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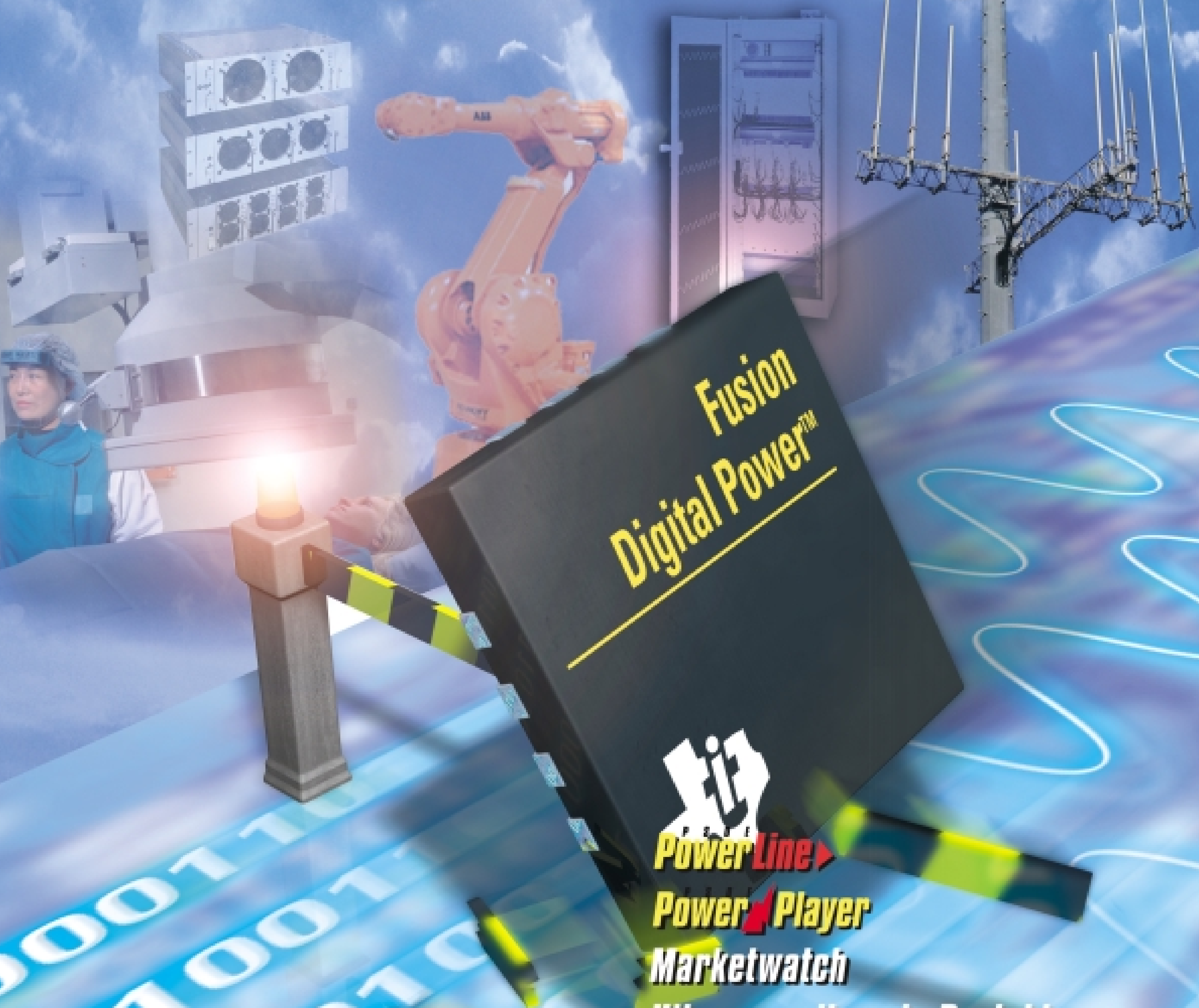
Power Systems Design EUROPE

Power Control Intelligent Motion

April 2005

Power Supply Control Goes Digital



PowerLine

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Marketwatch

Ultracapacitors in Portables

Design Tools for Simulation

ISSN : 1613-6365

Power Systems Design EUROPE

Viewpoint

Industry News

PSDE PowerLine

PSDE PowerPlayer

Cover Story

Features

New Products

Power Systems Design EUROPE

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Advertising Rates, Sizes and Digital File Requirements available at:
www.powersystemsdesign.com

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www.powersystemsdesign.com/psd/subslogn.htm

Registration of copyright: January 2004
ISSN number: 1613-6365
Issue print run: 20,000
Printing by: Central - Druck Trost GmbH & Co. Heusenstamm, Germany

Send address changes to:
circulation@powersystemsdesign.com

Volume 2, Issue 3

Warmer Days Are Fast Approaching!

We have been busy attending many of the power trade shows in Europe, the US and China. It gives you a good picture into the global world of "Power Electronics" and also a good feeling about how valuable our "niche" in power plays into the many aspects of today and into the future products of tomorrow.

What was important at Embedded in Nuremberg? The overall size and weight of a motor drive or of a power supply is influenced by other circuit requirements beside the power electronics. Power management starts always at the device level with the controller ICs that conserve energy by putting non-required functions to sleep or by slowing down clock cycles, followed by the distributed power at the board level. Additionally, embedded system solutions are being incorporated to boost the design to higher levels of performance.

What does embedded technology do for power depends upon the application. Individuals working on automotive controllers see the benefits quite clearly. The motor drive industry is a fertile applications arena for embedded solutions, so complex conversion as well.

APEC in Austin Texas has the focus on energy efficient solutions including digital power. California legislation will drive the power supply manufacture to do more efficient solutions for active level of full power and the standby operation.

EMV in Stuttgart gave a good view of EMC orientated design that includes all areas of electronics. The conclusion is that EMC design has become part of the development process from the beginning on, instead of an add on process afterwards.

The PCIM China show gave us the clear message that the potential in China for power electronics designs and development is huge.

Our new publication PSD China under the direction of our editor Liu Hong is receiving positive feedback from the marketplace.

The June PCIM Nuremberg show is coming up soon. PCIM is a big Power Family Party that no one should miss. The PCIM Nuremberg conference is the platform to provide a future view into technology. The strength of this technology can conserve our rapidly depleting natural resources. It can improve our lives and it can be a means of ensuring future generations a better world to live in.

I am again looking forward to seeing you at PCIM in Nuremberg the place to meet the power experts.

Best regards,

Bodo Arlt
Editorial Director
The Power Systems Design Franchise

Dr. Mark Thompson President and CEO

Fairchild Semiconductor announced the appointment of Dr. Mark Thompson as President and CEO. Thompson, who will also become a member of the Fairchild Semiconductor board of directors, will succeed founding President and CEO Kirk Pond effective as of the company's annual stockholders' meeting on May 4.

Pond will remain chairman of the board. Thompson currently serves as Fairchild's executive vice president of its Manufacturing and Technology Group.

"I'm pleased the Board is moving forward with the final stage of our existing succession plan by appointing Mark Thompson to lead the company into its next phase of growth," said Pond. "We've transformed the company into the leading supplier of semiconductors to optimize system power while building one of the most cost-effective and skilled manufacturing operations in the industry. Mark is the right person to now accelerate the company's next evolution, focusing on developing higher margin, more complex products to increase growth and deliver superior financial performance.

Since Mark joined Fairchild, I have been consistently impressed by his knowledge, integrity, judgment, people skills and commitment to exceptional performance. I'm confident our customers, investors and employees will be similarly impressed by his abilities," concluded Pond.

"I have great respect for the work Kirk and his team have accomplished establishing Fairchild and transforming it from a standard components manufacturer into a profitable, leading global supplier of solutions to optimize system power and I am honored to have been chosen to be his successor," said Thompson. "We will build on a company that is well positioned in terms of process technology, account position, employee talent and financial health by accelerating our move to higher value, more integrated IC solutions."

Thompson holds a Ph.D. from the University of North Carolina and a bachelor's degree from the State University of New York. He previously served as vice president and general manager of Tyco Electronics Power Components Division.

www.fairchildsemi.com

Semikron Reports Record Turnover

In the business year 2004 Semikron enjoyed a turnover increase that reached double figures. This huge improvement compared to last year's figures means that the Semikron Group registered the biggest turnover in its corporate history. Semikron, the European market leader in the field of power modules (with a market share of 33% according to the IMS study), benefited in the previous business year not only from 40% growth increases on the Chinese and US markets. Japan and Korea are also fast-growth markets for Semikron. And thanks to the recent initiative to form a global network comprising the top 9 Semikron companies in the field of power electronics systems (see contemporaneous press release on Semikron Solution Centers), the company has managed to secure further growth potential worldwide.

"These good figures give us the leeway we need to actually implement our strategies," commented Peter Frey, Managing Director Sales/Marketing, Semikron International. "The years of investing in Asia are finally beginning to pay off."

www.semikron.com

Rutronik and Osram Extend Franchise to Italy

Rutronik and Osram Opto Semiconductors (OS) have expanded their franchise agreement: Effective immediately, Rutronik assumes responsibility for distribution in Italy as well. With that, Osram takes a decisive step towards a pan-European franchise with Rutronik. The extensive cooperation between the two companies is rooted in a long-term, successful partnership: For four years now Rutronik has been positioning itself as the most successful Osram distributor in Europe. Meanwhile, Osram OS has become one of Rutronik's largest lines. Following Rutronik's mid-2004 nationwide launch in Italy, Europe's third-largest distribution market, the expansion of the franchise has been a logical consequence of the effective cooperative relationship. Rutronik has a presence in Italy with eight branches and a 55-strong sales team. In addition to Germany, the Osram franchise extends already to the Benelux countries, France, Spain, Switzerland, Portugal and Eastern Europe. The portfolio includes all design-in products such as Golden Dragon LEDs, OLEDs, high-power laser and intelligent displays.

www.rutronik.de

License Agreement for Double-Sided Cooling MOSFET Packaging Technology

STMicroelectronics and Siliconix announced that the two companies have concluded an agreement whereby ST will license from Siliconix a new power MOSFET packaging technology that provides superior thermal performance via top and bottom heat dissipation paths in systems using forced air cooling.

Offered by Siliconix under the PolarPAK name, the new package's leadframe and plastic encapsulation are similar to those used for most standard power MOSFET packages, ensuring good die protection and easy handling in manufacturing. Yet compared with the standard SO-8, the PolarPAK package dissipates heat so efficiently that it can handle twice the current within the same footprint dimensions.

By delivering superior thermal performance and reducing package-related losses, the 5mm by 6mm PolarPAK package allows designers to create smaller, more compact circuit designs with a lower component count. With a height dimension of just 0.8 mm, half the height of the SO-8, the PolarPAK package enables end products that are thinner as well.

www.vishay.com

www.st.com

eupec Website in Chinese

Just in time for PCIM China 2005in Shanghai in March, eupec GmbH, started their Internet site to their Chinese customers in Chinese language.

With this, we meet our Chinese customers' wishes and underline our commitment to the Chinese market, summarises company spokesman Jörg Malzon-Jessen the additional language version.

The amount of enquiries from China has been increasing significantly and shows a growing interest in eupec products. Apart from good contacts to Chinese partners over the past few years, eupec contributes this to the fact of having been one of the first manufacturers of semiconductor products who have been participating in PCIM Shanghai since it first took place in the year 2002.

www.eupec.com

Murata Joins POLA

Murata and Texas Instruments announced plans to expand a global effort to promote pin-compatible, non-isolated, point of load plug-in power modules and provide a second source centered on leading semiconductor technology.

Murata has joined the POLA alliance, a group that includes TI, Emerson's Astec Power, Artesyn Technologies and Ericsson Power Modules. Murata will offer telecom and data communications power supply designers pin-compatible footprints that provide the same functionality and form factors as other members of the POLA alliance. To date, POLA companies have manufactured and introduced more than 70 products with the same electrical designs to ensure full interoperability and true second sourcing.

POLA plug-in power modules, available today in volume production, are based on the PTHxx series with Auto-Track sequencing, introduced by TI in 2003 (See: power.ti.com/sc03105). Artesyn, Emerson's Astec Power and Ericsson Power Modules are delivering POLA, pin-compatible modules to hundreds of customers. Murata's plug-in modules are expected to be available in the second quarter of 2005.

Late last year, POLA members announced their intention to join the PMBus digital protocol initiative with other leading power supply manufacturers and semiconductor makers. The coalition agreed to develop and support a new communications standard defining an open architecture for power systems control using an industry-standard I2C serial bus. POLA plans to implement the new digital protocol in future generations of plug-in power modules.

www.murata.com

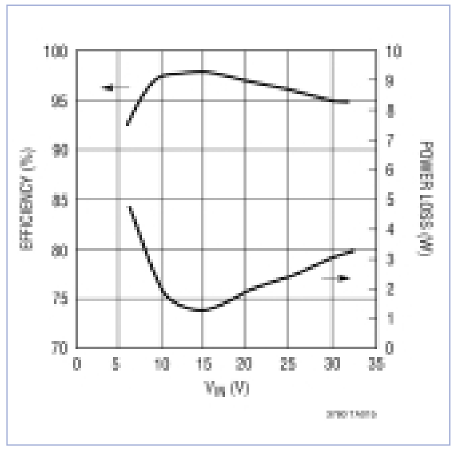
www.ti.com

Power Events

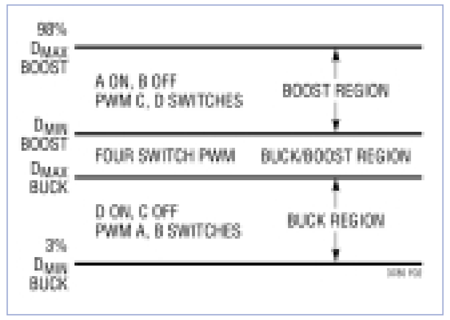
- ***SENSOR+TEST**, May 10-12, Nuremberg, www.sensor-test.de*
- ***PCIM Europe 2005**, June 7-9, Nuremberg, www.pcim.de*
- ***Automation Seminare**, June, Germany, www.mesago.de/automationseminare*
- ***GEMV Energietechnisches Forum**, June 14-15, Kiel, www.gemv.de*
- ***EPE 2005,** September 11-14, Dresden, www.epe2005.com*
- ***H2Expo 2005,** Aug. 31 - Sep. 1, Hamburg, www.h2expo.de*
- ***INTELEC2005,** September 18-22, Berlin, www.intelec.org*
- ***ISPS/IPC/DRIVES,** 22-24 November, Nuremberg, www.mesago.de/sps*

New 4-Switch Buck-Boost Controller Delivers High Power Density and High Efficiency

A common DC/DC converter problem is to generate a regulated output voltage which lies somewhere between a wide range of input voltages. To help put this problem into a clearer perspective, it is useful to think of two everyday applications. Firstly, consider a Telecommunications 3G base station. These base stations consist of multiple rack-mounted cards within a large cabinet enclosure. This cabinet provides cooling for the cards via a large bank of cooling fans. These fans operate at a nominal 24V and take multiple amps of current in this type of configuration. However, the power source for this array of cooling fans can vary depending upon the design constraints and whether the system has switched to battery back-up power. As a result, the power source could come from one of either a 24V or 12V back-plane voltage, or a bank of sealed lead-acid (SLA) batteries. These SLA batteries usually have an output voltage range of between 10V to 13.6V. Another application is portable medical equipment, such as a kidney dialysis machine or a patient monitoring device. In this instance, these machines are usually powered via an AC adaptor – the output being 12V at a couple of amps. But, in this case, the dialysis



LTC3780 Efficiency and Power Loss Curve for a 12V output with a 5A load.



LTC3780 's Operating Modes versus Duty Cycle.

machine can also be powered by a number of NiMH batteries as a back-up power source. Now the input voltage can vary from 9V to 18V, but is still required to give a fixed 12V output.

The traditional approach in solving this type of problem has been to use either a single-ended primary inductance converter (SEPIC) or a buck/boost converter. These types of converters will deliver a fixed output voltage whether the input voltage is above, below, or equal to the output voltage. However, there are some significant drawbacks when using a SEPIC converters:

- Complicated design due to the multiple inductors or bulky transformer required.
- The control loop is difficult to control during the transition between operating modes.
- The solution footprint is large and also has a high height profile.
- The efficiency of conversion is low – usually mid-70s to low 80s percent.
- Thermal problems can arise at higher output power levels.

A more effective approach would be to use a single inductor-based controller which can control four external switches to perform the step-down, step-up and

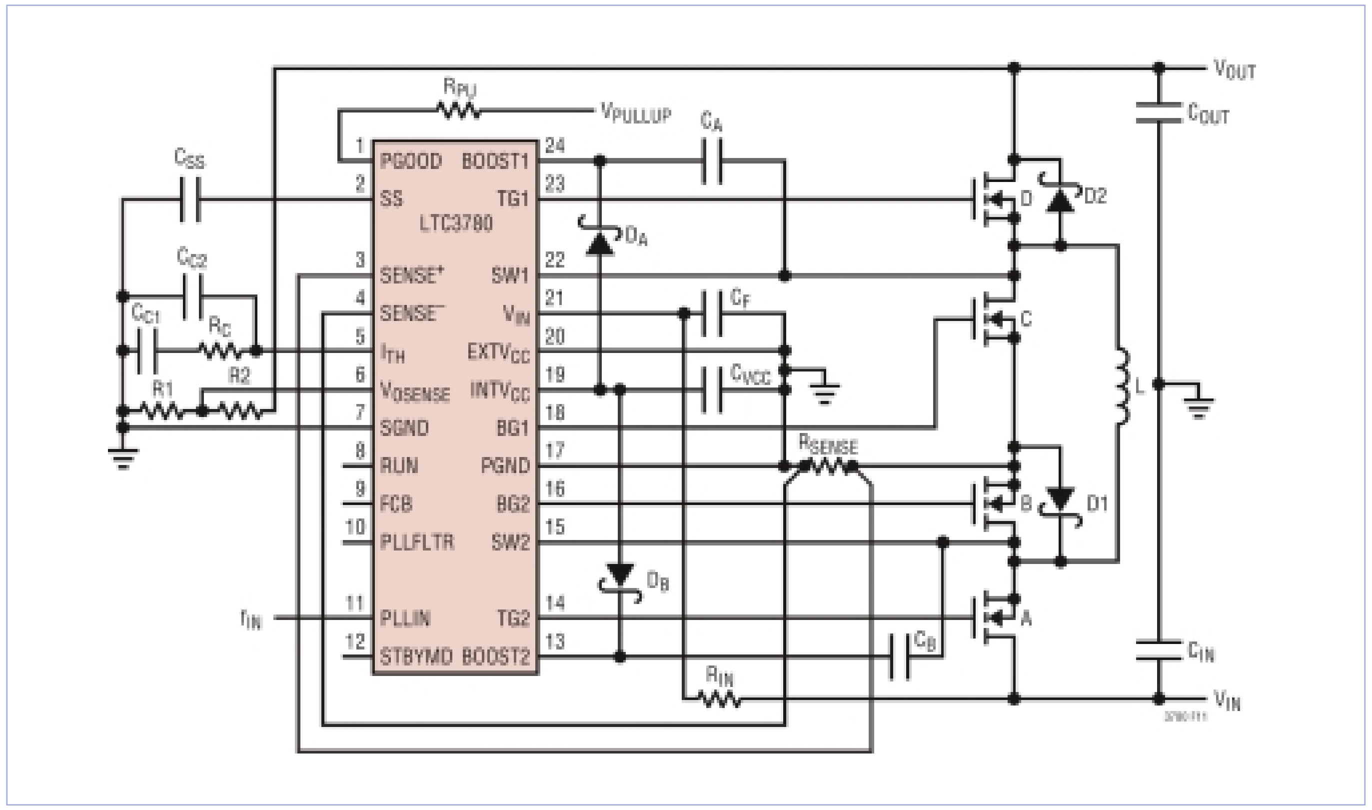


Figure 1. LTC3780 simplified layout diagram.

100% duty cycle modes. This type of 4-switch buck-boost converter would have the advantage of being easy to design, have high power density and also provide high efficiency operation due to its synchronous drive capability.

New Approach

A new 4-switch controller IC from Linear Technology does all of the above. The LTC3780 offers a compact solution footprint, high efficiency operation in the 95% range and a simple design using a single off-the-shelf inductor and a current sense resistor. Its constant frequency current mode architecture allows a phase-lockable frequency of up to 400kHz. With a wide 4V to 30V input and output range and seamless transfers between operating modes, the LTC3780 is ideal in telecom, medical, industrial and automotive applications.

The LTC3780 is a current mode controller that provides an output voltage above, equal to, or below the input voltage. Utilizing a proprietary topology and control architecture, the LTC3780 employs a current-sensing resistor in Buck or Boost modes. The sensed inductor current is controlled by the voltage on the ITH pin, which is the output of the error amplifier. The VOSENSE pin (refer to figure 1, pin 6) receives the voltage feedback signal, which is compared to the internal reference voltage by the EA.

The top MOSFET drivers are biased from floating bootstrap capacitors CA and CB (refer to left side of schematic in figure 1), which are normally recharged through an external diode when the top MOSFET is turned off. Schottky diodes across the synchronous switch D and synchronous switch B are not required, but provide a lower drop during dead time. Low inductor ripple current and the use of synchronous rectifiers allow the LTC3780 to achieve very high efficiency over a wide input voltage range. When the input and output are 12V, the 4-switch buck-boost has 98% efficiency at a 2A load and 97% at a 5A load. With its current mode control architecture, the converter has excellent load and line transition response, minimizing the required filter capacitance and simplifying loop compensation. As a result, very little filter capacitance is required. The single sense resistor structure dissipates little power (compared with multiple resistor sensing schemes) and provides consistent current information for short circuit and overcurrent protection.

www.linear.com

Tin Oxide Based Material to Replace Carbon Composition Resistors

By Kirk Schwiebert, Director of Marketing, Ohmite Manufacturing Coompany

For years, carbon composition resistors were the most versatile and widely used resistors in the electronics world. Its low inductance, relative precision, low cost, wide resistance range and good surge capabilities made it a solid choice for almost any application. Today, however, carbon composition resistors have become more difficult to acquire, and the range of sizes and packaging are limited. To address the growing need for a carbon comp replacement, Ohmite has developed a new, Tin Oxide based, bulk ceramic resistive material. I will explain composition of this resistive material and its basic electrical properties.

Tin Oxide, bulk ceramic resistors are made from tin oxide, antimony and glass. Tin Oxides (SnO_2) have been used in resistor manufacturing for years. Most thin film resistors are made by depositing a thin layer of tin oxide onto a ceramic core and spiral trimming to desired value. In pure SnO_2 conductivity is directly proportional to free electron concentration (_ = [e-] q _) thus the conductivity will depend on partial oxygen pressure and is expected to sharply rise with temperature (making TCR unacceptable for resistor application). The addition of antimony is a proven way of limiting TCR effect of pure tin oxide. Conductivity model of SnO_2 doped with Sb_2O_3 shows free electrons concentration independent of partial oxygen pressure and temperature.

Tin oxide – antimony composition showed good "resistor properties" however by itself has limited resistance range and is fairly brittle. A glass phase is commonly used to bond tin oxides. We chose 2 commercial frits and designed a series of experiments to illustrate resistance and TCR range of tin-oxide/glass matrix. Samples were prepared by grinding and mixing frits with tin-oxide/antimony at given volume-to-volume ratios, pressed to 0.5 in. pellets and cintered.

As expected porosity decreases and density increases with firing temperature. Networking of tin-oxide particles controls conductivity in the matrix. Tin-oxide particles are better networked after 1200°C firing then 700°C; hence conductivity increases with cintering temperature.

TCR generally shows decrease with firing temperature, which once again should be credited to improved connections between tin-oxide particles therefore reducing glass' contribution to TCR.

Composition of glass and manufacturer of SnO_2 selection had a bigger effect on overall electrical properties than originally expected. Glass composition had effects on conductivity mainly due to the different types of structures it developed.

The major advantage of tin-oxide technology is its bulkiness and high density, which naturally lead to high pulse handling capabilities. In surge application precision and TCR play a secondary role, most popular resistance values are in the range of 1-100 Ohm _and low inductance is desired in high frequency switching applications.

www.ohmite.com

Power Supply Control Goes Digital

Parameters can simply be changed by software

A long wearing dream finally became reality: The recent introduction of digital power supply controllers by Texas Instruments enables the design of power supplies with capabilities that have not been possible before with analog controllers.

By Marcus Zimnik, Texas Instruments

This article discusses the merits of digital power supply control and gives an overview of Texas Instruments' Fusion Digital Power products.

Most power supply applications today are controlled by analog controllers. However, in the recent years the industry added more and more digital controlled architecture to power supply controllers. This silent change was hidden to most power supply designers as they still were programming the functions of the control IC in an analog manner. Predictive gate drive or a simple function like UVLO (under voltage look out) are a good examples for added digital control architecture to analog power supply control ICs. Thus it has been only a matter of time until full digital control will hit the street. So what is digital power supply control all about when many digital functions are already present in analog ICs?

What makes a controller a digital controller? The principal difference between analog and digital control is the format of the parameters that are used in operating the power supply. Analog components typically consist of comparators and amplifiers and the signals are kept analog as long as practical. The configuration values like frequency setting, soft start time etc are set using passive analog components such as resistors and capacitors. In contrast digital components typically consist of data converters and timers and the signals are usually converted into digital data as soon as practical. Here the configuration values are set using data memory and may be non-volatile or volatile.

What drives the digital decision?

1) Flexibility

There are many aspects that drive the digital decision. The major driver is flexibility. With digital control the power supply designer is not anymore bound to the hard coded decision trees buried inside the control IC. For instance, the usual reaction to an over-current event is to shut down the converter and initiate a restart. The power supply designer has no option and changing the pre-programmed behavior requires a significant amount of external circuitry in most cases. With a digital controller the power supply designer now has the option what to do in such an event. Whether it is to accept a certain amount of over-current events to ride through a short overload condition or to shut down the power supply immediately. The designer has the ultimate freedom to decide the right course of action to a given stimuli allowing complex algorithms yielding to sophisticated functions. This flexibility also allows implementing adaptive control law schemes. For example the power supply can automatically set for highest efficiency by calculating Pout/Pin or to switch compensation parameters when the power supply enters discontinuous mode. As the transfer function changes at the mode boundary, the control loop has to be changed also in order to provide optimum performance under both operating conditions. With digital control, changing the compensation parameters can be accommodated within one clock cycle.

2) Communication

Another driver is communication. A digital communication interface allows a host or system level processor to control and monitor the power supply. This digital interface provides entry for other digital tasks like on-the-fly programmability. This feature has been already well adopted in processor applications using VID code (voltage identification code).

Beyond programming, communication permits remote data logging of the operation conditions of the power supply.

Shifts in the captured data (e.g. temperature rise, output voltage ripple increase) can be leading indicators of pending failures. These trends can be used to enhance system reliability by failure prediction and allow downtime avoidance and intelligent fault management.

3) Programmability

All these options are possible due to software programmability of the power supply. This approach promotes platform design and offers a faster time to market window as parameters can simply be changed by software. The product differentiation now lies in the hand of the software engineer and is not anymore limited by hard-coded analog controllers. Since the digital controller allows the integration of many functions that else wise would have been implemented with additional components, the number of components in a complex power supply can be reduced. This lowers manufacturing cost and enhances reliability.

4) Accuracy

The above mentioned features are results of programmability and are the most significant differentiators in favor of the digital power supply controllers. Besides that, digital power supply control is much more accurate compared to analog control. When designing a power supply in the analog world, the designer has to account for the component tolerances. For instance the switching frequency in identical power supplies is never equal (except they are synchronized) due to component and IC manufacturing tolerances. The same is true for the loop compensation values. The designer has to take into account worst case scenarios and consider this when selecting the components. In contrast, the switching frequency in digital power supply controllers is derived from a highly accurate crystal oscillator clock and compensation values are just numbers stored in a memory. This yields to a very accurate control and allows tweaking the design more to the theoretical limits resulting in higher performance.

5) Cost

Tolerances in current sense thresholds usually require over-designing the power stage to the worst case tolerance. A digital controlled power supply could calibrate itself and eliminate these tolerances. Over designing the power stage due to worst case tolerances isn't necessary anymore. This results in smaller components, smaller form factor and lower cost for the power supply. Since most of the cost in a power supply is in the power stage, the cost saving could be quite significant.

Devices for digital power supply control

To enable all this new features mentioned before, Texas Instruments recently introduced its Fusion Digital Power Products. By combining expertise in analog power management and digital signal processing, TI is able to offer leading edge solutions for both isolated and non-isolated power supplies. Solutions include the whole range of ac line to point of load applications like uninterruptible power supplies (UPS), server, telecom, datacom, industrial and voltage regulator modules (VRM) applications. Fusion Digital Power products are designated with the prefix UCD.

The UCD7K Fusion Digital Power Control Drivers (Figure 1) interface the digital power controller to the power stage. These devices offer the digital controller direct control of the power stage. A programmable analog over-current limit with flag provides protection for the power supply in the unlikely event that the digital controller does not detect a failure situation in time. They also supply the bias voltage for the digital controller. The UCD7K family features TIs TrueDrive technology enabling high current drive in the MOSFETs Miller plateau region for high speed switching.

The UCD8K controllers (Figure 2) integrate PWM circuitry and a Fusion Digital Power control driver to close the feedback loop in the analog domain under digital supervision. They provide most of the benefits of digital power control and can be used with more modest digital controllers. These controllers are for use in digitally assisted power supplies in which a standard micro-controller or a DSP is already present or required. The UCD8K family includes circuitry and features to greatly ease implementing a converter with high level control features. Digitally assisted power supplies provide programmability of many power supply parameters such as Switching Frequency, Synchronization, Dmax / V*S Limit, Start/Stop voltage, Input OVP, Soft-start Profile, Current

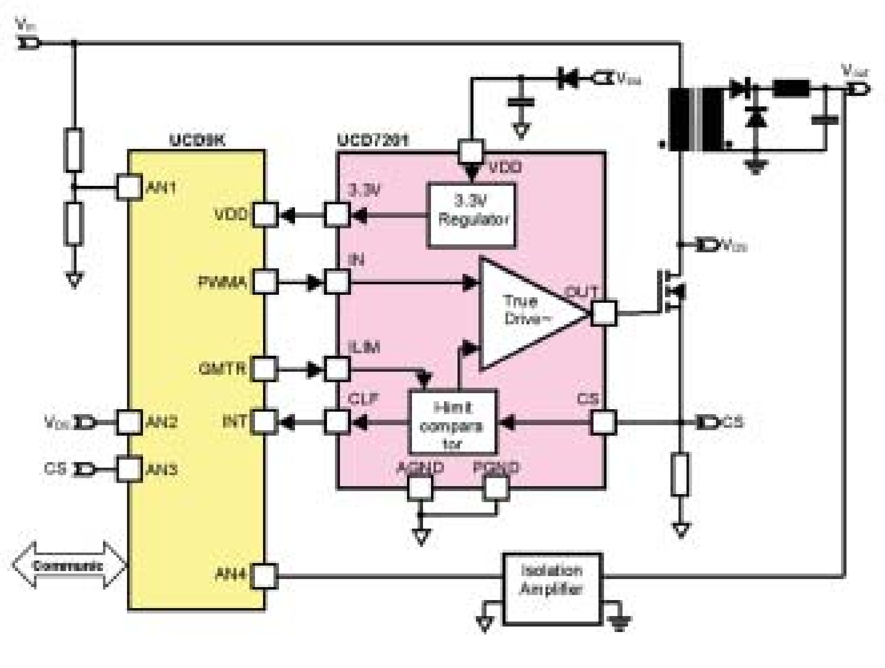


Figure 1. Full Digitally Controlled Isolated Forward Converter

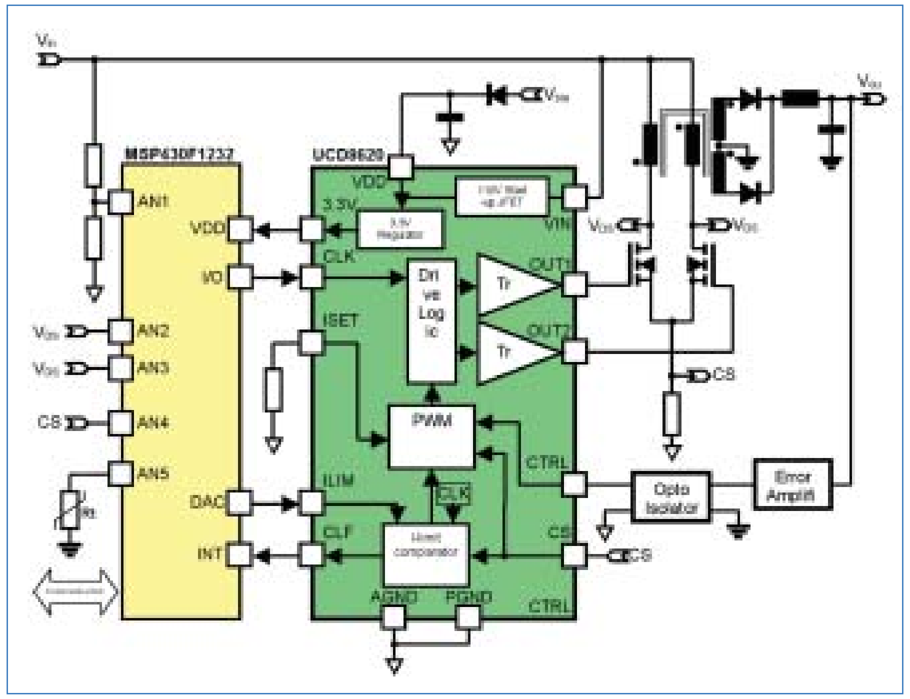


Figure 2. Push-Pull Converter with UCD8620 and MSP430F1232.

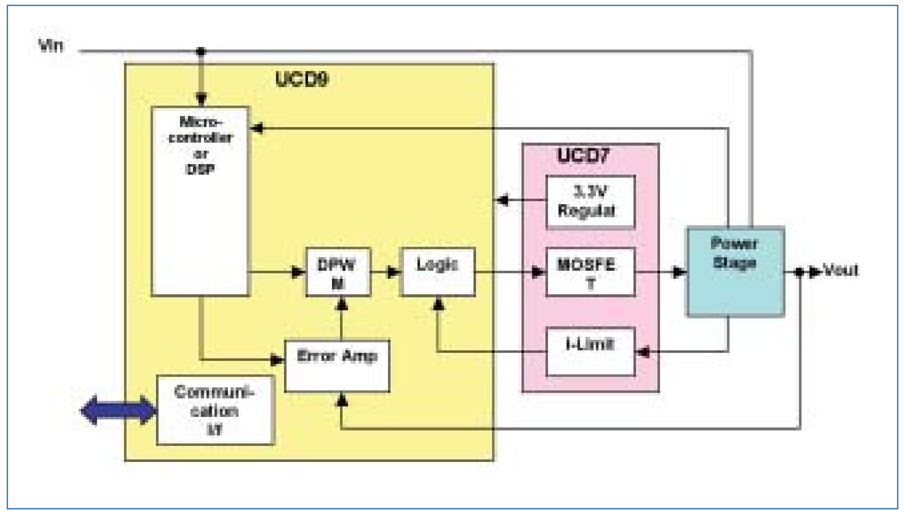


Figure 3. Full Digitally Controlled Power Supply with UCD9K and UCD7K.

Limit Operation, etc. and status reporting of Input V/I/Power, Overload, and temperature. The UCD8K devices can be pin programmed to work either in voltage or current mode applications.

UCD9K devices (Figure 3) are digital power controllers that provide full digital power management capabilities including monitoring and supervision to closing multiple feedback loops in the digital domain. This family integrates the resources that provide the user flexibility to develop their own intellectual property in digital power management.

The UCD9501 is a DSP based digital power supply controller with an enhanced digital PWM resolution of 150ps. A 32bit, 100MIPS DSP engine enables complex, multi loop applications being controlled by a single UCD9501. For instance one UCD9501 can control a dual interleaved PFC stage and a phase shifted controlled full bridge. Besides closing the loop digitally, the UCD9501 offers a variety of interfaces to the outside world like CAN, I2C, SPI etc. TI's UCD9k controllers are supported with Code Composer Studio Software. This is an integrated development environment (IDE) that provides key development tools to reduce development time and effort.

Digital power supply controllers enhance the performance of power supplies and enable functions not possible with analog implementations. These controllers add flexibility and increase reliability of power supplies, while reducing total BOM and cost. Texas Instruments' Fusion Digital Power Products represent the ideal platform for all different complexities of digital power supplies.

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[1] Power Supply Seminar SEM–1600 Topic 6: "A Practical Introduction to Digital Power Supply Control", by Laszlo Balogh, Texas Instruments Literature No. SLUP224.
[2] Fusion Digital Power Control Solutions, Texas Instruments Literature No. SLUB008

www.ti.com

APEC Marks Digital Turning Point

Most agree digital technology is the future of power management

By Chris Ambarian, iSuppli

The 20th annual Applied Power Electronics Conference and Exhibition (APEC) in Austin this year might well be remembered as the turning point for market recognition of the importance of power electronics.

Digital power issues took center stage at APEC. Texas Instruments Inc., Potentia Semiconductor Corp. and iWatt Inc. all announced innovative new products, all taking a completely digital approach to power, and all of them different.

The Digital Power Revolution

The subject of digital power seemed to be discussed by everyone at the show. Whether you are at the vanguard of Digitally-Controlled Power (DCP), or a die- hard analog skeptic—or confused and lost somewhere in between—you were talking about it, and probably had an opinion on it.

To iSuppli Corp., DCP is a foregone conclusion; the only remaining questions relate to how much of the industry it will penetrate, in which applications, and when. This process has already started. The real issue is the Power Operating System (POS), iSuppli believes. DCP concerns the making of a power supply using digital techniques to control the conversion devices and functions. Digital Power Management (DPM) involves the use of digital techniques and communication to control the power supply in relationship to the local system in which it is operating. The POS represents the idea of using software to control an entire system of power conversion, control and distribution devices—a system that inherently is defined by the user's application needs.

Digital Discord

While most market participants agree that digital represents the future of power management, there was some debate over what digital technology can and cannot do.

iSuppli at APEC asked a representative of Texas Instruments Inc.—the apparent 800-pound gorilla in the DCP space—if an analogy to the sensorless vector control of a motor drive could be implemented in digital technology. He replied with a calm and authoritative "no". Two days later, iWatt announced just such a chip, apparently not knowing that it could not be done.

There also is a great deal of resistance among the analog design community to many of the digital concepts. Many of the analog designers were evaluating the viability of DCP by imagining doing what they do today, but using digital techniques. And many of them don't see the merit of this. For example, the analog makers would say that the control loops can be done effectively and much more cheaply in analog. But what if digitalization enables a loopless topology? What if digital offers a greater level of control? The iWatt chip appeared to short-circuit the brains of a lot of senior designers; they just couldn't seem to comprehend the idea that a regulated power supply could be accomplished without a control loop.

Analog designers also say that the DPM function can be accomplished by smacking a port on an existing analog solution. It remains to be seen how this approach compares on a cost basis with porting to a digital solution that has much the same functionality—or even better, porting to one of the totally new topologies enabled by digital, ala iWatt.

The analog designers' identities seem to be tied up with their black-art expertise in analog; it's just too scary or painful to imagine that such knowledge might not be valuable in the near future.

However, the analog suppliers find themselves very much in the same position as mom-and-pop grocery stores in the United States. iSuppli's advice to those too nostalgic to move on is: "You'd better get over it. Wal-Mart is coming."

Christopher Ambarian is a senior analyst with iSuppli Corp. Contact him at cambarian@isuppli.com

www.iSuppli.com

Ultracapacitors Make Portable Products Go Further

Store more energy than conventional capacitors

The big power pulses required in portables overstress existing battery technologies, severely limiting their practical life between charges. And if you need to be charging frequently, that's not exactly portable.

By Dr. Adrian Schneuwly, Maxwell

Now more popular than ever, portable electronics are marvels of engineering, with more features and functions than we could have imagined even a few years ago. They allow us to put cameras, video, high fidelity audio, GPS navigation and wireless communications capabilities into our pockets. All of these features can be found today in commercially available products, which are no larger than a deck of cards. Despite all these capabilities, they often become mere toys because their batteries are not up to the task. The big power pulses required in moving camera motors, burning images into flashcards and sending bursts of information over wireless systems, all overstress existing battery technologies, severely limiting their practical life between charges. And if you need to be charging frequently, that's not exactly portable.

The combination makes the difference

The reality is that we've become dependent on our new portable tools. It only takes a few weeks for a "nice to have" handheld portable to become a necessity. But what's the consumer to do when their tool is reduced to an inconvenient toy because it runs out of battery life? One option is the next generation energy source now being hyped to replace batteries; the eternally "right around the corner" fuel cell. Many companies are on the verge of demonstrating micro fuel cells that power a notebook for hours and then instantly refill from a small methanol fuel cartridge, similar to refillable fountain pens. Although clever, these fuel cells are a long way off from commercialization. Furthermore, they have the same challenge as batteries: very poor power performance.

In applications requiring only high amounts of energy and low amounts of power, for example calculators, clocks/watches and portable radios, a battery or set of batteries can be more than sufficient to supply a small amount of current over a reasonable amount of the product's lifetime. However, in applications with an additional demand for high power, batteries have proven to be less than satisfactory. So how do we get enough power for all the features of our portable products and still have the energy to use them for a long time? The answer is really quite simple; use two different components, one for power and one for energy. The solution for power: ultracapacitors.

Today, the best ultracapacitors are extremely high power devices, offering power densities up to 20 kW/kg, while their energy is still a fraction of that of batteries, Compact in size (small-cell ultracapacitors are often the size of a postage stamp, or smaller), ultracapacitors can store a considerably greater amount of energy than conventional capacitors and can release that energy at both a high or low rate. They have an extremely long life and are designed to last the lifetime of the product into which they are designed. When combined with the newest technology in high-energy batteries, the best of both worlds is possible; high power features and long operating life.

Portable products

As the need for smaller and more lightweight systems increases, design engineers require innovative design approaches to reduce size and heaviness without sacrificing overall performance and reliability.

There are two primary uses for ultracapacitors. The first is for temporary backup power in electronic devices for functions such as computer BIOS settings, telephone and camera configuration settings, and short-term emergency power when the primary power source is insufficient. Here the ultracapacitor is charged from the primary power supply, but functions as a backup power source when the primary source fails.

The second use for ultracapacitors is supplying peak power in electronic devices. In these applications, ultracapacitors are used in tandem with batteries for systems that require both constant low power discharges for continual function and a pulse of power for peak loads. Here, ultracapacitors relieve batteries of peak power functions, resulting in an extension of battery life and a reduction of overall battery size which in turn can allow for product size reduction.

In fact, ultracapacitors have been used in a variety of applications, ranging from portable scanners for factory barcode reading to digital cameras. Any application that requires the storage of electrical energy and the discharge of highly variable amounts of power is a potential market for ultracapacitors. Many of the end products into which our ultracapacitors have been designed are now beginning commercial production.

High Power Pulses Opportunities

Digital cameras have a variety of frequent pulse loads, from lens motors to memory writing. Expensive rechargeable batteries (and the cost of the charging circuitry) are being replaced with embedded ultracapacitors and conventional, replaceable, off-the-shelf alkaline batteries. Normally, even though alkaline batteries have a lot of energy, they can't deliver the power needed to operate the camera. By pairing the alkalines with an ultracapacitor, each does what they do best; the alkalines deliver continuous energy, and the ultracapacitor delivers pulses of power. As such, users do not have to rely on rechargeable batteries, making the camera smaller, lighter, and truly portable. The advantage of the ultracapacitor is that it will last for the life of the product and allows the customer to use inexpensive basic alkaline's rather than the new expensive type. Even by using two ultracapacitors across four alkaline you do not jeopardize the life of the product.

The major high peak demands are observed during the microprocessor activity, writing to disk and LCD operation. Graph 2 shows the voltage swing for each cycle. As it can be seen the voltage drop increases rapidly with batteries only, but when an ultracapacitors are placed in parallel in the system the entire voltage drop is decreased and maintained.

In conclusion the results show that by adding ultracapacitors to the product it allows the end customer to use inexpensive alkaline batteries, which in the long run saves them money and allows ease of use As it can be seen from the chart below the performance of the capacitor has not changed even after 16 sets of battery changes, which was equivalent to about 9000 cycles.

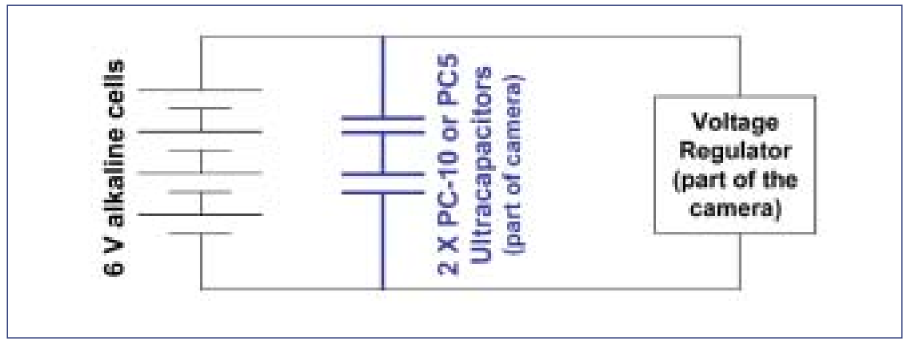

Figure 1. Ultracaps mounted in parallel to the alkaline batteries.

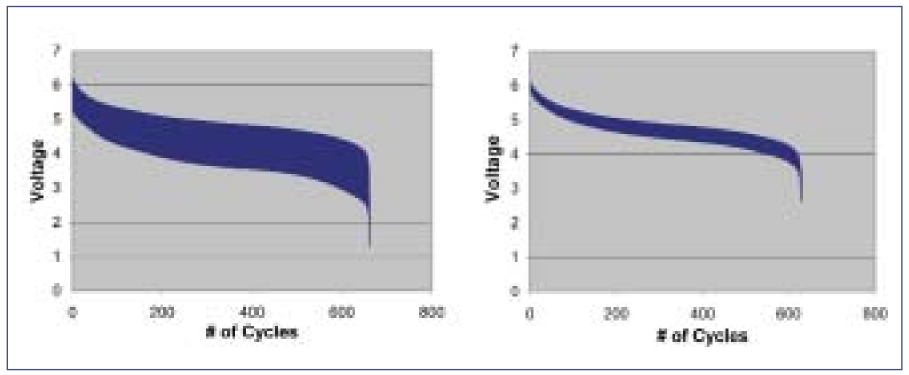

Figure 2. Voltage swing without ultracapacitors(left) and with (right)

Wireless Systems using burst-mode communications

Wireless systems that use burst-mode communications techniques benefit in the same way as cameras. Burst-mode communications are used in local areas such as stock and commodity exchange floors, warehouses and even in restaurants, where order takers and information processors use wireless terminals and modified PDAs to communicate real-time information to a central data center. High power loads are not the only consumer applications to benefit from ultracapacitors. An entire range of applications are made possible by another feature of the ultracapacitor; it can be recharged as quickly as it can be discharged

Fast Charge Opportunities

A number of children's toys use this "instant charge" design concept to make toys. The most popular is a small race car which has an ultracapacitor inside; you charge up the car in less than 10 seconds from a set of alkalines in a small charging pod. The play scheme fits the short attention span of children very well, and adds a real-world "pit stop" element to racing.

Ultracapacitors also enable the ability to instant charge hand tools. The weekend handyman can also reap the benefits of ultracapacitors with instant charge modules for cordless tools. Many times when we just need to drill a couple of holes, we find that the battery is dead and we have to wait for an hour recharge to do a 2-minute job. With the ultracapacitor, this is no longer a problem.

New Opportunities

Integrated tools with cell phone, camera, PDA and MP3 functionalities as well as beacons with GPS, personal alarm and emergency features have all been demonstrated and a flood of additional devices are forthcoming. Stuffing all these features into a small package requires a lot of energy AND power. Ni-cads, currently used to supply the power, have a finite life and would ultimately need to be replaced. By contrast, an ultracapacitor can cycle enough

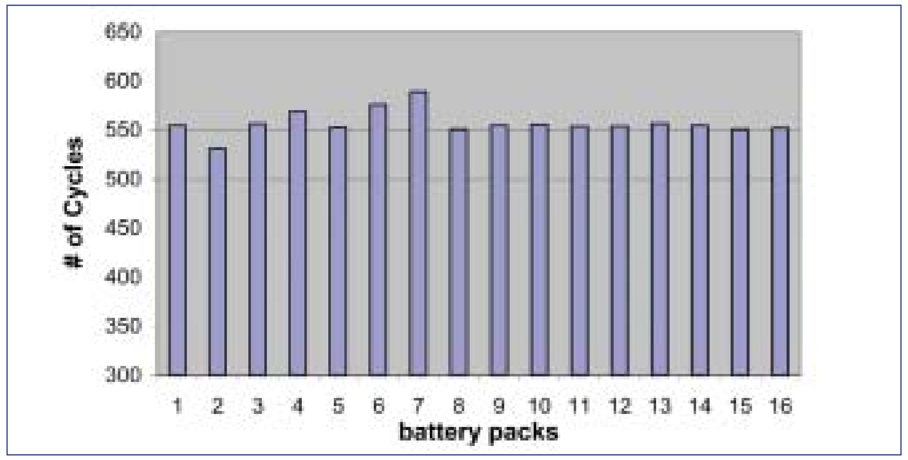

Figure 3. Number of cycles per battery pack using the same U/C pack.

times to last the life of the product. Another advantage that ultracapacitors have over ni-cad batteries impacts product manufacturing. While ni-cad batteries need conditioning during the manufacturing process, ultracapacitors do not. As a result, ultracapacitors can actually speed up manufacturing, translating into decreased production time and cost. In conclusion, you can get all the power out of a battery and kill it, or you can carry a huge battery, but that defeats the whole pocket appliance concept.

The greatest opportunities for ultracapacitors in consumer electronics are all those ideas that can only be accomplished by separately addressing power and energy needs. The right approach is to design intelligently and use two components to solve two different requirements, a battery for energy and an ultracapacitor for power.

Conclusion

New power-intent electronic products such as wireless communication devices and digital cameras are creating significant markets for energy storage and power delivery. Today, ultracapacitors are a viable component for production-intent designs in the power electronics world. Numerous firms are well into the production cycle for ultracapacitor-based systems, recognizing the advantages and availability of the ultracapacitor to meet their business and technical requirements. Ultracapacitors are available, cost effective, and perform well in industrial systems.

Engineers generally address peak power needs by designing the primary energy source, such as an engine or a battery system, to the size needed to satisfy peak demands, even if those demands occur for only a few seconds. Sizing an entire system for peak power needs, rather than for the average power requirement, is costly and inefficient. Such systems can be significantly improved by storing electrical energy from a primary energy source such as a battery and then delivering that energy in controlled high power bursts when required. Such high power delivery provides electrical systems with dynamic power range to meet peak power demands for periods of time ranging from fractions of a second to several minutes. Batteries are not designed to provide bursts of power over many hundreds of thousands of cycles. Ultracapacitors perfectly meet this requirement.

There are two primary uses for ultracapacitors. The first is for temporary backup power in electronic devices and secondary short-term emergency power when a primary power source is insufficient. Here ultracapacitors have become an alternative to batteries in applications where the ultracapacitor is charged from the primary power supply, but functions as a backup power source when the primary source fails.

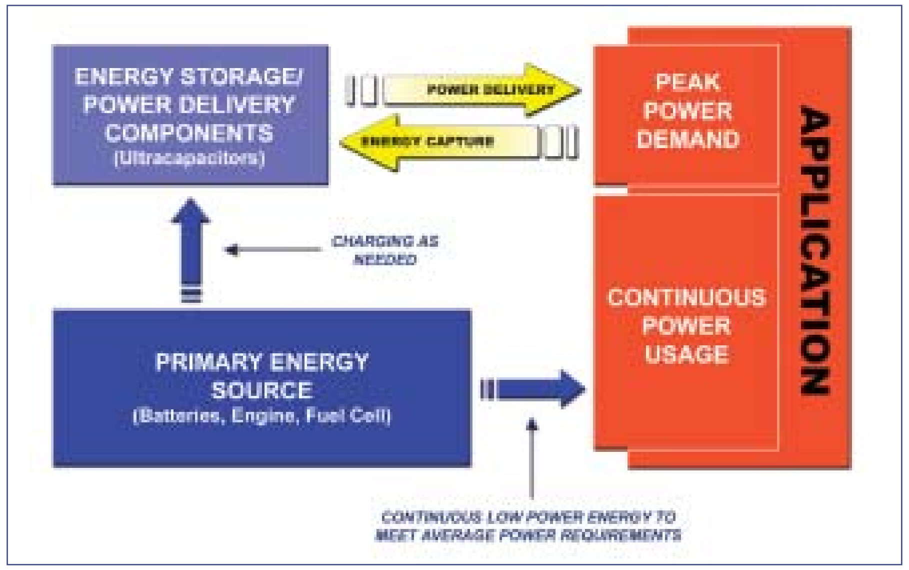

Figure 4. “application model”

The second use for ultracapacitors is in supplying peak power in electronic devices. In these applications, ultracapacitors are used in tandem with batteries for systems that require both constant low power discharges for continual function and a pulse of power for peak loads. Here, ultracapacitors relieve batteries of peak power functions, resulting in an extension of battery life and a reduction of overall battery size.

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Pulling the Plug on the Gremlin

Knowing about the circuit-breaker allows precisely maintenance

Modern energy distribution systems expect circuit-breakers to do more than simply protect. Therefore, low-voltage controls and distribution from Siemens A&D also concentrate on the standards of modern control technology: bus capability, software support, diagnostics and documentation.

By Bernd Schwinn, Siemens AG

Until a few years ago, the task of low-voltage circuit breakers was solely to protect the subsidiary energy distribution systems. However, the situation has changed in recent years due to an increase in the competition dominating the production sector. Even in highly developed industrialized countries, the pressure of rationalization permeates down to energy supply and distribution. As a consequence, intelligent, communication-capable modules must be used which can be harmoniously integrated in existing system structures.

The VL and WL circuit-breakers from the Siemens low-voltage controls and distribution Sentron product range are modern components which enable the targeted optimization of energy distribution. An example situation illustrates the situation which confronts production operation on a daily basis.

The energy distribution of a production site in a plastic processing company in southern Germany is protected by Sentron circuit-breakers, among others. The desired protection parameters can be set on the front panel of the respective ETU45B trip unit using the rotary coding switch. Additional communication via the Profibus DP enables the values to be output.

Figure 1. Even when the ETU55B tripping unit is used for the Sentron WL circuit-breaker, the parameters that were set once are automatically transferred to the device when the communication starts up or when a circuit-breaker is replaced.

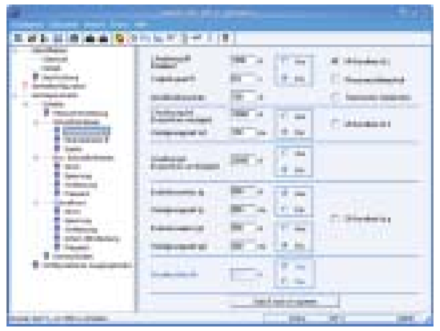

Figure 2. The well-known tree structure ensures that the Switch ES Power software is easy for the operator to use. If a computer with the software running on it is connected to a circuit-breaker, it immediately recognizes the possible parameters and settings.

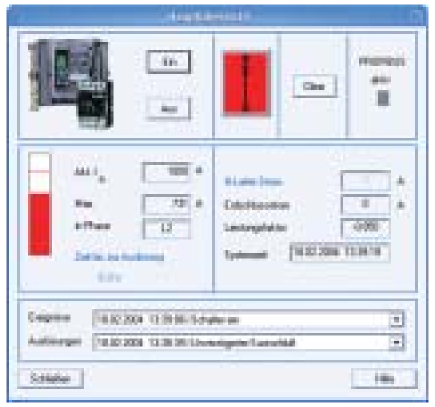

Figure 3. The main view of the parameter/diagnostics software is the starting point for the online diagnosis. The most important status information is displayed on just one screen.

When two tripping events occurred, the system electricians were able to localize the cause of the fault immediately using the data lines. The parameter for the short-time delay of the short-circuit release (S release) was set to the minimum value (1.25 times the nominal current) using the rotary coding switch. However, this value didn't correspond to the significantly higher setpoint value that had been calculated in the planning phase using the Simaris deSign software. One possible reason for the unexpected tripping event had been found.

Simplified cause research

By checking all of the characteristic values, the technicians were also able to quickly detect a second cause: A tripping current of over 1,400 A in one phase had overloaded the energy distribution system which has a 1,000 A limit set for continuous operation (Fig. 2).

Knowledge of the number of tripping events and the timestamps of the events immediately directed the system electricians onto the right track, so that they were able to deduce the exact series of events that had lead up to the tripping of the circuit-breaker.

A generator set in the production with a large inrush current had automatically activated itself acyclically. A rarely occurring current peak, combined with the large inrush current, had a value that exceeded the tripping conditions of the circuit-breaker, causing the tripping event.

Although the setpoint values of the circuit-breaker had been documented and printed out using the Switch ES Power software during the acceptance inspection, the parameters were later changed. Without the incorporation of intelligent, communication-capable circuit-breakers, the true causes of the tripping event would have remained unknown for a long time (Fig. 3).

The typical example of the tasks of a reliable energy management system illustrates the importance of an intelligent circuit-breaker. Since system faults or irregularities generally aren't simply the result of one single cause, and Murphy's law states that in the majority of cases the fault will be sought in the wrong place, data regarding operating cycles, maintenance-relevant events, parameters as well as consumption and status information should be automatically saved to the greatest possible extent, so that it is immediately available, if required, when a fault needs to be analyzed. In order to unify the communication within the energy distribution system, the communications profile 3.122 for low-voltage controls and distribution switchgear devices has been agreed upon by the Profibus-Nutzerorganisation (Profibus user organization) in coordination with the manufacturers. Circuit-breakers are also described within this communication profile.

As mentioned earlier, the Sentron family of Siemens circuit-breakers consists of two series, the molded-case VL circuit-breakers and the air WL circuit-breakers. Both types of circuit-breakers are connected to the higher-level control via the Profibus DP. Furthermore, they also support the Profibus DPV1 function extension. Parallel to enabling communication between the switchgear devices and SPS, this makes it possible to exchange data with a commissioning or diagnostics tool as well as with an HMI (Human Machine Interface) system, so that large amounts of data can be transferred on demand via an acyclic channel.

The unique feature of the circuit-breakers, which fit ideally in modern, communication-capable systems, is that Siemens offers a software tool for programming and data management of both the VL and the WL series. This affords the user maximum support and the Switch ES Power software makes the work of the commissioning personnel significantly easier.

Parameterization for Professionals

The Switch ES Power software makes it possible to output and display the switchgear identification data. The program can load data from a computer or laptop even when the Sentron circuit-breakers are simultaneously exchanging data with other stations (for example an SPS) via Profibus. Software settings can even be specified offline, and are then transferred to the circuit-breakers when a line connection exists (Fig. 4).

Depending on the respective features of the circuit-breakers, a variety of settings are available. To ensure clarity, the appropriate parameters for the specific application are stored in the familiar tree structure. When a connection with the circuit-breaker is established, the Switch ES Power software automatically recognizes which type of circuit-breaker is

Figure 4. The most important settings of the ETU45B tripping unit are entered using the rotary coding switch on the front. These can be read using the Switch ES Power software.

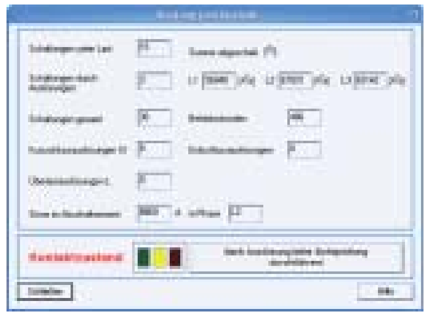

Figure 5. The circuit-breaker supplies all of the information required for active maintenance management and also outputs maintenance information independently.

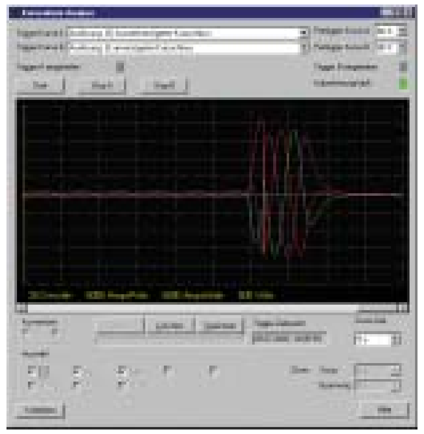

Figure 6. The change of the voltage and current with time during triggered events can be recorded using "Messfunktion Plus" ("Measurement Plus") and analyzed using the Switch ES Power software.

connected, displays the relevant parameters, and only allows the editable fields to be changed. This enhances the clarity of the program and also prevents the user from entering information incorrectly.

After all of the settings have been specified, the values can be loaded into the circuit-breaker, exported for use in other circuit-breakers, or be saved on the hard drive for documentation. During the saving procedure, the software creates an additional HTML file which displays the information in a clear manner. This file can be viewed using a standard browser.

Through the integration into the Simatic-Step-7 environment, all of the specified circuit-breaker parameters can be transferred in the S7 file format using the Object Manager of the Switch ES Power software. This has the advantage of ensuring that the correct protection parameters will always be loaded each time the SPS starts up or each time a circuit-breaker is replaced, since the values are only entered once. The energy distribution is thus fully integrated within the Siemens "Totally Integrated Automation" (TIA) system concept.

Diagnostics simplify energy management

Large amounts of diagnostics information is decisive for fast and effective troubleshooting and error elimination. The functional range depends on the type of circuit-breaker used. The first level of advance warning is attained when one of the freely specified threshold values is reached.

If one of the monitored measured values is exceeded, a threshold warning signal is triggered, which can be acted upon immediately. Exceeding a threshold value in itself does not lead to the circuit-breaker breaking the main circuit (Fig. 5).

The next safety level contains warning information. The user can see the time that will elapse before the line is tripped (if no counter-measures are undertaken) as well as the cause of the warning (e.g. an overload). The circuit-breaker hardware stores all the events that occur (warnings, threshold warnings, control information) in a logbook with the appropriate time stamp. The clocks in the individual circuit-breakers can be synchronized to facilitate the analysis of consecutive events.

If a tripping event does occur, the cause of the trip can be quickly diagnosed using the Switch ES Power software. The circuit-breaker supplies the tripping reason as well as the current that led to the tripping event and the appropriate phase and enters the event in the tripping logbook with the appropriate time stamp.

If the circuit-breaker is equipped with the "Messfunktion Plus" ("Measurement Plus") option, it is also possible to use the Switch ES Power software to record the change of the voltage and current with time for different specifiable events (e.g. a tripping event). In this way, the operator of the energy distribution system receives detailed information that was previously not accessible. Comprehensive information makes it possible to carry out an analysis to prevent the same or similar incidents from occurring again in the future.

As a further highlight, the "Messfunktion Plus" ("Measurement Plus") option also enables harmonic analysis of the voltage and current. All information relevant to maintenance is recorded and can be loaded. This includes, for example, the number of operating hours, tripping events and operating cycles. In addition, the circuit-breaker also measures the Joule heating values flowing across the contact at the moment the circuit is broken and empirically calculates the contact erosion.

Intelligent switchgear makes maintenance easier

The more information that is known about the processes in the circuit-breaker, the more precisely maintenance can be planned. This results in savings in both costs and in personnel management.

The example of the Sentrol VL or WL circuit-breakers connected to the Switch ES Power parameterization/diagnostics software clearly illustrates the positive effects that intelligent low-voltage controls and distribution have in the daily operation of a plant.

However, whoever doesn't find these positive effects sufficient can gain added convenience and safety in their plant by using the ETU55B tripping unit to prevent undesired alterations to the operating parameters. In the practical example mentioned at the beginning of this article, the incorrect parameters were entered at a later point in time using the rotary coding switch. When using the ETU55B, however, values can only be entered using an input device on site, or by the controller using Profibus. When starting up the communication system or when a circuit-breaker is replaced, the parameters that were originally set using the software in SPS are automatically transferred to the device. This ensures that the plug is pulled on the gremlin once and for all.

www.siemens.com/sentron

DESIGN AND SIMULATION

Design Tools Needed for Even the Smallest Device

Manufacturers push the limits of size versus power dissipation

With all the press and design support effort given to the newest and most sophisticated devices, it is important to remember that like the "O" rings in the space shuttle the smallest and simplest device can cause catastrophic system failure if improperly selected for a design. For that reason it is important to have simple design tools and methods to examine the thermal stresses of these ubiquitous devices in systems to insure safe operation.

By Alexander Craig and Eric Hertz, Fairchild Semiconductor

As the cost of Printed Circuit Board (PCB) board space becomes more and more valuable, circuit designers continue to push for smaller and less costly solutions for their component needs. The difficulty is the drive for "circuit miniaturization" versus the need for more power. With advances in new silicon technology, it is often found that the die has become so small that we are now primarily up against package size limitations in our quest for smaller packages versus power dissipation.

In the 1960s, we utilized thru-hole packaging where the leads are perpendicular to the device and suitable for insertion mounting into a PCB. This was a good solution that in some areas is still being used today but it is limited to designs that can accommodate larger size components with single-side board device population. Since the thru-hole component mounts directly thru the board, only 1 side of the PCB can be used.

As far back as the 1970s, we began utilizing Surface Mount Technology whereby the leads don't penetrate the PCB surface but are mounted on the surface using reflow techniques. Not only can these devices be smaller in size but also allow the designer to use both sides of the PCB more effectively. These packages types include the likes of the TO263 (D2pak) that has a footprint of 155mm2 and other smaller packages such as TO252 (Dpak) that take up only 1/3 of the board space, or 57mm2. Improved manufacturing processes and equipment in the 1980s and 1990s enabled us to again drastically reduce the footprint of semiconductor packages. The most common Small Packages widely used today are SO8 (30mm2) *FDS6694, SSOT6 / SC59-6 (9mm2) *FMB5401, SOT23 (7.4mm2) *BAT54 , SC70-6 (4mm2) *FFB2907A, and more recently released new packages such as SOT563F (2.56mm2) *FJYF2906, SOT323 (2.5m2) *FJX597JBTF and SOT623F (1.68mm2) *FJZ594JBTF. Currently, there is work being done on packages <1mm2 footprint and chip scale packages. (* Fairchild Semiconductor Part Number)

Semiconductor manufacturers continue to respond to market needs by offering a variety of new packages that continue to push the limits of size versus power dissipation. With the variety of packages being offered today, it is important for designers to utilize tools to properly select the "right" device for the application.

Small Surface Mount packages (<30mm2) are used for a variety of discrete components such as Diodes and Transistors, including; MOSFETs, Small Signal, Schottky, TVS, JFETs, etc. When a designer is selecting a small package device, the first place that is often researched is the datasheet. In some cases, the datasheet is an excellent tool to help choose the proper device but in more cases then not, this can often be a tedious and unrewarding exercise. Many datasheets today only contain limited data on key electrical specifications pertaining to the device operation but thermals/power dissipation is often ignored.

Datasheets specifications are meant to be used as a guide for a device's performance under a particular circuit/environment. In most cases, this may or may not represent the application that the designer is working on. Another issue in regard to datasheets is that over time some datasheets have become more of a marketing tool and less of an engineering tool. A better way to determine if a device us properly suited for an application is through package modeling.

Since the silicon is small compared to the package and the silicon thermal impedance resistance is small compared to the package thermal impedance. Figure 1 below shows the assembly drawing for the BAW56. One can easily see that the Silicon chip is small enough to fit in the lead. So small changes in the size of the die have negligible effect in the thermal path (Figure 1).

This model uses the electrical/thermal analogy in which temperatures are represented by voltages and power or heat flow is represented by current. Thermal resistances are represented by resistors and thermal mass is represented by capacitors. Since the capacitor values are so large the absolute charge tolerance at any point in time "CHGTOL" for SPICE may need to be adjusted to a larger value SPICE default =10-14 C. The values for the Resistors and Capacitors are derived by curve fitting empirical data. Using the electrical model for the device to determine the power loss though not required is suggested since the data sheets for these devices generally have limit data. The electrical models also provide the user the ability to examine complex in-circuit operation. PSPICE is used in these examples but any circuit simulator is capable of performing the same analysis. This approach allows the user to examine the operation for different ambient temperatures.

Lets take the BAW56 an 85V 200mA small signal diode in a SOT-23 as an example. The data sheet states that the device has a thermal resistance of 357 oC/W. The device has a Maximum junction temperature of 150 oC. So in 25 oC ambient the BAW56 can dissipate P = (Tjmax-Ta)/RqJA = 350mW which is listed as PD on the data sheet. But it is important to note that this is the average steady state power and this, is what determines the parameters like IF(AV), (Average Rectified Forward Current) which is listed as 200mA But also listed on the data sheet is IFSM, (Non-repetitive Peak Forward Surge Current) which lists 1A for 1s the Vf for 1A is not listed but the Vf or 150mA is 1.25V so the Vf for 1A must well over 1.25V but for arguments sake assuming Vf at 1A is 1.25V that means a PD of 1A x 1.25V = 1.25W for 1s that is almost 3 times the PD on the data sheet. This shows the importance of understanding the transient

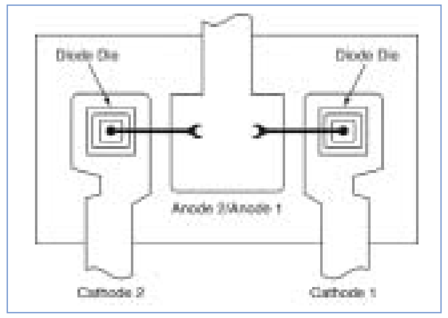

Figure 1. Assembly drawing for the BAW56.

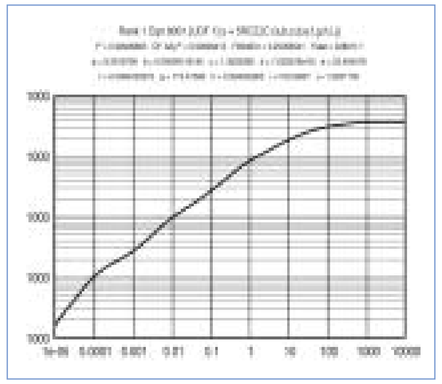

Figure 2. Equation 1 is fitted to the data.

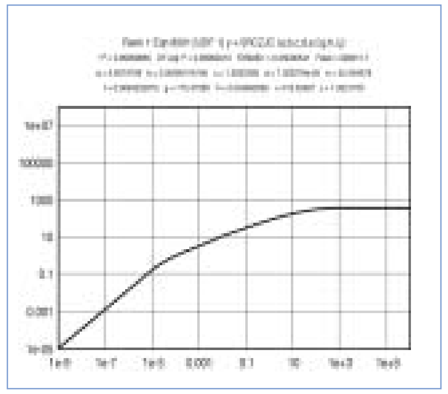

Figure 3. Equation 1 is well behaved out side the range of the data.

$$Z1(t) := R1\left(1 - e^{-\frac{t}{R1 \cdot C1}}\right) + R2\left(1 - e^{-\frac{t}{R2 \cdot C2}}\right) + R3\left(1 - e^{-\frac{t}{R3 \cdot C3}}\right) + R4\left(1 - e^{-\frac{t}{R4 \cdot C4}}\right) + R5\left(1 - e^{-\frac{t}{R5 \cdot C5}}\right)$$

Equation 1.

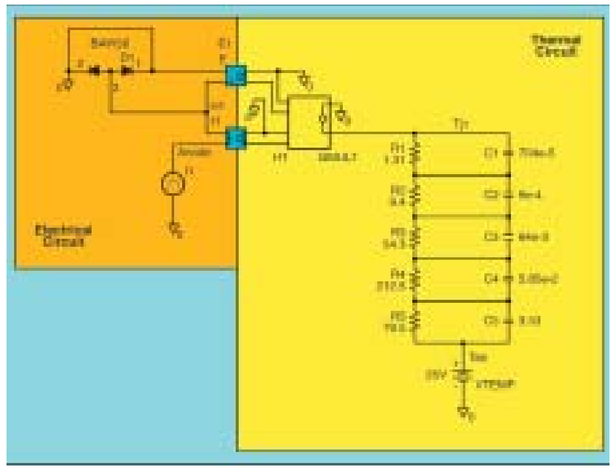

Figure 4. Spice will calculate the Junction temperature for any Power pulse.

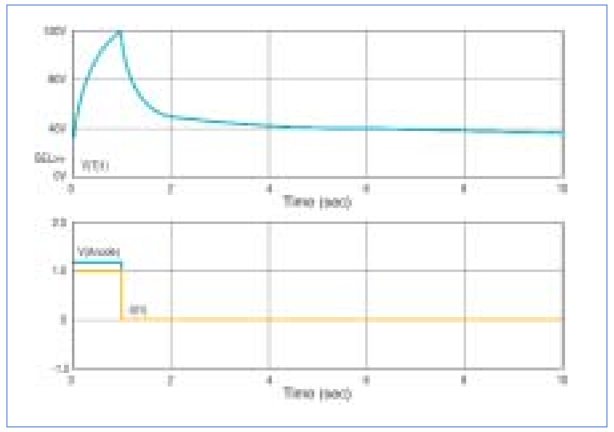

Figure 5. The 1A 1s pulse current situation.

performance of a device. By creating a simple model for the thermal impedance of the SOT-23 mounted to a PCB, one can more accurately determine the safe operation of a device. The model is a simple RC ladder network the R & C values are determined by curve fitting the Equation 1 to the measured data. Z1(t) is the thermal impedance for a power pulse of width equal to (t).

This equation is fitted to the data as seen in figure 2. It is important that the values allow the model to be well behaved out side the range of the data. To insure that the values selected provide a stable model two requirements are met. First the sum of all the R values must equal the RqJA value 357oC/W for the SOT 23. Second extending the graph to a point that is in the range of the fastest the part will operate. See Figure 3.

By simply applying the R & C values is a circuit simulator such as SPICE as is shown in Figure 4 Spice will calculate the Junction temperature for any Power pulse. By using a electrical model along with the voltage controlled voltage source E1 and current controlled voltage source H1 supplying the Voltage controlled current source G1 the engineer can easily model a complex waveform or operating condition. By adjusting VTEMP different ambient temperatures can be examined.

Figure 5 Shows the 1A 1s pulse current situation listed in the data sheet this pulse results in a Tj rises to ~120C for the typical device a part.

This same type of analysis can easily be performed for any device. All that's requires is the thermal impedance model for the device or the package for any small device.

In conclusion, the quest for "circuit miniaturization" continues to push the size versus power envelope of silicon & packaging capabilities. The result of this ongoing quest is that it has become increasingly more critical to insure that a chosen device is properly suited for the intended application. Like the "O" rings in the space shuttle example, even the smallest, seemingly non-essential device can cause the entire system to break down and fail. When selecting and electronics device, datasheets are a good start, but to truly determine the thermal stress levels, package modeling which takes into consideration electrical and thermal performance is recommended. Only then, can one more confidently determine that a device is properly suited for the application.

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Simplifying Complex Power Sequencing

Use POLs designed specifically for tracking

If requirements conflict, it can be necessary to use more than one power rail of the same voltage, and start up in a different sequence.

By David Cooper, Applications Manager, Potentia Semiconductor

Most complex ICs use more than one voltage rail, and to guarantee reliable operation and avoid damage, many have very specific requirements for the relationship between the different rail voltages. The power system must not only control their startup sequence, it must also ensure that the correct sequencing is followed during shutdown. It has become increasingly important to review the manufacturers' datasheets for all devices used on a card, in order to determine what power rails are needed and how they inter-relate during sequencing.

If requirements conflict, it can be necessary to use more than one power rail of the same voltage, and start up in a different sequence. For best performance, the shutdown sequence needs to be maintained, as far as possible, under fault conditions, to limit damage to any other ICs on the card. This article reviews the challenges presented by complex power sequencing which are being addressed by a new breed of dedicated power management controller.

Modular power systems

Most high-performance power systems use modular DC-DC point of load converters (POLs) as building blocks, as shown in Figure 1. In this type of power system each POL operates independently, and even identical devices start up and shut down at a slightly different input voltage level.

The time required for each voltage rail to come within specification at startup depends on the load, and at shutdown each voltage rail decays at a different rate depending on the hold-up capacitance. Consequently the voltage relationships between the POL outputs are unpredictable, and an overall management function is necessary to ensure proper sequencing.

Sequencing

Because of the wide variation between POLs, a simple sequencing control based on fixed time delays is not usually sufficient. To guarantee proper system operation even under overload or fault conditions, an interlocked sequencing control gives the best performance, with a separate startup and shutdown threshold for each rail. Independent timers for each rail allow additional flexibility to meet particular system needs. At startup, each power rail must reach its pre-set startup interlock voltage before the next rail is started. If any rail fails to meet its startup threshold due to a fault, the power system is immediately shut down without attempting to start the subsequent rails. Similarly, during shutdown each rail must drop to its shutdown threshold

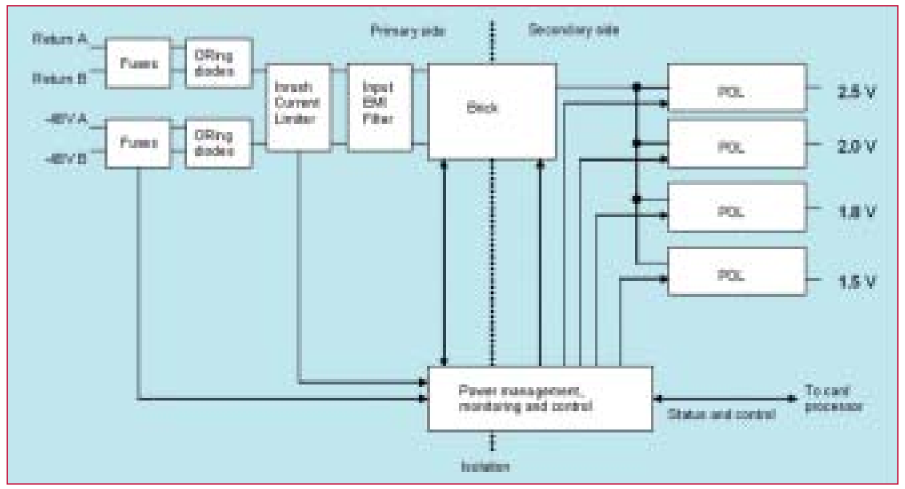

Figure 1. Typical high-performance power system using modular DC-DC point of load converters as building blocks.

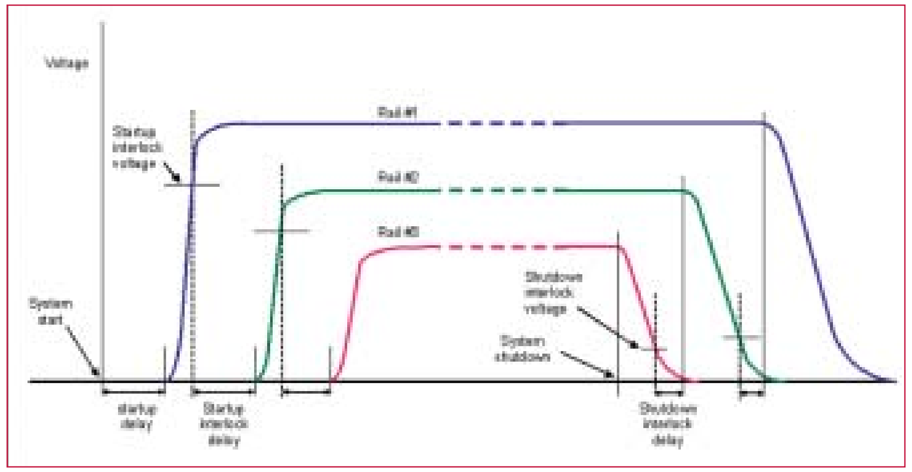

Figure 2. Interlocked sequencing between three voltage rails, with separate interlock thresholds and time delays for each rail.

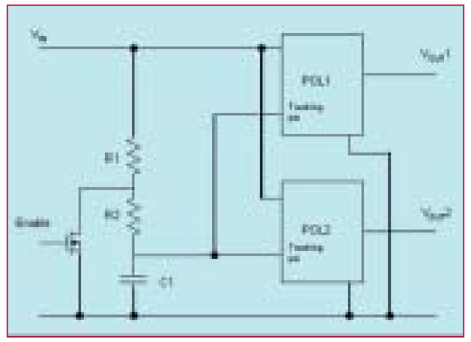

Figure 3. By interconnecting the tracking pins of POLs outputs are made to track accurately without reducing efficiency.

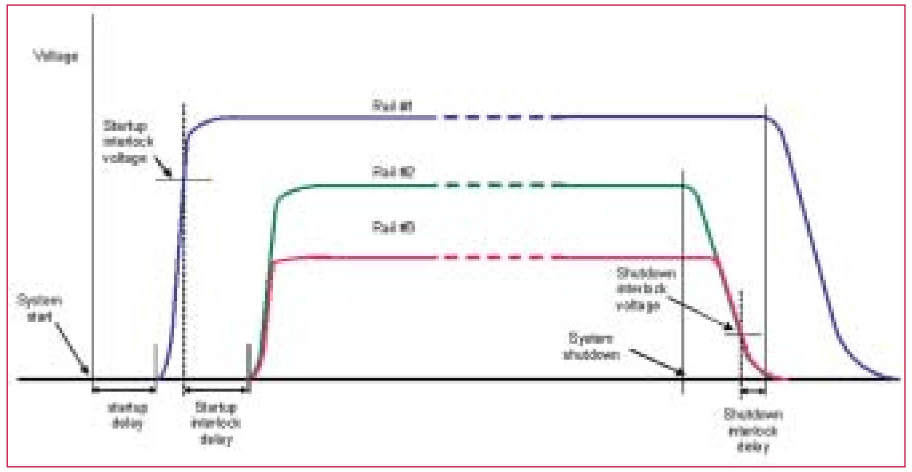

Figure 4. Sequencing and tracking of three rails. Rails 2 and 3 track during start-up and shutdown, using tracking POLs.

before the next rail shuts down. Figure 2 illustrates this type of interlocked sequencing between three voltage rails, with separate interlock thresholds and time delays for each rail.

During normal operation, if a fault occurs on any rail the complete power system is shut down. To preserve the sequence as far as possible, each rail that would normally have shut down before the failed rail is immediately shut down at the instant the fault is detected. All remaining rails shut down in sequence. After a shutdown, all rails must drop to their preset restart thresholds before any rails attempt to restart. This prevents a possible incorrect startup sequence when the holdup capacitors on all rails have not yet fully discharged.

Tracking

In some cases, two or more voltage rails must precisely track during startup and shutdown. Essentially, both voltages must start up at the same instant and any voltage difference must be minimal.

It is possible to implement tracking by adding a MOSFET at the output of each POL and controlling the MOSFET turn-on so that the rails precisely track. However, this approach is not very practical at low voltages and high currents since the MOSFET degrades the efficiency and regulation. A much better alternative is to use POLs designed specifically for tracking. These are available from several suppliers and include a tracking pin that directly controls the output voltage during startup. Simply by interconnecting the tracking pins of several POLs as shown in Figure 3, the outputs are made to track accurately without reducing efficiency.

The sequence controller can simply treat these two rails as a single entity, allowing them both to start after the previous rail reaches its startup interlock threshold. Figure 4 illustrates sequencing and tracking for three rails.

Rail 1 uses an interlock voltage and time delay, as in Figure 2. Rails 2 and 3 track during startup and shutdown, using tracking POLs.

Sequencing using a power management controller

Several manufacturers have introduced dedicated power management ICs capable of very complex sequencing control. For example, the PS-2406 from Potentia Semiconductor controls startup and shutdown sequencing for up to four POL converters and the PS-2610 controls up to six POLs. These devices also provide many other power management functions such as voltage readout, output trimming, output voltage fault protection and fault logging. All operating parameters are fully configurable, allowing the sequencing and other functions to be easily set up to meet the needs of a specific application.

When using either device, the required sequencing is simply entered into the PowerCenter Designer configuration software, where it is displayed in a highly logical and graphical format. The power converters to be used are first entered into a Topology diagram, as shown in Figure 5. Once the basic power topology has been entered, the startup sequence is selected through a series of checkboxes, shown graphically on screen (Figure 6).

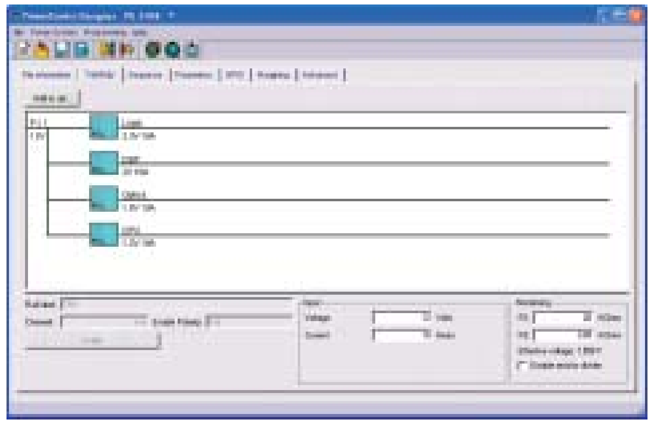

Figure 5. Configuring the basic power topology.

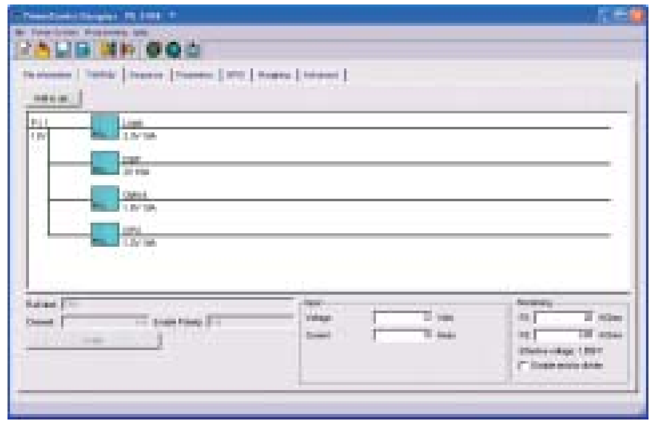

Figure 6. Selecting the startup sequence.

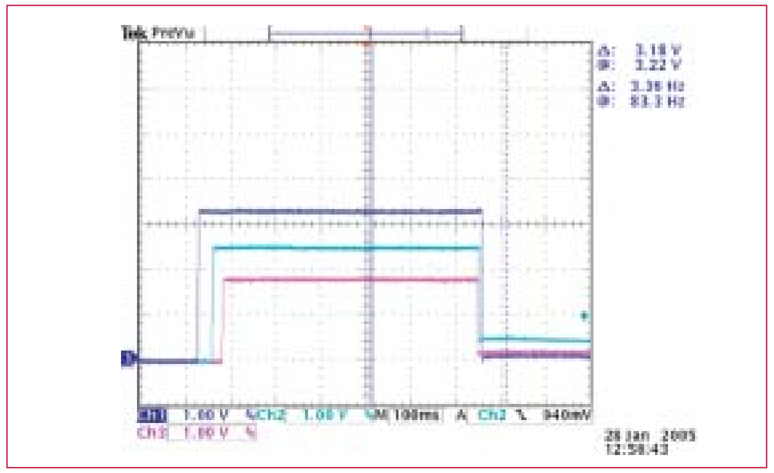

Figure 7. Scope plot of the startup and shutdown of three power rails controlled by a PS-2406.

The required interlock thresholds and timers for each rail are then entered into a Parameters table. To further simplify the task, all parameters are initially set as default values and in most applications only a few may need to be changed. Finally, the device GPIO pins are configured.

When the configuration is complete, it is downloaded into the device through I2C or JTAG ports using a programming cable during the development process, or through an in-circuit tester in production. If the order of sequencing or the parameters need to be changed, amendments are simply re-entered using the configuration software. Figure 7 shows an actual plot of the startup and shutdown of three power rails controlled by a PS-2406, and closely follows the idealized waveforms of Figure 2.

Summary

Although the power sequencing requirements for a card power system can be quite complex, the use of a configurable power management device can guarantee the sequence is correctly achieved under all conditions, while dramatically simplifying the design.

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Design Considerations When Using Optocouplers

Shielding provides common-mode rejection of up to 15 kV/_s

Designing robust electronic systems is challenging. The selected components need to meet environmental conditions that may include electromagnetic noise, electrostatic discharge, common mode transients and high voltages. Optocouplers meet all these challenges by providing signal isolation combined with high voltage insulation.

By Alexander Jaus, Agilent Technologies, Germany

Market trends such as the trend towards lower operating voltage levels to reduce power consumption and smaller packages to fit in the restricted space in smaller electronic assemblies present designers with new challenges. Other considerations concerning printed circuit board layout, operating conditions, application specific parameters and regulatory requirements are essential, too, and have to be accounted for in early design stages. The designer often has choices between different solutions and technologies. This article will highlight some of the design considerations related to optocouplers.

Optocouplers are used for two primary reasons. First the signal isolation, to improve signal quality by eliminating group loop current, and blocking noise signals and common mode transients, and second the electrical insulation, to protect both the optocoupler and sensitive circuitry from damage resulting from high voltage potentials, and to make the component or equipment safe for users.

Regulatory aspects are critical

Applications calling for galvanic isolation often take place in environments where high voltages are present. The ability of the isolator to sustain and to isolate high voltages, both transient and working, is the reason why optocouplers are required in many designs. Equipment operators and circuits within equipment may need safe isolation and protection from high voltages. Because of the potential dangers of high voltages, galvanic isolators and the equipment in which they are used are often subject to safety standard regulations. The intent of these regulations is to offer security to the user and to provide guidelines to the industry on the application of high voltages. Given the large assortment of regulating organizations and the associated standards and specifications, regulatory compliance for optocoupler manufacturers and equipment suppliers can be confusing.

Various regions of the world determine their individual standards and an organization in that country issues approvals or certificates for equipment and products. Since standards bodies have often begun as national organizations, many countries have their own regulatory environment. As international commerce grows there is a trend toward continental or international safety regulations and standards. Table 1 shows several of the standards bodies involved with electrical/electronic systems in general, and isolation components specifically.

Note that the DKE authors DIN specifications, and that for historical reasons some DIN specifications are called VDE (Verband Deutscher Electrotechniker) standards. While VDE wrote the original version of these specifications, the responsibility for maintaining and developing German standards belongs to DKE. The DKE also represents German interests within CENELEC and the IEC.

Organization Name	Charter
CENELEC (European Committee for Electrotechnical Standardization)	Harmonizing of European Standards
UL (Underwriters Laboratories, Inc.)	U.S. Standards
IEC (International Electrotechnical Commission)	International Electronic Standards
CSA (Canadian Standards Assoc.)	Canadian Standards
DKE (Deutscher Elektrotechnische Kommission)	German DIN/VDE Standards

Table 1. Some of the most frequently-encountered standards bodies.

Region:	International	Europe	U.S.	Canada	Germany
Organization:	IEC	CENELEC (EN)	UL	CSA	DIN/VDE
Industrial	204 604	50178	508	14-M91	160
Information Technology Equipment	950	60950	1950	950	60950
Medical	601	60601	2601-1	601	750
Household	65	60065	8730-1	--	860
Measurement and Control	1010-1	61010-1	1262	1010	0410 0411
Telecom	950	60950 41003	1459	225	804

Table 2. Application Categories Vs. Global/Regional Safety Standards.

Region:	International	Europe	U.S.	Canada	Germany
Organization:	IEC	CENELEC (EN)	UL	CSA	DIN/VDE
	IEC 60747-5-2	EN 60747-5-2	1577	Component Acceptance Notice #5	DIN EN 60747-5-2

Table 3. Optoisolator Component Level Specifications.

Table 2 shows equipment-level specifications from regulatory organizations for major categories of applications. Each equipment specification is a master document, with many subordinate specifications referenced to complete the total regulatory requirements.

Table 3 shows the most significant specifications for optoisolator components. The equipment level specification can reference the component level specification as a subordinate document, or there may be no direct connection between equipment and component level specifications.

For optocouplers the most relevant component level standard today is IEC/EN/DIN EN 60747-5-2 . VDE 0884 was the dominant worldwide standard for optocouplers until it was supplanted by IEC/EN/DIN EN 60747-5-2 in January, 2004. IEC/EN/DIN EN 60747-5-2 defines safety related parameters such as isolation voltages (maximum and working), clearance and creepage distances and other critical optocoupler related parameters. The European regulatory authority (EN) and related national authorities such as German DKE/VDE follow the IEC for new standards.

More detailed information on regulations affecting optocouplers is provided in the Agilent Optocoupler Designer's Guide. A copy in Adobe Acrobat format may be downloded at: www.agilent.com/view/optocouplerguide.

Although functional isolation or level shifting can be achieved by various technologies such as high voltage integrated circuits (HVICs), reinforced isolation, which is considered to be failsafe within the maximum specifications, is provided only by qualified pulse transformers and optocouplers. Emerging technologies such as magnetic isolators or magnetic couplers currently can only be considered to provide functional isolation, since there is no final worldwide accepted standard that covers them. Designers need to be aware of what isolation quality is required for their end product and choose the right technology to meet these requirements.

Any optocoupler that passes IEC/EN/DIN EN 60747-5-2 testing is certified for reinforced isolation and therefore is qualified as isolator for safety critical applications. The maximum isolation voltages relate to package dimensions (internal and external clearance, creepage), the ability of their dielectric isolation to withstand high voltage, and the mold compound characteristics (comparative tracking index or CTI). In addition, the optocoupler component standards are recognized by various equipment-level standards, which is helpful for the equipment qualification as well.

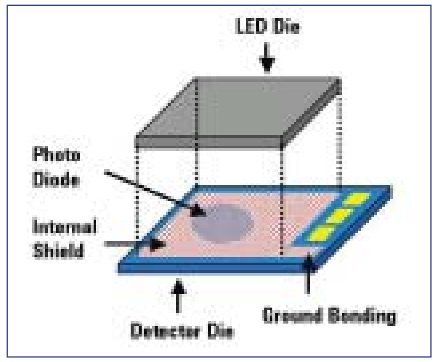

Figure 1. Agilent's shielding technology significantly reduces the parasitic capacitance between input lead frame and detector IC.

Common-mode rejection (CMR)

Circuit designers often encounter the adverse effects of common mode noise. CMR failures are related to high voltage transients causing leakage current across the isolation boundary due to parasitic capacitances. Optocouplers have very low parasitic capacitances, generally less than 1 pF, which compares to the 40 pF or more common to pulse transformers.

Leakage current is proportional to the parasitic capacitance and can be quite significant. A transient with 10 kV/_s slew rate (dV/dt) causes around 7 mA of leakage current: more than 1000 times higher than the current of the photodiode. Because that 7 mA can interfere with the functionality of the photodiode, which is basically a high gain transimpedance amplifier.

Therefore shielding technology is used to minimize the leakage current and shunt away the remaining leakage current from the critical nodes of the output IC, especially from the photodetector area. The shielding performance of the optocoupler is critical for the overall CMR immunity. Agilent uses a proprietary shielding technology, which provides CMR performance of up to 15 kV/_s (Figure 1). Further improvements can be achieved by optimizing the input circuit, for example splitting the LED-biasing resistor and using a low impedance output stage which does not require a pull-up resistor.

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Next Generation Power Chips

Next generation cell phones are the target

The introduction of simple, dedicated Power Management Unit ICs (PMUs) offered significant improvements, saved a lot of PCB space, and reduced overall costs. The technologies used for these devices were 1.2µm CMOS, BiCMOS.

By Tobias Buehler, austriamicrosystems AG

Approximately ten years ago when the first cellular phones emerged, they contained a number of discrete power components. The overall form of the first cell phones was very bulky, and their high power consumption only allowed for short standby and talk times. In response to increased consumer demand for smaller, higher performance wireless electronics, engineers have developed advanced design techniques, that allow saving PCB (printed circuit board) real estate and provide a faster and more efficient performance.

The introduction of simple, dedicated Power Management Unit ICs (PMUs) offered significant improvements, saved a lot of PCB space, and reduced overall costs. The technologies used for these devices were 1.2µm CMOS, BiCMOS or in some cases simple bipolar technology. In these early designs, the pass transistor of the high current LDOs had to be external, due to weak transistor performance, resulting in poor regulation characteristics and higher power drain, compared to today's more efficient designs.

Only when submicron CMOS processes were introduced could low impedance power transistors be integrated with justifiable silicon area and digital functionality could be increased with more complex state machines. Additionally, simple DC/DC converters, chargers and backlight switches became integrated into the PMUs.

Most vendors' preferred BiCMOS processes due to its better analog performance, but this came with much higher manufacturing costs compared to standard CMOS processes. In response, dedicated engineering efforts were undertaken in CMOS designs to yield special design techniques with nearly equal performance as BiCMOS.

Today, the demands on Power Management Unit ICs increase every day and new trends indicate that many or all features not currently covered by the chip set will eventually be integrated into the PMU. Very often considered an ASIC, these function-rich PMUs enable cell phone manufacturers to decide with very short notice to add special functionalities, demonstrating great flexibility. The more modern 0.35 _m/0.25 _m technologies allow for complex digital parts with up to 100k gates.

Another important issue is the 5 V compliance of the process, due to the direct battery connection. Fully charged Li-Ion Batteries exhibit 4.2 V, and even regulated AC adapters output 5 V. This will become one of the main challenges for future power chips, because the latest 0.18 _m/0.13 _m CMOS technologies are only available with 3.3 V options.

Current Solutions

Highly integrated PMUs are being introduced to the market. One device is manufactured in a 0.35 _m CMOS technology and housed in a thermally enhanced 6 _ 6 mm 48 pin QFN package.

Features of the device include 10 programmable high performance linear regulators, two highly efficient DC/DC step up/ step down converters, a 2 _ 0.5 W stereo audio power amplifier, a complete chemistry independent battery charger and eight programmable general purpose I/Os for interrupt, hardware enable and high current LED supply.

The LDOs offer unparalleled regulation characteristics, comparable with the best available discrete components. The typical output noise is less than 30 _V (100 kHz bandwidth), which allows direct connection to ultra sensitive RF blocks such as VCOs and reference oscillators. The line and load regulation is better than mV static and ± 10 mV transient. Any battery noise will be suppressed effectively at the LDO output. Especially TDMA systems produce a high battery ripple due to the RF power amplifier (GSM: 217 Hz) that is periodically turned on and off. Peak currents of up to 2 A and parasitic battery resistance of 0.3 Ohms lead to a 0.6 V ripple. The LDO has the task of properly isolating this noise from the locked PLL circuit. To achieve this analog performance, the LDO is designed as a two-stage amplifier, with a high gain, low bandwidth outer loop and a nested high bandwidth low gain inner loop.

Figure 2 displays a simplified symbolic schematic to show the two loops. (The realization on silicon is slightly different and much more complex.) Dynamic biasing reduces the current consumption down to 50 _A. The internal 300mA current limitation protects the device in the event of short circuits. The integrated PCH 1 Ohm pass transistor guarantees low dropout voltages of 150 mV at 150 mA. The resistor divider is programmable in 50 mV steps from 1.85 V to 3.4 V.

Digital circuits are less critical concerning noise and regulation characteristics. Therefore digital regulators can be designed with a much lower power drain. Memories and baseband processors also require lower supply voltages down to 0.8 V.

Depending on the applications running on the CPU, the battery life for portable devices can be increased by dynamic voltage frequency scaling (DVFS). The clock speed and the actual supply voltage of the processor are dynamically adjusted to meet the required MIPS. The dependency power consumption to supply voltage is quadratic; thus even small voltage reductions will lead to significantly lower power demand.

Therefore, the digital LDOs of the device can be programmed “on the fly” from 0.75 V to 2.5 V in 50 mV steps. This feature helps to run large applications on mobile battery powered devices and maintain an acceptable battery life.

To further increase efficiency, a DC/DC step down converter should be used to act as a pre-regulator for the digital LDO. In this case, the input

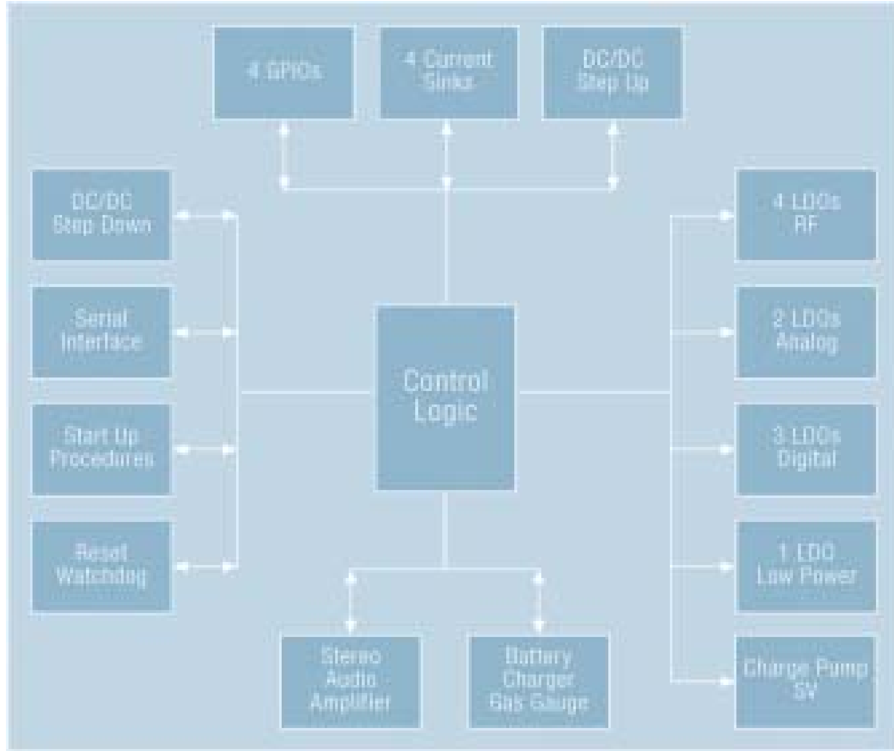

Figure 1. Block Diagram PMU.

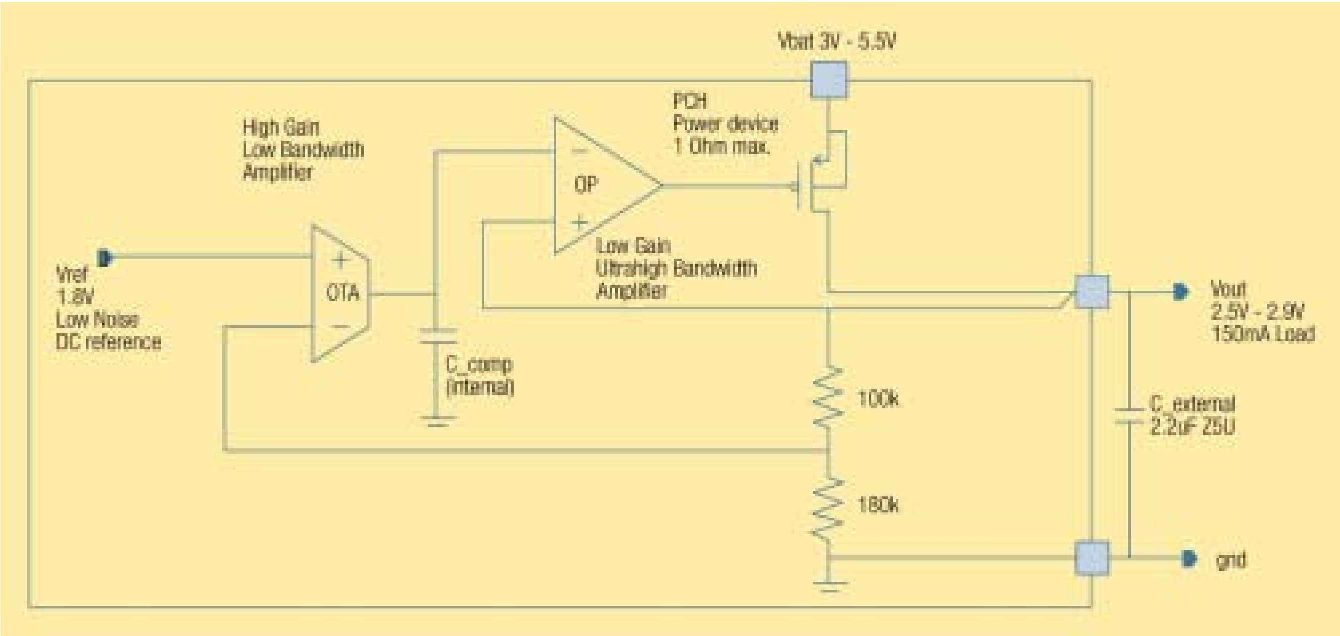

Figure 2. Symbolic schematic to show the two loops.

voltage of the LDO will be only a few 100 mV higher than the output voltage.

The DC/DC step down converter works at 1MHz to allow the use of small and inexpensive external components. Only a 4.7µH inductor and a 4.7µF capacitor are required—no external Schottky diode. The achievable efficiency with low ESR coils is 95% at 100 mA.

An increasingly popular feature in cellular phones is polyphonic ring tones. Users enjoy listening to music samples and want to move beyond the simple buzzer sounds of previous generation phones. To achieve this, it is necessary to drive a small speaker at high power. The required 0.5 W to 1 W power in an 8 Ohm speaker can only deliver by a battery powered audio amplifier, and fits perfectly into a PMU. High power supply rejection, especially in TDMA systems, is also important for audio amplifier (217 Hz).

More and more cell phones are equipped with color displays requiring white LEDs for backlights. The typical dropout voltage of white LEDs is in the 3.5 V to 4.2 V range and therefore needs a step up converter. Display manufacturers integrate this LED into the display module and connect them in series. Three to four LEDs require 10 V to 16 V total supply voltage, typically generated by a DC/DC step up converter. The output voltage is regulated to the actual voltage drop of the white LEDs in order to achieve the best efficiency.

Another common function of PMUs is the battery charger. The requirements come in three stages of charging: trickle charge for empty batteries, constant current and finally constant voltage charging. All parameters should be programmable to meet different charging algorithms. Additionally, a real battery current integrating "fuel gauge" helps to provide an accurate and linear battery indicator for the user.

Next Generations

The typical partitioning of a cellular phone shows the digital baseband processor, the analog baseband, memories, the radio and the power chip. The analog and digital baseband are also manufactured in CMOS as is the PMU. Using the latest technology (such as 0.13 _m) shrinks digital components by a factor of two (compared to 0.18 _m), but analog components are reduced by only a few percent. The engineering effort required for a digital shrink is limited, but analog cells have to be completely redesigned. Therefore, the optimum partitioning for future platforms will be the marriage of analog baseband and power management units. As mentioned before, the 0.25 _m CMOS technology with the high gates density allows for increased digital functionalities. All baseband Sigma Delta Converters need significant digital pre- and post filtering, but it is feasible using this technology.

Necessity of increased battery lifetime will demand additional DC/DC converters (e.g. RF-power amplifier supplies). Combining the different blocks, high power switching components, and low noise A/D converters on one piece of silicon will be a tough challenge for PMU designers. Careful floor-planning and layout, as well as unique on-chip isolation techniques, will enable design engineers to develop stable, reliable highly integrated PMUs.

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Why Digital Power Conversion?

DC/DC converters approaching the magical limit of 100%

Using digital PWM control opened the horizon to cost effective implementation of many additional functions by being able to change the operation and the characteristics of the converter with simple software programming.

By Lou Pechi, Power One

Starting with a look into the background leading to the need for Digital Power Conversion. In the last several years lot of buzz was created about the need for Digital Power Conversion (DPC). While all this talk was going on, most of the manufacturers were trying to outdo each other by introducing higher and higher efficiency and power density DC/DC converters. With efficiencies approaching the magical limit of 100%, the incremental improvements from manufacturer to manufacturer were quite minimal. With differences of efficiencies reduced to just a few percent the only differentiation between the products that remained was price.

At the same time semiconductor manufacturers introduced a multitude of control and monitoring ICs, filling the need to control the proliferation of voltages on a typical circuit board. Matching the controllers to the DC/DC converters was difficult, since there were not enough connections provided to the converter's internal circuitry. Inhibit inputs to the converters, could be used to sequence several of them, while external circuitry, occupying large board space, was required to perform any other functions. When considering all the external components, the actual result was a decrease of the overall power density for the power conversion functions.

Additionally, customer's system engineers were spending inordinate amount of design time trying to implement all the circuitry required to support the DC/DC converters. Troubleshooting and testing the system added to the design time and became an issue as well. With the quick and frequent improvements and the resulting changes of customer's end-equipment, the design and development time increased to unacceptable levels and needed to be reduced.

During the same time, arguments, about the merits of various system power architectures on the circuit board such as: Distributed Power Architecture (DPA), Intermediate Bus Architecture (IBA) and other high to low voltage conversion methods were going on as well. As the number of voltages increased and exceeded three voltages per board, IBA became the architecture of choice.

Examining these customer's needs and comparing them to what was available on the market from both analog converter and semiconductor manufacturers, it became obvious that dramatic improvements in performance could be achieved by combining intelligence and power conversion. Since electronic brains by their nature are digital, it made sense that the converter brains be digital as well.

The building block of the whole architecture had to be a digitally controlled Point of Load (POL). While the switching section could use a traditional driver that powers two output FETs, (Figure 1) the control circuitry required the use a digital Pulse Width Modulated (PWM) controller.

The PWM section of the controller (Figure 2) operates by monitoring the POL output voltage. The output voltage in turn is summed with a programmable ratio of output current and compared with a reference voltage. The sum of the signals is amplified and converted by the Analog to Digital Converter (ADC) to a digital value, filtered by a Digital Filter and fed to the Digital Pulse Width Modulator (DPWM). The DPWM converts the filtered digital value to a PWM signal which controls the FET drivers. The bandwidth of the circuit allows the calculation of a new value of error at every cycle for switching frequencies of up to 2 MHZ.

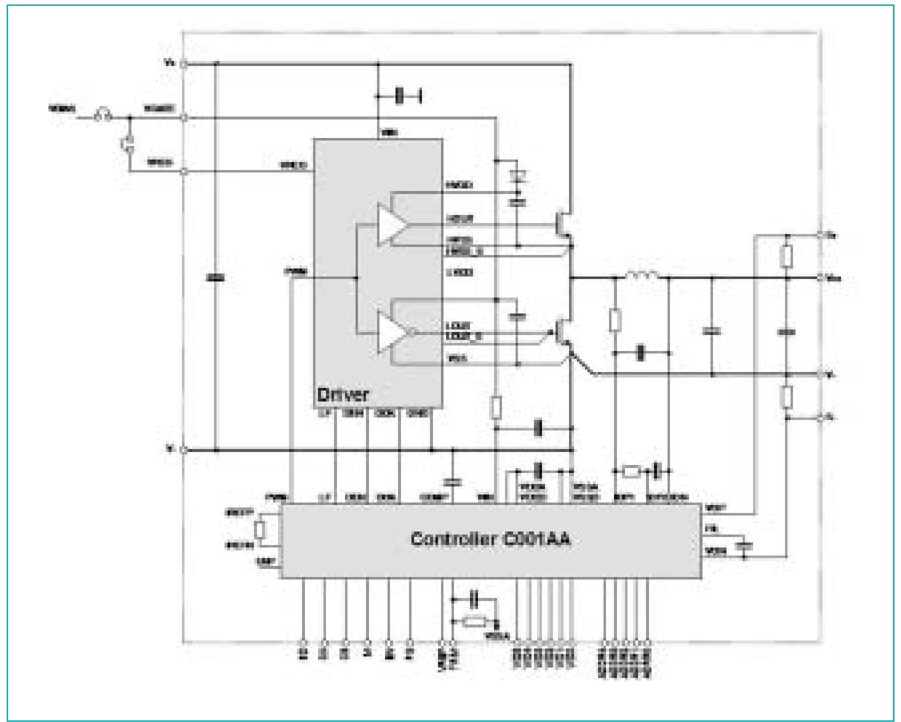

Figure 1. Z-POL Digital PWM Converter.

Using digital PWM control opened the horizon to cost effective implementation of many additional functions by being able to change the operation and the characteristics of the converter with simple software programming.

The addition of communications capabilities, allowed the Z-POL to communicate with other Z-POLs and through a Digital Power Manager (DPM) with the host system.

The DPM, functions as a traffic controller, communicating bi-directionally over a single serial bus with all the Z-POLs on the circuit board while interfacing with the host system through a standard industry accepted I2C bus.

The Z-One Digital IBA system achieves both logistics and performance benefits by simply using only two sophisticated components: a Digital Power Manager (DPM) and a Z-POL converter. The DPM bi-directionally communicates with up to 32 Z-POLs through a single wire Z-One Digital Bus and with the main system through a standard I2C Bus.

The DPM, through a GUI I2C interface, besides communicating with the main system, is capable of setting each one of Z-POL's parameters, such as: output voltage, sequencing, tracking, protection type and thresholds, frequency, fault propagation, interleave, and feedback loop compensation. The DPM constantly monitors each Z-POL's output voltage, current and temperature, as well as the status of: over and under voltage protection (OVP & UVP), power good high and low (PGH & PGL).

Benefits from the usage of Digital IBA vs. standard analog IBA are realized in: product performance, development time, material logistics management, and lower production costs. While the most obvious overall benefit is cost saving, the reduction in component count, reduction of different part numbers, reduction of number of vendors, reduction in the number of traces that needs to be laid out on a circuit board, and the overall savings in board space are just a few additional benefits that can be realized. With frequent new end-equipment releases, shorter design times, quicker development time not only saves development cost but allows for increased revenues resulting from faster new end equipment production releases.

While many of the functions described, could be achieved by using analog DC/DC converters and external discrete control and monitoring ICs, such systems, besides occupying large board space would be very complicated and expensive. The simplicity and sophistication of the Z-One Digital IBA provides a cost effective solution that addresses all the requirements for new circuit board power requirements. Using Digital Power Conversion with the integrated power management supports the customer's needs, by allowing quicker introduction of competitive products at competitive costs.

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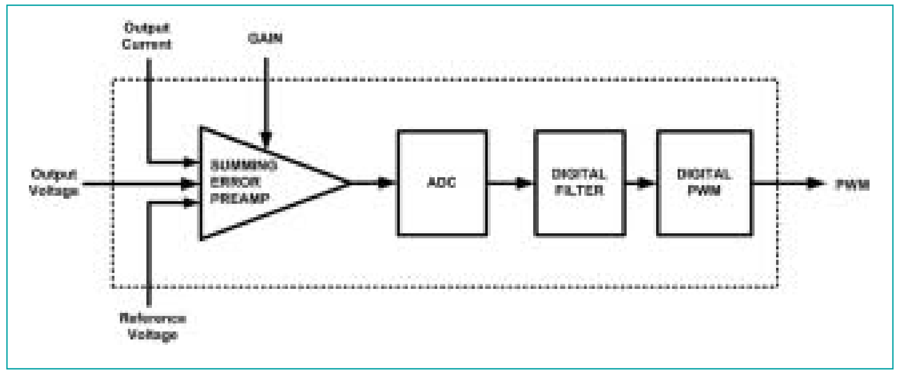


Figure 2. PWM Section of the Controller.

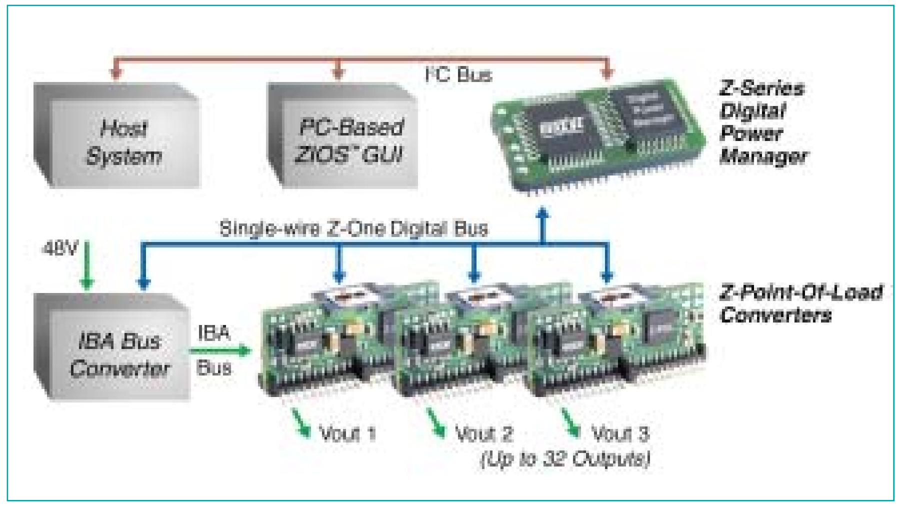


Figure 3. Z-One Digital System.

	IBA with External Power Management	Z-One Digital IBA
# of components	200+	9
# of traces	600+	76
PCB Space	~10 sq. in.	4.4 sq. in
Development Time	2 Weeks	2 Days
Total Cost	$150+	$120
Power Management	Limited	Unlimited

Figure 4. Benefits of Z-One Digital System Implementation.

High-Accuracy Current Transducer

LEM has introduced the ITB 300-S low-cost, high-accuracy current transducer. Specified for 300 ARMS nominal measurements, this new model joins the IT current transducer at a lower price point while offering a level of performance that is only slightly lower than other members of the family. Linearity is better than 0.001% and overall accuracy at ambient temperature is 0.05%. Thermal offset drift is very low, at only 1μA/K.

Featuring galvanic isolation, the ITB 300-S can be used for current measurement of any type of waveforms (including DC, AC, mixed and complex). It has been designed to operate from a bipolar +/-15 V DC power supply, and will accommodate a round primary conductor of up to 21.5 mm diameter.

In addition to its normal current output (150 mA for 300 A primary), an additional output indicating the transducer state (opened or closed contacts) is available.

The new model offers an extended operating temperature range of -40 to +85°C, compared to the +10 to +50°C of the IT models, allowing its use in a wider range of applications, including high precision power supplies, medical equipment, calibration units, precise and high stability inverters, power analysers and metering.

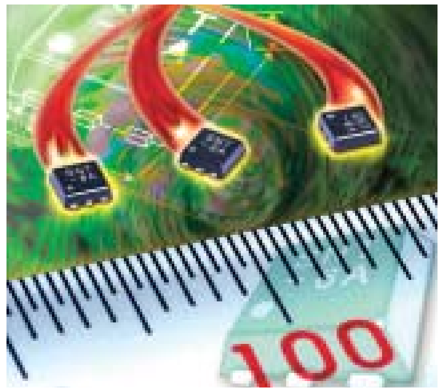
The transducer is CE marked, conforms to the EN 50178 and EN 50155 standards and is suitable for industrial and traction applications.

LEM Components offers these transducers with a two-year warranty.

Visit LEM at PCIM 2005, Hall 12/401.

www.lem.com

Voltage Regulator for Portable Equipment



Seiko Instruments' S-1167 Series voltage regulators are ideally suited as power supplies for portable equipment, battery-powered devices, and cellular phones requiring ultra low current consumption, a small package design and the reliability and accuracy of CMOS based technology.

Ultra low power consumption, high ripple rejection, low dropout voltage (150 mV typical), and high output voltage accuracy (±1%) are distinctive features that make this positive voltage regulator an extremely reliable and cost-effective solution.

With a current consumption level of 9μA typical during operation, the S-1167 realizes a 70dB ripple rejection rate; optimal for noise sensitive applications. The device boasts a wide input voltage range of 2.0 to 6.5V while providing a 1.5 to 5.5V selectable output voltage in 0.1V steps.

Two compact package designs can be specified to meet individual integration requirements (SNT-6A(H) and SOT-23-5). A built-in shutdown circuit ensures battery longevity and energy management, while integral overcurrent protection assures continuous performance.

Technical Contact:
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www.sii-ic.com

IGBT for TIG Welder Applications

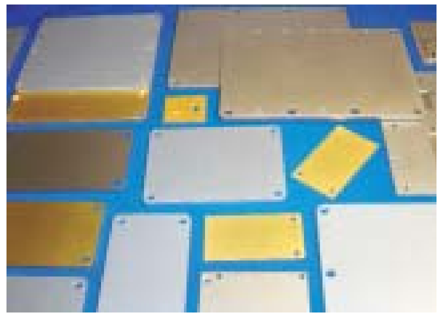
Advanced Power Technology announced two new IGBT products for TIG Welding applications: APT200GN60J and APT200GN60JDQ4. These discrete devices use the latest generation Field Stop Trench Gate Technology and are offered in the industry standard SOT-227 package. These products are specifically targeted for TIG welding applications, and are an addition to APT's new product line of discrete Field Stop IGBTs. APT200GN60J is a single IGBT and APT200GN60JDQ4 includes a 100A anti-parallel diode. Other anti-parallel diode options are available.

These IGBTs are used in the output inverter of aluminum TIG welders. The device can also be used in any application requiring very low conduction losses at high currents and 0 to 30 kHz switching speed.

Data sheets are available to assist the designer, describing the features and benefits of this new 600V IGBT in greater detail. These may be downloaded from APT's website.

www.advancedpower.com

AlSiC Metal Matrix Composite



Unlike traditional packaging materials, AlSiC enables a tailored coefficient of thermal expansion (CTE), offering compatibility with various electronic devices and assemblies. The isotropic CTE value of AlSiC can be adjusted for specific applications by modifying the Al-metal/SiC-particulate ratio. AlSiC's CTE matching capabilities eliminate the need for thermal interface stacking, increasing reliability in the field.

AlSiC also exhibits a high thermal conductivity that results in extremely efficient thermal dissipation. Coupled with its superior CTE matching, AlSiC's high thermal conductivity prevents the bowing and flexing of packaging and substrate material that can lead to failure. Traditional packaging materials with lower thermal dissipation can cause delamination, leading to air gaps and poor reliability.

The CPS AlSiC near and net-shape fabrication process both produces the composite material and fabricates the product geometry, resulting in a cost-effective product and allowing rapid prototyping for high volume advanced thermal management solutions. The unique casting process enables integration of very high thermal conductivity inserts (>1000 W/mK) or cooling tubes for more advanced thermal management solutions.

CPS Corporation is the worldwide leader in the design and production of AlSiC (Aluminum Silicon Carbide), a metal matrix composite that provides highly reliable and cost-effective thermal management solutions for power electronics including base plates for insulated gate bipolar transistors (IGBT).

For more information about CPS' AlSiC, visit booth # 12-125 at PCIM Europe or call (508) 222-0614.

www.alsic.com

Low Pressure Thermal Management Material

Bergquist's new Sil-Pad 1500ST (Soft Tack) electrically insulating thermal interface material provides exceptionally high thermal performance, even at contact pressures as low as 69 kN/m2 (10 psi). The material is designed to provide an electrically insulating interface between a power device and its heatsink. Sil-Pad 1500ST is inherently tacky on both sides, allowing it to be automatically dispensed and placed without the use of adhesives.

Sil-Pad 1500ST is an elastomeric material reinforced with fibreglass for resistance to cut-through. Supplied in thicknesses of 0.2mm and 0.3mm, it is designed for continuous use across a wide temperature range (-60°C to +180°C), providing a thermal conductivity of 1.8W/mK. With a dielectric constant of 6.1 (at 1kHz) and volume resistivity of 1011Ohm-meter, Sil-Pad 1500ST provides electrical insulation in applications such as power supplies, automotive and motor control.

The ability of Sil-Pad 1500ST to wet out the surfaces to which it is applied – even at very low pressure – ensures its thermal performance is consistent across a wide range of contact pressures. Bergquist supplies Sil-Pad 1500ST 8 mil in roll form for auto dispensing. Custom die-cuts are also available.

Sil-Pad 1500ST is the latest in Bergquist's extensive range of thermally conductive, electrically insulating Sil-Pad materials. Like all Sil-Pad materials, Sil-Pad 1500ST provides a clean and efficient alternative to the use of mica, ceramics or grease in thermal management for electronic assemblies. In particular, the use of Sil-Pad materials can eliminate the risk of cracking or breakage caused by the brittle nature of mica, which must be used in combination with grease to improve thermal conductivity.

www.bergquistcompany.com

Very flat SMD Power Chokes for IC-Design

There is a new magnetically shielded SMD Power Choke of the series WE-PD: The Type XS. That is the smallest dimension in the group of WE-PD with a surface of only 6 mm_ and a height of only 3.3 mm.

Being available in the most common inductance values, this components series is perfect for different switch-controller applications. The very low DCR-value allows high efficiency for DC/DC-converters. The WE-PD Type XS is lead-free and is suitable for the most popular ICs like Linear Technology, National Semiconductor, On Semiconductor, ST Microelectronics, Texas Instruments and Fairchild.

www.we-online.com

Active EMI Filters for DC-DC

Ideal Vicor subsdiary Picor annonces the introduction of three new additions to the QPI family of active EMI filters. The new products, QPI-3, QPI-5 and QPI-6, support 24 and 48V DC-DC converter applications with higher current ratings and lower costs. Providing attenuation from 150kHz to 30MHz, the QPI products deliver over 40dB of common-mode and more than 70dB of differential-mode noise attenuation at 500kHz. All products are pin and footprint compatible with previous versions in compact (25.4 x 25.4 x 5.1mm) surface-mount packages, offering board space savings of 50% to 80% over passive EMI filter solutions.

The QPI-6 meets the specifications for the international 36 to 76Vdc telecom bus, including the 100V, 100ms surge requirement. Rated at 14A, the unit supports single or multiple DC-DC converters requiring up to 672W of input power at 48 volts input. The QPI-3 and QPI-5 operate over a 10 to 40Vdc range to support industrial bus and COTS defence applications. The QPI-3 and QPI-5 are rated at 7 and 14A, respectively. The units support single or multiple DC-DC converters requiring up to 360W of input power at 24V input.

E-mail:vicoruk@vicr.com

www.vicoreurope.com

55W AC-DC Power Supply Combines Superior Thermal Management with Low Cost

Power-One introduces the BLP55-Series of 55W single-output ac-dc power supplies. Benchmarked with all available outputs: 5, 12, and 24V, the cost-effective BLP55 utilizes superior thermal-management techniques to deliver full-rated power with only 10 CFM cooling. BLP55 products are designed to meet the rigorous requirements of networking, data communications, commercial, and industrial applications.

Reduced airflow requirements facilitate greater overall-system layout flexibility as the BLP55 does not have to be located directly adjacent to the system cooling fan. Depending on system configuration, the BLP55 may also eliminate the need for a dedicated power-supply cooling fan, especially in space-constrained 1-U "pizza-box" applications.

A compact 3.00" x 5.00" x 1.25" (76.2mm x 127.0mm x 31.8mm) package combines enhanced features and performance with compliance to established industry-standard footprints and connectors. Standard features include remote sense, internal overvoltage protection, and 85-264VAC wide-range input.

Regulatory agency approvals include UL recognition to UL60950-1/CSA 22.2 No. 60950-1 and TUV approval to EN60950-1. Onboard EMI filtering provides Class B compliance to FCC CFR Title 47, Part 15, Sub-Part B - Conducted; and EN55022/CISPR 22 Conducted Class B.

www.power-one.com

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