ISSN: 1863-5598

ZKZ 64717
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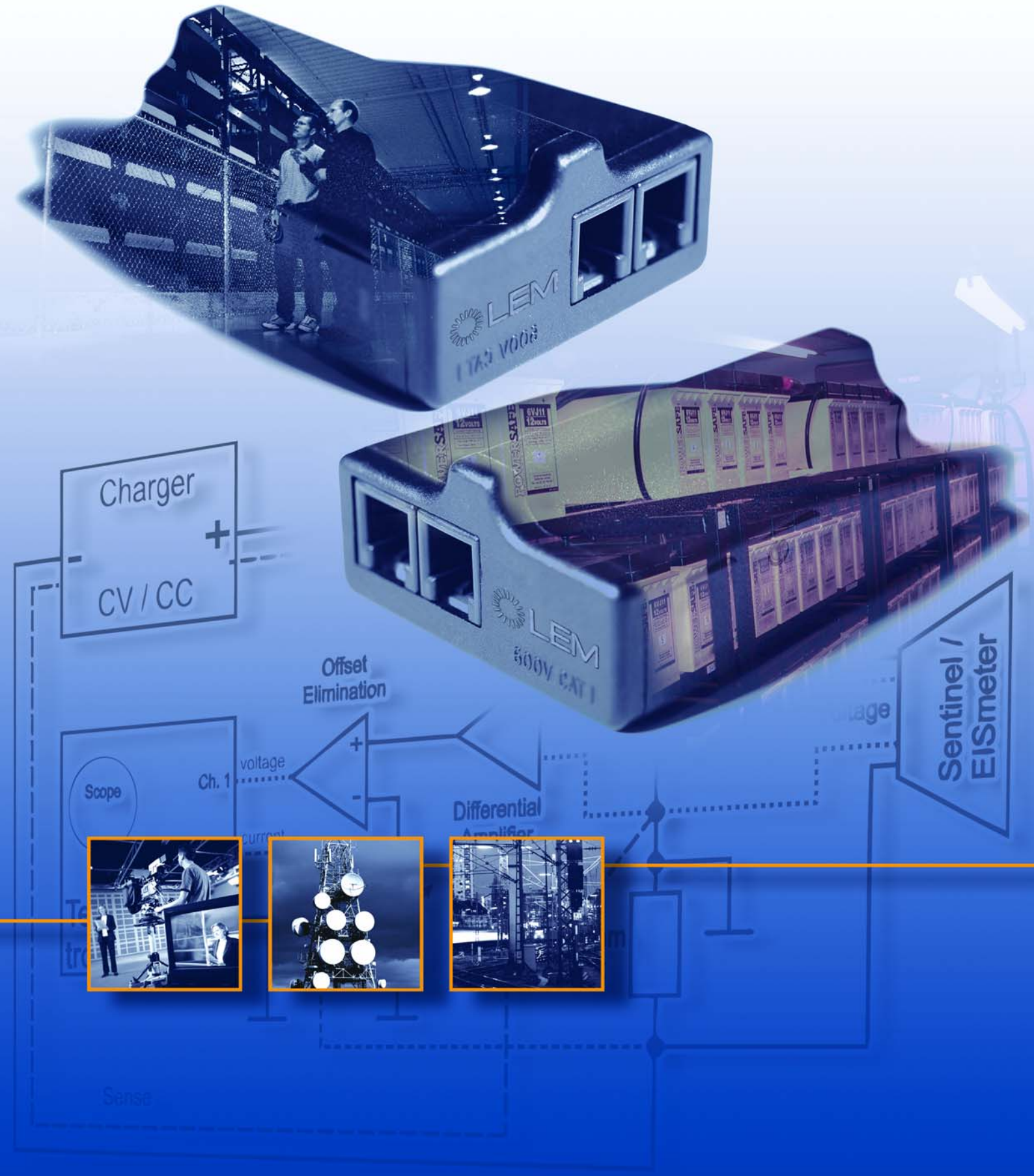
Bodo's Power Systems®

Electronics in Motion and Conversion

December 2008

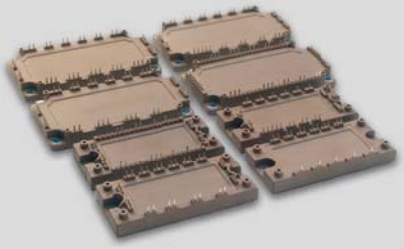


FUJI ELECTRIC
DEVICE TECHNOLOGY
e-Front runners

Knowledge is power
power is our knowledge

DualPack
with Soldering Pins
1200V : 225A - 450A

DualPack
with Spring Contacts
1200V : 225A - 450A



6-Pack IGBT
600V : 15A - 150A
1200V : 10A - 150A
1700V : 100A - 150A

PIM IGBT
600V : 30A - 100A
1200V : 10A - 75A

1-Pack
1200V : 1200A - 3600A
1700V : 1200A - 3600A

2-Pack
1200V : 800A & 1200A
1700V : 600A & 1200A

2-Pack IGBT
600V : 50A - 600A
1200V : 50A - 450A
1700V : 150A - 400A

1-Pack IGBT
600V : 600A
1200V : 200A - 800A

High Power 6-Pack
1200V : 225A - 450A
1700V : 225A - 450A

Special version available for rough environments

IPM-IGBT
600V : 15A - 300A
1200V : 15A - 150A

Discrete IGBT
600V : 5A - 75A
1200V : 3A - 25A

Fuji Electric Device Technology Europe GmbH
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The Gallery

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PrimePACK™ is a trademark of Infineon Technologies AG, Munich

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- Superior EMC

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www.IGBT-Driver.com

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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 09/2006

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

Events

Power Electronics 2008
Moscow
December 2-4
http://www.powerelectronics.ru

APEC 2009
Washington DC
February 13- 21
http://apec-conf.org

Embedded 2009
Nuremberg Germany
March 3-5
http://www.embedded-world.de

EMC 2009
Stuttgart Germany
March 10- 12
http://www.e-emv.com

Believe in Santa and in His Deliveries

The annual Christmas drawing has taken place, entries with pictures of locomotives went into the drawing and the winners have been notified. While all those who participated will get a little present from Santa, there are three very happy children out there who won. Entries came in from all over the world confirming that my magazine has global coverage. The world developed into a single market place a long time ago, design and manufacturing have spread out, most companies operate globally and my gifts find children everywhere.

The year 2008 with its disaster scenario in world finance has shown a need to focus on sustainable and long-term strategies. Electronica in Munich highlighted engineers as innovators advancing technical solutions for a better world. The SPS/IPC/DRIVES show demonstrated power electronic systems achieving higher efficiency. Reducing power consumption is one of the greatest ways to overcome limited power resources. Take a look at Arunjai Mittal's Guest Editorial in the November issue which highlights the prospects for efficient energy utilization. Renewable and alternative power sources are complementing pathways for future development.

A very successful veteran of power electronics and former PCIM Conference Director, Jean-Marie Peter, started his career when he was seven years old with a Marklin train that his grandfather put under the Christmas tree for him. Understanding the physical basis of running the loco on ac power was his inspiration to become an engineer and, now, Jean-Marie has given his train set to one of his grandchildren. What worked once could work again.

Frank Vernon Jorgensen at SEMICON in Stuttgart suggested another great way to inspire future engineers by taking older school children on field trips to see technical innovation happening, such as the CERN labs in Grenoble, where physics comes down to the very basics of understanding our universe. He told me that after such a recent field trip a number of the children found their way into physics and engineering. America will have Mr. Obama as their new President in 2009 and the world expects him to get the Wall Street crisis under control. I wish that a similar worldwide focus would be put on the best possible education for children. Education is an asset that cannot erode; it is a platform resilient to the changes in our world. In addition to the joy it brings me to see the happy winners, this the basis for my gifts being educational toys. PCIM will be the next big event where you might be lucky enough to win a train set.

My Green Power tip for this month:
Spend your resources on good education for your children; lead them by example to an understanding of the physics and opportunities for efficient energy usage in heating, cooling and lighting your household. Closing doors, turning down heating and turning off lights that are not needed will result in a great reduction of your energy consumption. And the right toys will be extra fun. There is a lot we can do for our children's future.

Merry Christmas and a Happy New Year

Bodo Arlt

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DESIGN!

Demand versatile Supervisors that can be adapted to the changing needs of your system designs.

Eliminate the need for a different supervisor for every design and platform. The ISL88016 and ISL88017 allow users to choose from 26 different customized V_{TRIP} selection settings.

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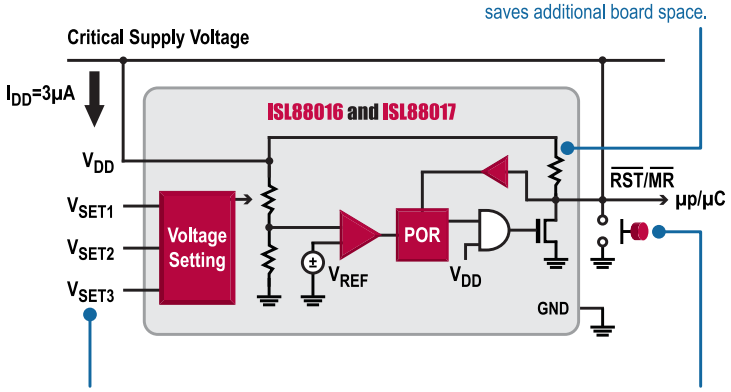
20kΩ **Integrated Pull-Up Resistor** saves additional board space.



Set the V_{SET} pins: HIGH, LOW or Floating to choose from **26 different V_{TH} combinations**

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intersil.com/ibuy

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intersil.com/power

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Celebration of 30th Anniversary

In 2008, the German branch of Mitsubishi Electric Europe B.V, based in Ratingen celebrates its 30th anniversary. In addition to a summer event held for around 500 employees and their families on June 20th 2008, an anniversary event for an expected 400 customers and partners is due to be held in October 2008. “For 30 years our German branch has been an essential part of the European business of Mitsubishi Electric. The excellent achievements and the constant success of our company are due to our committed employees, business partners and customers”, explains Noriaki Himi, German Branch President.

The branch, opened in 1978 is situated close to the city of Düsseldorf and develops and distributes the electric and electronic products of its parent company Mitsubishi Electric Corporation in Tokyo. Around 500 employees, originating from 26 countries are also responsible for customer services, and product servicing. The branch’s export activities, across various industries, cover large parts of Western and Eastern Europe as well as Russia and South Africa.

www.mitsubishichips.com

H2Expo Confirmed as Key Innovation Forum

Over 1400 conference delegates and trade fair visitors in Hamburg

H2Expo, 7th International Conference and Trade Fair on Hydrogen and Fuel Cell Technologies, has again confirmed its position as a major international innovation forum. It attracted more than 1400 conference delegates and exhibition visitors, providing them with information on the latest developments and products at this two day event at CCH-Congress Center Hamburg. About 40% of conference participants were from abroad. Interest in the trade fair was also strong, with a wide range of application examples from some 50 exhibitors. The “H2 in Action” section featured a series of fuel cell powered vehicles, including the first presentation of a new mobile hydrogen fuelling station by Linde Gas.

“This has once more demonstrated the great importance of H2Expo as an information platform for this forward-looking industry,” said Bernd Aufderheide, CEO of Hamburg Messe und Congress GmbH. “H2Expo was an excellent opportunity to present flagship projects to an expert audience in this international context. Hamburg is a leader in this field.” He added that the concept of holding the event at two-year intervals was working well. “We are very pleased with the rise in exhibitor and visitor numbers.”

“H2Expo in Hamburg plays a very significant role in the development and transfer of hydrogen and fuel cell technology,” said Dr. Subhash Singhal of Pacific Northwest Laboratory, USA. Together with Professor Wolfgang Winkler of the Hamburg University of Applied Sciences, he was chairing the conference, which provided a forum for exchange on experience and results between experts from Europe, Asia and the US. Professor Winkler emphasised that the conference and trade fair were particularly important for Hamburg as one of the leading centres of the maritime and aviation industries, “in particular for economic development”. He added that the trade fair and conference acted as an interface between research organisations and international corporations.

H2Expo was described as “one of Europe’s most important technical and scientific events in hydrogen technology” by Dr.-Ing. Gerd Würsig of the sponsoring organisation Germanischer Lloyd. He highlighted in particular the diversity of exhibitors, and their high quality. And he also mentioned the high-ranking delegates at the symposium and the various workshops.

“Hamburg is indispensable for us,” said Werner Hoyer of the German Aerospace Centre (DLR). He mentioned DLR’s close cooperation with Deutsche Airbus GmbH, for which DLR was developing a fuel cell for emergency power supply on board the Airbus A320, and hence the vital role of Hamburg and H2Expo. “And we will be building on our cooperation with Airbus,” he added. Hans-Jürgen Heinrich of Airbus Deutschland said “We have had a lot of discussions with other users interested in fuel cell system applications in maritime and aviation projects”. These are examples of the outstanding opportunities at H2Expo for generating synergies in the use of fuel cell tech¬nologies and applying them in practice.

“Hamburg is now the hydrogen hotspot in Germany,” said Dr. Joachim Kroemer of Proton Motor. Proton presented their fuel cell powered commercial vehicle EcoCarrier HY3, developed in cooperation with Wilhelm Karmann GmbH. “We had very good response to our innovative product,” he said.

“H2Expo is an important forum for exchange between suppliers and users,” said Keno Leites of ThyssenKrupp Marine Systems AG. He felt the conference had a strong international position, enabling vital exchanges on technical innovations.

“I am surprised to see so many participants from abroad here at H2Expo,” said Dr. Claus Fischer of Heliocentris Energiesysteme GmbH, reporting good to very good visitor figures at his company’s stand.

Huau-Ruei Shiu of the Industrial Technology Research Institute from Taiwan stressed the importance of exchanges on the different scientific approaches in Asia and Europe, highlighting the important role played by H2Expo in this respect.

Christian Tuchel of Linde AG noted the great interest shown by trade visitors in the joint stand of the Hamburg Initiative for Fuel Cell and Hydrogen Technology. He stressed the importance of H2Expo in demonstrating the good cooperation between government, research and users. “One of the major functions of this fair is to attract public attention to current and future projects in this industry.”

The Zemships conference (Zero Emission Ships) was held for the first time in the framework of H2Expo, and met with very good response, according to conference chairman Heinrich Klingenberg, CEO hySOLUTIONS. He said that H2Expo had given visitors an opportunity to experience technical applications in fuel cell technologies in practice, “for example by excursions on the world’s first fuel-cell powered passenger vessel.” The important role of Hamburg for development and application of hydrogen and fuel cell technology was emphasised by Marieke Reijalt, Executive Director of the European Hydrogen Association, at the Zemships Conference. “Hamburg is setting an example, with a whole range of applications in this sector. That is important for the political work at European level.”

The next H2Expo – 8th International Conference and Trade Fair for Hydrogen and Fuel Cell Technologies, will be held at CCH-Congress Center Hamburg in October 2010.

www.h2expo.de

Ferraz Shawmut Global Leader in Thermal Management

R-Theta Thermal Solutions Inc., a Canadian company based in Toronto, has joined forces with Ferraz Shawmut Thermal Management. With this acquisition, the scope of Ferraz Shawmut's cooling unit business has grown in three ways:
First the product range of high tech solutions in water and phase change cooling now

embraces R-Theta's high performance air cooling solutions.
Second the geographical coverage is broader than ever, with a North American base joining Third the historic European plant in La Mure, France, and our brand-new set-up in Kunshan, China.
Emmanuel Carmier Director Thermal Management explained the improvements and new installations in La Mure to be strongly competitive in the market.
The revenue is enhanced by R-Theta's sales, essentially on the North American market.
This kind of global scale is vital for Ferraz Shawmut Thermal Management, putting us in an ideal position to advise and serve our big OEM customers (manufacturers of electrical and electronic equipment). So Ferraz Shawmut Thermal Management has become a global partner for key accounts, with the ability to serve them wherever they're developing and producing around the world.
Ferraz Shawmut Thermal Management's global business will continue to grow, as it faithfully follows the continuous improvement in the performances of electronic components that makes better cooling a must, as well as the increasing use of electronics in every area of industry, with the development of power efficiency, renewable energies and transportation. That growth relies on the innovative and competitive nature of the solutions to offer to OEM customers in electronics and in transport: compact, lightweight solutions to extract heat efficiently.

www.ferrazshawmut.com

Certificates of Registration to the aerospace quality standard AS9100

KEMET has announced that their Tantalum and Ceramics manufacturing operations have been awarded Certificates of Registration to the Aerospace Quality Standard AS9100. Registration is rapidly becoming a prerequisite for aerospace customers and the certificate will reduce the need for numerous customer audits.
AS9100 is a set of requirements for quality management systems that include all ISO 9001:2000 requirements expanded to address international aerospace requirements approved by major aerospace companies around the world. Registration is reserved for companies committed to providing excellent customer service, continual improvement, and outstanding product quality.

www.kemet.com

Standby Power Product Brand

Ultralife Corporation, a global leader in high-energy power solutions and communications systems for diverse applications, today announced its launch of RPS Power Systems, a supplier of backup power hardware solutions for mission-critical power needs in the telecommunications, utility, financial and information-services industries.
Acquired by Ultralife in November 2007 under the name of Reserve Power Systems, Inc., RPS provides comprehensive hardware solutions incorporating energy storage and electronics for critical power applications and renewable energy needs. RPS offers an extensive range of market-competitive products, including VRLA (Valve Regulated Lead Acid) batteries, racks, cabinet systems, trays, cables and accessories as well as soon-to-be-announced UPS systems, telecom inverters and power distribution units.

www.rpspowersystems.com
www.ultralifecorp.com

Fuji Electric and Semikron Team Up

Fuji Electric Device Technology Co., Ltd. , Japan, leading global manufacturer of power semiconductor components and with the third-highest ranking of worldwide IGBT module supplier market share (source: Worldwide market for power semiconductor discretes and modules 2008, IMS-Research) and Semikron International GmbH, Germany, market leader for diodes and thyristor modules with a 37% market share ("Worldwide market for power semiconductor discretes and modules 2008", IMS-Research) and expert in packaging technology for power semiconductor modules, signed a supply and licence agreement at Semikron in Nuremberg. Fuji Electric will supply IGBT semiconductor chips to SEMIKRON; in return Semikron will supply Fuji Electric with freewheeling and rectifier diode chips, and module cases in spring contact technology. Power modules with spring contacts will be manufactured by Fuji Electric under licence. Under this co-operation, the two companies are forging the basis for mutual supply of power semiconductor chips. With the new freewheeling diode and rectifier diode chips from SEMIKRON and the IGBT chips from Fuji Electric, both companies are expanding their product range to offer customers the optimum chip/module combination for a given application. By using the same spring contact technology Fuji Electric and SEMIKRON are able to increase the market penetration for industrial drives, power supplies and home appliances. This matches the second source policy of customers.
Dirk Heidenreich, CEO of Semikron International and Dr. Hisao Shigekane, President and Representative Director of Fuji Electric Drive Technology sign the agreement.

www.fujielectric.com
www.semikron.com

Dietmar Hilgers VP Manufacturing and Supply Chain

Munich, Germany – October 13, 2008 – Vincotech, a Gores Group company and trusted provider of power modules and other technologies used in industrial, solar, automotive and GPS applications, today announced that Dietmar Hilgers has been appointed vice president of operations. In this newly created position, Hilgers reports to Rainer Sendrowski, General Manager Vincotech Group, and is based in Unterhaching, Germany.
A 15-year veteran of the automotive industry and a functional expert in Toyota Production System principles, Hilgers manages Vincotech's global operations, including its manufacturing plants in Bicske, Hungary, and Shenzhen, China. He also oversees global quality, supply chain and strategic purchasing.

www.vincotech.com

Mike Heitzman VP of Marketing

Qspeed Semiconductor, manufacturer of high performance power semiconductors, has named 25-year semiconductor business executive Mike Heitzman as vice president of marketing. Heitzman has spent his entire career in the semiconductor industry, including top management positions at ON Semiconductor and Motorola's Semiconductor Products Sector. His diverse business expertise comes from experience in general management, operations, strategy implementation and marketing for the semiconductor industry.

Most recently, Heitzman served as vice president of technology development for ON Semiconductor in Phoenix, Ariz. Prior to that, Heitzman was vice president and general manager of the company's Analog and Power Management Products Division, where he led a team in refocusing the division's new product development strategy and introduced energy-conserving power management products that earned global recognition.

www.Qspeed.com

Distributor to Boost European Sales and Service

As part of its program to strengthen local support, gain a closer understanding of customers' needs, and as part of its ongoing strategy to achieve the highest levels of communication and service, Ericsson Power Modules has signed a distribution agreement with ELFA AB.

Under the agreement, ELFA will support Ericsson Power Modules' sales in the main parts of Europe, serving customers and expanding both sales and demand in the catalog and buy-online market segments for Ericsson's product portfolio. ELFA's inventory will include Ericsson Power Modules' isolated and non-isolated DC/DC converters and regulators. The ELFA catalogue, often referred to as the reference book of the electronics business, is distributed by way of 134,000 copies to electronics users throughout Europe.
The high level of technology, ruggedness and reliability of Ericsson Power Modules products results in excellent solutions for the communication industry, as well as applications that are in demand in the medical, avionics, computing, military, space and industrial market sectors.

www.ericsson.com
www.elfa.se

Tom Larson Elected to Board of Directors of ESDA

TREK, INC., a designer and manufacturer of high-performance electrostatic instrumentation and high-voltage power amplifiers, announces that Tom Larson, Sales Manager at TREK, was elected to the Board of Directors by members of the Electrostatic Discharge Association at the organization's 2008 Annual Meeting and Symposium held in Tucson, Arizona. Larson will serve a three year term as a member of the ESDA Board. This is his first time serving on the Board.

www.esda.org
www.trekinc.com

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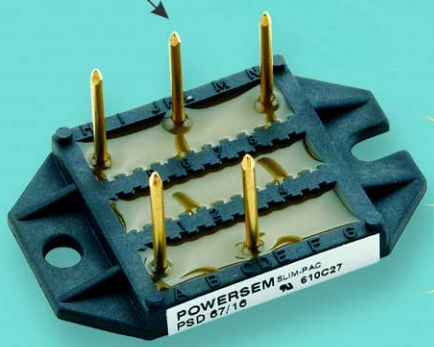
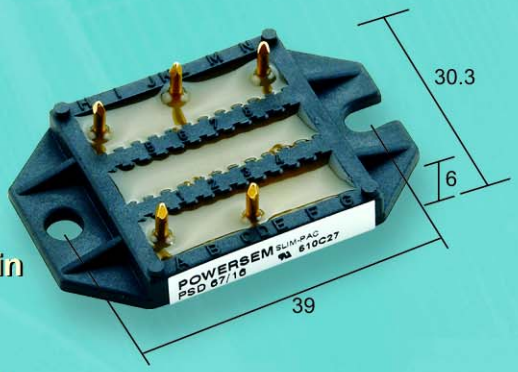
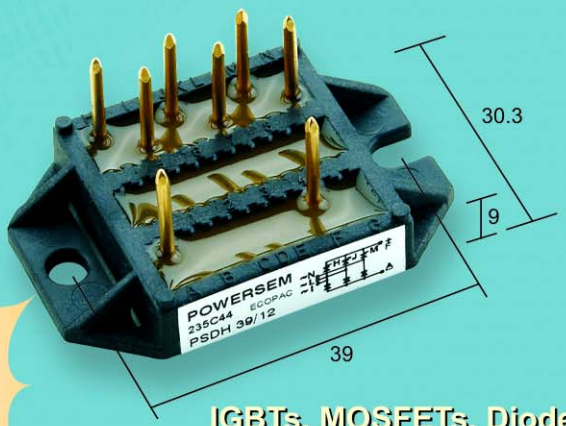
Lowest Profile Package for Power Modules with Highest Performance and Widest Choice of Customized Circuit Configurations

Rectifier Bridges in SLIM-PAC™



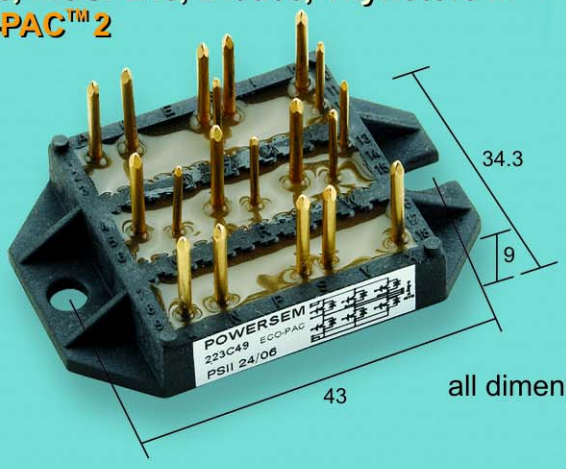


AC Controllers, Diodes, Thyristors, IGBTs in ECO-PAC™ 1

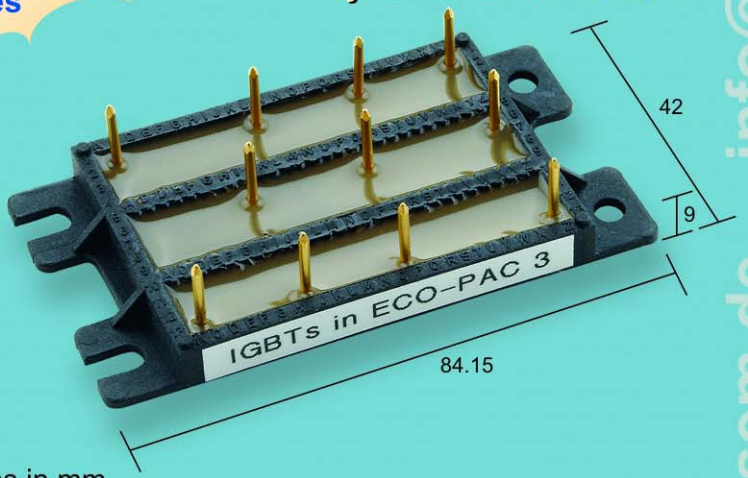


Two different pin heights are available with all ECO-LINE™ - Modules

IGBTs, MOSFETs, Diodes, Thyristors in ECO-PAC™ 2



IGBTs, MOSFETs, Diodes, Thyristors in ECO-PAC™ 3



all dimensions in mm

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- One Package Concept for Current Ranges from 29 A - 200 A and Blocking Voltages from 600 V - 1800 V
- Two different pin heights are available with all ECO-LINE™ - Modules

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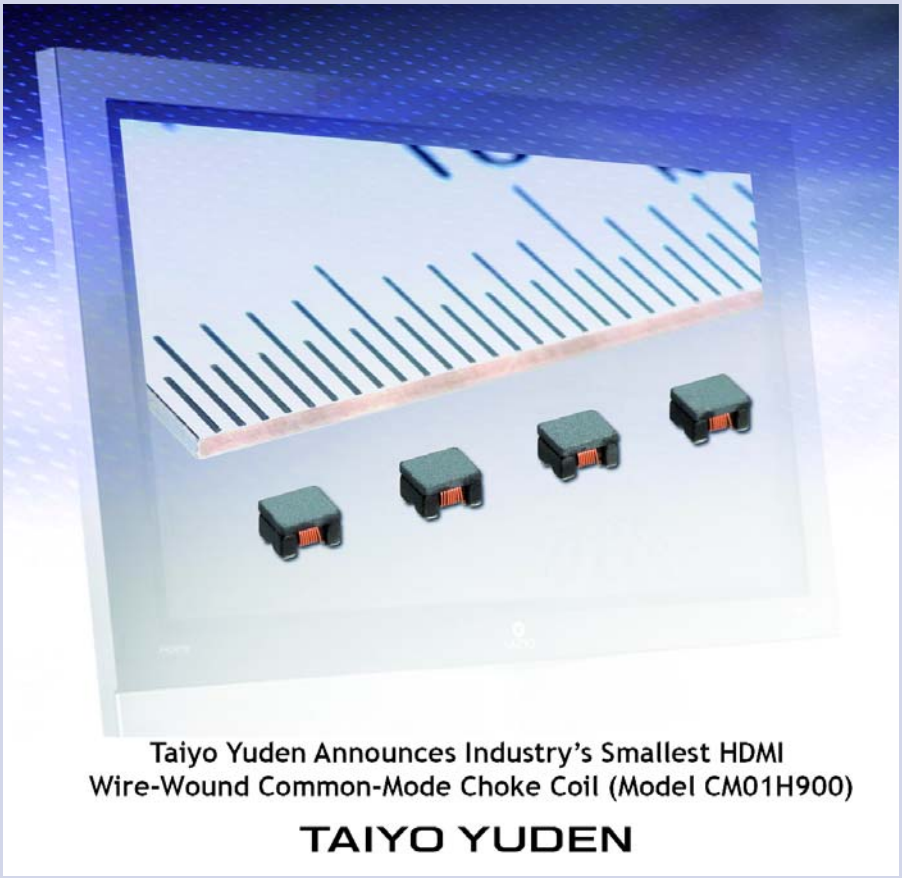
Industry's Smallest HDMI Wire-Wound Common-Mode Choke Coil

Innovative wire-winding and production techniques produce 1210 case size choke coils with 8GHz cut-off for common-mode noise reduction in flat-screen TVs and other high-definition applications

TAIYO YUDEN (U.S.A.) INC. announces the CM01H900 wire-wound common-mode choke coil for HDMI transmission line interfaces, offering ultra-compact size and improved high-frequency characteristics for common-mode noise reduction in high-speed differential signal interfaces. Typical applications include flat-screen TVs, Blu-Ray disc recorders, PC video output interfaces and other high-definition digital imaging devices. As the industry's smallest HDMI choke coil—measuring just 1.2mm L x 1.0mm W x 0.9mm H (max)—the CM01H900's ultra-compact EIA-1210 case size package facilitates development of thinner-profile OEM equipment. Key specifications include:

Market demand is increasing for high-frequency choke coils used in HDMI interfaces and compact HDMI terminals for the new high-definition digital video cameras entering the market. To meet this need, TAIYO YUDEN's innovative wire-wound inductor design and production technologies were used to develop extremely compact components that also feature enhanced high-frequency characteristics, including a typical cut-off frequency of 8GHz. In addition to today's mobile-device HDMI terminals, the CM01H900 will be ideal for use in common-mode noise countermeasures in the next generation of ultra-high-speed interfaces that are not yet on the market.



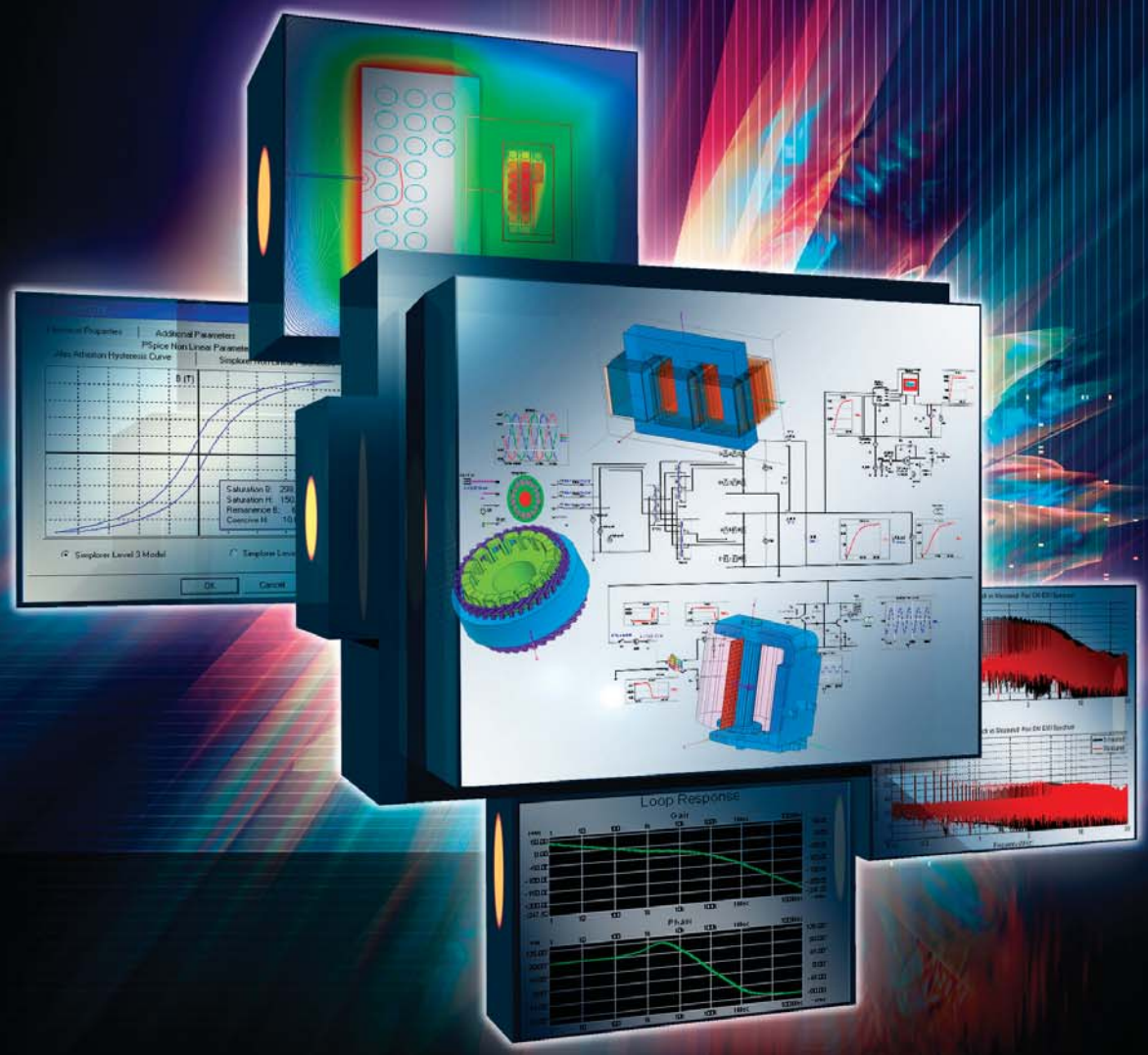
Taiyo Yuden Announces Industry's Smallest HDMI Wire-Wound Common-Mode Choke Coil (Model CM01H900)

Ordering Code	Common-Mode Impedance (Ω @ 100MHz)	DC Resistance R_{DC}, Max.	Rated Current, Max.	Rated Voltage, Max.	Insulation Resistance, Min.	Cut-Off Frequency, Typ.	Characteristic Impedance, Typ.
CM01H900	65 min. (90 typ.)	0.5Ω	250mA	20V	100MΩ	8.0GHz	100Ω

Mass production of the CM01H900 choke coil began in April 2008, with monthly production expected to reach 15 million units by the end of 2008. For further information about the company's complete line-up of high-performance inductor and ferrite products, visit the company web site.

Now in its 58th year, Tokyo-based TAIYO YUDEN CO., LTD. is a worldwide manufacturer of surface-mount and leaded passive components, Bluetooth modules, CCFT inverters and recordable digital media. With approximately 50% of the worldwide market in high-frequency multilayer chip inductors used in cell phones, the company reports annual sales of US$2.06B. Worldwide, TAIYO YUDEN employs more than twenty thousand people. The company's North American affiliate, TAIYO YUDEN (U.S.A.) INC., operates sales and engineering offices in Chicago, IL, Raleigh, NC, Irving, TX, and in California at San Jose and San Diego.

www.t-yuden.com



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Sustainable Energy Through Power Electronics

By Gilbert Declerck, President and Chief Executive Officer of IMEC

Generating and using energy in a sustainable way is fast becoming a worldwide top-priority. Power electronics, which uses solid-state technology to control and convert electrical power, will be one of the key enablers of new energy-saving technology. But today, power devices made with silicon are reaching their intrinsic material limits. Further innovation and improvement will require wide bandgap semiconductors with higher performance than silicon. GaN is one of these promising semiconductor materials. It is not only a wide bandgap semiconductor, but it also has very good electron mobility characteristics, significantly reducing conduction and switching losses. And last but not least, GaN can be deposited on top of large silicon wafers, paving the way for cost reduction and increasing the chance of market acceptance.

In the 20th century, when fossil fuel was the driver of a first industrial revolution, our economy was characterized by lots of manual labor, big factories and the production of material goods. We acted as if the resources of the world were unlimited. However, nowadays, we are confronted with the depletion of our resources and the limits imposed by fossil fuels. On top of that, climate change forces us to reconsider our energy consumption and switch to a more environmentally conscious use of energy. Currently, our economy is driven by technological innovation, improving the quality of our lives through immaterial goods such as services and content. Technological innovation will also prove to be the key in tackling the energy challenges, where the only way to go is a dramatic switch to renewable energy and energy saving in all conceivable ways. Photovoltaic systems, non-food-based biofuels and hybrid cars generate sustainable energy, while power-efficient intelligent ICT systems

and smart LED lighting are technological solutions to limit energy consumption. Many of these new technologies will be driven by power electronics.

Power electronics for generating and converting energy are already used in advanced applications like solar converters, motor drives, hybrid electrical vehicles or switch mode power supplies. However, further innovation and improvement of energy generating devices will require the use of wide bandgap semiconductors that allow the production of devices with high breakdown voltage. III-nitrides wide bandgap materials, for example, offer a combination of high voltage and high electron velocity which significantly reduce the switching and conduction losses. The use of wide bandgap semiconductors will allow us to make power efficient devices. But wide bandgap semiconductors are not only seen as an enabler for the new generation of power devices. They are also considered as potentials for reducing the total energy consumption through e.g. LED lighting ... And last but not least, wide bandgap semiconductors offer promising perspectives for newer cleaner technologies, e.g. in the hybrid automotive industry. Indeed, the figures prove the key role of power electronics in renewable and reduced energy consumption: Although they only represent about 10% of the total semiconductor market, the power electronics industry has a higher combined aggregate growth rate (>11%) than the total semiconductor industry (~7%).

But a new technology for power electronics will only gain market acceptance as replacement of existing technologies or as enabler of new technology when its cost is competitive with existing solutions. It is therefore of key importance to find materials and processes that offer an optimal mix of performance and cost. Galliumnitride (GaN) has proven to be such a material. It is not only a wide bandgap semiconductor that allows higher breakdown voltage. Thanks to its very good electron mobility characteristics, it significantly reduces switching and conduction losses compared to silicon. Due to its outstanding capabilities for power, low-noise, high frequency, high temperature operations Gallium nitride considerably extends the application field of solid-state operations. Moreover, GaN has very promising cost reduction perspectives. GaN growth on 200mm silicon wafers has recently been demonstrated, being an important step towards processing GaN power devices on large-diameter silicon wafers.

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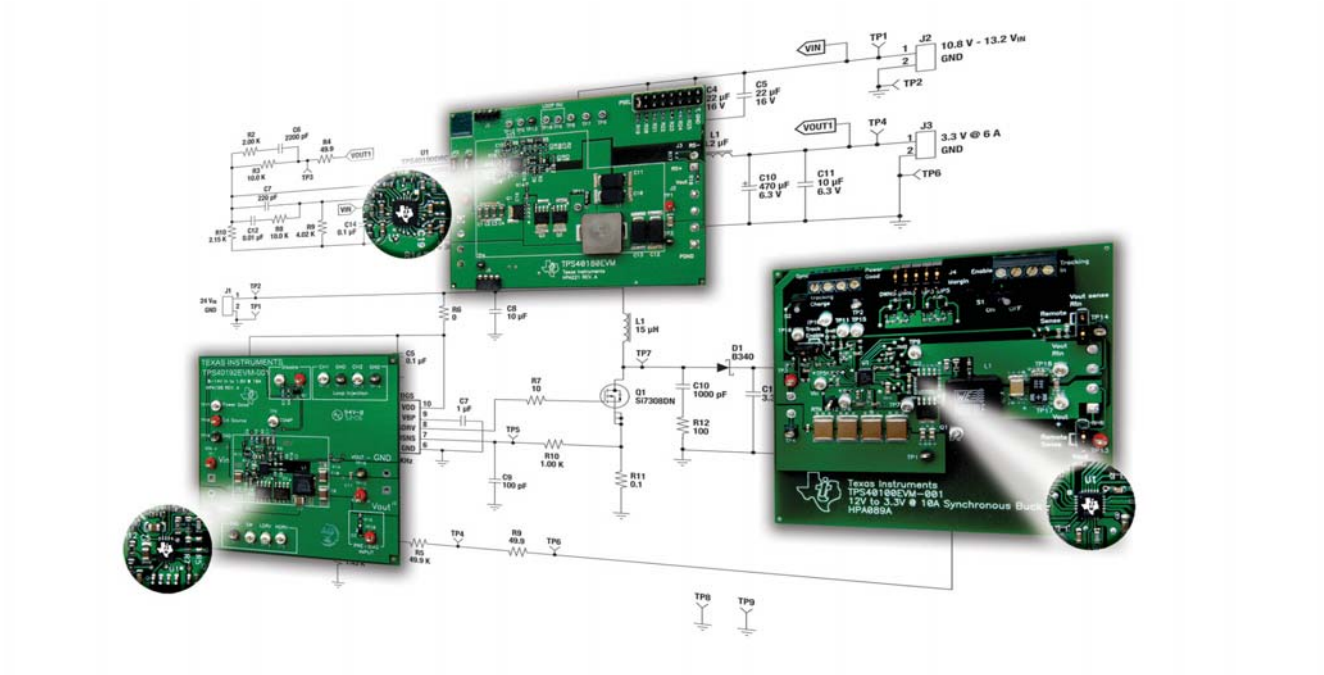

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TPS40042	3 to 5.5	External	600 kHz	Pre-biased output support	√	3 x 3 mm 10 SON
TPS40140	2 to 40	0.7 V ±0.5%	Adjustable to 1 MHz	One 2-phase output or two single-phase outputs stackable to 16 independent phases	√	6 x 6 mm 36 QFN
TPS40180	2 to 40	0.7 V ±0.75%	Adjustable to 1 MHz	Stackable to 8 independent phases	√	4 x 4 mm 24 QFN
TPS40192/3	4.5 to 18	0.591 V ±0.5%	300/600 kHz	Power good and enable pins	√	3 x 3 mm 10 SON
TPS40195	4.5 to 20	0.591 V ±0.5%	Adjustable to 600 kHz	Master/slave 180° out-of-phase sync pin	√	16 TSSOP or 3.5 x 4 mm QFN
TPS40200	4.5 to 52	0.7 V ±1%	Adjustable to 500 kHz	External synchronization pin	√	4 x 5 mm 8 SOIC
TPS40210	4.5 to 52	0.7 V ±2%	Adjustable to 1 MHz	Universal for boost, SEPIC, flyback	√	5 x 3 mm 10 MSOP or 3 x 3 mm 10 SON
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Electronics Industry Digest

By Aubrey Dunford, Europartners

GENERAL

The worldwide mobile phone industry felt the impact of the global financial crisis in the third quarter of 2008. Global mobile handset shipments grew a disappointing 5 percent year-over-year,- the industry's weakest growth rate since 2002 -, to reach 303 million units in Q3 2008, so Strategy Analytics.

SEMICONDUCTORS

Based on current guidance from many chip makers, Q4 sales will be lower than those in Q3.

Worldwide sales of semiconductors increased by 1.6 percent to $ 23 billion in September compared to September 2007, so SIA. Sales grew by 1.1 percent from August 2008. Sales of $ 196.4 billion for the first nine months of 2008 were up by 4 percent compared to the first nine months of 2007. Excluding memory products, industry sales in September grew by 7.8 percent year-on-year.

Measured in Euro, European semiconductor sales in September 2008 were € 2.323 billion, up 4.1 percent on previous month and down 9.5 percent versus the same month a year ago, so the WSTS.

Texas Instruments is taking actions that will reduce expenses by about one-third, or more than $ 200 million annualized, in its Wireless business (sales of $ 915 M in Q3), especially in its cellular baseband operation.

Samsung Electronics dropped a $ 5.9 billion unsolicited bid for flash memory card maker SanDisk, citing the U.S. company's deepening losses and uncertain outlook.

Qimonda announced a global restructuring and cost reduction program. As a part of this program, Qimonda has reached an agreement with Micron Technology to sell its 35.6 percent stake in Inotera Memories, its joint venture with Nanya Technology, to Micron for $ 400 M in cash.

Atmel board of directors rejects unsolicited proposal from Microchip Technology and ON Semiconductor, saying that the proposal is inadequate in multiple respects, including value, conditionality and complexity.

Microchip Technology, a provider of microcontroller and analog semiconductors, has acquired Hampshire, a supplier in the touch screen controller market.

Microsemi, a US-based manufacturer of analog mixed signal integrated circuits and high reliability semiconductors, paid approximately $ 20 M to acquire Babcock. Babcock is involved in power supplies and power conditioning units for satellite, airborne, shipboard, and
ground based electronics systems. In addition, Babcock manufactures relays, remote power controllers, contactors, timers, and sensors.

Maxim Integrated Products has entered into a definitive agreement to purchase Mobilygen, a privately held, fables semiconductor company with leading technology in H.264 video compression.

Wacker Chemie plans to construct a new polysilicon production plant at its Nünchritz site (Saxony, Germany) with a nominal annual capacity of 10,000 metric tons. The new plant is expected to achieve full capacity by the end of 2011.

OPTOELECTRONICS

Cree, a market leader in LED lighting, announces a longterm strategic agreement with the Austrian Zumtobel Group, a global market leader in the professional lighting industry, to supply LED downlights to the European market.

PASSIVE COMPONENTS

TDK announces the result of the voluntary public takeover offer for Epcos. Together with the 47.95 percent of the shares TDK has directly or indirectly purchased outside the offer, the company now has a total shareholding of 94.35 percent in Epcos. TDK and Epcos will be able to create a leading electronics components company with a strong presence across customer sectors and regions, so TDK.

Bourns, a manufacturer of automotive sensors, circuit protection solutions, magnetic products, microelectronic modules, precision potentiometers, panel controls and encoders and resistive products, has acquired substantially all of the assets of the Transient Blocking Unit business of Fultec Semiconductor. Terms of the transaction were not disclosed.

OTHER COMPONENTS

Electronic design automation (EDA) industry revenue for Q2 2008 declined 3.7 percent to $ 1357.4 M, compared to $ 1408.8 M in Q2 2007, so The EDA Consortium.

Western Europe revenue was up 10.5 percent in Q2 2008 compared to Q2 2007, with revenues of $ 273.4 M. The four quarter moving average growth for Western Europe was up 11.6 percent. North America, EDA's largest region, purchased $ 585 M of EDA products and services in Q2 2008, which represents a 13.3 percent decrease compared to Q2 2007. The four quarter moving average growth rate was down 6.9 percent for North America. Q2 2008 revenue from Japan increased 13.7 percent to $ 281.8 M compared to Q2 2007. The four quarter moving average increase was 13.1 percent for Japan. Rest-of-World (ROW) decreased to $ 217.1 M in Q2 2008, a 9 percent decrease compared to the same quarter in 2007. The four quarter moving average growth was positive at 6.7 percent.

DISTRIBUTION

Avnet reported revenue of $ 4.49 billion for first quarter fiscal 2009 ended September 27, 2008, representing an increase of 9.7 percent over first quarter fiscal 2008. Pro forma revenue growth was up 0.9 percent over the prior year first quarter. Net income for first quarter fiscal 2009 was $ 92.8 M, as compared with net income of $ 105.5 M, for the first quarter last year.

EBV Elektronik, an Avnet company, relaunchs its complete web presence: www.ebv.com. The new site, available in six languages, features the fast delivery of all the latest information about its entire range of products and services, as well as the company's new, intuitive 'Product Matrix', that enables visitors to find their preferred products in seconds.

This is the comprehensive power related extract from the
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Major Shifts Threaten DC-DC Converter Market

By Jeff Shepard, President, Darnell Group

Dc-dc converter modules could become a thing of the past. Today is rife with opportunities and dangers for dc-dc converter makers. The opportunities have narrowed as a result of the current global economic downturn, and the dangers have increased in the near-term, according to Darnell Group's tenth in-depth analysis of the dc-dc converter module and IC markets.

New power architectures are driving the average wattages of isolated converters down. Makers of non-isolated point-of-load converters are seeing their value-added opportunities reduced by new system powering architectures. In addition, new semiconductor packaging options are emerging that will impact the opportunities for value-added, such as power multi-chip modules, power-supply-in-package, and power-supply-on-chip. The sometimes-hidden backdrop for these changes is the emergence and growing importance of various forms of digital power management.

The impact of today's economic troubles will vary widely, from potentially devastating to hardly noticeable, depending on the specific market segment and product category being considered. One of the primary factors driving the new power architectures has been the growing number of power rails in a typical piece of electronic equipment. One system maker said that the number of rails is increasing – about 20 for mid-range servers and 30 for high-end servers. This is true for PCs, as well, with the number of power rails increasing from 2 in the initial designs to 10 or more today. A typical circuit card in an Ethernet router may have 40 or more different voltage buses, each with its own dc-dc converter.

This would appear to be a good situation for dc-dc module makers, but it is not. System makers always have a "power budget," the percentage of the system cost that can go to powering it. Let's say the power budget is 8%. This doesn't change just because the number of voltage rails has increased. If the number of rails doubles, the power budget does not. The cost of power has to be cut in half just to stay within budget, which module makers can't necessarily afford to do. The solution has been the replacement of almost all dc-dc modules in high-end equipment with so-called "embedded" solutions (i.e. in-board dc-dc converters that are built into the system by the system maker).

Figure 1 illustrates the effect this shift is having on the dc-dc converter module market. In 2006, the Intermediate Bus Architecture (IBA) was the dominant dc-dc module power architecture for electronic equipment. Because of the large consumption of point-of-load (POL) converters by the IBA, the market enjoyed "long-term" growth potential. Beginning in 2007, the IBA started to be replaced by embedded or "down" solutions, which Darnell Group refers to as the Centralized Control Architecture (CCA). This shift led to a replacement of many POL modules with down solutions, reducing the potential worldwide unit market growth for dc-dc converter modules.

In the near-term, unfortunately, there is a second impact reducing growth. The current economic slowdown is projected to further reduce overall dc-dc converter market size (both modules and ICs) in 2009. By 2013, after the near-term economic slowdown has passed, growth is projected to recover, although the market will continue to show declining module sales. This decline will not affect the overall size of the dc-dc converter market; the market is simply shifting away from modules to embedded solutions.

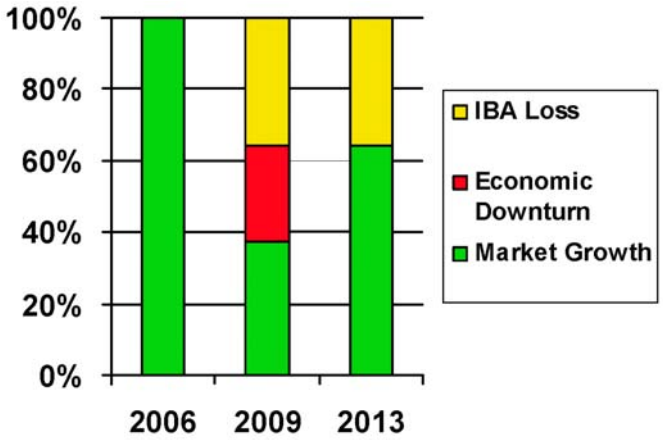

Figure 1: DC-DC Converter Module Market Growth Shifts

The impact of the adoption of architectures such as the CCA (and the economic slowdown) is already being felt in a reduced demand for dc-dc modules. Without the CCA or the economic slowdown, the market was expected to reach about $4 billion in 2009. Now, with the combined impact, the dc-dc modules market is forecast to be $3.8 billion in 2009. This is simply less growth, not negative growth. The market has not shrunk; it has just shifted from higher-priced modules to lower-priced ICs.

This potentially bleak landscape is not going to change. Digital IC technology shrinks transistors and puts more and more onto the ICs. As transistors shrink, they need to operate on lower voltages. Cost-sensitive consumer systems, such as plasma TVs, can have as many as 15 separate voltage rails, many of which may require monitoring and sequencing.

Improved on-line design tools are also contributing to the decline of modules. Semiconductor makers ranging from National Semiconductor and Intersil to Analog Devices offer on-line development tools and libraries of reference designs, making it easy for system designers to implement lower-cost embedded dc-dc converters. Some of these design tools have been on-line for 10 years and offer sophisticated simulation capabilities, optimization tools, and more. The resulting designs, while not as thoroughly optimized or sophisticated as state-of-the-art modules, are much better than earlier generations and are generally more than good enough for use in mainstream (but not necessarily leading-edge) system designs.

The growing importance of power management (primarily optimizing energy efficiency) compared with power conversion is another factor driving the value out of dc-dc converter modules. Power management began to take on increasing importance with the emergence of digital power technologies about five years ago. Today, digital power management (often implemented with the industry-standard PMBus™ protocol) is a requirement. System architecture standards such as the Advanced Telecommunications Architecture (ATCA) and Power-over-Ethernet (PoE) are changing the demand characteristics of this market. Finally, there are emerging standards that go beyond the board or rack level and up to facilities power management that are propelling the adoption of digital power management.

How power supply companies choose to deal with these threats will be more important than how they weather the financial crisis, since it addresses their entire business model. Bus converters are still in demand, according to system makers. Legacy systems will continue to require non-isolated modules, as well. And some applications don't use the large number of voltage rails required in computer and communications systems. Industrial and Medical systems, for instance, are good markets for dc-dc modules. The smaller size of these segments is offset by the higher average selling prices of the products.

In fact, the Industrial, Medical and Military segments are expected to grow in importance as far as dc-dc modules are concerned. The worldwide Industrial dc-dc converter market is projected to be about $800 million in 2009, which is small compared to Communications and Computers, but still substantial. These applications consume proportionately more isolated dc-dc converters compared with applications such as computer servers.

Medical – usually a very small unit market – has grown to the point that it can be broken out by equipment class in Darnell's forecasts. Medical applications are not expected to experience any significant slowdown in growth. While there may be delays in some large projects, overall expenditures on medical electronics are expected to continue growing at modest rates.

Military is traditionally a specialized, difficult market to get into, but the commercial, off-the-shelf (COTS) portion represents $130 million in revenue. Arms manufacturers will have to seek new markets as the economic crisis and changing priorities curb military spending in the U.S. and Europe, according to Jane's Information Group. These segments are highly susceptible to changes in political direction. Many of the spending commitments for 2009 have already been budgeted, and growth of about 9% to 10% is expected in this sector. A soft economy could even help growth in this area, as politicians increase spending in an effort to boost economic activity in their respective districts.

So the shifts seen in the dc-dc converter module market are only partly affected by the financial crisis and economic slowdown. Declining sales for IBA products have to be balanced with increasing sales for CCA products (i.e. power management ICs). The effects of the economic crisis will be near-term, but the trend to "down" solutions will be long-term. The market for modules has taken a permanent change in direction.

http://www.darnell.com/dcdc

Watching Out for You

Continuous monitoring is important in backup battery applications

We increasingly rely on technology to provide us with a feeling of security; cameras, emergency telephones and even safety lighting have a reassuringly high profile, letting us know that, if they are ever needed, they're available. Ensuring their availability in times of emergency can often demand an infallible power supply, which in turn falls to the venerable backup battery. But how do you know your battery backup really is infallible?

by Alan Denny, LEM

This is a problem that has beleaguered the manufacturers of equipment that relies on batteries for emergency power; when you really need it most, how will you know it will work? It is a particularly relevant question for manufacturers of uninterruptible power supplies (UPS), whose sole purpose is to supply electricity, to computer systems or medical equipment, in case of mains power failure. In these circumstances, it is not only imperative that the power is available but that it is delivered within definite time and supply tolerances.

Most battery backup systems are constructed from a number of valve regulated lead acid (VRLA) cells to create monobloc batteries. Although described as 'maintenance free', the technology has well known weaknesses, any one of which can render the battery inefficient or even completely inactive.

Weak, aged or otherwise 'unhealthy' batteries therefore represent a serious hazard in these systems, so it is commonplace to carry out regular maintenance checks on their state of health (SOH) and state of charge (SOC). However regularly these are done, there is still a risk of a battery failure occurring between maintenance checks and to combat this some companies are turning towards systems that offer constant SOH and SOC monitoring, in-situ.

Continuous monitoring

It may sound like a simple solution but in reality it comes down to economics. Continuous monitoring solutions can typically add 50% to the cost of the battery, even reaching as much as 70% when installation and operation is factored in. With such a high cost, it can prove cheaper to replace the batteries on a regular basis, before the Mean Time Before Failure (MTBF) would suggest they have reached their end-of-life. However, like routine maintenance this too is fraught with uncertainty, because environmental conditions can play a large role in the MTBF of a battery.

The answer many manufacturers seek is a low cost, continuous monitoring system that provides comprehensive diagnostics of a battery's SOH and SOC, under all conditions. In March 2007 LEM, a specialist in this class of intelligent transducer, teamed up with RWTH Aachen University, one of the world's leading authorities on sealed and vented lead acid batteries diagnostics and management, to set a roadmap for the development of advanced low cost battery monitoring management.

While other manufacturers have pursued more 'fashionable' battery technologies, RWTH Aachen University has maintained and furthered a centre of excellence that concentrates on the most established and widely selling battery chemistry. The LEM-Aachen partnership is a long term co-operation to research the failure modes of VRLA ,(Valve Regulated Lead Acid) flooded and gel batteries and to look at the next generation of monitoring and analysis systems, including SOH and SOC.

Through this partnership and by listening to the needs of users, LEM has continued the development of its solution for continuous monitoring, known as Sentinel. Capable of measuring cell voltage, internal temperature and internal impedance, Sentinel offers a level of diagnostic measuring comparable to that offered by much more sophisticated – and expensive – laboratory equipment, but at a cost that does not prohibit its application as a continuous monitoring solution.

In order to develop Sentinel, LEM conducted extensive R&D using the aforementioned lab-based equipment, as shown in Figure 1, employing a wide selection of battery makes and brands. In this case, the method being applied and replicated in Sentinel is electrochemical impedance spectroscopy, which can also be implemented in hand-held devices and is commonly used during routine maintenance.

Before explaining how this sophisticated methodology is replicated in a cost-effective, single-chip solution, it is worth outlining exactly what level of diagnostics it achieves, and how that can help protect the integrity of a battery-based UPS.

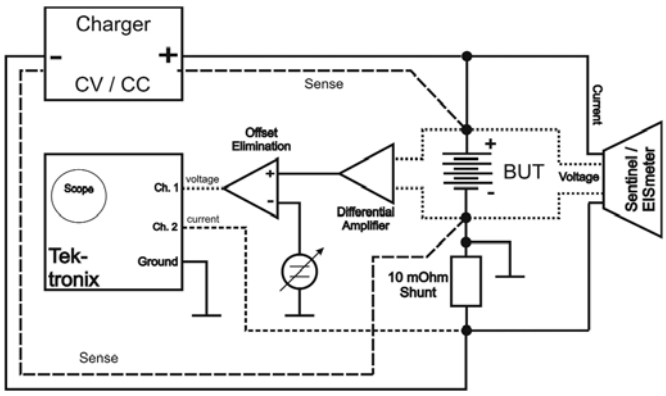

Figure 1: Test set-up for the evaluation of the monitoring devices.

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An ageing problem

The majority of systems in this class use lead-acid battery technology, a technology that is well known to suffer from degradation in capacity and increase of internal resistance, due to ageing. However because the technology is so well established, the ageing condition is also well understood and can, therefore, be identified through the detection of several phenomena.

One effect that is particularly common is loss in capacity, due largely to the use-model of the batteries. In a UPS, the batteries are discharged with a high current, which can lead to the growth of large crystals on the electrodes. It is a condition that can be partly controlled through proper battery conditioning but in severe causes it can prove irreversible. It can also lead to growth of small crystals – or "dendrites"- which, if left undetected, can grow together and create short-circuits within the battery.

A short-circuit may also result from internal corrosion, where flakes from the terminals drop on to the electrode. Significant contributors to corrosion include temperature, voltage and local acid concentration, normally affecting the positive terminal. Any of these age related effects will lead to a loss of battery capacity, or power, and so any kind of diagnostic must be capable of identifying them, in order for the appropriate action to be taken before catastrophic failure results.

The above effects lead to a decreasing battery's capacity or power. Any type of diagnostic shall be aiming for an identification of these ageing effects.

In the tests conducted, an electrochemical impedance spectroscope (EISmeter by RWTH Aachen Universaty) was used to employ full spectrum measurement; a series of sinusoidal waveforms are applied to the battery and the resulting impedance measured across a spectrum of frequencies, between a few mHz and 7.5kHz. The results are derived through a Fourier analysis to calculate the real and imaginary part of the voltage response for a given frequency. The result, the complex impedance, can be obtained by analysing the relationship between the voltage response and the excitation current, in amplitude and phase angle.

For the Sentinel solution, this was impractical, as the processing power needed to achieve this would render any solution commercially non-viable for a continuous monitoring system. The challenge, therefore, was to develop a methodology where only a single frequency could be used for measurement, but was capable of achieving comparable results to the EISmeter. Figure 2 shows a comparison between the impedance measurements made using the EISmeter (full spectrum) and the Sentinel.

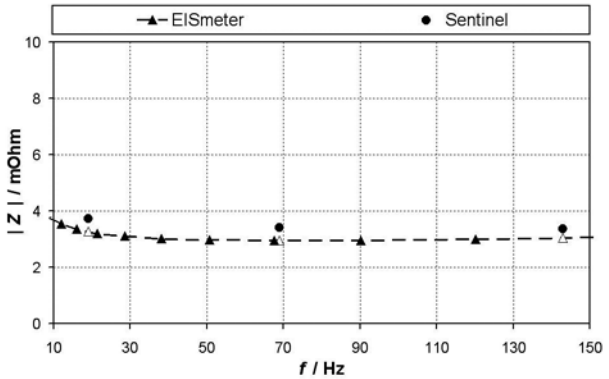

Figure 2: Comparison between impedance modulus given by the EISmeter and impedance values given by the Sentinel versus frequency.

Trend analysis

As the results in Figure 2 show, the two values are very consistent. Although a slightly higher value was returned using the Sentinel, this could easily be compensated for through calibration. However, for the purposes of battery diagnosis, it is the relative – not absolute – differences that are of interest. As the measurements are carried out on a continuous basis, it is the trend data that is important, which can be clearly seen in the results. This, coupled with temperature and voltage measurement all carried out using a single integrated circuit, constitutes the intelligence in the Sentinel solution.

Sentinel is the first single integrated circuit (system-on chip) monitoring for VRLA and flooded cells that provides measurement for individual cells and monoblocs for internal temperature, voltage and impedance as standard. Each module monitors an individual cell or monobloc, from 2 to 12 volts nominal, reporting over a proprietary communications bus to a Battery Data Logger (BDL).

The function of the Sentinel is to derive key electrical parameters under test to determine the ability of the battery to perform in the event of a mains failure.

Up to 250 Sentinel modules can be accessed via a single serial bus, making installation extremely easy as pushing plugs into sockets using pre-terminated data bus cables.

Each Sentinel has an integrated temperature sensor for the continuous measurement of individual cell skin temperature. This is essential in the detection of potential thermal runaway and also enables intelligent temperature controlled charging profiles. Not subject to the restrictions of a single ambient sensor, cell skin temperature is more accurate and reliable.

The measurement of individual cell temperature enables thermal mapping of the battery, which until now has only been available as an expensive additional service cost.

LEMs unique True Energy Layer method of impedance measurement, together with a more robust test current ensures accurate and repeatable results every time. The impedance is measured by performing many "short-duration, mini discharge" of the bloc using a square-ware signal at a set frequency for a duration of 4.5 seconds as shown in Figure 3.

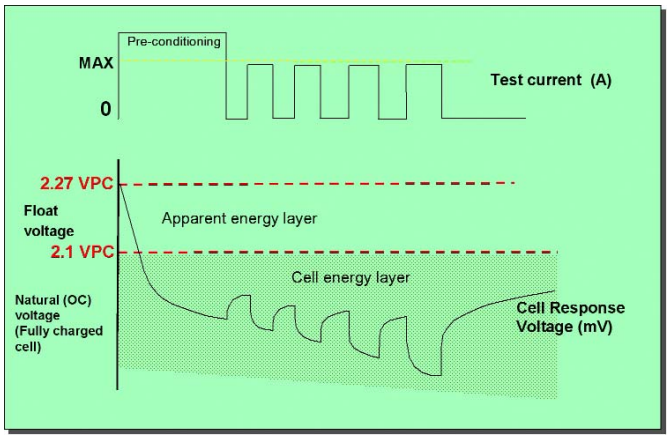

Figure 3: Impedance wave form

This action of the single longer pre-conditioning pulse at the start brings the cell into the right "energy layer" state before starting to draw measuring pulses. The latter creates a varying cell voltage response which, combined with the reference pulsed current, provides an impedance value.

Figure 4: Sentinel

The Sentinel's impedance test method perturbs only the cell under test. High currents through sections of the battery are not required and DC links is not disturbed by any oscillations.

This is the first time that temperature, impedance and voltage have been combined in a module for single cell, or monobloc, monitoring. Combining accurate temperature, discharge (dynamic) and floating (static), with accurate ripple current measurements, the Sentinel system represents the most comprehensive battery monitoring system available today.

It is also designed for simple installation, requiring around a quarter of the time it takes to install less comprehensive systems. This is achieved through its monolithic design and simplified communications system. Using a proprietary communications bus, which LEM has termed the S-bus, each self-contained unit operates autonomously yet can be directly controlled from a central intelligence unit, called the Battery Data Logger (BDL); a monitor and data-logger with comprehensive alarm parameters and data storage facilities (see Figure 5).

Figure 5 MicroGuard, the battery data logger

Only this intelligent combination of the single or monobloc measurement units with the accurate information on temperature, voltage and impedance with the central intelligence given by the Microguard (BDL) including current measurement that allows an intelligent analysis of the state of health of the battery

Configurations allow up to 250 Sentinels in eight strings, with up to 8 float/discharge currents being monitored, with all data available via an network interface.

Because the Sentinel is itself powered by the cell being monitored, it is designed to remain in 'sleep' mode for the majority of the time, only 'waking up' to take measurements. The wake cycle takes less than 100mS and is conducted approximately once every 5–10mins, which means for the vast majority of time the Sentinel is consuming minimal power from the host cell.

The use of lead-acid batteries in UPS systems is likely to increase, given our growing dependence on evermore sophisticated electronic devices. While the failure of an individual cell could spell catastrophe for any system employing a UPS as an emergency power source, using LEM's Sentinel, that failure can be predicted, averted and, therefore, cost-effectively rectified long before any collateral damage occurs.

LEM firmly believes that continuous monitoring is important in these applications, but that it should cost no more than 15% of the cost of the battery. Because impedance is known to change in most modes of failure, it remains to date the most effective method of detecting deterioration of failure in a cell. In order to achieve true readings it is necessary to test a cell at a current level sufficient to penetrate the 'surface' charge present and for this reason the Sentinel has also been developed to automatically optimise the impedance signal test level, for any voltage between 1.5 and 15V.

The Sentinel system is a single-chip solution capable of operating completely automatically, providing extremely cost-effective and reliable monitoring for safety and mission critical applications. The operation of an entire system could be based on the integrity of a single cell. However, Sentinel maintains that integrity thus avoiding what could be a potential catastrophic failure.

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Reliability and energy efficiency are two major aspects for today's state of the art inverter designs. Infineon's new EconoPACK™4 provides robust module design in combination with the new energy efficient IGBT4 and Emitter Controlled 4 Diode chip technology.

By Wilhelm Rusche, Infineon Technologies AG

Power semiconductor devices, based on newest technologies, enter more application areas [1, 2]. The use of semiconductors for energy generation by help of regenerative energy system is just one example. Automation systems also take advantage of this development. They produce less power losses, generate less noise, become lighter and smaller. Looking at the variety of applications, state-of-the-art semiconductor systems with a higher power density are needed. Decisive factors of such power modules are a high reliability, robustness and a long life time.

For Applications above 75kW, the EconoPACK™+ modules have set a new standard for power modules in the beginning of 2000. These Econo power modules offered the inverter design engineers the possibility to create compact inverters.

Based on these Econo modules success stories and as a consequence of continuously increased application requirements Infineon developed a new power module for the power range from 22kW to 75kW.

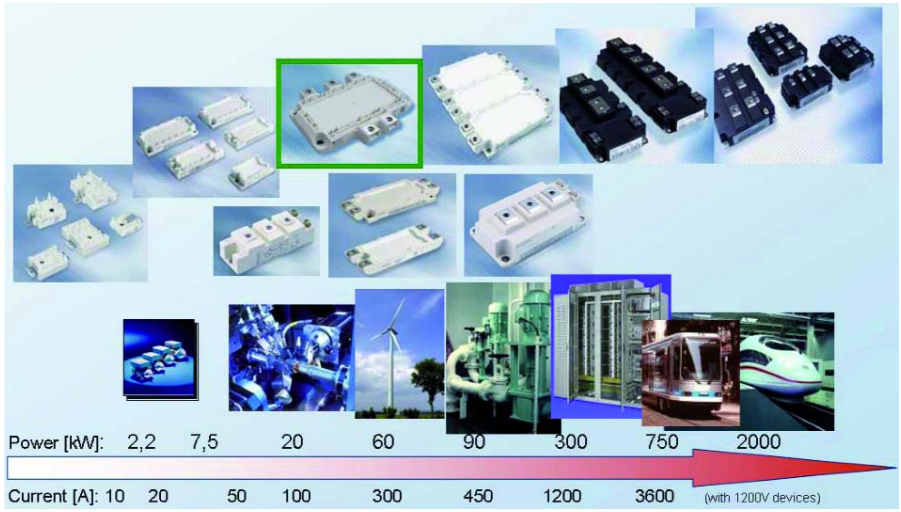


Figure 1: Infineon power modules 1200V

Robustness and reliability under vibration conditions are in the focus not only in traction applications but more and more also in case of standard industrial drives. It is a must for power module engineers to implement such increased demands during new product developments. Construction and power class of semiconductor devices define to a high extent the required connection technology.

For drive and UPS applications in the power range up to 30kW the EconoPACK™ and EconoPIM™ modules with its solderable pins have changed the structure in the past.

This new IGBT module is the EconoPACK™4 shown in figure 2.

EconoPACK™4 – The housing concept for a new standard

The EconoPACK™4 is a six pack IGBT module including a NTC resistor for temperature measurement.

The package based on the well-known Econo housing principle [3] is characterized by its flat geometry. As a result of the higher power ratings, compared to the EconoPACK™ and EconoPIM™ module, the main terminals are implemented as screw

Figure 2: EconoPACK™ 4, SixPACK with integrated NTC

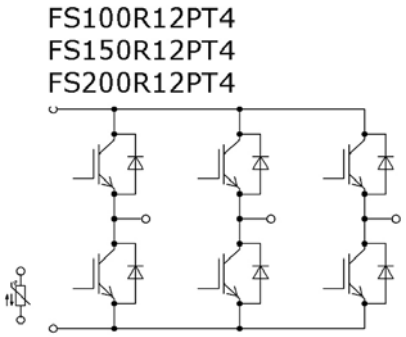


Figure 3: Product range EconoPACK™4 1200V

connections. These power terminals feature the so called flow through concept, similar to Infineon's EconoPACK™+. One module side contains the screw terminals for the DC link and the opposite side of the package the screw terminals for the AC output connection.

The module height of 17mm only reduces the demand of volume significantly while keeping the mounting procedure very easy. A relatively flat inverter structure is the result.

Optimised gate driver connection is possible by placing the driver on top of the module. The innovative module design also takes care of the inverter system costs by providing reliable and solder less press in contact with PressFIT [6] auxiliary terminals for the driver board connection. During the mount-

ing process the control pins are pressed into the driver board by a defined force and a gas-proof connection is reached. The Press-FIT contacts also provide the flexibility for the use of a solder process, if required.

Inside the module the power terminals and the auxiliary terminals are connected to the DCB by US welding. The impressively benefits in reliability and performance of the US metal welded terminals, compared to the today used technologies, were already described in further articles [4, 5].

Infineon new 4th generation of IGBT4-T4 and Emitter Controlled 4 Diode inside

The device is equipped with the latest semiconductor technology [1, 2], the IGBT4 and the Emitter Controlled 4 diode. The new 1200V IGBT4 generation combined with the improved Emitter Controlled diode from Infineon provides three optimized chip versions that are designed to the needs of modern inverter concepts. Two main success criteria during the development of a new chip generation are low static and dynamic losses.

The IGBT4-T4 chip, used in the EconoPACK™4, with its fast switching characteristic provides 20% lower switching losses compared to the previous IGBT3-T3 generation. This loss reduction is an advantage for the efficiency of power modules.

Reducing losses is not enough. Additionally the switching characteristic of the device itself was also an important issue. The new IGBT generation and its versions are optimised for the needs of the application. The IGBT4-T4 is slightly softer than the previous low power IGBT3-T3 chip, and the IGBT-E4 version is slightly softer than the medium power IGBT3-E3 chip. As aimed by the design the E versions are clearly softer than the T series [1, 7]. With the consequent implementation of US welding in combination with an “in-frame-bus bar” the module provides significantly low parasitic stray inductances which is essential to utilize the advantages of the IGBT4-T4to the fullest [1,2].

The softness respectively the switching speed of the IGBT depends also on the junction temperature. Increasing the junction temperature means increasing the softness of the IGBT. However a proper characteristic of the device must be given already at low temperature e.g. 25°C. The turn-off and turn-on behaviour is exemplary shown for a 1200V/150A EconoPACK™4 IGBT module in figure 4 at Tvjop=25°C.

A comparable robustness as the well known

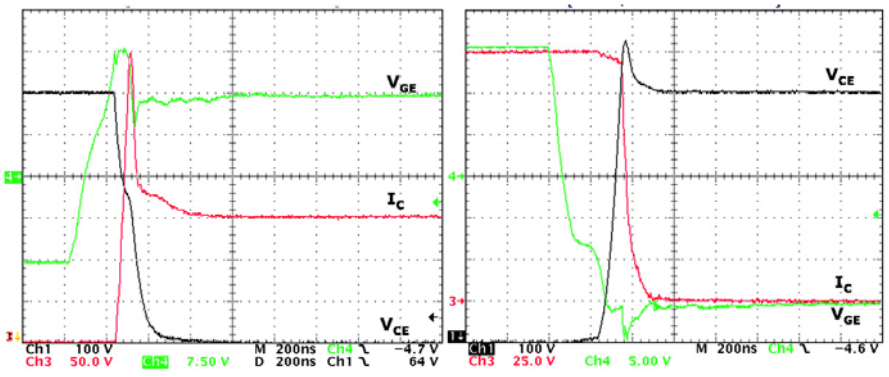


Figure 4: Turn-on and turn-off EconoPACK™ 4, V_{CE}=600V, I_C=I_{Cnom}, R_G=R_{Gnom}, T_{vj}=25°C

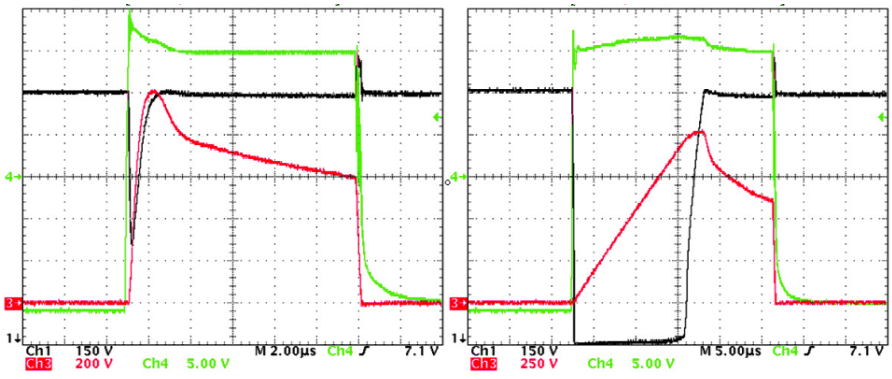


*Figure 5: SC1 and SC2, V_{CE}=900V, V**GE**≤15V, R_G=R_{Gnom}, tp≤10µs, Tvj=25°C*

predecessor IGBT3 is given. The IGBT4-T4 withstands an unprotected short circuit as it is exemplary depicted in figure 5 for a FS150R12PT4.

The IGBT4 technology allows a 25K higher maximum chip operation temperature of T_{vjop}=150 °C compared to the operation temperature of 125°C of the previous generations. This higher operation temperature results in the potential of higher output power by use of the full temperature swing under the same cooling conditions. Additionally the optimization of the chip assembly and contact technology shows a noteworthy power cycling (PC) improvement shown in figure 6. Depending on the application conditions this ensures at least the same PC lifetime expectation and higher output current as a consequence of the increased operation temperature.

The new power semiconductor generation has been optimized to improve its character-

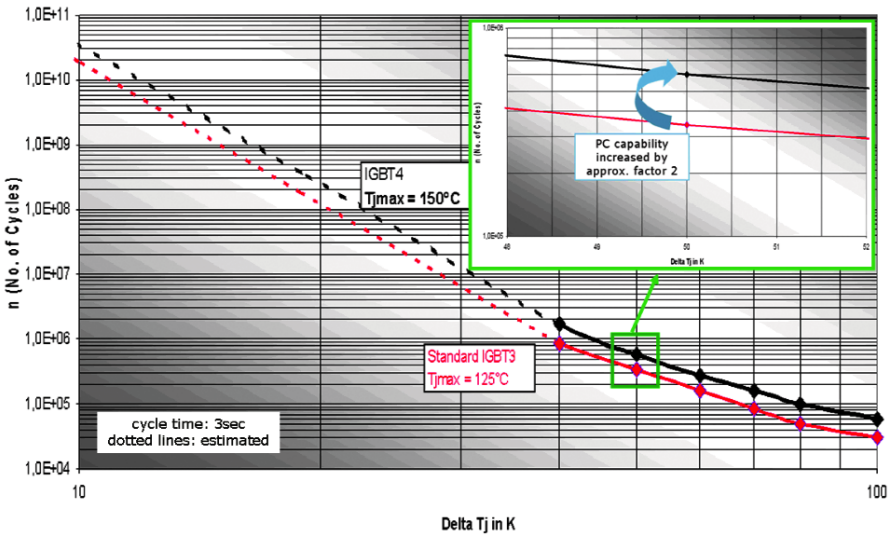


Figure 6: Power cycling (PC) reliability diagram for 1200V Standard modules and typical lifetime for an EconoPACK module with IGBT4 at ton ≈ 1s, I≈Inom.

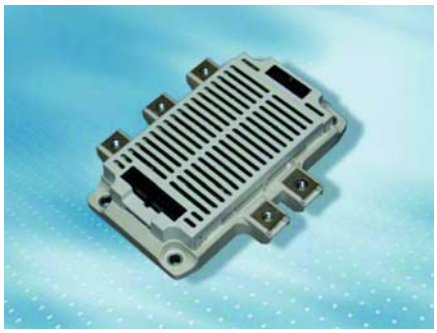
istic and to increase the output power of the inverter as a consequence of the increased operation temperature of Tvjop=150°C. The new IGBT EconoPACK™4 product family will start with 1200V blocking voltage and with 100A, 150A and 200A rated current. All 1200V EconoPACK™4 devices provide the advantages of the new IGBT4-T4 and Emitter Controlled 4 diode chip technology.

The next step with a higher integration level of the EconoPACK™ 4 is already started with the MIPAQ™ serve module. The MIPAQ™ serve provides all the advantages of the EconoPACK™4 in addition with an adapted optimized galvanically isolated driver electronic on top.

MIPAQ™ serve

Based on the EconoPACK™4, the MIPAQ™ serve is a semiconductor module in SixPACK configuration with additionally integrated drive- and control electronics. The module includes the driver stages for the IGBTs and a temperature measurement with digital output signal.

In addition to the increased reliability achieved by mechanical improvements in the area of power electronics, the construction being used offers more features that make the module more reliable.



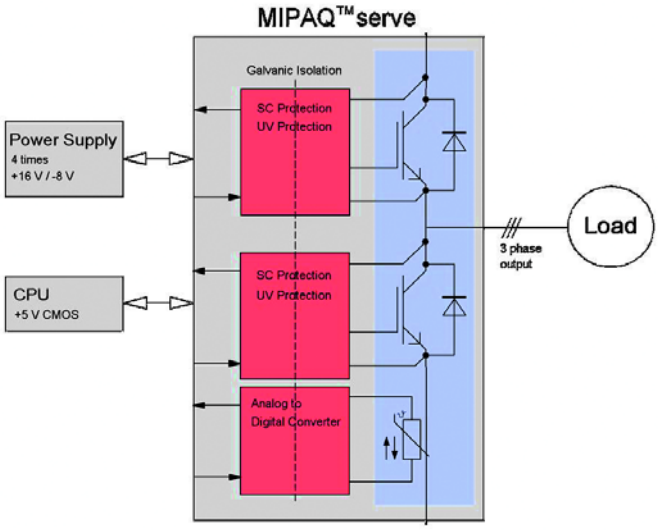


Figure 7 : MIPAQ™ serve, 1200V SixPack with integrated IGBT driver and digital temperature measurement based on EconoPACK™4

1. A low voltage detection protects the module in case the supply voltage is not sufficient
2. The monitoring of the IGBTs' saturation voltage VCEsat guarantees an efficient short circuit protection of the semiconductor
3. A precise temperature recording enables the user to define the static thermal situation
4. Error signals for high- and low-side-driver inform about the functioning of the driver parts
5. Use of PressFIT-technology for connecting the drivers to the module

Apart from these electronic features, the device selection has been made in such a way that the highest possible reliability is achieved. This is supported for example by the waiving of optoelectronic components. The short distance of drivers and power electronics and the resulting generation of heat would influence the life time of optocouplers. This would have a negative impact on long-term reliability. Instead of optocouplers, galvanicly isolating couplers based on Infineon Coreless Transformer Technology (CLT) are used, which form the core of the EiceDriver™ part 1ED020I12-F [8].

New products like "EconoPACK™ 4" and the "MIPAQ™ serve" share new technologies like, PressFIT contacts, the US welding technology and the latest IGBT and Diode chip technology. All these products from Infineon are well prepared for the next future trends in power electronics. The EconoBRIDGE™ 4, a half controlled input rectifier, will extend the EconoPACK™4 product family as well as the 600V and 1700V IGBT SixPACK modules.

Further information about the EconoPACK™ 4 is available at .

http://www.infineon.com/econopack4

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Power Semiconductors Take the Lead for Pulse Power Applications

Solid State Switches from ABB for pulse power applications

Pulse power applications have for long been dominated by electron tubes like thyratrons and ignitrons. Due to the increased performance, the controllability and the long life time of power semiconductor devices, the tubes are gradually being replaced by power semiconductor assemblies The improved power semiconductor devices also enables the use of pulse power equipment in new applications, where tubes are not a viable solution.

By Adriaan Welleman and Björn Backlund, ABB Switzerland Ltd, Semiconductors

ABB Switzerland Ltd, Semiconductors in Lenzburg has been successfully producing power semiconductor devices for several years which are optimized for pulsed power applications. These components will replace in the near future most of the high power electron tubes like thyratrons or ignitrons in various applications. Most of the applications are for pulse modulators switching very short high energy pulses.

The speciality of these optimized semiconductor devices of ABB is the very fast switch-on capability – in micro second range -, the high current rise rate and the capability to handle high peak currents. This is often realized by combining a GCT-semiconductor device with a special designed driver unit which is optimized for fast switch-on operation, but has no switch-off capability. Therefore it can be used for capacitor discharge applications for pulse forming networks for pulse modulators. With these devices it is possible to pulse very high energy into a load, which can be a Pulse Transformer or a Klystron. Using this type of devices ABB is making complete switch assemblies which combine the IGCT (Integrated Gate Commutated Thyristor) semiconductor devices, often in series connection, an isolated clamping system, integrated power supply, optical triggering and air or water cooled heat sinks. Other devices, like thyristors or IGBTs, are also used for these applications depending on the specific application requirements. The following two examples show how BiPolar as well as BiMOS-devices have successfully been implemented in different pulsed power systems.

Power Supplies for Airport Approach Radar Systems

For several years a complete solid state switch assembly with optimized semiconductor devices was developed for the Massachusetts Institute of Technology (MIT) in Boston/USA, and these switches are in the meantime the key component for the modernization of Airport Approach Radar Systems. After long term tests, type tests and field tests, MIT recommended the ABB technology to the FAA (Federal Aviation Administration) who has in turn recommended this to an equipment maker in USA, who is the producer of the airport radar systems. In 2007 ABB Switzerland Ltd received an order for a total of several hundred complete switch assemblies, each containing 3 IGCT devices. The order is one of the largest of its kind for this application and is a clear breakthrough for the technology itself. This new technology was used to refurbish the existing radar systems at all 132 civil airports in the US and replace the relative unreliable thyratron tubes. Per airport at least two systems are used and including some spares, a total quantity of 296 switches has been supplied. The customer and end-user are both very happy with the technical and logistic performance of ABB.

Advantages for the end-user

The solid state semiconductor switch has, compared with thyratrons, a clear longer life time and is practical maintenance free. Despite higher initial costs of the switch, the solid state design is cheaper during operation and already paid back after a few years. This because thyratron tubes have to be regularly adjusted and replaced which results in cost for the tube, the maintenance person and the down period of the system. It is expected that further new developments will be direct equipped with solid state switches. Because the ABB switch is built up with bipolar monolithic – one wafer per device - IGCT components, it shows a very high reliability compared with other semiconductor technologies, especially for pulsed applications. This is good for radar system users, but also other application areas like medical systems, safety systems and environmental protection systems are benefiting from this technology since the last years. ABB is actually involved in several other

Figure1: 296 Units of this type, completely assembled with air cooled heat sinks, power supply and glass fibre epoxy clamping system are used for the US Airport Radars

projects and deliveries in the application field of pulsed energy and the world wide customer base recognizes the long term collected know-how. The demand for solid state technology in pulsed power is rapidly increasing and beside the standard semiconductor component business a new market segment can be served.

Technology and Data

The solid state switch used for the Airport Approach Radar Systems is built-up with three IGCTs in series connection. The devices are reverse conducting, and have a switching part (with GTO structure) and a freewheeling diode monolithic integrated on one silicon wafer. The result is a practical induction free construction. The driver unit is special designed for very fast turn-on and because the application is for capacitor discharge, there is no need for turn-off. As the driver unit is direct assembled around the semiconductor device again very low induction is the result.

Figure2: The IGCT Component complete with driver unit. The switching part and the freewheeling diode are monolithic integrated on the same silicon wafer

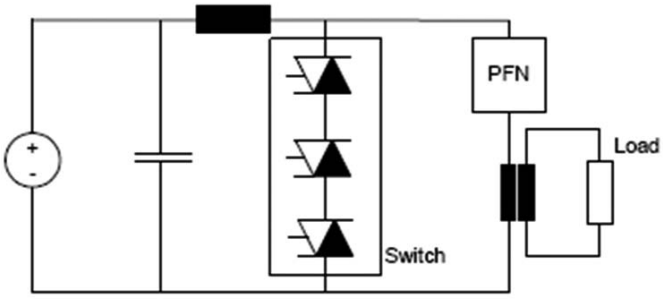

Figure3: Simplified circuit diagram for the assembly used for the US Airport Radars

Three components each with a blocking voltage of 4500V are sandwiched between air cooled heat sinks. All three driver units are powered by one 25 kHz / 4A current source, with a HV cable through an inductive coupling. The triggering of the driver units is done by an optical signal which is transferred from a light distribution box. The safe operation area for this type of switch is in the range of 6.5kVdc, Peak Current 1.4kA, Pulse duration 2.5µs, Current Rise Rate 6kA/µs, Pulse Repetition Rate 1200Hz and ambient temperature of -10 … 50°C.

Power supply with BiMos devices for large fish barriers

To clean a number of rivers and canals in the US from excessive vegetation, Asian carps were released in these waters some years ago. Since the carps have no natural enemies, they could grow in size, some grow up to 1.5 m length, their numbers are beyond what was expected, and their ability to jump up to 1 meter above the surface has made them even dangerous to people. Especially for the Chicago Sanitary & Shipping Canal, a 50 m wide and 9 m deep canal that carries a quite big portion of waste water, thus enhancing the vegetation growth, the carps became a serious problem. To avoid that the carps spread to other rivers and lakes, measures had to be taken, and in support, the state of Illinois funded solutions to control the carps without poisoning or exterminating them. A US company got the assignment to build electric fish barriers that are able to repel the carps from passing certain sections of the canal. This is done by installing electrodes in the riverbed that sends electrical impulses in the water. The impulses can be sensed early by the carps and hence they avoid approaching them and turn back instead, thus staying within the boundaries set by the fish barriers.

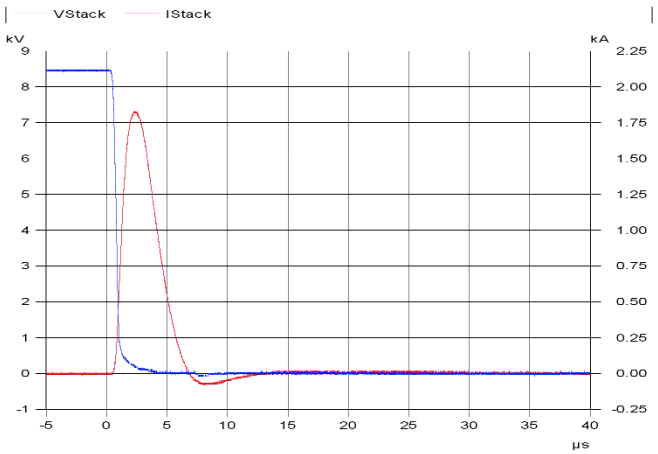

Figure4: Wave form from the type testing with increased voltage and current

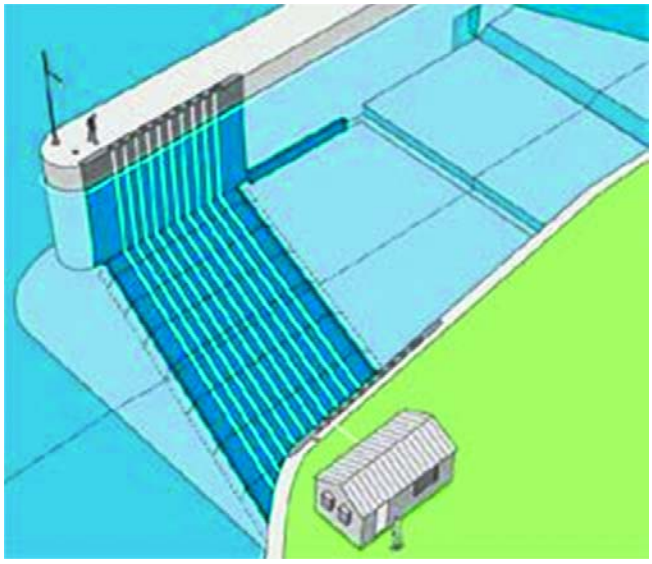

Figure5: Outline of the canal with fish barrier, electrodes and the switch gear building

Technology and Data

To realize this project the US Company turned to ABB to take advantage of the experience gathered in the pulsed power field. The required power was larger than any other installed fish barrier which made it a real challenge just to define and specify the project. The final design was a switch that can deliver short rectangular pulses from a 650 kJ capacitor bank with an amplitude of 30 kA at 3.4 kV DC at a nominal frequency of 15 Hz into a 42 µH load. The pulse repetition frequency can be set between 0.5 and 100 Hz.

To realize the switch assembly, standard HiPak IGBT-modules were used. Due to the high voltage and high current 32 pieces of the 3.3 kV, 1.2 kA module 5SNA 1200E330100, that normally are used in traction applications, were used with 16 pieces in parallel and 2 pieces in series connection. Each fish barrier has two switches making a total of 64 IGBT-modules per barrier. The first barrier is since

Figure7: IGBT Modul ABB P/N: 5SNA 1200E330100. 32 pieces are used per switch

some time in operation and when the results have been evaluated it will be decided if this kind of electric barriers will be also installed in more rivers and canals in other parts of the country.

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Simple tools for MOSFET driver selection

Select the correct power-switching element for the application

A simple spreadsheet, and a few equations, could hold the key to selecting the optimum MOSFET driver for each application.

By Cliff Ellison, Microchip Technology Inc.

Charging and discharging a MOSFET's gate requires the same amount of energy, regardless of how fast or slow the gate voltage transitions. Selecting the right MOSFET driver for a specific application, therefore, requires a thorough understanding of power dissipation in relation to the MOSFET's gate charge and operating frequencies.

MOSFET drivers are typically used to convert logic signals to higher voltage and current levels to achieve fast response times for turning MOSFET gates on and off. For example, MOSFET drivers can be used to convert a 5V, low current microcontroller output signal to an 18V drive signal, with a current of several amperes, for a power-MOSFET input.

A MOSFET driver's power dissipation is due to one of three factors: charging and discharging the MOSFET's gate capacitance; the driver's quiescent-current draw; and cross-conduction or shoot-through current in the MOSFET driver. Of these three factors, power dissipation due to the charging and discharging of the MOSFET's gate capacitance is the most important, especially at lower switching frequencies. This is shown by:

$P_c = C_g \times V_{dd}^2 \times F$

Where

C_g = MOSFET gate capacitance
V_{dd} = Supply voltage of MOSFET driver (V)
F = Switching frequency

The importance of peak drive current

In addition to power dissipation, designers must understand the peak drive current required from the MOSFET driver and the associated turn-on and turn-off times. Matching the MOSFET driver to the MOSFET in a specific application depends on the speed at which the application requires the power MOSFET to be switched on and off. The optimum rise or fall time in any application is based on a number of requirements, such as Electromagnetic Interference (EMI), switching losses, lead/circuit inductance and switching frequency. The relationship between gate capacitance, transition times, and the MOSFET driver current rating is provided by:

$dT = [dV \times C]/ I$

Where

dT = Turn-on/turn-off time
dV = Gate voltage
C = Gate capacitance
I = MOSFET peak drive current

The total MOSFET gate capacitance can be determined by looking at the total Gate Charge (QG). QG is given by:

$Q_G = C \times V$

Then $I = Q_G / dT$

This method assumes a constant current. A good rule of thumb is that the average value is typically half of the MOSFET driver's peak current rating.

MOSFET drivers are rated by the driver output peak current drive capability. The peak current rating is typically stated for the part's maximum bias voltage which means that, if the MOSFET driver is being used with a lower bias voltage, its peak current drive capability will be reduced.

For example, the required MOSFET peak-drive current can be calculated by using the following design parameters from a vendor's data sheet.

MOSFET gate charge = 20 nC (Q)
MOSFET gate voltage = 12V (dV)
Turn-on/turn-off time = 40 ns (dT)

Based on the above equation,
therefore: I = 0.5A
Another method that can be used to select the appropriate MOSFET driver is to use a time-constant approach. This uses the MOSFET driver resistance, any external gate resistance, and the lumped capacitance.

$T_{charge} = ((R_{driver}+R_{gate}) * C_{total}) * TC$

Where

$R_{driver} = R_{DSON}$ of the output driver stage
R_{gate} = Any external gate resistance between the driver and the MOSFET gate
C_{total} = Total gate capacitance
TC = Number of time constants

For example:

Q_{total} = 68 nC, V_{gate} = 10V, T_{charge} = 50 nsec, T_C = 3, R_{gate} = 0 ohms
$R_{driver} = (Tc_{harge}/TC*C_{total}) - R_{gate}$
therefore R_{driver} = 2.45 ohms

As this equation represents an R-C time constant, using a TC of 3 means that the capacitance will be charged to 95 percent of the charging voltage after the Tcharge time. Most MOSFETs are fully on by the time the gate voltage reaches 6V. Based upon this, a TC value of 1, representing 63 percent of charging voltage, may be more useful for the application and allow a lower-current driver IC to be used.

MOSFET drivers for motor control

In motor-control applications, where the motor speed and direction of rotation vary, the voltage applied to the motor needs to be modulated. The most appropriate gate-drive scheme for achieving this will be dictated by the type of motor, power-switching topology and power-switching element.

The first step is to select the correct power-switching element for the application which, in turn, would depend on the ratings of the motor being driven. An important parameter to consider is the start-up current value, which can be up to three times the value of the steady-state operating current.

There are two main choices for power-switching elements in motor drives: MOSFETs and IGBTs. Assuming that a MOSFET

is the preferred element, the MOSFET driver rating for the gate-drive application can be determined.

As shown in Figure 1, the input stage of the device converts the incoming low-voltage signal to a full range, GND-to-Vdd signal that turns a cascaded chain of increasingly stronger drive stages on and off. MOSFETs Q1 and Q2 represent the MOSFET driver's pull-up and pull-down output driver stages. Viewing the MOSFET driver's output stage as a push-pull pair of MOSFETs, makes it is easy to understand its operation.

For a non-inverting driver, when the input signal goes to a high state, the common gate signal of Q1 and Q2 is pulled low. The transition of this gate node from Vdd to GND

The information in the datasheet for the chosen MOSFET is used to insert values into the appropriate boxes for input conditions. These conditions will include MOSFET drain-to-source voltage (Vds), MOSFET gate-to-source voltage (Vgs), MOSFET driver voltage (Vdd), switching frequency, duty cycle, estimated rise time (tr) and the total gate charge (QG).

The MOSFET driver's peak output current (IPK) is then calculated. From the IPK, the most appropriate and cost-effective MOSFET driver can now be identified. After arriving at the chosen MOSFET driver, the tool calculates the device's power dissipation and the maximum ambient operating temperature allowed without heat sinking.

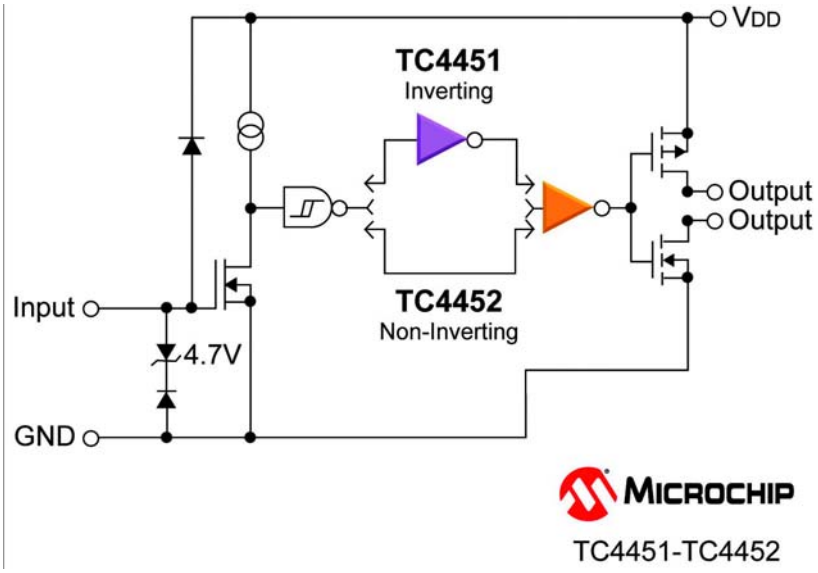

Figure 1: Example block diagram of a MOSFET driver

typically occurs in less than 10 ns. This fast transition limits cross-conduction time between Q1 and Q2, and quickly brings Q1 to its fully enhanced state in order to reach peak current as soon as possible. This is one of a number of possible MOSFET driver configurations.

The equations shown above can be used to select the correct MOSFET driver once the type of motor, power-switching elements, and gate-drive scheme are known.

Spreadsheet holds the key

When a MOSFET has been chosen, a vendor-supplied spreadsheet, such as Microchip Technology's Power MOSFET Driver Calculator (www.microchip.com/MOSFETDriverCalculator), can be used to select the most appropriate MOSFET driver. This easy-to-use tool enables quick determination of the MOSFET driver's required peak current.

Conclusion

There are two important factors to consider when selecting the optimum MOSFET driver for a particular application: the MOSFET driver's power-handling capability in relation to device package and ambient operating temperature; and the peak drive current required from the MOSFET driver, calculated from the total gate charge of the power MOSFET.

Simple spreadsheet tools, such as Microchip's Power MOSFET Driver Calculator and the equations provided in this article, enable designers to quickly zero-in on possible choices of MOSFET drivers that are suitable for each application.

www.microchip.com

Capacitor Advances for Leaner, Faster, Power Distribution

Designers can replace conventional capacitors

Power distribution networks for PC processors are slimming down to respond more quickly to large changes in current demand at low operating voltages. High-speed voltage regulator modules and new capacitor technologies optimised for very low equivalent series inductance allow engineers to reduce size and component count by eliminating the large number of capacitors traditionally required for bulk and mid-frequency decoupling.

By Erik Reed, Kemet Electronics Corporation

The Power Distribution Network

A modern, low-voltage microprocessor can change its current demand from a few amperes to over a hundred amperes in nanoseconds, but cannot tolerate an accompanying voltage shift greater than a few tens of millivolts. This places tough demands on the Power Distribution Network (PDN) to maintain voltage regulation in response to rapid load changes. Figure 1 illustrates the nature of the challenge by showing the direction and speed of power-flow through the PDN in response to a quickly changing load current.

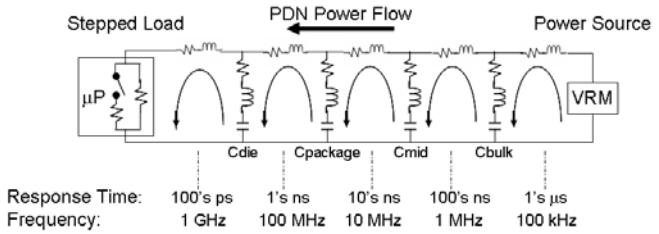

Figure 1: Direction and speed of power-flow

During the first few instants after the load current changes, the small capacitances associated with the die and package supply short-term energy with time constants of tens of nanoseconds. The next level of decoupling has traditionally been a combination of mid-level and bulk-storage capacitors placed between the processor and the Voltage Regulator Module (VRM). Since the VRM cannot respond quickly to load changes, the decoupling capacitors in the PDN hold the voltage steady until the VRM can sense the load change and respond appropriately; typically within a few microseconds.

The VRM is usually a DC-DC converter that steps down the typical 12V produced by the computer's main AC-DC power supply to the lower voltages required by the microprocessor. This can be as low as 1.0V for the latest processors with low-voltage cores. Recent evolutions of VRM technology have produced devices with higher switching frequencies and wider control bandwidth. Whereas conventional VRMs were unable to respond to load changes faster than a few kHz, advanced designs can now track load changes as fast as 100kHz. As a result, the requirement for bulk capacitance has fallen from the order of tens of thousands of microfarads to a few hundred microfarads. However, the requirement for mid-frequency decoupling remains.

For mid-frequency decoupling, MLCCs have been preferred for their combination of low ESL, low ESR and acceptable cost. To meet progressively increasing performance demands, however, engineers have turned to high-capacitance MLCCs to limit growth in the sheer number of capacitors required. Although these devices have helped reduce part count, the total footprint is nevertheless increasing and the cost per component is also rising. Other challenges for high-capacitance MLCCs include lower than expected capacitance due to DC bias application, small AC signal levels, TCC effects at elevated temperature, and ageing effects.

Consolidating Decoupling Capacitance

The reduced requirements for bulk decoupling capacitance now make it feasible to satisfy both bulk and mid-frequency coupling using a small number of capacitors offering moderately high capacitance, provided the devices also have low ESL and low ESR to match the speed of MLCCs. To achieve this, Kemet has enhanced the structure of tantalum-polymer capacitors, which have recently taken over from traditional wet electrolytic capacitors for bulk storage. The enhancements have resulted in a new generation of low-ESL tantalum polymer capacitors. These allow engineers to replace the traditional array of bulk and mid-frequency decoupling capacitors with a much smaller number of devices; in some cases only a single capacitor may be required.

Bulk decoupling design, generally, has been moving away from wet-electrolyte wound-aluminium capacitors towards aluminium or tantalum capacitors featuring solid polymer electrolyte. Their significantly lower ESR allows acceptable performance with fewer capacitors while maintaining reasonable cost. Desktop PCs have tended to use wound aluminium conductive-polymer capacitors, while notebook PC design has preferred tantalum polymer or stacked aluminium polymer devices as a result of their very low ESR, moderately high capacitance, volumetric efficiency and low profile.

This technology has provided a good basis on which to develop a new type of capacitor capable of satisfying both bulk and mid-frequency decoupling requirements. To produce low-ESL tantalum polymer capacitors capable of exceeding the performance of MLCCs, device designers have focused on minimising the loop area defined by the capacitor's high-frequency current path and the plane of the circuit board.

Reducing Capacitor ESL

The effect of the loop area on equivalent inductance can be shown by considering the high-frequency path between the capacitor electrodes as a short loop of wire, as shown in figure 2. An AC current passing through the wire creates a time-varying magnetic field around the wire.

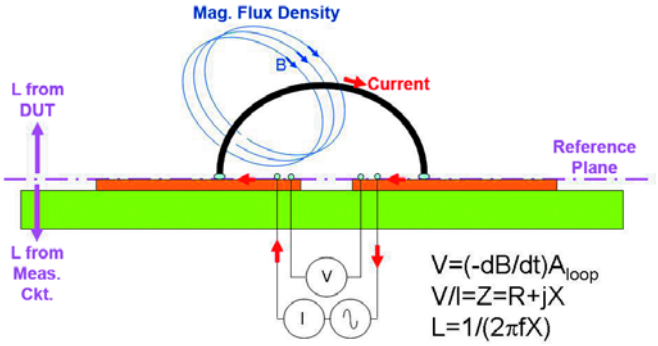

Figure 2: High-frequency path between the capacitor electrodes

Some of this magnetic flux couples with the loop of wire and generates a voltage across it. The generated voltage depends directly on the area of the loop and the amount of time-varying magnetic flux density. While the flux density is proportional to the current in the wire, it also depends on the shape of the current path; wider current paths result in lower flux density than narrow paths. Since the inductance of the wire is dependent on the ratio of the generated voltage to the current passing through it, reducing the area of the loop at the same time as increasing the width of the current path has the effect of reducing the inductance.

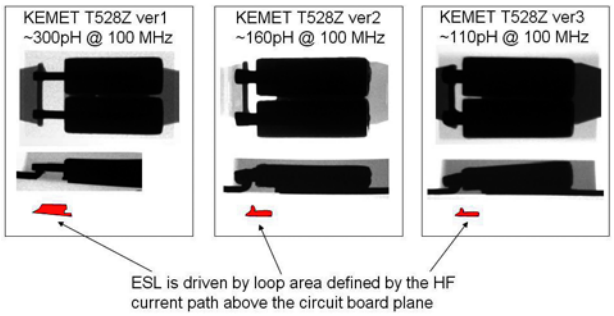

Figure 3: X-ray photographs of three low-ESL tantalum capacitors

Figure 3 shows x-ray photographs of three low-ESL tantalum capacitors recently introduced to the market. Comparing these photographs with figure 2, a current path and current loop can be readily identified. Given that high-frequency current will take the shortest path available along the surface of the loop formed by the device and connecting circuitry, the loop in each case is highlighted by the outlined surface shown below the respective x-ray pictures. The smaller this outlined loop area, the lower the resulting inductance. With ESL values of no more than 0.3nH, the pictured devices have much lower inductance than conventional tantalum capacitors, whose ESL usually falls between 1nH and 4nH.

Hence, low-ESL tantalum-polymer capacitors have been successfully developed, but it is important to note that the ESL of the capacitor cannot be completely separated from the inductance of the circuit in which it operates. This means high-performance circuits not only demand low-ESL capacitors but also require careful circuit board design to achieve the lowest total inductance.

Low-ESL Capacitors in Practice

Figure 4(a) and 4(b) compare the performance of two types of low-ESL capacitors against a conventional decoupling network comprising conventional tantalum bulk capacitors with MLCCs performing mid-frequency decoupling. In this experiment each assembly was connected to a fast electronic load with rise time of 18ns simulating the behaviour of a low-voltage microprocessor.

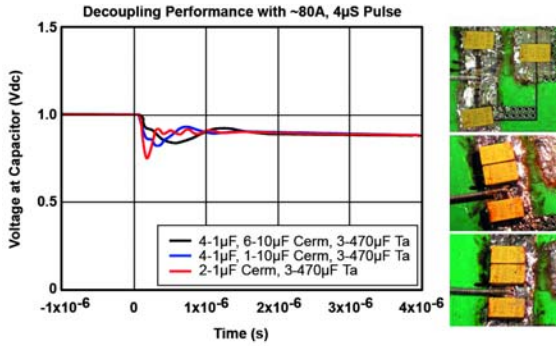

Figure 4a: Performance of two types of low-ESL capacitors

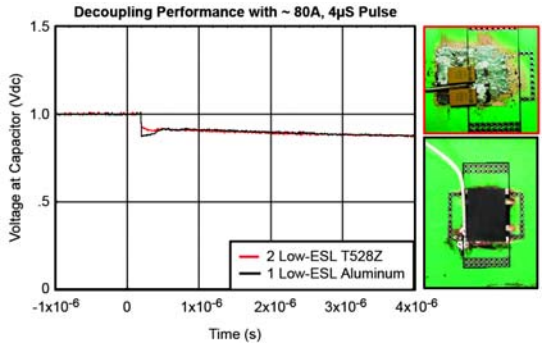

Figure 4b: Performance of two types of low-ESL capacitors

A current step of -80A and duration 4µs was applied. The ideal desired response is a voltage drop of about 0.1V, with no undershoot or ringing. In figure 4(a) showing the response of the conventional network, both undershoot and ringing are present due to interactions between the tantalum capacitors and MLCCs. Although it is possible to trade off ringing against depth of undershoot, neither can be eliminated completely.

Figure 4(b) shows the response of the two types of low-inductance capacitors. The pair of Kemet T528Z tantalum capacitors produces very similar response to a single, low-ESL aluminium capacitor. Both devices are clearly superior to the conventional decoupling network. However, the two low-ESL tantalum devices occupy less total board area than the single aluminium device, and are also delivered in a standard EIA 7343 footprint.

Conclusion: Slimmer PDNs for Future PC Platforms

The test results for low-ESL aluminium and tantalum capacitors show that these devices can be used for decoupling purposes in PDNs supplying high-performance processors operating at core voltages as low as 1.0V. By using these devices alongside new, high-bandwidth VRMs, designers can replace large numbers of conventional aluminium, tantalum and ceramic capacitors with just a few high-performance, low-ESL capacitors while at the same time controlling costs and conserving board space.

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Power Management Device for Door Zone Systems

Battery life is the most important factor in electronic modules for automotive

Vehicle manufacturers call for lower and lower current consumption for every module in the car: severe requirements are common to almost all the 'over key' applications in the body segment. Those specific electronic subsystems must also operate in ultra-standby mode, drawing a very low quiescent current, and this minimum sink current maximizes and extends the battery life. The most effective way to reduce current loss is to optimize at the 'module level' and not at 'device level' as was done for the previous generation of modules.

By Martina Giuffrida, Technical Marketing Engineer, STMicroelectronics and Giovanni Torrisi, Senior Technical Marketing Engineer, APG CAR BODY Division, STMicroelectronics

The Door Zone System module has become a widely used solution: this module typically contains a supply reference (voltage regulator), motor controllers (mirror folder and adjustment, power window), bulbs drivers (to drive footwell, exterior, and blinker lamps), special load drivers (camera view supply, electro-chromic mirror glass control, mirror heater) and a transceiver block that is responsible for the communication between all the subsystems in the automobile. The transceiver can be either a CAN or LIN module, according to cost and technical requirements. While CAN provides serial communication with a high level of security and robustness in noisy environments and can reach a bit rate of 1Mbit/s, the creation of the LIN protocol assured the same level of reliability as the CAN solution, with a significant cost reduction, although much slower.

A new device, (named L9952GXP, see Fig.1) gathers a Power Management Strategy, a Lin Physical Layer, and Power Actuator Drivers in an 'all-in-one' solution that provides a sensible improvement, simplifying the Door Zone Applications' implementation. More specifically, the device embeds several features, as two 5V low drop voltage regulators (the first one for microcontroller supply with a current capability of 250mA and the second one for peripheral supply with a current capability of 100mA), the window watchdog, and "wake-up" logic with cyclic contact monitoring. The device is LIN 2.0 compliant; a 24-bit SPI interface is used for mode control and diagnostics, and all the outputs are short circuit and temperature protected.

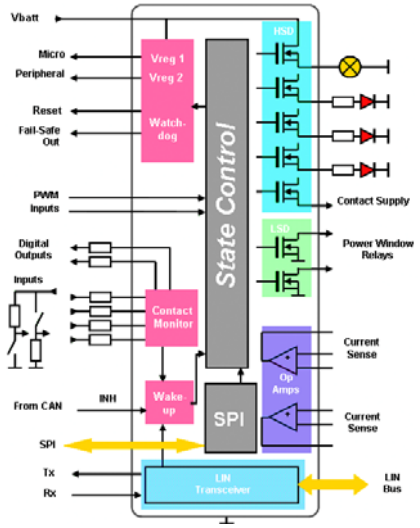

Figure 1: A Power Management Strategy, a Lin Physical Layer, and Power Actuator Drivers in an 'all-in-one' solution that provides a sensible improvement

Battery life is the most important factor in electronic modules for automotive, and this in turn means that current consumption of electronic devices must be minimized. Because of this, car makers focus on quiescent current when choosing a specific device for a specific application. In this sense, one of the most valuable features of the L9952GXP, also called the companion chip, is its advanced power management: this concept, in applications like the door zone, reduces system quiescent current to a minimum. In order to do this, two independent voltage regulators (V1 and V2) are necessary.

V1

The first voltage regulator provides 5V supply voltage and up to 250mA continuous load current for the external digital logic (micro controller, CAN transceiver ...). In addition, regulator V1 drives the internal companion chip's 5V loads. The voltage regulator must be protected against overload and over-temperature. An external reverse current protection has to be provided by the application circuitry to prevent the output capacitor from being discharged by negative transients or low input voltage. The output voltage precision is better than ±2% (including temperature drift, line regulation and load regulation) for operating mode; respectively ±3% during low current mode. Current limitation of the regulator ensures fast charge of external bypass capacitors. The output voltage is stable for ceramic load capacitors bigger than 220nF (instead of bigger and expensive electrolytic capacitors).

If device junction temperature hits thermal shutdown, all outputs except V1 will be deactivated - high side switches, low side switches, and the other regulator V2, LIN. Hence, the microcontroller has the possibility for interaction or error logging. In case of exceeding a higher thermal shutdown

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threshold (TSD2), V1 will then be deactivated. A timer is started and the voltage regulator is deactivated for 1 second. During this time, all other wakeup sources (CAN, LIN, and WU1...4) are disabled. After 1 second, the voltage regulator will try to restart automatically. If this higher threshold (TSD2) occurs within one minute and for 8 consecutive times, the device enters a mode named 'VBAT standby mode'. This standby mode, later described, can also be reached in case of a short to ground of V1 after the initial turn on. In this case, the reactivation (wake-up) of the device can be achieved with signals from CAN, LIN, WU1 to WU4, SPI.

V2

The smaller voltage regulator, V2, supplies additional 5V loads (for example, logic components, external sensors, external potentiometers). The continuous load current is 50mA. The regulator provides accuracy better than ± 3% at 50mA (±4% at 100mA). In case of a short to ground of V2 after the initial turn on, the V2 regulator is switched off. The microprocessor has to send a clear command to reactivate the V2 regulator.

The power-management functionality of the device allows it to reach the quiescent current required for different sleep modes. Typical values are in the range of 100ìA per module. The concept of the power-management functionality of the L9952GXP is depicted by the fact that the microcontroller can be operated in stop or halt mode, or can be disabled even by switching off the 5V supply. The required read-out of the contacts is executed by the power-management device. Thus, the device can be operated in cyclic and in static read-out configuration of the contacts, depending on the carmaker's specification and target for quiescent current. The setting is programmed via SPI before entering the sleep mode, and then the companion chip operates independently. The time base for the cyclic contact supply and read-out is generated autonomously inside the power management device by using an integrated RC oscillator. An additional filtering strategy (debouncing) for wake-up inputs is realized without any additional use of the microcontroller, using the internal time base. This avoids any wake-up events induced by EMC noise.

VBAT standby mode

To achieve minimum current consumption during VBAT standby mode, all the functions (except the ones for wake-up functionality) are switched off.
In VBAT standby mode the current consumption of the L9952GXP is reduced to 7ìA, typical (without cyclic sense feature selected). The transitions from active mode to either V1 standby or VBAT standby are controlled by SPI.
VBAT standby mode is dominant; if relevant bits, V1 standby and VBAT standby are set to "1", the device will enter VBAT standby mode

V1 standby mode

In this mode, outputs and internal loads are switched off. To supply the microcontroller in a low power mode, the voltage regulator 1 (V1) remains active. The intention of the V1 standby mode is to preserve the ROM contents of the external micro. A cyclic contact supply and wake-up input sense feature (for cyclic monitoring of external contacts) can be activated by SPI.

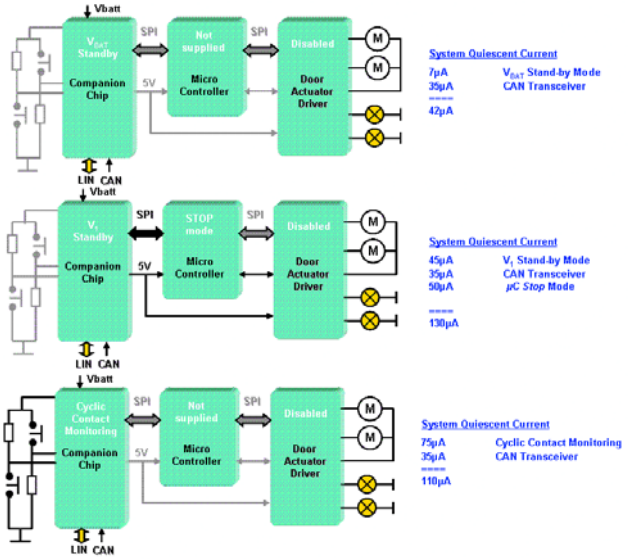

Figure 2 shows the two possible standby modes in a door aone module VBAT standby and V1 standby. Both of them, described below, support the cyclic contact sensing.

Cyclic contact monitoring

In addition to a continuous sensing (static contact monitoring) at the wake-up inputs, a cyclic wakeup feature is implemented. This feature allows periodical activations of the wake-up inputs to read the status of the external contacts. The periodical activation can be linked to Timer 1 (0.5sec to 4.0sec in 0.5sec steps) or Timer 2 (50ms). The input signal is filtered with a filter time of 16us after a programmable delay (80us or 800us). A wake-up will be processed if the status has changed versus the previous cycle.

Both standby modes (V1 and VBAT) support cyclic sense of the contacts.

Compared to the static contact monitoring, the main advantage of the cyclic contact supply and sense is a significant reduction of power consumption. For the open active contact (closed in not active state) - for example, when the power consumption in static mode is around 10mA for one contact; with the cyclic contact sense, this contact supply current is reduced to a short time when the contact is checked while the current consumption of the L9952GXP increases by approximately 65uA. Furthermore, when cyclic contact monitoring is adopted, the contact does not have to be powered by an external power source.

Contact monitoring is done during the "On-Time" phase of the timer selected for cyclic sense functionality. During the remaining timer period, the contact is not powered: this is why it is not consuming any power.
Of course, this feature does effect some contact configurations like opening contact, contacts which have two stable positions (On/Off), and contacts with parallel resistance or parasitic resistance (due for example to humidity).

However, regardless of the configuration, the cyclic monitoring limits the current consumption in case of a stuck contact switch.

In order to reduce WU input leakage current when the contact is not powered and floating, the current sink or current source configuration is active only during the "Off-Time" phase of the timer for cyclic sense.. When the contact is checked (timer "On-Time" phase), the wake-up input is automatically reconfigured to the setup used in Active mode where an internal pull-down of 200K¿ is activated.
As shown in Figure 3, any of the outputs has to be set to timer 1 or timer 2 mode to be able to power the contact in standby mode. Timer 2 is usually intended for contact sense, but timer 1 can be used as well if its settings are appropriate. The cyclic sense of the contact is based on the selected timer settings. The WAKE_UP input which is used for contact sensing must have the filter configuration relative to the adopted timer settings that means the right period and "On-time".
If the configuration of the Output and the WAKE_UP input filter is correct and the

device is switched to stand by mode, during every “On-time” phase of the selected timer the contact supply is activated (black contact supply in Figure 3) and the contact status is evaluated at the WAKE_UP input. The input signal is filtered and the WAKE_UP is processed when a level change on the input is detected.

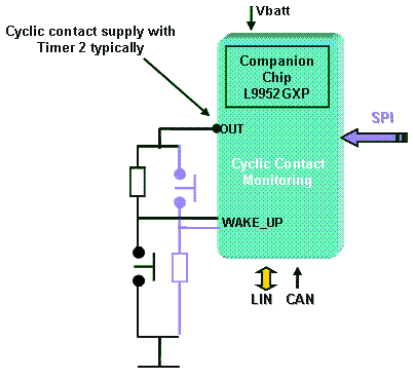

Figure 3: Any of the outputs has to be set to timer 1 or timer 2 mode to be able to power the contact in standby mode

Thermal behavior

The L9952GXP is housed in PowerSSO-36, which is a new power package ST designed to meet the market requirements that continuously call for increasing thermal performance.

Thermal performance is an especially critical factor within the small PCB area of the door zone system, which integrates several electronic devices closely together. For this reason, new power packages such as the PowerSSO family have been designed r to save space PCB real estate and to improve thermal performance as compared to standard “SO” plastic packages. The body dimension of a PowerSSO-12, for example, is the same as an SO-8, while the body dimension of a PowerSSO-24 is the same as an SO-16. The main difference between the “classic” plastic packages and the newer power packages is that in these new ones the heat dissipation from the chip to the PCB is performed through an exposed slug or pad soldered directly onto the PCB. This characteristic improves the overall junction-to-ambient thermal resistance when compared to the “SO” standard packages for integrated circuits, where the heat propagates through leads only. Building on ST’s long experience as a leader in power management ICs and smart-power technology, the L9952GXP reduces the PCB area and Bill of Materials, thereby enabling customers to minimize the complete system cost.

All these features make the L9952GXP a sophisticated but user-friendly power management device ideal for compact and lightweight systems. A very low quiescent current can be achieved with the use of this device. Control and diagnostics are managed through a serial peripheral interface (SPI), and superior thermal performance is guaranteed with the small power packages as the PowerSSO-36, that offers the optimum trade-off between thermal behavior, dimensions, and cost.

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Time Controlled Power-Save Mode

More Flexibility For Low-Power Synchronous Buck Converters

Modern synchronous buck converters for portable applications provide so called power-save mode operation to maintain high efficiency over the entire load range. At light loads, the converter operates with pulse frequency modulation (PFM mode) and provides automatic transition into pulse width modulation (PWM mode) at medium to heavy loads.

By Markus Matzberger, Portable Power Systems Engineer, Texas Instruments

This article discusses the basics of buck converters, the differences between PWM Mode and PFM Mode operation and describes in more detail a time controlled PFM mode technique, which is used in modern buck converters.

In several applications (e.g. audio), the PFM output ripple voltage, frequency and transitioning point between PFM and PWM operation is often a concern. With a time controlled PFM Mode, the performance can be fine tuned with external components to meet these specific application requirements.

Buck Converter Basics

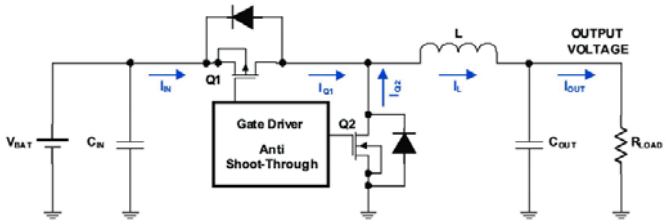


Figure 1: Simplified Synchronous Buck Converter

Figure 1 shows a simplified schematic of a buck regulator featuring the high-side PMOS switch (Q1) and low-side NMOS rectifier (Q2). Each MOSFET also includes a back-gate diode as shown in the diagram.

A buck converter operates by applying a fixed frequency pulse width modulated (PWM) waveform to a low-pass filter composed of an inductor L and an output capacitor COUT. The filter then averages the PWM waveform, resulting in a DC output voltage. For highest efficiency considerations, low voltage DC/DC converters generally use synchronous rectification (SR) schemes for minimizing the conduction loss, refer to Figure 1.

$$V_{OUT} = D \bullet V_{IN} = \frac{t_{on}}{T_{sw}} \bullet V_{IN}$$

To begin a discussion of DC/DC converters, a few fundamental relationships need understanding. In an ideal (lossless) buck converter, the input voltage and the duty cycle of the switch determine the output voltage.

Where the duty cycle is defined as the ratio of the main switch Q1 ON time to the switching period. This relationship holds as long as there is continuous current flowing in the inductor.

The next step is to follow the operation of the circuit for one switching cycle.

In a first step, the PWM signal turns on the main switch (Q1) and the inductor current transitions from the SR (Q2) to the switch (Q1). The current flows from the input capacitor via the high-side switch (Q1) through the inductor into the output capacitor and into the load. To close this loop, the current returns back to the input capacitor. During this phase, the current in the high-side switch (Q1) and the inductor ramps-up until the high side switch is turned off.

In a second step, the PWM signal turns off the main switch (Q1) and the inductor current transitions from the switch (Q1) to the SR (Q2). The current still flows from the inductor into the output capacitor and into the load, but it returns back through the low-side MOSFET rectifier (Q2). The inductor and rectifier current will ramp down. During the rectification cycle, the input capacitor is charged-up.

Figure 2 shows a scope plot of a buck converter operating with a load current of 200mA. The load current is equal to the average inductor current. Note that the input voltage is 3.6V and the output voltage 1.8V, therefore the duty cycle is c.a. 50%.

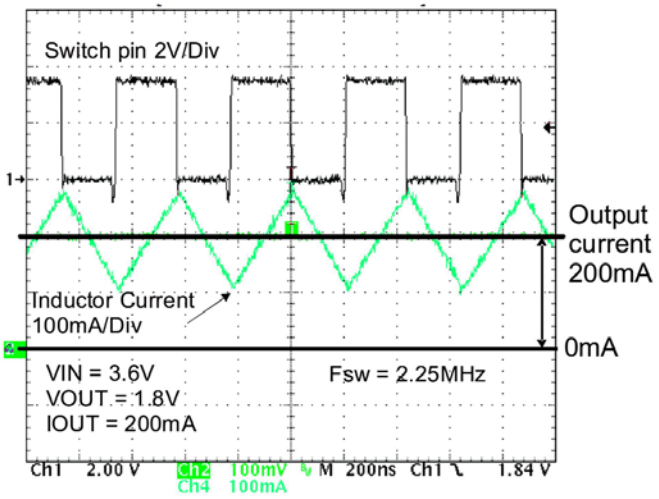


Figure 2: Buck Converter, Fixed Frequency PWM Operation

Another important relationship relates the inductor value to the amount of AC ripple current in the converter.

$$\Delta I_L = \frac{(V_{IN} - V_{OUT}) \bullet D \bullet T_{sw}}{L} = \frac{V_{IN} - V_{OUT}}{L \bullet F_{sw}} \bullet \frac{V_{OUT}}{V_{IN}}$$

The inductor peak current is defined as:

$$I_{L(PEAK)} = I_{OUT} + \frac{\Delta I_L}{2}$$

Conversely, the inductor valley current is defined as:

$$I_{L(VALLEY)} = I_{OUT} - \frac{\Delta I_L}{2}$$

Why PFM Mode?

The formulation “PFM mode” stands for Pulse Frequency Modulation. PFM is a nonlinear operation in which a series of inductor current pulses are applied to the load and output capacitor to maintain the output voltage within preset boundaries. This mode effectively lowers the frequency of the switching-cycle events, thereby lowering the switching losses in the converter.

In modern low-power DC/DC regulators, when Power Save Mode (PSM) operation is enabled converters are automatically turning into PFM mode regulation under light load condition.

During PFM operation, the Switched Mode Power Supply (SMPS) is kind of in sleep mode. Only the internal reference and a low quiescent current comparator are enabled to supervise the output voltage, a nonlinear control scheme is applied.

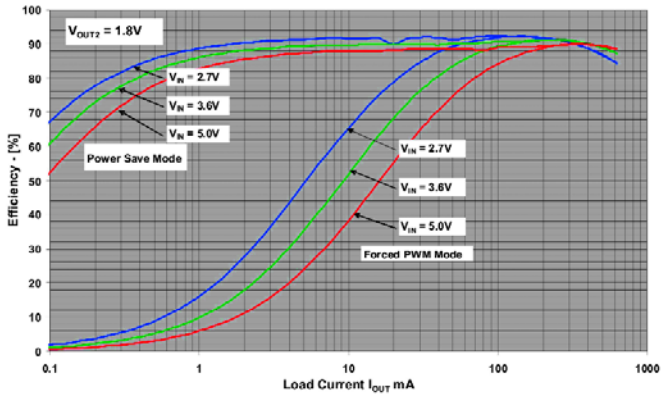


Figure 3: Efficiency Comparison: PFM Mode vs. Fixed PWM Mode

Most of the other functions of the DC/DC converter are turned-off, thereby dramatically reducing the quiescent current consumption down to c.a. 15 to 20uA. Once the output voltage falls below a certain threshold, the DC/DC converter wakes up and operates until the output voltage is within its regulation limits.

PFM operation is primarily aimed to increase the DC/DC converter’s efficiency under light load conditions. But as a side effect, it has influence on two major parameters of the DC/DC converter:
output voltage ripple
switching / burst frequency

The increase in conversion efficiency at light loads can be seen in Figure 3.

Figure 4 shows the change in PFM switching frequency and its impact on the output ripple voltage as the output current is increased from 1.5mA to 50mA. This example is based on the TPS62260 device (2.25MHz, 600mA buck regulator) showing constant PFM output ripple voltage, whilst the switching frequency is increasing with higher load conditions.

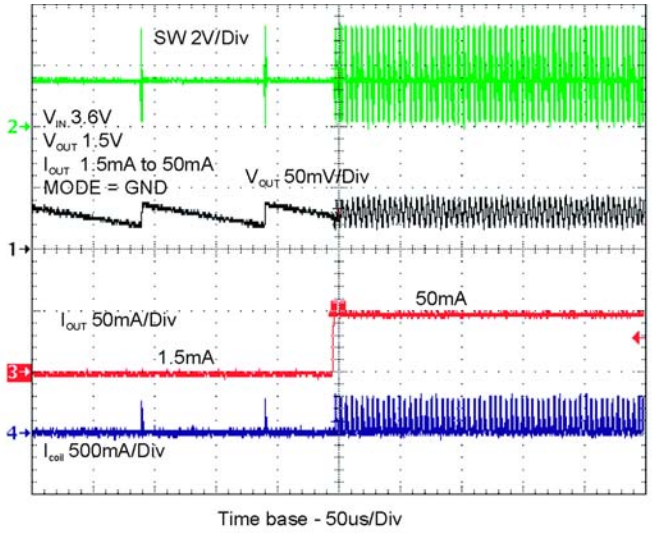


Figure 4: PFM Mode Frequency vs. Load Current (TPS6226x)

Time Controlled PFM Mode (TPS62240, TPS62260, TPS62290)
The TPS62240, TPS62260, TPS62290 family of 2.25MHz buck converters features a single threshold, variable on-time controlled PFM mode. These devices feature an on-time controlled inductor peak current modulation (vs. fixed inductor peak current) when operating with a VOUT/VINratio of less than 85%.

In this case, the inductor peak current depends on the effective inductance value. As a result, the output ripple voltage and the PFM frequency can be influenced by both, the inductor and output capacitance.

Below equation helps to estimate the PFM inductor peak current. The time period (T1) reflects the nominal duration of a single PFM pulse.

$$I_{L(PEAK\_PFM)} \approx T1 \bullet \frac{(VIN - VOUT)}{L \bullet V_{IN}} \bullet V_{OUT}$$

With T1 ≈ 0.62µs, L in µH

In PFM mode, the device typically operates in a single pulse mode and reduces progressively the dead-time between pulses as the load current increases. As a matter of facts, the PFM frequency increases up to the point it can not be supported any longer by a single pulse. To maintain the output voltage within regulation, the device adds further pulses to the sequence of maximum 16 pulses. In case the load requirement can no longer be supported by a series of 16 pulses, the device will automatically enter PWM mode operation.

The load current at which the device transitions from PFM into PWM mode is mainly a function of the input and output voltages as well as the inductance value.

$$I_{(PFM/PWM)} \approx \frac{I_{L(PEAK\_PFM)}}{2}$$

A typical application circuit for 1.8V output voltage using TPS62240 is given in Figure 7. The characteristics in Figure 8 to Figure 10 have been measured with this circuit.

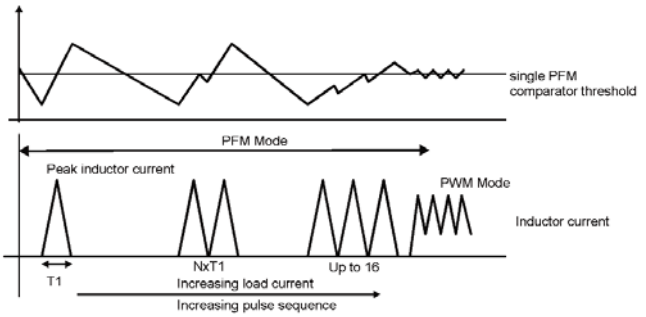


Figure 5: On-Time Controlled PFM Scheme (TPS62240, '260, '290)

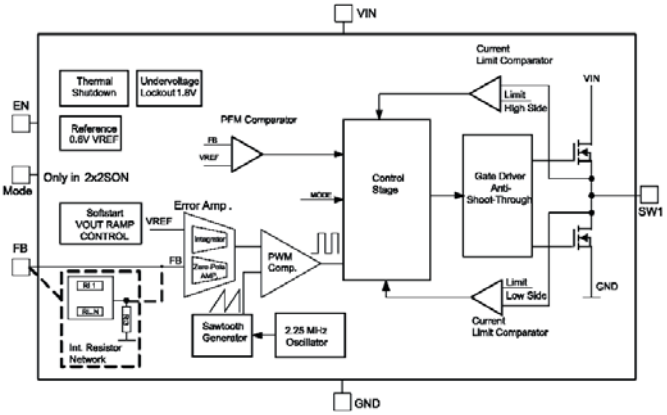


Figure 6: Single Threshold PFM Regulator Block Diagram (TPS62240)

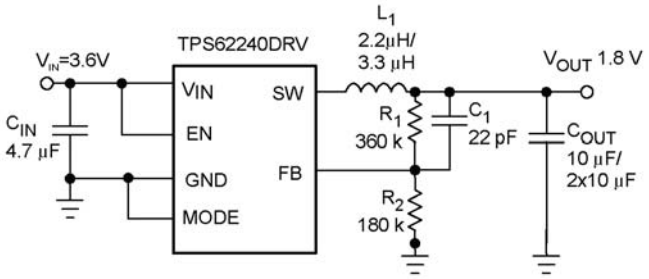


Figure 7: Typical Application Circuit of TPS62240 for 1.8V Output Voltage

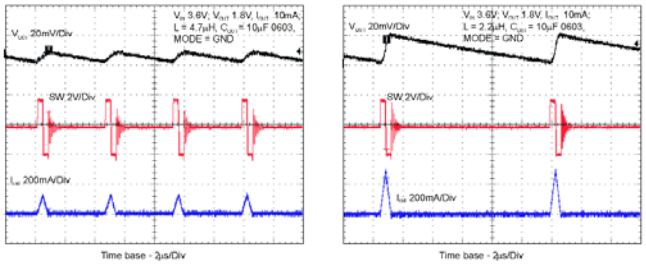


Figure 8: Output Ripple Voltage vs. Various Inductors

Figure 8 shows the difference in the output ripple voltage that can be achieved by using different inductance. In the left graph, a 2.2µH inductor has been connected to the device resulting in a 20mV peak to peak ripple voltage at 10mA load. In the right hand-side graph, the inductor value is roughly double, the output ripple voltage half and the PFM frequency is approx. twice as high. In both cases an effective capacitance of 6µF (i.e. 10µF nominal) has been used.

Figure 9 shows different PFM frequency characteristics over load current and LC filter combinations. The PFM/PWM mode transition point is primarily defined by the inductor value and the operating condition and nearly independent of the output capacitor value.

The PFM/PWM transition point can be tailored by the inductor selection. For audio and low-power RF transmitter applications, an earlier PFM/PWM transition point (i.e. at low load current) can help to minimize interferences with other noise sensitive components in these systems. The fixed frequency operation in PWM mode provides the lowest output ripple

The PFM frequency characteristic starts at a few kHz (at very light load) and increases with rising load current. Further load increase increments the PFM pulse count, thus lowers the PFM burst frequency down to the PFM/PWM transition point. The PFM frequency at this point can be approximated as:

$$f_{(PFM/PWM)} \approx \frac{1}{16*T1} \approx 100kHz$$

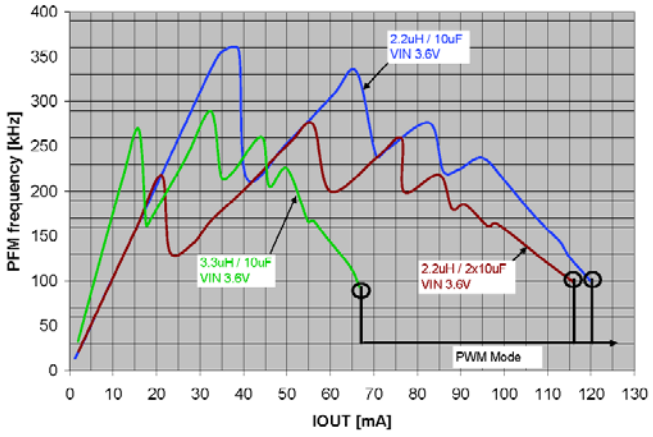


Figure 9: PFM frequency vs. load current vs. LC components

Figure 10 presents the peak-to-peak output ripple voltage characteristic vs. load current for a set of inductor and output capacitor combinations.

For a given output capacitor (e.g. 10uF 6.3V 0603, 6uF effective), the output ripple voltage characteristic can be improved with larger inductances (e.g. 2.2µH to 3.3µH). Furthermore, the PFM/PWM mode transition point is shifted towards lower output current values.

For a given inductor (e.g. 2.2µH), increasing the effective output capacitance (2x 10uF 6.3V 0603, 12uF effective) helps to improve

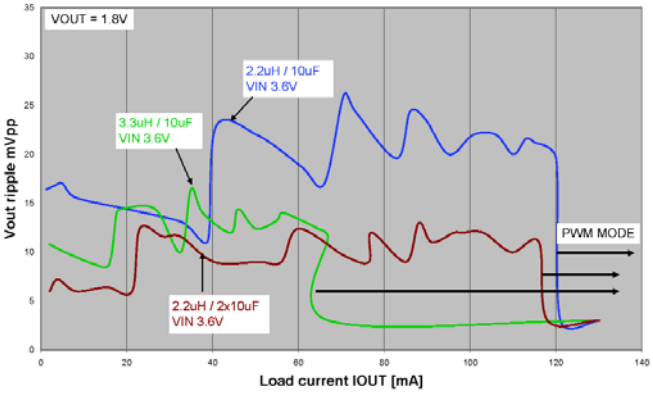


Figure 10: PFM output ripple voltage vs. load currents vs. LC components

the output ripple voltage performance without impacting the PFM/PWM transition point. Suitable inductor ranges from 2.2µH to 4.7µH, output capacitors from 10µF to 22µF.

Conclusion

In practice, some designers of portable systems try to avoid designs with variable-frequency converters because of the concern about EMI or other aspects related to variable-frequency operation. In some cases, these concerns are valid due to the interaction of PFM converters with sensitive subsystems elsewhere in the portable product. However, PFM architecture offers real benefits.

The basic operational differences between PWM and PFM architectures have been reviewed. TI continuously drives forward the development and optimization of PFM techniques to achieve best performance on key parameters such as output ripple voltage and quiescent current.

If it is determined that the variable frequency operating range is too wide for a sensitive application, the system designer should consider the use of time controlled PFM mode. This offers some more flexibility to adjust the PFM output ripple voltage, to tune the burst frequency characteristic and certainly offers better efficiency over fixed-frequency PWM mode.

As with many engineering problems, there is no single best answer but a range of application specific issues that need to be considered.

www.ti.com

Integrating PID Controllers into Automated Processes via Ethernet

Ethernet will play a significant role in the foreseeable future

Ethernet communications is rapidly gaining popularity in industrial applications because it enables the real-time exchange of information between processing equipment and companies' Ethernet-based management systems.

By Sean Wilkinson, Watlow

Ethernet technology is becoming widely accepted due to multiple factors, including:

- the speed advantages over lower baud rate protocols
- the number of tools available for troubleshooting and optimizing a network,
- the broad base of competitive vendor support and solution options and
- the large pool of trained personnel who are familiar with the technology.

In addition, the ability to bridge existing proprietary communications schemes makes it possible to phase in the use of Ethernet rather than having to replace everything at once.

When asked, engineers most frequently respond that they expect to use Ethernet to integrate control systems in the future. But a follow-up question, inquiring which Ethernet protocols they plan to use, is often met with confusion since some do not realize there are thousands of protocols that are compatible with, and can coexist on Ethernet networks.

In attempting to navigate this sea of protocols, it is natural to look first to familiar ones that offer the functionality we are used to using on office networks, at home and on the Internet. Using such protocols, Ethernet can extend access to remote users through web browsers and e-mail. But for an engineer tasked with automating a process, the challenge is to connect devices to other devices to integrate automatic functions. For example, a temperature controller may need to get its set point from a Programmable Logic Controller (PLC).

For the purpose of automation, Ethernet protocols such as HTTP, which allows web browsers to display web pages, and SMTP by which email messages are transmitted, are ill suited. These protocols are designed to transmit information over Ethernet, but the information is in a form that requires human interpretation. One purpose of automation is to relieve humans of the tedious task of monitoring and adjusting a process based on feedback from sources such as pressure gauges and mercury thermometers that require human interpretation. Another purpose of automation is, of course, to improve process results by removing variations in human interpretations and occasional misinterpretations from the process.

What is needed for automation are not protocols that transmit messages intended for human eyes to interpret, but rather protocols that transmit information structured for automation devices to interpret. An example of a control automation problem can be used to illustrate this need.

An engineer who plans to automate a candy packaging machine must consider not only the sequential functions that fill the open bag with candy, close the bag and drop the sealed bag in to a box, but also the critical temperature control of the sealing bar that insures the candy stays safe, secure and fresh in the sealed package. The engineer must also consider the reliability of the process and the ease-of-use.

A PLC may be ideal for the sequential functions, but accurately controlling temperature is also important. Here the candy packaging engineer is traditionally faced with a dilemma. The system can use the PLC to perform temperature control directly or standalone temperature controllers can be used in conjunction with the PLC.

Performing temperature control in a PLC presents numerous challenges. Programming can be difficult, requiring expertise that may not be available. Control algorithms can interfere with other program functions by consuming processing bandwidth, or require the use of a more expensive PLC than would otherwise be required. Control may be sub-optimal because a simple on-off control algorithm, the easiest to program in a PLC, is used.

Figure 1: Thermistors

The alternative, using a standalone temperature controller, resolves these issues. Commercially available temperature controllers include advanced control algorithms and automatic tuning, so little expertise is required. The calculations and I/O updates

associated with temperature control are performed by the PID controller's processor, freeing the PLC's processing bandwidth for other tasks. But in the past due to differences in the supported protocols, getting standalone temperature controllers and PLCs to communicate has been time consuming, costly and difficult as well. If the PLC and temperature controller do not communicate, the machine depends on the operator to integrate these functions.

For example, if the candy packaging machine uses a PLC to move the product and a separate temperature controller to heat-seal the package, when the demand for candy increases and the production line speeds up, the sealing operation must happen faster which may require a higher temperature set point. If the PLC and temperature controller are not coordinated by the automation system, if they do not communicate, someone has to manually change the temperature setting on the controller. Without the communications link, the chances are greater that the temperature setting will not be correct and the candy will not be properly sealed in the package.

Figure 2: Sensors

Engineers often prefer to use standalone temperature controllers when performance of control loops is important. They are also used when the PLC application could be negatively impacted by incorporating the temperature controller, but traditionally the cost and difficulty of integrating a temperature controller was a major barrier. Because now many PLCs and a growing number of temperature controllers support Ethernet-based protocols intended for industrial applications, this barrier is falling away.

One such protocol is EtherNet/IP™

According to the Open DeviceNet Vendors Association (ODVA™), the agency that sponsors both DeviceNet™ and EtherNet/IP™, EtherNet/IP™ is a member of a family of networks that implements the Common Industrial Protocol (CIP™) at its upper layers. CIP™ encompasses a group of messages and services for manufacturing automation applications including control, safety, synchronization, motion, configuration and information. EtherNet/IP™ provides users with the network tools to use standard Ethernet technology for manufacturing applications while enabling Internet and enterprise connectivity.

Using EtherNet/IP™ specifically yields the advantages of an Ethernet network, as well as the advantages of CIP™ designed for device-to-device communications. Those advantages include:

Explicit messaging, which allows devices to be configured via the network. A device can be detected and completely configured automatically in the event a piece of hardware is replaced.
Implicit messaging, which allows efficient communication of data and instructions from one device to another or from one device to many consumers of data on the network. This minimizes network traffic and allows the speed advantage of Ethernet to be achieved.

Assurance of interoperability
All devices are tested by ODVA™ and users can expect fewer problems when putting devices from multiple vendors together on a network.
Integration with other EtherNet/IP™ compliant devices such as programmable logic controllers (PLCs) or touch screen human-machine interfaces (HMI).

EtherNet/IP™ allows engineers to integrate various components such as PLCs and temperature controllers with each other in effective and efficient control schemes.

An example of a temperature controller designed for such automation solutions is the new EZ-ZONE™ PM controller from Watlow. With the EZ-ZONE PM controller the engineer has the option to configure a panel mount controller as a high amperage power controller output with a high-performance PID controller, an over/under limit controller or these functions can be combined into an integrated controller. The new EZ-ZONE PM provides a wide range of serial communication choices including EtherNet/IP™, Modbus® RTU, and Modbus® TCP. These protocols give you the ability to easily and inexpensively connect to a PC, PLC or HMI to remotely configure, manage and monitor the system's performance. The EZ-ZONE is ideal for applications where space is limited and a 1/16 DIN panel mount is necessary. Having a less crowded panel, fewer wiring connections, fewer discrete components and better thermal loop monitoring with error reporting are all benefits to the user. The controller decreases design and assembly time, requires less panel space, minimizes system complexity and best of all, lowers the total cost of ownership.

Another example, Watlow's SERIES PD controller utilizes embedded Ethernet technology to provide a convenient, economical means for setting up and viewing key process variables. The SERIES PD controller is ideally suited for a broad range of temperature and process control applications where the operator interface is supported from a remote location. This single or dual loop DIN-rail mount controller offers up to four control/alarm outputs plus up to two digital or current transformer inputs. To support access by remote users, the SERIES PD provides a web server for configuration and operation via a web browser. An e-mail can be sent to service personnel for notifying operators of alarms and other conditions. In order to better support integration in automation solutions, in 2005, the SERIES PD became the first temperature controller to offer ODVA™ Ethernet/IP™ conformance tested communications.

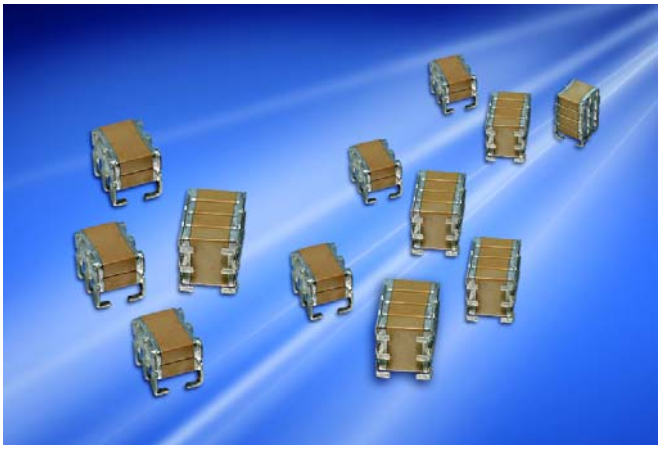
Figure 3: Ethernet connectivity

Watlow's EM gateway offers Ethernet connectivity for existing devices that communicate via the Modbus® RTU protocol on an RS-485 network. The EM gateway provides a quick, convenient and economical means of adapting controllers to Ethernet connectivity by bridging communications from Modbus® RTU on RS-485 to Modbus® TCP on Ethernet. The EM gateway also acts as a web server for supported temperature controllers, allowing users to remotely monitor the process variables and alarms. The user can remotely set the set points for temperature control in an Internet browser. Users can receive e-mail messages when alarms occur in supported controllers. The features of Ethernet protocols act as extensions of the user interface, making it more convenient for operators and supervisors to monitor processes and equipment. For industrial automation solutions the gateway bridges messages from, for example a PLC supporting Modbus® TCP on Ethernet to a 485 network of devices communicating via Modbus® RTU. With products such as this, engineers can begin converting networks to their vision of an Ethernet future without having to replace everything at once.

While there are many options for integrating devices in automation solutions, it is clear that Ethernet will play a significant role in the foreseeable future. There are numerous Ethernet protocol options, some provide more functionality for remote access by users and others provide more functionality for integrating devices. The emergence of protocols such as EtherNet/IP™ enables engineers to attain the advantages of using Ethernet in industrial applications. The broad support by suppliers for these protocols allows an engineer to choose the best device for the job without compromising the ease-of-use that comes with fully integrating the control system.

www.watlow.com

MLC Capacitors Provide lower ESR than Tantalums



HolyStone (Europe) Ltd. has announced the release of their SMC series of stacked Multilayer Ceramic Capacitors. With capacitance values of up to 27uF, the SMC Series design offers the high capacitance levels similar to tantalum product, but with the advantage of extremely low ESR.
This, along with the strain relief provided by the lead frame design, makes HolyStone's SMC Series, with its MLCC design, particularly useful in power supply, surge protection, DC-DC converters, industrial control circuits and other consumer product applications where high CV is required.

www.holystonecaps.com

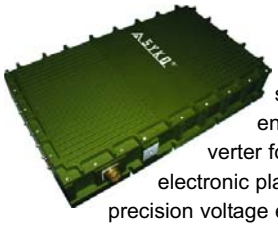
Slim Line EMI Filter

LCR Electronics, a leading manufacturer of EMI filters, electronic products and high-end enclosures for commercial, appliance and telecom, military and aerospace applications, now offers a series of double-stage, low-profile EMI filters that provides easier assembly and reduced material costs.
The new 088 Series integrates a high attenuation EMI filter and IEC power entry socket with an illuminated power switch and either a fuse or a re-settable circuit breaker into one compact package, reducing the number of components that need to be incorporated into a system.

www.lcr-inc.com

www.bodospower.com

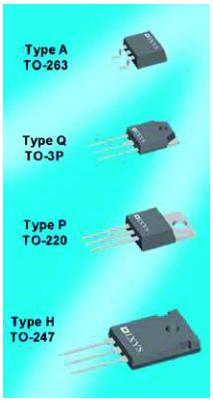
Precision Network Generation



The new FBV series is a front-end DC/DC converter for the supply of electronic platforms with a precision voltage e.g. 24V and a tolerance of ±2% as a function of input voltage, output current and an ambient temperature of –40°C - +85°C. The precision network is generated from the vehicle's rough network with a voltage range of ≤0,4 to ≥1,5 times the nominal voltage Unom. Voltage drops lower 0,4 times Unom or voltage interruptions down to 0V are bridged with an active Hold-up time of 10 ms to >50ms. An active cross plugging protection prevents the converter's damage in the case of a wrong input voltage connection. Transients of 50V-50ms / 70V-2ms or 100V-2ms (VG96916/MIL1275B) are absorbed by an active transient protection filter without current reflexion in accordance to the international Patent of SYKO. The converter is integrated in an IP65-housing (optionally higher protection level) and the EMC-activities lead to the compliance of the VG95373 level 2 for the input and output circuit. A floating and polarity independent Sleep-mode switches the converter inactive and realises a stand-by current of ?0,5mA, which makes the FBV series ideal for mobile applications on land, in water and in the air.

www.syko.de

TrenchPTM P-Channel Power MOSFETs



IXYS Corporation announces the introduction of -50V to -150V TrenchPTM P-Channel Power MOSFETs with 30% lower device on-resistance per unit area than best-competing P-Channel devices on the market. This new family of P-Channel devices capitalize on benefits derived from IXYS' advanced trench cell technology commonly implemented in their portfolio of industry recognized power devices. They feature an ultra low on-resistance (Rdson) and gate charge (Qg), minimizing conduction and switching losses, while promoting improved operating and thermal efficiencies.
These devices are ideal for 'high side' switching applications where a simple drive circuit referenced to ground can be employed, bypassing additional 'high side' driver circuitry commonly involved when using an N-Channel MOSFET. This enables designers to reduce component count, thereby improving drive circuit simplicity and overall component cost structure. Furthermore, it allows for the design of a complementary power output stage with a corresponding IXYS N-Channel MOSFET, for a power half bridge stage with a simple drive circuit.

www.ixys.com

Filters Suitable for all Single-Phase Applications

With the EMC filter series, Tyco Electronics extends its catalogue range to include a new high-performance, universally applicable single-phase filter for current ratings of up to 30A. Due to its two-stage construction and use of high-quality components, this extremely compact dual-circuit filter series delivers high common mode and differential mode attenuation over the entire frequency range of 100KHz to 30MHz.
The EMC filter series is ideally suited to all types of single-phase applications, which require high attenuation to reduce wire-induced interference to within required limits. The filter can be used in a wide range of devices, both in consumer electronics and in industrial single-phase applications, such as motor drives and switch mode power supplies.

www.tycoelectronics.com

TOPSwitch®-HX Offline Switcher ICs

Power Integrations launched five new members of its popular TOPSwitch-HX family of AC-DC power conversion ICs in the company's new 2-mm-high e-SIP-L package. The new products are ideal for slim power adapters used with netbook/laptop computers, printers and video game consoles, and for LCD TVs and monitors where the trend recently has been toward lower-profile and more energy-efficient products.
The TOPSwitch-HX family is highly efficient from light load to full power, which benefits a wide range of applications where government regulations limit energy usage at all power levels.

www.powerint.com

Integrated Stepper Motor with USB 2.0

The DMX-J-SA by Arcus Technologies is an advanced stepper motor/driver/controller with a built-in USB 2.0 interface that simplifies communication and programming tasks. The product offers design flexibility and easy integration into the host system.
By combining the stepper motor, the motor driver, and a controller into one NEMA 17 package, the DMX-J-SA provides a complete single axis solution that can reduce system hardware requirements for many automation and control applications.
The motor driver component is rated at 2.0 Amps max at 24 Volts and supports 16 micro-step operation.

www.arcus-technology.com

Energy-Efficient Analog Products for Automotive Applications

National Semiconductor announced a series of innovative, energy-efficient products that enable emerging automotive applications in LED lighting, powertrain, safety and infotainment systems.
National's temperature sensors, data converters, audio and operational amplifiers (op amps), as well as power management and interface circuits, address the need for reliability and precision with high temperature environments and wide operating voltage ranges. Many of these devices, identified by the letter Q in the device name, conform to the Automotive Electronics Council's AEC-Q100 reliability specification, a special manufacturing flow that requires extended testing and screening. All of these products help electronic system designers develop safer cars with better fuel efficiency and provide the driver with comfort and convenience.

www.national.com/analog/automotive

Programmable Four-String High-Brightness LED Driver

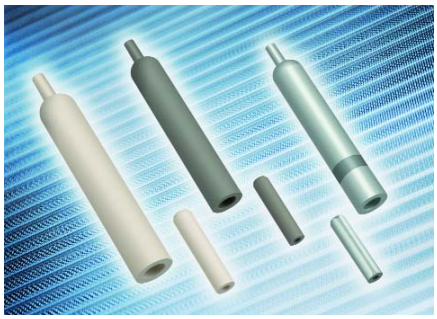
Maxim Integrated Products introduces the MAX16826 programmable, four-string high-brightness (HB) LED driver for white, RGB, and RGB-plus-amber LED configurations. Designed to enable the transition to green lighting technology in automotive applications, this device maximizes system flexibility and provides the lowest solution cost for backlight drivers.
The MAX16826 integrates a switching regulator controller; a 4-channel, linear current-source driver; an ADC; and an I2C interface. The I2C interface allows dynamic programming of the output voltage to maximize power efficiency; it also allows manufacturers to program LED current for each string to accommodate LED binning variations, thereby reducing implementation cost.

www.maxim-ic.com

Injection-Molded Heating Elements

Thanks to an innovative production technology from EPCOS, world market leader in thermistors, PTC heating elements can now be manufactured in injection molding technology. As a result components can be made in any nearly any desired shape, such as tubes, nozzles or rotor blades of ventilators and not only as round disks, rings or rectangular plates as before. These custom-fitted shapes open up many new applications for ceramic heating elements.
Because the heating elements can be incorporated precisely where the heat is required, they also avoid transmission losses and save energy.

www.epcos.com



300W Regulated Isolated DC/DC

FDK Corporation expands its Sensei Series of isolated dc/dc converters with the addition of a new high power regulated quarter brick converter that provides 25 Amperes (A) of output current (300W) with minimal derating at elevated temperatures. The FPQR48T01225 converter is targeted for Intermediate Bus Architecture (IBA) and Distributed Power Architecture (DPA) in telecommunications, WiMAX, data processing, computing, and storage applications that require a regulated 12V distribution bus.
The FPQR48T01225 converter operates from a 36Vdc to 75Vdc input and provides a tightly regulated 12Vdc output. It delivers up to 25A with an efficiency in excess of 92.5%.

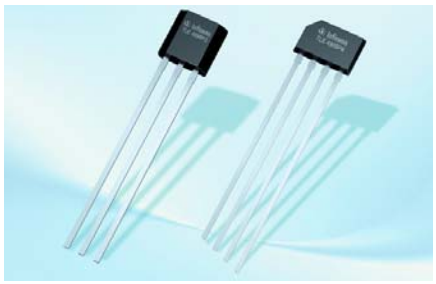
www.fdk.com

Highly-Integrated Battery Charger for Portables

Intersil Corporation announced the ISL9222A, a battery charger innovation designed to detect auxiliary and external power connections in mobile devices.
The ISL9222A is a high input, single cell, Li-Ion battery charger IC that incorporates a charger and digital logic (OR gate) into a single chip. This compact package enables customers to create small footprint solutions.
The ISL9222A's high level of integration and small size make it ideal for applications that require overvoltage protection, test fixture power detection or reverse blocking.
The ISL9222A accepts an input voltage up to 28V, but is disabled when the input voltage exceeds the overvoltage protection threshold (typically 7.2V) in order to prevent excessive power dissipation. The 28V rating eliminates the overvoltage protection circuit required with a low input voltage charger.

www.intersil.com

Linear Hall Sensors with Unique Temperature and Stress

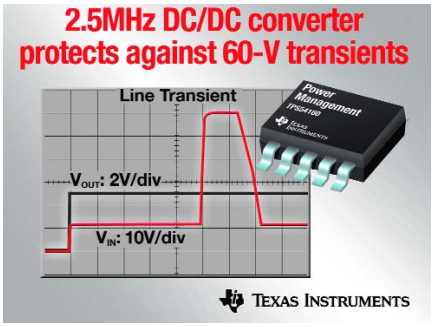


Infineon Technologies AG introduced two new programmable linear Hall sensors designed for use in automotive and industrial applications requiring highly accurate rotation and position detection. The new TLE4997 and TLE4998 sensors offer the highest accuracy of Infineon's linear Hall sensors and are fully automotive qualified. Additionally, the TLE4997 sensor provides unique temperature compensation and the new TLE4998 sensor adds unique compensation of stress over lifetime.
Both sensors are suited for a wide range of applications. Automotive applications include, for example, pedal and throttle positioning, suspension control, torque sensing and gear stick position detection.

www.infineon.com/sensors

65-V SWIFT DC/DC Converter

Expanding on the company's popular integrated SWIFT™ family of DC/DC converters, Texas Instruments Incorporated introduced a new 65-V input, 1.5-A output step-down switcher with integrated FET that achieves significant energy savings in light-load efficiency. The wide-input converter helps saves up to 25 percent of board space compared to competitive wide-input voltage solutions and eases design in industrial and automotive applications.



The TPS54160 non-synchronous buck's 3.5-V to 65-V input voltage range provides designers flexibility in applications with input transients. By leveraging TI's innovative Eco-modeTM light-load switching technique, the converter is able to achieve a low 116-uA operating current and 1.3-uA shutdown current, resulting in longer system run-times and a more efficient power system design.

www.ti.com

17mm profile height Bridge Rectifier Modules

These modules expand POWERSEM's vast family of single and three-phase rectifier modules with screw, solder and fast-on connectors.
The 17mm height modules are following the trend in power modules, gradually replacing the old 30mm profile height standard. The 17mm bridge rectifiers from POWERSEM allow new product designs to be slimmer while retaining the same power capacities.

The three phase Bridge Rectifier Modules PSDS 62 (63A at 110°C, 800 to 1800V) and PSDS 82 (88A at 110°C, 800 to 1800V) have both screw connections.
The mechanical, electrical and thermal parameters from the new PSDS 62 and PSDS 82 are the same as our well-known 30mm PSD 62 and PSD 82.
This makes the transition to our new slimmer rectifiers for many users much easier.

www.powersem.com

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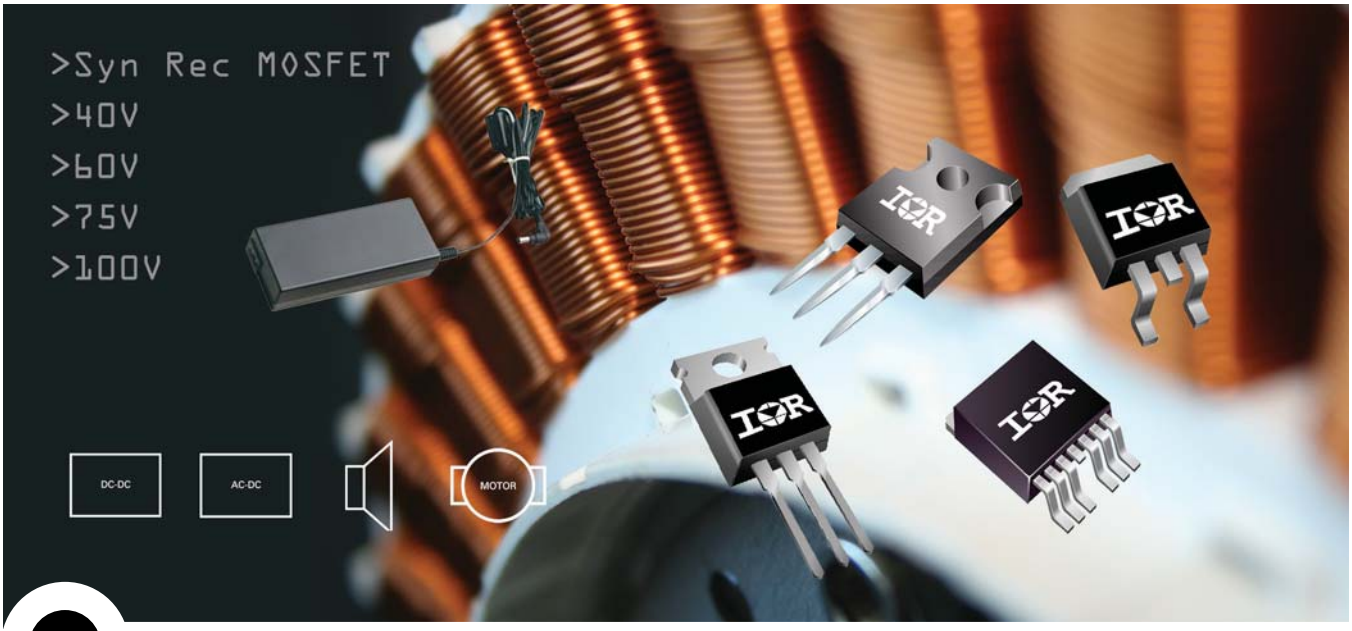

Lower $R_{DS(on)}$ Higher Performance

Part Number	V_{DS} (V)	I_D (A)	$R_{DS(on)}$ Max @ V_{GS}=10V (mΩ)	Qg (nC)	Package
IRF2804S-7PPBF	40	320	1.6	170	D²PAK-7
IRFP4004PBF	40	350	1.7	220	TO-247
IRF2804SPBF	40	270	2.0	160	D²PAK
IRF2804PBF	40	270	2.3	160	TO-220
IRFB3206PBF	60	210	3.0	120	TO-220
IRFS3206PBF	60	210	3.0	120	D²PAK
IRFP3206PBF	60	200	3.0	120	TO-247
IRFB3306PBF	60	160	4.2	85	TO-220
IRFP3306PBF	60	160	4.2	85	TO-247
IRFP4368PBF	75	350	1.8	380	TO-247
IRFB3077PBF	75	210	3.3	160	TO-220
IRFP3077PBF	75	200	3.3	160	TO-247
IRF2907ZS-7PPBF	75	180	3.8	170	D²PAK-7
IRFS3207ZPBF	75	170	4.1	120	D²PAK
IRFP4468PBF	100	290	2.6	360	TO-247
IRFB4110PBF	100	180	4.5	150	TO-220
IRFP4110PBF	100	180	4.5	150	TO-247
IRFS4310ZPBF	100	127	6.0	120	D²PAK
IRFP4310ZPBF	100	134	6.0	120	TO-247

- 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

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