLPX Series range from 68 to 82,000 µF, tolerance ±20%, with voltages from 10 to 450 Vdc. Special ratings are also available. OEM pricing for the Type SLP and SLPX Series capacitors starts at $0.37 each in quantities of 1000, with lead times from stock to 8 weeks after receipt of order.

www.cde.com

Innovative Power Switching Devices for Energy Efficient Home Appliances

Infineon Technologies AG introduced a family of power switching devices for use in high energy efficiency electric motor drives of home appliances. The new 600V IGBT RC-Drives family (RC for Reverse-Conducting) enables more cost-effective design of variable speed electric motors, which can reduce the energy consumption of appliances by up to 30 percent in many applications.

Variable speed motor drives in such appliances as washing machines, refrigerator compressors, inverterised air conditioners, and dishwashers use electronic controls and a switching power supply to obtain the best efficiency under different usage conditions. The IGBT (Insulated Gate Bipolar Transistor) RC-Drives family integrates Infineon's market leading TRENCHSTOP™ IGBT technology and a free-wheeling diode into a single die resulting in a device with low conduction losses and package shrink compared to competitor solutions. This in turn allows for a reduction in the system circuit board area and heat sink size, plus can reduce the overall motor drive system cost by up to 10 percent.

www.infineon.com

900V Rugged and Fast Polar Series Power MOSFETs

IXYS Corporation announced the 900V additions to its comprehensive Polar HiPerFETTM Power MOSFET product portfolio. Available with drain current ratings from 10.5 Amperes to 56 Amperes, these new 900V additions complement IXYS' high-voltage Polar HiPerFETTM MOSFET product line (available from 500V to 1200V), providing the end customer a broader selection range of robust, energy efficient high-voltage MOSFET solutions to choose from. These new 900V devices combine advantages derived from IXYS' Polar Technology platform and HiPerFETTM process to provide improved power efficiency and reliability in today's demanding high-voltage conversion systems that require bus voltage operation of up to 700V.

IXYS' Polar Technology platform has been especially tailored to minimize on-state resistance while maintaining a low gate charge. This results in a substantial reduction in conduction and switching losses of the device. Lower thermal impedances are also achieved, increasing the total power density capability of these devices. Power switching capabilities and device ruggedness are further enhanced with a fast intrinsic diode with low reverse recovery charge (Qrr) and improved turn-off dV/dt immunity.

IXYS offers a full range of discrete standard thru-hole and surface mount packages for these new Polar HiPerFETTM additions. Versions are also offered in IXYS proprietary ISOPLUS packages, providing UL recognized 2500V isolation with superior thermal cycling and thermal performance.

www.ixys.com

Brochure on Durable Electronics & Lighting Solutions

The Durel Division of Rogers Corporation has issued a new six-page brochure on Durable Electronics & Lighting Solutions. The brochure provides a detailed overview of Rogers' comprehensive capabilities in screen-printed electronics and associated services, gained from over 20 years of design and high volume manufacturing experience in printed electronics, low power EL backlighting systems and EL driver ICs.

The Durable Electronics & Lighting Solutions brochure presents essential information on three product category areas where Rogers provides innovative "solutions" for customers: User Interface, Driver Electronics and Printed Electronics. Rogers' capabilities in ultra fine screen printing, precision registration, design and materials and global high volume manufacturing are also described in the brochure.

To download a copy of the new Durable Electronics & Lighting Solutions brochure, or for more information on the complete family of DUREL products from Rogers Corporation, visit

www.rogerscorp.com/durel

Single-Chip Battery Fuel Gauge with Protection

Texas Instruments introduced the industry's smallest, full-featured battery fuel gauge integrated circuit for portable consumer, commercial and industrial applications. The bq3060 turns a battery into a "smart battery" that measures and maintains an accurate record of available capacity, voltage, current, temperature and other critical parameters for lithium-based batteries. The single chip also provides robust battery safety, including authentication, short-circuit and discharge protection. See: www.ti.com/bq3060-preu.

In addition to maximizing functionality and safety, the bq3060 dramatically reduces cost and size for smart batteries. The device comes in a 24-pin, 7.8-mm x 6.4-mm TSSOP package, and is a 50 percent smaller solution when compared to a high-end fuel gauge. The small size allows the chip to reduce the form factor of battery packs in many portable designs, including portable commercial, medical and test equipment.

www.ti.com

Updated Website for AMT Encoder Series

CUI Inc announced that it has launched a new version of amtencoder.com, a website dedicated to their proprietary AMT modular encoder series. The site now features detailed product pages, a resource area with technical documents, videos, frequently asked questions, a news section, and an inventor's bio. CUI's VP of Marketing Jeff Schnabel commented, "Users of the new amtencoder.com can expect to find a wealth of resources on this exciting technology and the products that utilize it."

The AMT encoder has been designed with proprietary, capacitive, code-generating technology that represents a breakthrough in cost vs. resolution. Capacitive technology holds numerous advantages over the optical technology typically used in today's modular encoders. The AMT's design allows users to select from a range of resolutions via an on-board dip switch, creating flexibility for companies utilizing multiple encoders in their applications. Additionally, common problems associated with optical encoders, including fragility of the optical disk, LED burn-out, limited temperature range, and high current consumption are eliminated by capacitive technology.

The AMT is available immediately through Digi-Key starting at $29.95 for 1 piece. Contact CUI directly for OEM quantities.

www.amtencoder.com

High Brightness Blue and Green 5mm Through-Hole LED Lamps

Avago Technologies announced a new series of 5mm green and blue high brightness, high performance Through-hole LEDs for use in Electronic Sign and Signal applications. Avago's competitively priced HLMP-Cxxx Through-hole round LED lamp series provide high reliability performance and high luminous intensity in electronic signs to help improve the contrast ratio and readability in sunlight. These new LEDs are also ideal for use in Traffic Signs, Variable Message Signs, and Monocolor Signs.

Each of the HLMP-Cxxx series LEDs are made with an advanced optical grade epoxy offering superior high temperature and high moisture resistance. Moreover, the package epoxy has high Ultra-violet resistivity which can reduce the effects of long term exposure to direct sunlight.

www.avagotech.com

ADVERTISING INDEX

Innovation never stops

Powerful
from SPT to SPT+

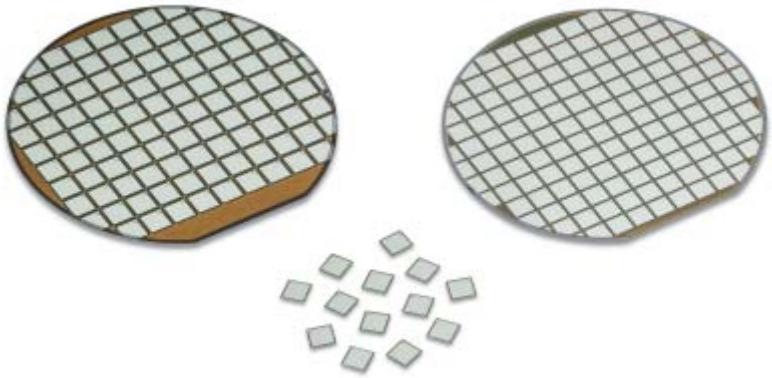
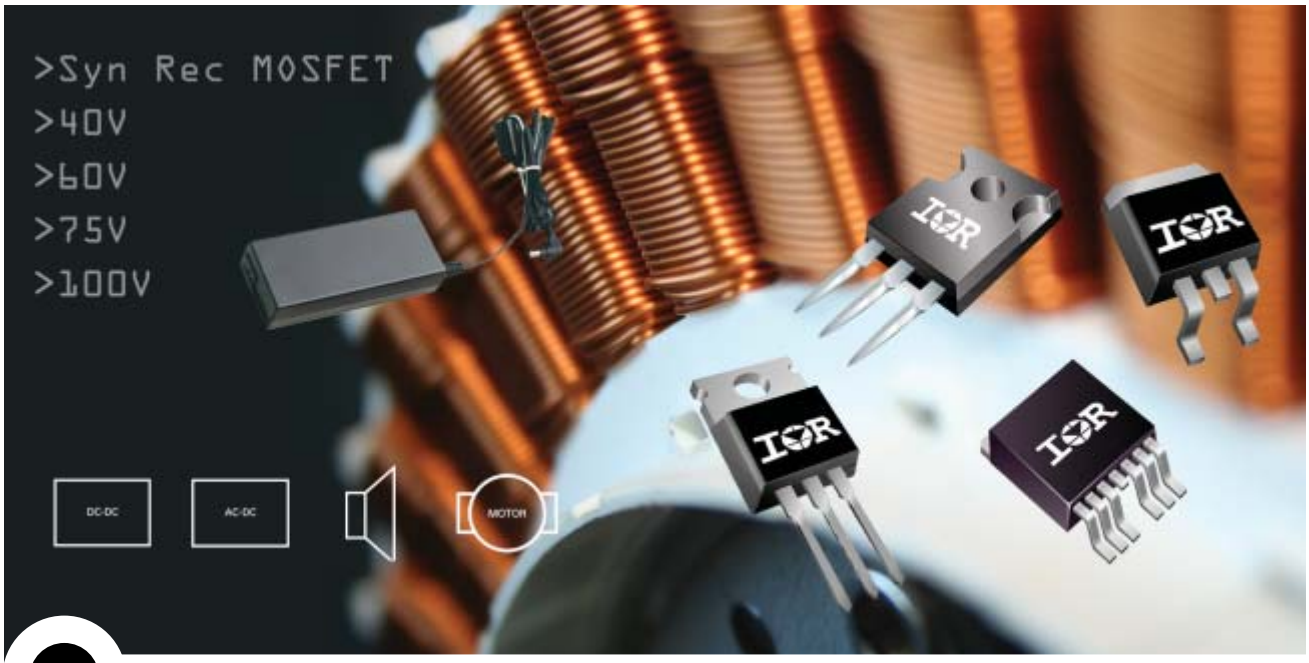


ABB Switzerland Ltd
Semiconductors
Tel: +41 58 586 1419
www.abb.com/semiconductors

Power and productivity
for a better world™

ABB



Lower $R_{DS(on)}$ Higher Performance

Part Number	V_{DS} (V)	I_D (A)	$R_{DS(on)}$ Max @ V_{GS}=10V (mΩ)	Qg (nC)	Package
IRFS3004-7PPBF	40	240	1.25	160	D²PAK-7
IRFP4004PBF	40	195	1.7	220	TO-247
IRFS3004PBF/ IRFB3004PBF	40	195	1.75	160	D²PAK/ TO-220
IRFR4104PBF	40	30	5.5	59	D-PAK
IRFS3006-7PPBF	60	240	2.1	200	D²PAK-7
IRFS3006PBF/ IRFB3006PBF	60	195	2.5	200	D²PAK/ TO-220
IRFB3206PBF	60	210	3.0	120	TO-220
IRFS3206PBF/ IRFP3206PBF	60	210	3.0	120	D²PAK/ TO-247
IRFR1018EPBF	60	79	8.4	69	D-PAK
IRFP4368PBF	75	195	1.85	380	TO-247
IRFS3107-7PPBF	75	240	2.6	160	D²PAK-7
IRFS3107PBF	75	195	3.0	160	D²PAK
IRFB3077PBF	75	210	3.3	160	TO-220
IRFR3607PBF	75	80	9.0	84	D-PAK
IRFP4468PBF	100	195	2.6	360	TO-247
IRFS4010-7PPBF	100	190	4.0	150	D²PAK-7
IRFB4110PBF	100	120	4.5	150	TO-220
IRFS4010PBF	100	180	4.7	143	TO-220
IRFP4568PBF	150	171	5.9	151	TO-247
IRFB4115PBF	150	104	11.0	77	TO-220
IRFS4115PBF	150	99	12.1	77	D²PAK

- Tailored for Synchronous Rectification
- Optimized for fast switching
- Up to 20% lower $R_{DS(on)}$*
- Up to 20% increase in power density*
- RoHS Compliant
- Lead Free

*Compared to previous generations

Your FIRST CHOICE for Performance

for more information call +49 (0) 6102 884 311

or visit us at www.irf.com

International
IOR Rectifier
THE POWER MANAGEMENT LEADER