Digital Power Products

This Power Product Roundup highlights recently introduced power components that feature a digital interface or digital control in the loop. Among the devices profiled here are power supply controller ICs, power management ICs, point-of-load power converters, and ac-dc power supplies. The following products are included in this feature:

- Digital Controller Provides Real-Time Adaptive Loop Compensation
- Analog Buck Controllers Feature PMBus Interface
- Digital Power Controllers Deliver High Efficiency
- Warranty On 300-W/400-W Power Supplies Is Extended To Five Years
- POL Regulators Offer Vertical Mount For Space-Critical Applications
- Buck Regulators Deliver Highly Integrated Designs
- Multi-Rail Digital PMUs Pack Numerous Features

Digital Controller Provides Real-Time Adaptive Loop Compensation

Designed to power ASICs, FPGAs, processors, and general POLs for networking, communications, server, storage, and advanced power module applications, Powervation’s PV3012 is a dual-phase digital dc-dc controller with Auto-Control. This is a feature that the company describes as the industry’s first and only real-time adaptive loop compensation solution. This digital control loop technology optimizes the trade-off between dynamic performance and system stability on a cycle-by-cycle basis without requiring any noise injection or other drawbacks of part-time measurement techniques. This is an advantage for designs that drive imprecise or variable loads, and also addresses the drift of power supply component parameters over temperature and time.

In addition, this technology relieves power supply designers of the burden of compensation and plant characterization, and reduces total design iterations, according to the company. Auto-Control also enables efficiency-boosting mode changes such as adding or shedding phases and light-load modes. David New, Powervation’s director of product marketing, notes that Auto-Control enables similar transient performance to be achieved in either single- or dual-phase operation, while solutions using fixed compensation will generally see a degradation in transient response in single-phase operation versus dual phase (Fig. 1.).

According to the vendor, the PV3012 represents the only digital power solution using anti-fuse-based memory structure, which enables -40°C to +125°C, 20-year memory retention. Powervation also claims to be the only company offering one-pin configuration, allowing eight complete profiles to be stored in a single device. Additionally, the company says it’s the only one running firmware on a proprietary dual-core DSP/RISC architecture for increased performance and flexibility.
The PV3012 delivers voltage precision of ±0.5% over line, load, and the full -40°C to 125°C temperature range. According to New, the best output voltage accuracy available from competing devices is ±1%. The converter’s output can be configured from 0.6 V to 5.5 V using PMBus commands or with an external resistor to access standard and DOSA set-point tables. Phases may be automatically added or removed as the load varies, maximizing efficiency over the load range (Fig. 2.)

Another feature of the controller is the company’s Digital Stress Share (DSS) single-wire bus, which enables multiple PV3012 devices to be connected in parallel to securely drive high-current multi-phase loads. (At the recent Darnell Power Forum, Powervation demonstrated a six-phase controller.)

The PV3012 is a system-on-chip solution based on a lean DSP/RISC dual-core architecture with a precision data acquisition engine running Auto-Control algorithms in firmware. This controller is designed to work with all leading gate drivers and FETs (Fig. 3.)

This full suite PMBus-compliant controller uses full differential measurements and an 11-bit ADC to provide precision system telemetry of current, voltage, and temperature information, as well as comprehensive fault and warning reporting over an SMBus interface. Additionally, the PV3012 delivers advanced digitally mapped temperature compensation of key parameters, which enables current measurement precision of 3% over the full load range. (In contrast, some competing solutions claim 5% or worse output current accuracy, says New.)
The RoHS-compliant PV3012 is now sampling in 32-lead QFNs. Pricing for standard units starts at $3.05 each in quantities of 1000 pieces. For more information, see www.powervation.com.

**Analog Buck Controllers Feature PMBus Interface**

Texas Instruments has introduced two 20-V stepdown voltage regulators with PMBus digital interface and adaptive voltage scaling capability for non-isolated point-of-load designs. The TPS40400 is a 2-MHz single-channel controller with a 3-V to 20-V input range, while the TPS40422 is a 1.2-MHz dual-channel or multi-phase controller with 4.5-V to 20-V input voltage range. These controllers combine high-performance analog voltage regulation with digital control to achieve greater than 90-percent efficiency, tight output voltage accuracy and design flexibility (Fig.1.) The devices’ unique adaptive voltage scaling capability is said to save up to 25-percent more power than previous solutions, and eliminates the need for up to 12 external components. The controllers achieve even greater power efficiency when paired with TI’s NexFET power MOSFETs, such as the CSD87350Q5D.

"Telecom, cloud computing data centers and mobile internet infrastructure applications require high-performance, low-risk digital power management solutions,” says Niklas Fallgren, vice president and general manager of OEM Embedded Power at GE Energy. "TI’s integrated digital power controllers help our DLynx point-of-load modules deliver real-time diagnostics and monitoring with adaptive voltage scaling, while ensuring PMBus interoperability.”

Designers can use TI’s graphical user interface software tool to configure the TPS40400 or TPS40422’s parameters to monitor and control the power system. In addition, designers can use TI’s SwitcherPro tool to develop internally and externally compensated designs in less than one minute, according to the vendor.

The TPS40400 and TPS40422 can be combined with the National 17-V LM25066 system power and hot-swap protection IC as a complete PMBus-compliant solution for 12-V systems with input protection and power conversion. The LM25066 continuously supplies the system management controller with real-time, accurate power measurement including voltage, current, temperature and fault data for each blade subsystem in a telecom or server application—enabling increased reliability. For those 48-V systems that generate a 12-V intermediate bus, the National ±48-V LM5066 and LM5064 system power and protection circuits accurately measure, protect and control the electrical operating conditions.

The TPS40400 comes in a thermally enhanced 24-pin, 3.5-mm x 5.5-mm QFN package. Unit pricing is $2.15 in 1,000-piece quantities. The TPS40422 comes in a 40-pin, 6-mm x 6-mm package, and is currently sampling with expected volume production later in the fourth quarter. Unit pricing is $3.10 in 1,000-piece quantities.
Digital Power Controllers Deliver High Efficiency

International Rectifier has introduced a new digital power platform that is said to dramatically improve energy efficiency in a wide variety of applications including high-performance server, desktop and computing applications. The new family of digital controllers is based on CHiL Semiconductor’s digital platform offering full telemetry and programmability, providing system designers a chance to differentiate their products with custom features.

This product family offers a fully compliant high-speed serial bus to meet new industrial requirements. These 5-, 6-, and 8-phase dual-output PWM controllers, in which phases are flexibly assigned between loops 1 and 2, can be easily configured for Intel VR12 and AMD SVI/PVI/G34 (see the table.) In addition, these controllers operate at switching frequencies between 200 kHz to 1.2 MHz per phase.

These controllers also offer efficiency improvements with features such as variable gate drive and dynamic phase control as well as programmable 1-phase or 2-phase operation under light loads. When used in conjunction with IR’s PowIRstage devices, this family offers an optimized end-to-end solution delivering high efficiency for next-generation servers.

According to Larry Spaziani, executive director of EPBU Business Development at IR, this family of controllers are based on the same technology used in previous generations of CHiL Semiconductor products. (IR acquired CHiL Semiconductor earlier this year.) However, adds Spaziani, in developing these latest digital controllers “we’ve provided some very specific functional updates as Intel and AMD have developed and deployed their server class processors now being designed into servers worldwide. The differences are very specific to some very challenging dynamic voltage changes, and the rigid regulation requirements demanded by our customers, but they are relative to proprietary (Intel and AMD) specifications so we cannot divulge these nuances publically.”

In comparison with competing devices, Spaziani believes IR’s digital controllers differentiate in four areas by providing industry-leading efficiency enhancements, a unique architecture for handling transients with a non-linear mode of operation, a high level of analog+digital trim and calibration (allowing very accurate telemetry), and a high level of flexibility since one product can be applied for both AMD and Intel, and graphics processors.
Other key features of the digital controllers include an adaptive transient algorithm on both loops to minimize output bulk capacitors and system cost, auto-phase detection with auto-compensation, and per-loop protection features. In addition, the digital ICs offer I2C, SMBus and PMBus system interface for full telemetry and programmability. Non-volatile memory for custom configuration, 3.3-V tri-state driver compatibility, +3.3-V supply voltage and 0ºC to 85ºC ambient operation are also featured.

Table. Key specifications for International Rectifier’s new family of digital controllers.

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Package</th>
<th>Control Loops</th>
<th>Phases</th>
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</thead>
<tbody>
<tr>
<td>IR3541</td>
<td>QFN 6 x 6</td>
<td>Dual Loop</td>
<td>4+1</td>
</tr>
<tr>
<td>IR3536</td>
<td>QFN 7 x 7</td>
<td>Dual Loop</td>
<td>5+1</td>
</tr>
<tr>
<td>IR3538</td>
<td>QFN 8 x 8</td>
<td>Dual Loop</td>
<td>7+1</td>
</tr>
</tbody>
</table>

All CHiL digital power solutions are fully supported by IR’s Digital Power Design Center (DPDC) GUI at www.irf.com, which facilitates design, development and deployment of the company’s digital solutions. Additionally, hardware support using IR's SVID emulator system enables customers to emulate and monitor either Intel or AMD serial interface protocols, as well as high-speed I²C communication. Pricing ranges from $2.00 each for the IR3541 to $3.25 each for the IR3538 in 1,000 unit-quantities. For more details, see http://www.irf.com/product-info/multiphase/digital/productsoverview.html.

Warranty On 300-W/400-W Power Supplies Is Extended To Five Years

TDK-Lambda Americas has extended its warranty for their digitally-controlled 300-W to 400-W EFE series power supplies from 3 to 5 years. “This warranty extension is based on the product’s conservative design and excellent field reliability data since its introduction in 2008. By extending the EFE series warranty to five years, we are providing our customers with a substantial reduction in their overall cost-of-ownership,” says David Norton, VP of marketing. Models in this series are certified to medical and/or ITE safety specifications. The EFE series’ 5-year warranty is effective for all units purchased on or after August 1, 2011.

All EFE series supplies include an integrated magnetics transformer (transformer and inductor windings on the same core) to boost efficiency to typically 90% and employ an 8-bit microcontroller for full digital control of the output and to handle housekeeping routines. This results in a 25% parts count reduction to achieve a 45% smaller and up to 56% lighter design when compared to similar competitive products. All models can be precisely factory programmed to accommodate non-standard system voltages.

The design of the EFE series allows the power supply’s performance, such as current limit and start-up characteristics, to be optimized digitally. This feature eliminates the hardware changes usually required in analog designs. A reduced cost primary-side control topology is employed, supervised by the microcontroller. This results in fewer parts and higher efficiency without sacrificing load regulation performance.

The EFE300-400M series is designed for both medical and ITE applications. With a 4-kVac reinforced input-to-output isolation and an output-to-ground isolation of 1500 Vac, the EFE300-400M meets the rigorous safety standards of IEC/UL 60601-1 for medical equipment, making it suitable for use in B (body) and BF (body floating) type medical and dental applications. Regulated dc outputs of 12 V, 24 V, or 48 V are standard, plus other voltages can be provided.

This series is available now with prices starting at $164.42 each in 100-piece quantities. For more information, see http://www.us.tdk-lambda.com/lp/products/efe-series.htm.
**POL Regulators Offer Vertical Mount for Space-Critical Applications**

Ericsson has introduced two new vertical-mounting members in its family of 3E digital point-of-load (POL) voltage regulators aimed at space-critical applications. The 12-A BMR462-SIP (BMR4622002) and the 20-A BMR463-SIP (BMR4632002) complement the recently announced 40-A BMR464-SIP (BMR4642002) and offer board designers the ability to select the most appropriate module for their configuration.

The BMR462-SIP and BMR463-SIP are based on Ericsson's leading-edge digital-core controller combined with the latest MOSFET technology and built-in energy-optimization algorithms. The voltage regulators can be configured and monitored via the standard PMBus communication protocol and the company's intuitive graphical user interface.

The 12-A BMR462-SIP, 20-A BMR463-SIP and 40-A BMR464-SIP save valuable board space for core components, as they enable vertical mounting—also known as single in-line packaging (SIP). The SIP approach means the BMR462-SIP and BMR463-SIP offer footprints of 1.58 cm² and 1.99 cm², respectively, making them ideal for space-critical applications. The primary applications for these devices are network routers, data storage and AdvancedTCA boards. Additionally, their low height of 15.6 mm makes them suitable for 15-mm narrow-pitch applications.

Both devices offer 66 W of power, input voltage from 4.5 V to 14 V, and typical power efficiency of 97.1% at 5-V input, 3.3-V output and half load. The BMR462-SIP and BMR463-SIP deliver power densities of 38 W/cm² and 33 W/cm² with dimensions of 20.8 x 7.6 x 15.6 mm and 26.3 x 7.6 x 15.6 mm, respectively.

Most power converters use synchronous rectification to optimize efficiency over a wide range of I/O conditions. However, at light loads the synchronous MOSFET will typically sink current and introduce additional energy losses associated with higher peak inductor currents, resulting in reduced efficiency. The device's adaptive diode emulation mode turns off the low-side FET gate drive at low load currents to prevent the inductor current from going negative, reducing the energy losses and increasing overall efficiency.

The two devices also offer a synchronization feature that allows several regulators to be locked to a common switching frequency to eliminate beat frequencies. This reduces EMI filtering complexity and the number of external components needed. Additionally, phase spreading reduces input capacitance requirements, and hence losses, because the peak current drawn from the input supply is spread over the whole switching cycle.

The BMR462-SIP and BMR463-SIP also feature comprehensive circuit protection including overtemperature protection, output short-circuit protection, output overvoltage protection, and input undervoltage lockout. Unit pricing of the BMR462-SIP (BMR4622002) and BMR463-SIP (BMR4632002) is respectively, $8.95 and $11.00 each in OEM quantities. For more information, see [www.ericsson.com/powermodules](http://www.ericsson.com/powermodules).

**Buck Regulators Deliver Highly Integrated Designs**

Summit Microelectronics has expanded its family of programmable dc-dc products with the SMB220 and SMB221 integrated 10-A and 20-A buck regulators. These products are said to deliver unparalleled integration with built-in MOSFETs, digital programmability and non-volatile configuration. The company also claims these devices deliver advanced power management functions along with class-leading power regulation at an unbeatable bill-of-materials cost. Target applications include enterprise servers and storage systems, enterprise and carrier switches/routers/base stations as well as emerging consumer digital media (IP digital television and set-top box).
The SMB220/SMB221 are 10-A/20-A single-output buck regulators combining Summit's digital programmability with high integration, compact size, and cost-effective bill-of-materials (BoM) necessary for dense system applications. Efficiency of up to 96% and 1% output regulation meets stringent digital core power requirements.

With a serial digital interface and on-board non-volatile memory, the SMB220/SMB221 family can be easily configured during development and re-programmed in-system by host software.

Input voltage range is 4.5 V to 16 V and output voltage range is 0.5 V to VIN, accurate to ±1.5% over load/line/temperature. Output voltage is digitally programmable in 10-mV steps up to 2.5 V and 20 mV steps up to 5.0 V while other custom voltages are supported with external resistors. PWM switching frequency is programmable from 250 kHz to 1 MHz and light load efficiency is supported by automatic pulse-skipping (PFM) operation.

Output enable, sequence delay, softstart and output voltage (UV) monitoring are all programmable as well. Output voltage monitoring is coupled to “PowerGood” or “Reset” signals with programmable output assignment and the output can be enabled via the serial I²C interface or by the ENABLE pins. Nominal output voltages may be changed once the system is powered up, enabling the latest SoCs/ASICs to reduce platform power using advanced voltage-clock scaling modes. The output voltage programming also allows for easy voltage margining to support system validation and characterization of these same advanced SoCs/ASICs.

The regulators’ 5-mm x 6-mm QFN packaging and minimal external components yield compact (typically <200 mm²) solution size. Programmed configuration is held in the OTP non-volatile memory but may be changed in system by host software via the I²C port. The rated operating temperature range is -40°C to +85°C.

Summit offers customers the SMB220/221EV companion evaluation boards and a graphical user interface (GUI) software. Available now, the SMB220 is priced $1.80 each while the SMB221 is priced at $2.50 respectively in quantities of 10,000 units. For more details see http://www.summitmicro.com/prod_select/summary/SMB220/SMB220.html.

Multi-Rail Digital PMUs Pack Numerous Features

Members of Akros Silicon’s Energy$ense family of multi-output, digital dc-dc power management unit (DPMU) ICs perform real-time power measurements and power-subsystem health monitoring, while achieving high efficiency (94% peak) and ultra-low standby current (<10 µA). The AS19xx series of Energy$ense dc-dc DPMUs also offer digital power control (via I²C) for selectable power operating modes, fast transient-handling capability for implementing adaptive power profiles, built-in spread-spectrum clocking for EMI management, and built-in sophisticated PWM-dimming for battery-draining LED-backlight displays.

“True to our leadership in network-based energy management, the AS19xx series incorporates unique Energy$ense features on top of essential digital power manager features so that our customers can deliver power-management innovation and performance in their equipment in an efficient and cost-effective manner,” says Parviz Ghaftipour, president & CEO. “Additionally, the AS19xx family of products addresses the needs of system designers by offering 10 pin-compatible products that pack a variety of features, including a wide input voltage range of 3 V to 27 V, load range of 0.5 A to 10 A, switching frequency from 100 kHz to 2 MHz, and internal spread-spectrum clocking with external synchronization input. These features minimize external BOM and board space, while offering great flexibility in multi-platform designs.”
The ten devices in the AS19xx series come in different combinations of synchronous buck, boost and LED-drive converter configurations. With unique feature sets to facilitate simple implementation of real-time and adaptive energy management schemes, the AS19xx series targets a wide range of applications including 4G LTE residential gateways and femtocells, tablets and large display-oriented consumer devices, ultra-books, e-books, digital photo frames, NAS and media hubs, Internet-TV and IPTV set-top boxes, automotive infotainment systems, solid-state lighting, communication equipment with cluster-power or intermediate bus architectures, and many others.

The AS19xx series consists of 10 triple- and dual-output power-managers that come in combinations of two synchronous buck regulators and a choice of a buck-boost or LED-boost controller. Devices come in either hardware-only mode or hardware and software (I²C) mode configuration. The software-mode devices provide access to advance power management features such as input power measurements, software-driven LED-dimming and daisy chaining.

The AS19xx is offered in 5-mm x5-mm, 32-lead RoHS-compliant QFN packages, in industrial temperature ranges from -40°C to +85°C. Available now, units are priced starting at $1.46 each in 3,000-piece quantities. For detailed information, see www.AkrosSilicon.com/Energy$ense_DC-DC.