PowerSage® PMICs

PSG5220 Operation and Integration

Training Prepared for Digi-Key

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Packet Digital's Strategic Supply Chain Partners

- Digi-Key is a critical part of Packet Digital's Supply Chain success

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Packet Digital Terminology Review

On-Demand Power®

- Packet Digital's patented technology for dynamic power management
- Hardware-based voltage scaling based on system activity is more effective than software based power management:
  - Less latency
  - Real-time system-wide power savings
  - Application independent

PowerSage®

- Product line of voltage regulators with On-Demand Power
- High-efficiency, full-featured voltage regulators
- Reduces power consumption by applying hardware-based autonomous voltage scaling

On-Demand Power Summary

- Advanced power management across platforms, operating systems, and devices:
  - Monitor activity intelligently across an entire system
  - Calculate and distribute the minimum power required to perform an operation, only when needed
  - Control the clock and supply voltages in real-time, outside the microprocessor
  - Provide just-in-time, just-enough, dynamic power management

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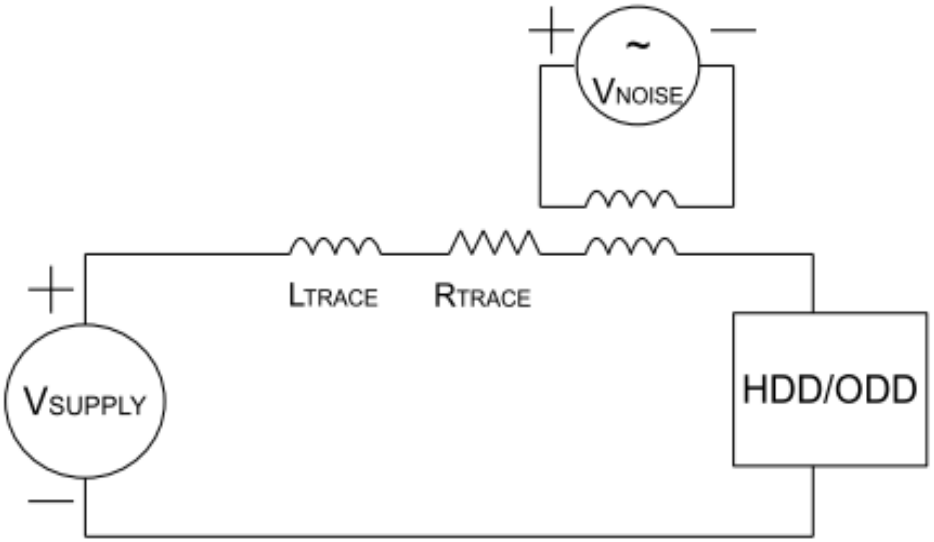
On-Demand Power Adjusts Output Voltage in Real-Time

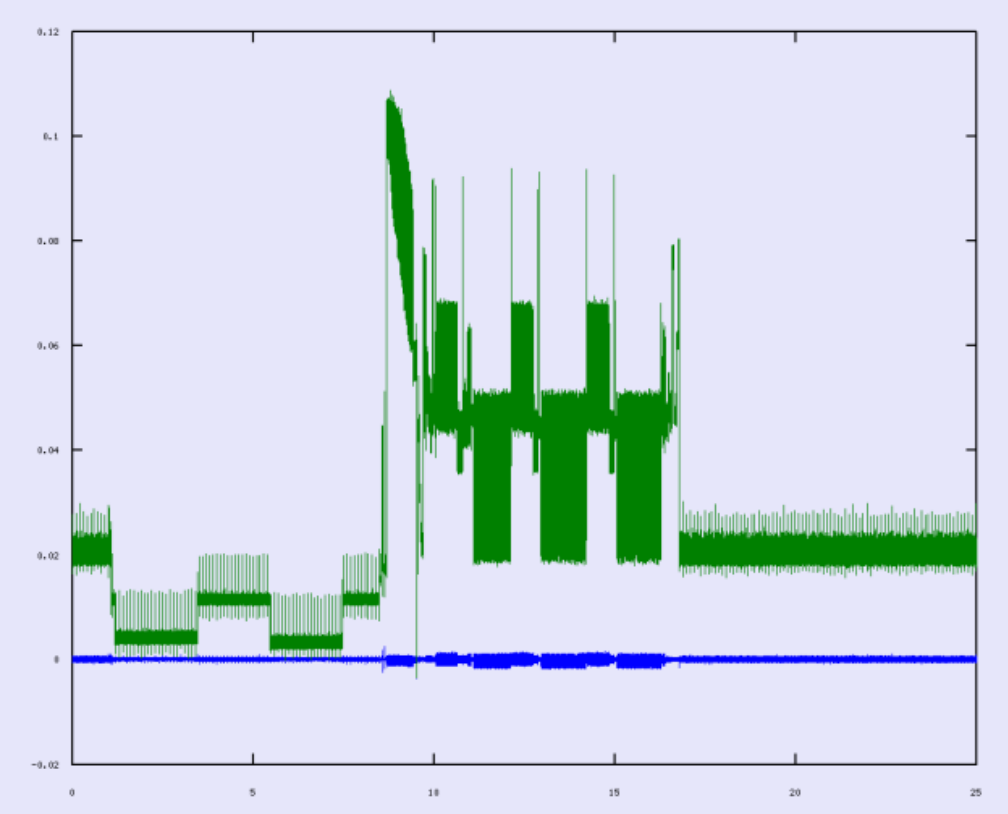
- The supply voltage must be higher in periods of activity to offset the effects of trace inductance, resistance, and noise
- Extra headroom, provided at all times, by traditional supplies increases the power consumption of the drives



$$V_{SUPPLY} \geq V_{REQUIRED} + V_{L\frac{di}{dt}} + V_{IR} + V_{NOISE}$$

PowerSage® Reduces Required Headroom and Lowers Power Consumption

- Conventional supplies must be 250-350mV greater than required by the drive for worst-case headroom for noise and load
- PowerSage® supplies just-in-time/just-enough power



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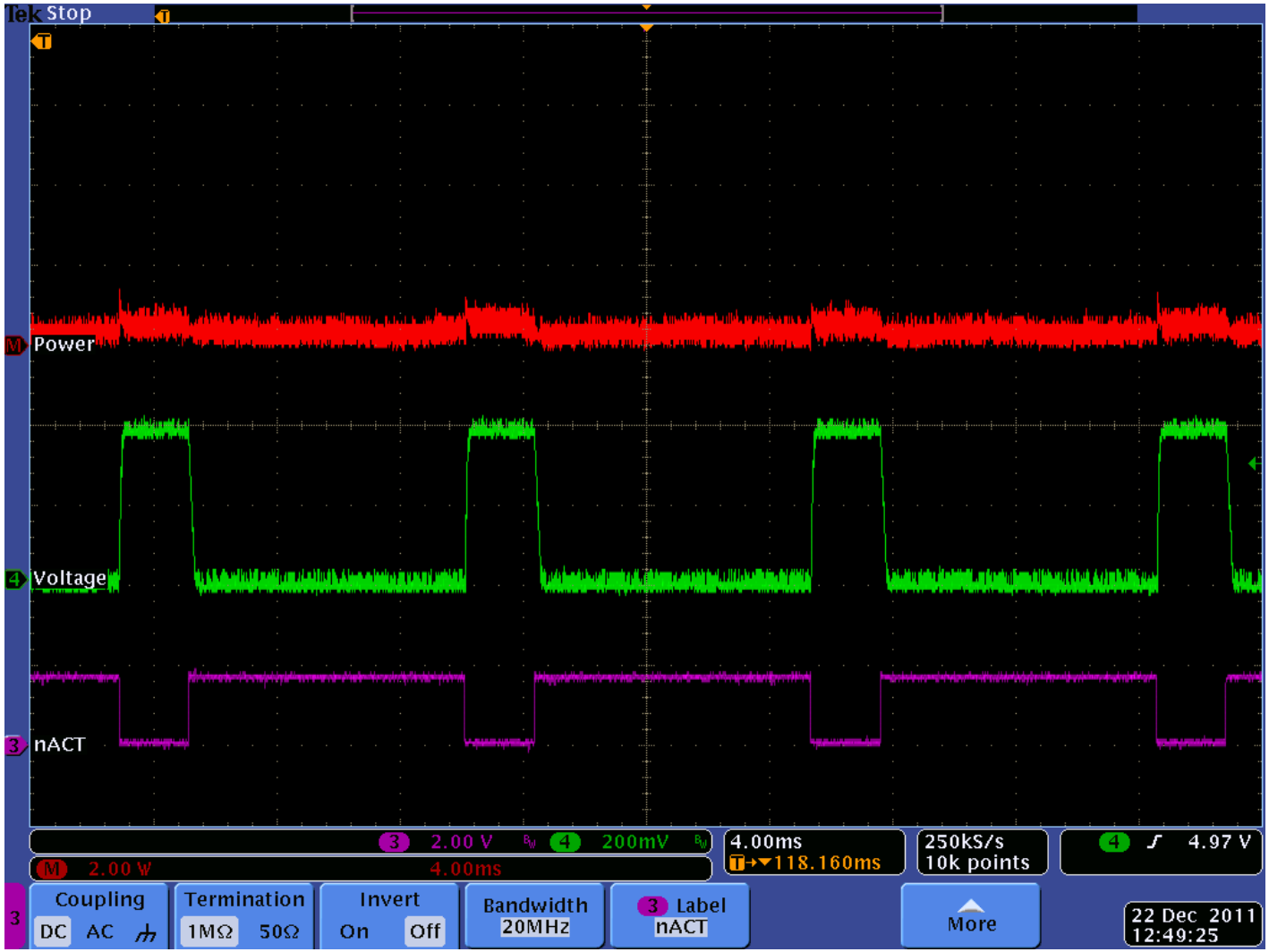
On-Demand Power – Activity Based Voltage Scaling



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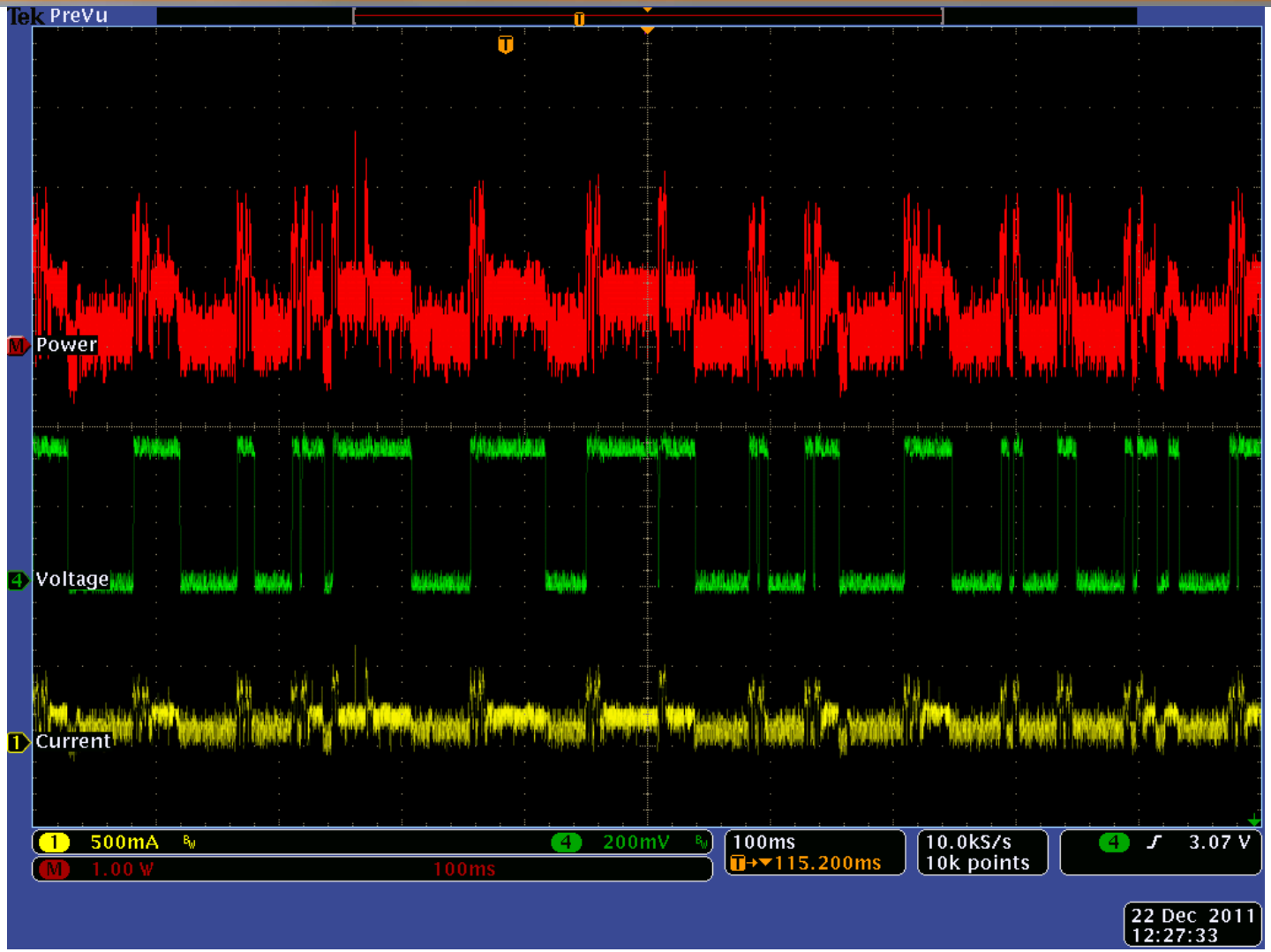
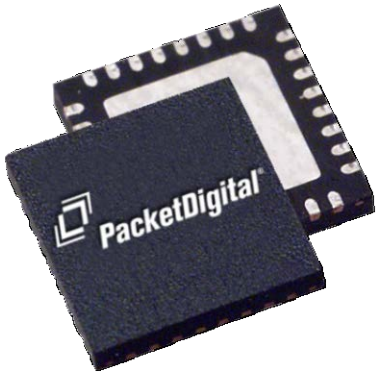
On-Demand Power – Current Sensing Voltage Scaling



PowerSage / On-Demand Power Advantages

- Energy Savings
- Battery Life Extension
- Reduction in Temperature
- Increased Reliability and Quality
- Reduced EMI, signal to noise (reduction in emissions with PowerSage)
- Ease of Integration



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Packet Digital's Unique Power Reduction PMICs

PowerSage® PMICs provide dynamic power management lowering power during active and idle states

- **PowerSage® PSG5220 –** a dual channel, point-of-load, PMIC for SATA devices: HDD, SSD, ODD. Available now with Eval Kit.
- **PowerSage® PSG5210 –** a single channel, point-of-load, PMIC for SATA peripheral devices: HDD, SSD, ODD. Tapeout ready.
- **PowerSage® PSG5320 –** a 5V/3.3V PMIC for system power in notebooks, desktops, servers, and portable electronic applications. Taped out Sep, 2011. Chips back Feb, 2012.
- **PowerSage® PSG5410 –** a single channel PMIC for DDR2/DDR3 power (VDDQ). Taped out Jan, 2012. Chips back April, 2012

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Future PowerSage® Designs -- Mobile Radio PMICs

Radio chips are currently in the architecture phase of design. We have been working with Department of Defense for final design requirements.

- **PowerSage® PSG6110 –** dynamic digital power management. Replaces EL7531.
- **PowerSage® PSG7110 –** PSG7110 – dynamic RF/analog power management. Replaces TPS40055.

PowerSage® Power Management Integrated Circuits Provide Power Savings to Many Products

LCD TVs

Portable DVD Players

Tablet Computers

Notebook Computers

Set-top Boxes

DSL Modems

Routers/Gateways

DVD/BluRay Recorders

NAS Devices

Portable Gaming

Gaming Systems

Mobile Phones

Data Center Servers

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PowerSage® PSG5220 – Advanced SATA Power Management Unit Features

- Dual synchronous step-down PWM switching regulator controller
- Power management for SATA drives
- Algorithm customization to tune for specific drives
- Can manage single or dual SATA drives
- Compatible with HDD, ODD and SSD
- Integrated dual high voltage regulator
  - Accommodates up to 24V battery voltage range
  - Typical output current up to 2A per channel (exceeds this with proper config)
- Programmable output voltage from 3V to 5V
- “Power Good” output indicator
- SMBus interface up to 100KHz
- No external clock or crystal required
- On-chip oscillator
- Ultra Low Leakage process to support lower power consumption
- QFN package (8mm x 8mm)
- Evaluation kits currently available

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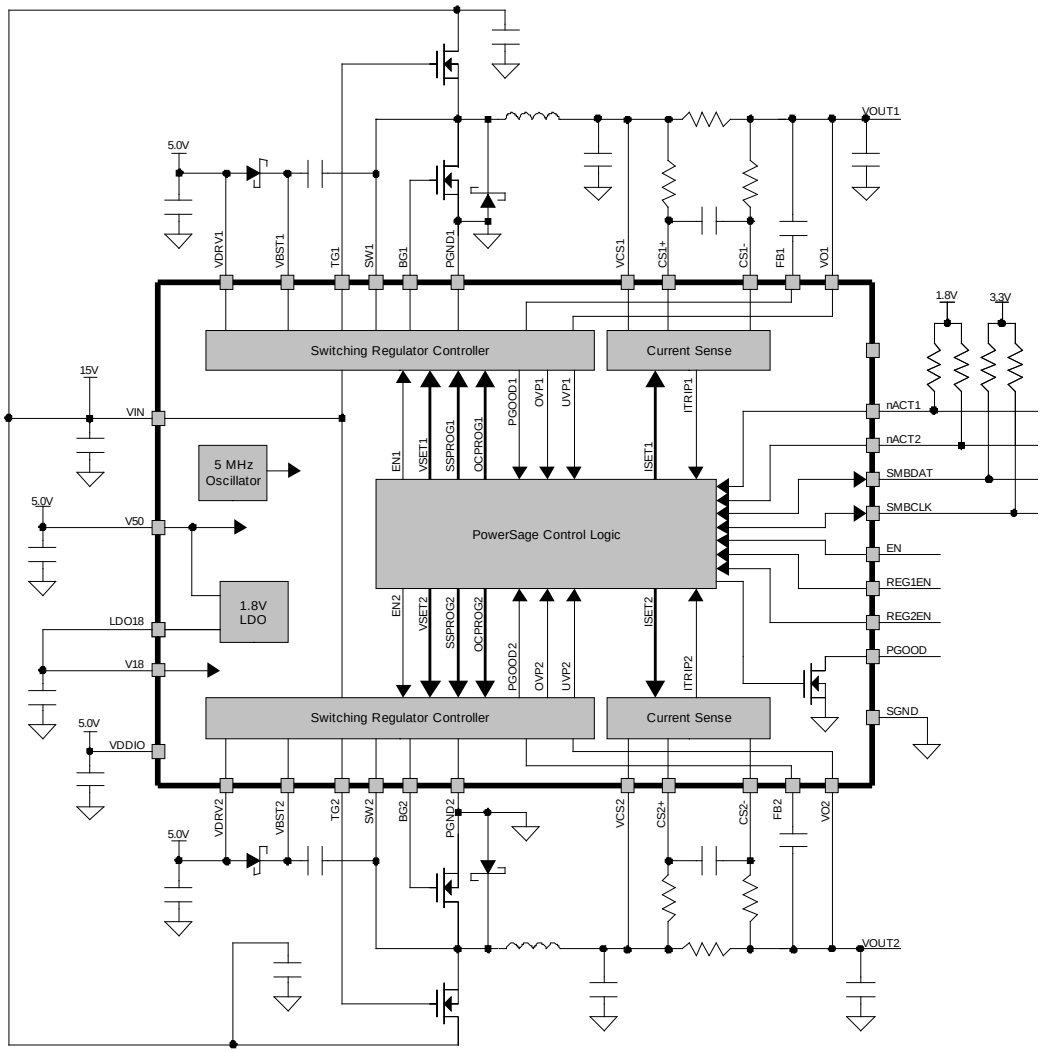
PSG5220 Functional Block Diagram

Datasheet Review

- •Features
- •Functional Block Diagrams
- •Application Circuit
- •Parametrics
- •Reference Circuit



PSG5220 Register settings/programming

- In operation, customers are required to program this part in-system. This will require additional support from Packet Digital.
- This is done through the SMBUS interface.
- From “Setting On-Demand Power Registers” Ap Note:

> *The output voltages of the PSG5220 are manually configured by writing values to registers internal to the chip. Optimizing output voltage levels and other configuration settings will maximize the power savings On-Demand Power will be able to deliver to your system.*

PSG5220 Applications

- SATA drives
- Mobile Computers
- Ultra-Mobile PCs
- Portable Media Players
- Other Mobile Devices

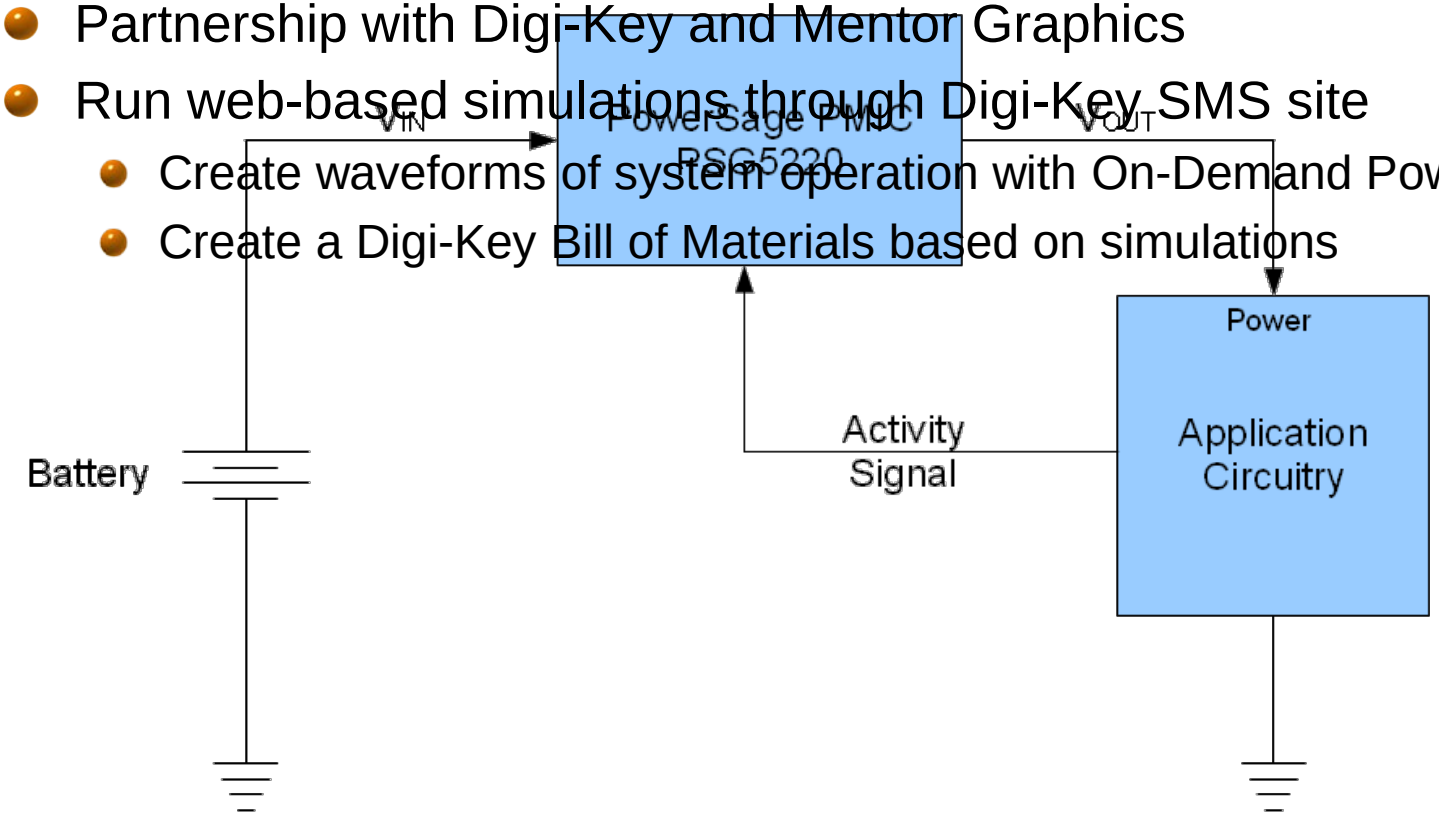
Packet Digital has also demonstrated great power savings by implementing PSG5220 into DVD Players, Servers, Desktops, DDR Memory applications, Mobile Radios…

PSG5220 Video Demonstration

- PSG5220 Intel FFVS for 2012 Chief River Design

PSG5220 On-Demand Power Integration

- Start with a traditional regulator design
- How would you do it?
- Drop in PSG5220
- Add activity signal(s)
- Partnership with Digi-Key and Mentor Graphics
- Run web-based simulations through Digi-Key SMS site
  - Create waveforms of system operation with On-Demand Power
  - Create a Digi-Key Bill of Materials based on simulations



PSG5220 Integration

- DVD player integration demonstration

LabVIEW DVD Power

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Packet Digital's PowerSage PMIC's

- What do you require in a good switching voltage regulator?
  - Static
  - Stability
  - High Efficiency
  - Accuracy
  - Good line-load regulation
  - Well controlled Dead time
- Packet Digital's PowerSage PMIC's are all of this and much more …
  - Dynamic → On-Demand Power
  - Power Savings
  - Improved performance (reduced emissions and heat)
  - Opportunity for weight reduction
- Plus, Packet Digital's PowerSage PMIC's are proven in:
  - Multiple drive manufacturers / types of testing
  - Multiple applications

Contact Info

- Please let me know how I can help:

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Q & A

Thank You