

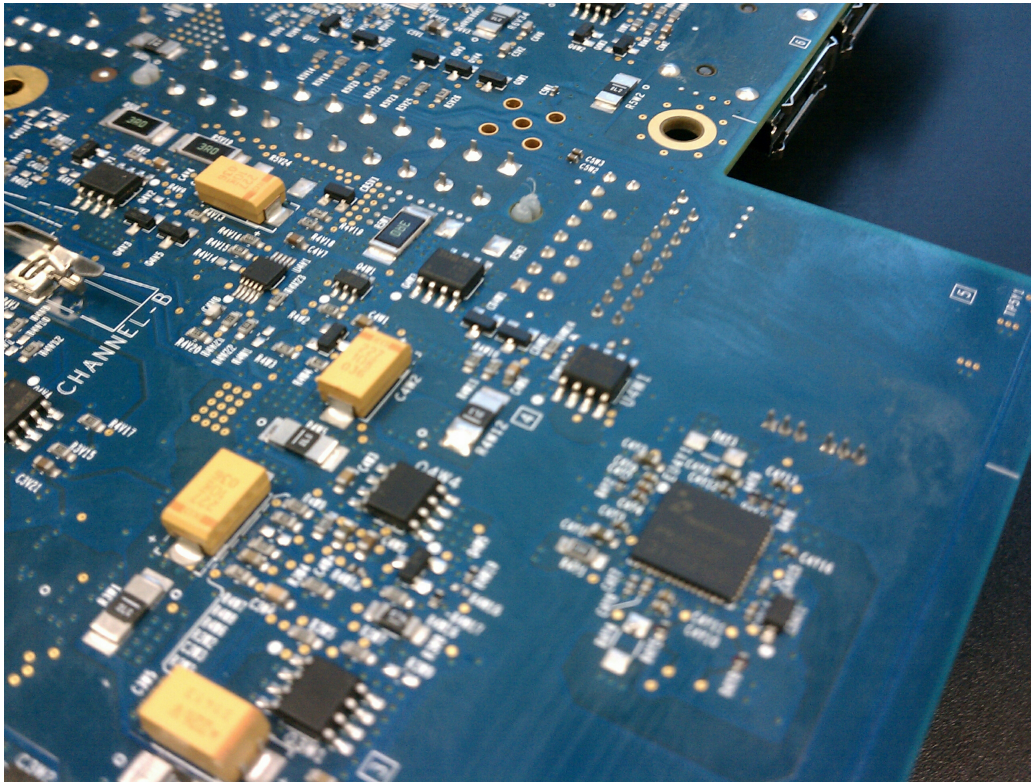
# Enabling PSG5220 on Elk Hill 2 CRB

## SATA Power Savings with On-Demand Power®

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### Executive Summary

Intel's Elk Hill 2 Customer Reference Board for mainstream notebook computers is equipped with Packet Digital's PSG5220 SATA Power Management PMIC. When enabled, the PSG5220 reduces the power consumed by the HDD, SSD, and ODD by providing real-time, autonomous voltage scaling to the drives through Packet Digital's On-Demand Power. This application note is an overview to enabling and configuring the PSG5220 on the CRB for rapid verification.



## 1 Introduction

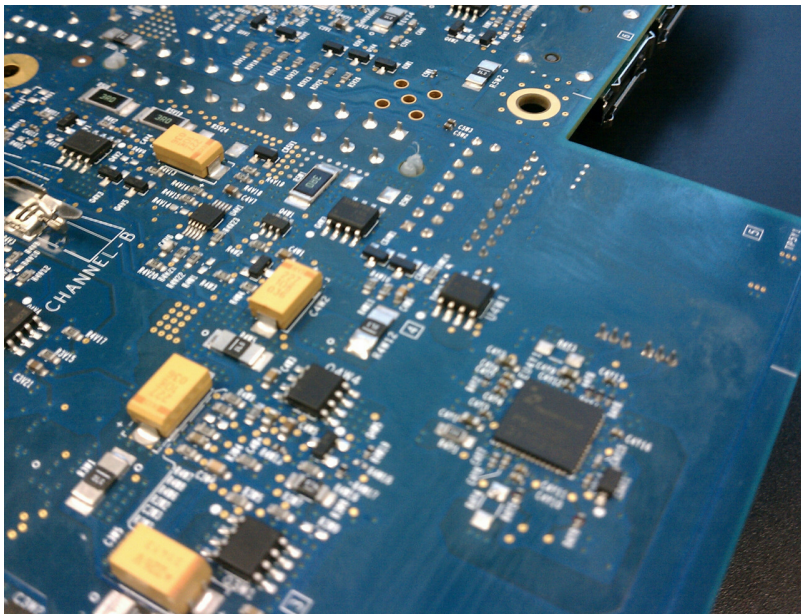
The PSG5220 is a SATA power management voltage regulator which incorporates On-Demand Power. When enabled, the On-Demand Power feature reduces the power consumption of the HDD and ODD, ultimately increasing the battery life of the platform. Power savings and battery life extension has been measured for all usage scenarios. This application note provides details on power savings and measurement techniques for evaluation.

## 2 Reference Documents

- PSG5220 Datasheet
- Elk Hill 2 CRB SATA VR PSG5220, Enabling and Evaluation Report by Intel Corp

## 3 Elk Hill 2 CRB

The PSG5220 SATA VR is designed to provide two channels of regulated power, one for the HDD and one for the ODD. The Elk Hill 2 implementation only enables one of these channels for evaluation. You may use this platform to evaluate On-Demand Power operation for the HDD and ODD independently. For new notebook designs, the PSG5220 may be operated in two-channel mode, one for each drive.



**Figure 1: PSG5220 Location on the Elk Hill 2 CRB**

Detailed schematic and layout information for Elk Hill 2 are obtainable from Intel. Please refer to platform documentation, including *Elk Hill 2 CRB SATA VR PSG5220, Enabling and Evaluation Report* for more information.

In addition to the required rework, set jumper J4J2 to position 1-2. This is connected to the enable (EN) pin of the PSG5220.

## 4 On-Demand Power

To enable the power saving features of the PSG5220, register writes through SMBUS are required. The values to be written to the registers vary depending on the HDD/ODD manufacturer and model.

### 4.1 SMBUS Serial Communication

SMBUS writes to the PSG5220 can be accomplished through customized firmware to the embedded controller (H8)+ or externally through header J4J1. The pin-out of the SMBUS header J4J1 is listed in Table 1. Please refer to the PSG5220 datasheet for SMBUS communication specifications.

**Table 1: SMBUS Header Pin-out**

Pin	Function
1	SMBUS Data
2	Ground
3	SMBUS Clock

### 4.2 Register Settings

Configuring and enabling On-Demand Power is accomplished through a series of register writes through SMBUS. Although the SMBUS registers used will remain the same, the values written will vary depending on the connected drive.

The Intel-specified 'Mainstream' and 'Best of Breed' (BoB) configurations for Elk Hill 2 are supported with a single set of register values. Refer to Intel documentation for a complete listing of BoB and Mainstream configurations for Elk Hill 2. The HDD and ODD used are listed in Table 2.

**Table 2: HDD and ODD Configurations for Elk Hill 2**

	Configuration	Device
HDD	Mainstream	Seagate Wyatt 320GB 5400RPM
HDD	BoB	Hitachi 7200RPM 320GB HTS723232L9A360
ODD	Mainstream/BoB	Panasonic BD-R UJ240

To use On-Demand Power with 'Mainstream' or 'BoB' drives, the settings in Table 3 and Table 4 can be used. These configuration settings will configure and enable On-Demand Power.

**Table 3: On-Demand Power Settings for Mainstream and BoB HDD**

<b>Address</b>	<b>Data</b>
0x06	0x48
0x07	0x4D
0x0B	0x37
0x0C	0x37
0x0F	0x00
0x10	0x1F
0x12	0x50
0x13	0xC3
0x16	0x50
0x17	0xC3
0x1F	0x82
0x03	0x09

**Table 4: On-Demand Power Settings for Mainstream/BoB ODD**

<b>Address</b>	<b>Data</b>
0x06	0x29
0x07	0x35
0x0B	0x33
0x0C	0x33
0x0F	0x00
0x10	0xFF
0x12	0xD8
0x13	0xB8
0x16	0xD8
0x17	0xB8
0x1F	0x82
0x03	0x0D

## 5 HDD Operation with On-Demand Power

To power the HDD with the PSG5220 and operate with On-Demand Power, connect the HDD to J8H1 and the ODD to J9E4. The PSG5220 will be powering the HDD. Upon start-up, the PSG5220 will be providing a static 5V supply to the drive. Configuring the PSG5220 with register settings defined in Table 3 will enable the power saving features of On-Demand Power.

## 6 ODD Operation with On-Demand Power

To power the ODD with the PSG5220 and operate with On-Demand Power, connect the ODD to J8H1 and the HDD to J9E4. Adapters are required to connect each of these drives to the respective connector. The PSG5220 will be powering the ODD. Upon start-up, the PSG5220 will be providing a static 5V supply to the drive. Configuring the PSG5220 with register settings defined in Table 4 will enable the power saving features of On-Demand Power.

### 6.1 Intel's Evaluation of PSG5220 Power Savings on Elk Hill 2

Intel has evaluated one PSG5220 SATA VR part under laboratory conditions.

Power measurements were performed to estimate the power savings while the VR is allowed to freely change the voltage (Table 5 and Table 6). This was done by using a set of codes provided by Packet Digital for this purpose.

**Table 5: Intel's Measured Power Savings - BoB HDD**

Workload	HDD Savings (mW)	ODD Savings (mW)	Total Savings (mW)
MMO7 DVD Playback - Elephant's Dream	33	54	87
WinDVD 10 DVD Playback - Elephant's Dream	33	130	163
WinDVD 10 Blu-ray Playback - Fantastic 4: Silver Surfer	32	130	162
Mobile Mark 07 Office Productivity	34	n/a	34
HDD playback 1080p - Elephant's Dream	49	n/a	49
IOMeter (32bit) 3-run average – HDD	72	n/a	72
PCMark Vantage HDD	50	n/a	50
PCMark Vantage Overall	30	n/a	30

**Table 6: Intel's Measured Power Savings - Mainstream HDD**

Workload	HDD Savings (mW)	ODD Savings (mW)	Total Savings (mW)
Mobile Mark 07 Office Productivity	8	n/a	8
HDD playback 1080p - Elephant's Dream	72	n/a	72
IOMeter (32bit) 3-run average – HDD	48	n/a	48
PCMark Vantage HDD	62	n/a	62

## 6.2 Intel's EMI Analysis with On-Demand Power on Elk Hill 2

Only the ODD was used in the far-field test since the observed difference between the HDD and ODD usage was insignificant with the near-field scans. Three modes were tested – Idle mode in which the SATA VR's power savings feature was not enabled while running the Blu-Ray movie, active mode in which the Blu-Ray movie was run and the power savings of the SATA VR was enabled and the windows idle mode in which measurements were done on the idle windows desktop.

The tests were performed without a chassis and verified against the open chassis FCC regulatory guidelines. The measurement range was 30MHz to 1GHz in 3m semi-anechoic chamber. To reduce non-related EMI only required IO ports were populated.

From observed results it was found that no emissions failed the open-box limit. The highest emission level was at 267 MHz with a 3dB margin. The margin across the rest of the emission spectra was 8dB or more. The emissions seen at 170, 268 and 340 MHz in the near-field scans were not detected in the far-field measurements. An increase in broadband emissions was observed in the 100MHz to 300MHz frequency range during the operation of the ODD and the emission level in this frequency range was less with the power savings feature enabled in the SATA VR. A graph of these test results is in Figure 2.

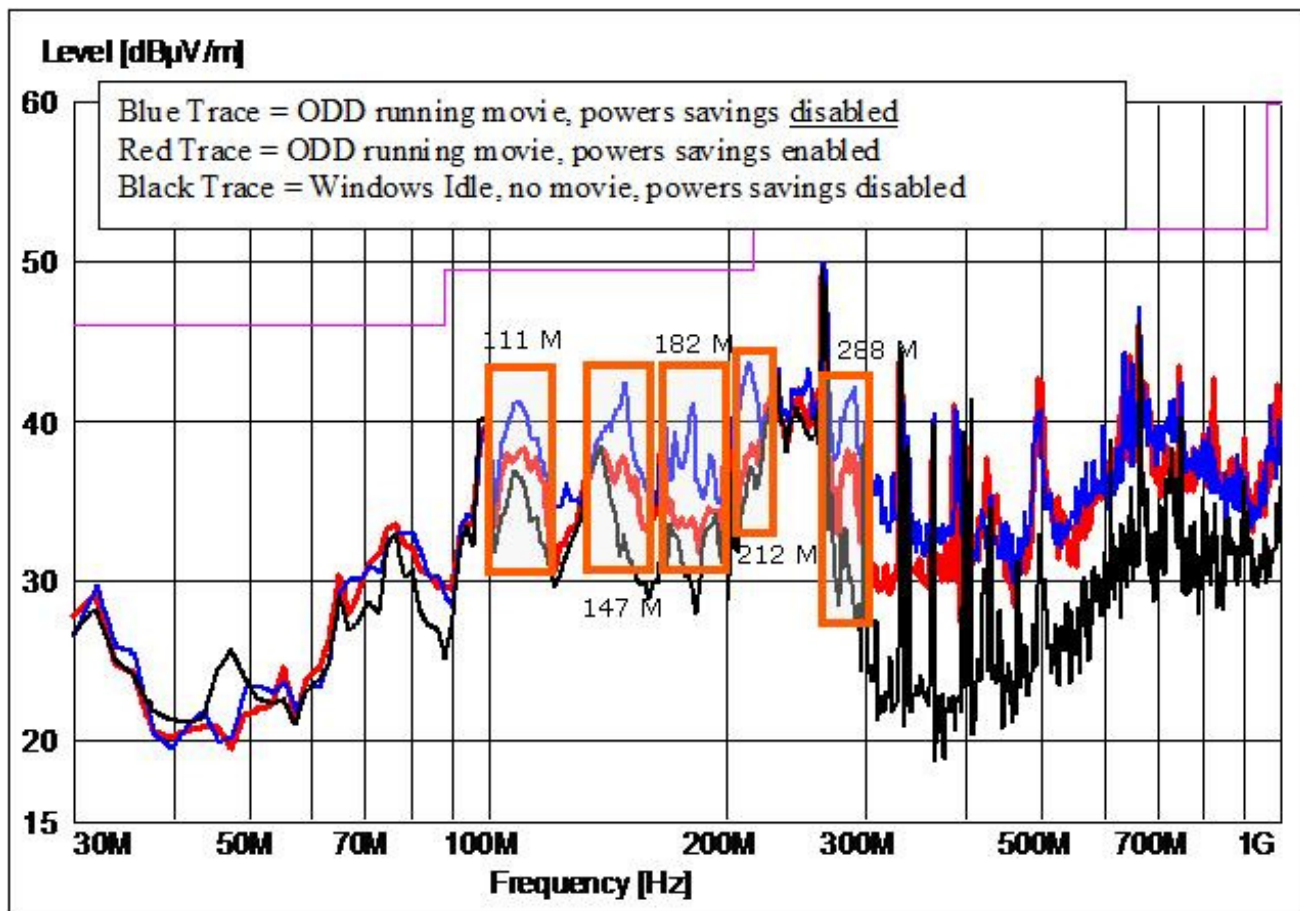


Figure 2: EMI Analysis, Comparing On-Demand Power to Baseline

## 7 PSG5220 in New Notebook Designs

The Intel Elk Hill 2 Customer Reference Board (CRB) is a convenient way to validate the PSG5220 in-system. Voltage regulator operation can be validated and power savings can be observed directly on the CRB.

To realize the highest level of battery life extension and the lowest power consumption for the HDD and ODD, the PSG5220 design should be operated in 2-channel mode. Each channel on the PSG5220 is identical. One channel should be used for the HDD and one channel for the ODD. Figure 3 shows the PSG5220 configured to 2-channel mode. Packet Digital's world-wide engineering support can assist in 2-channel designs.

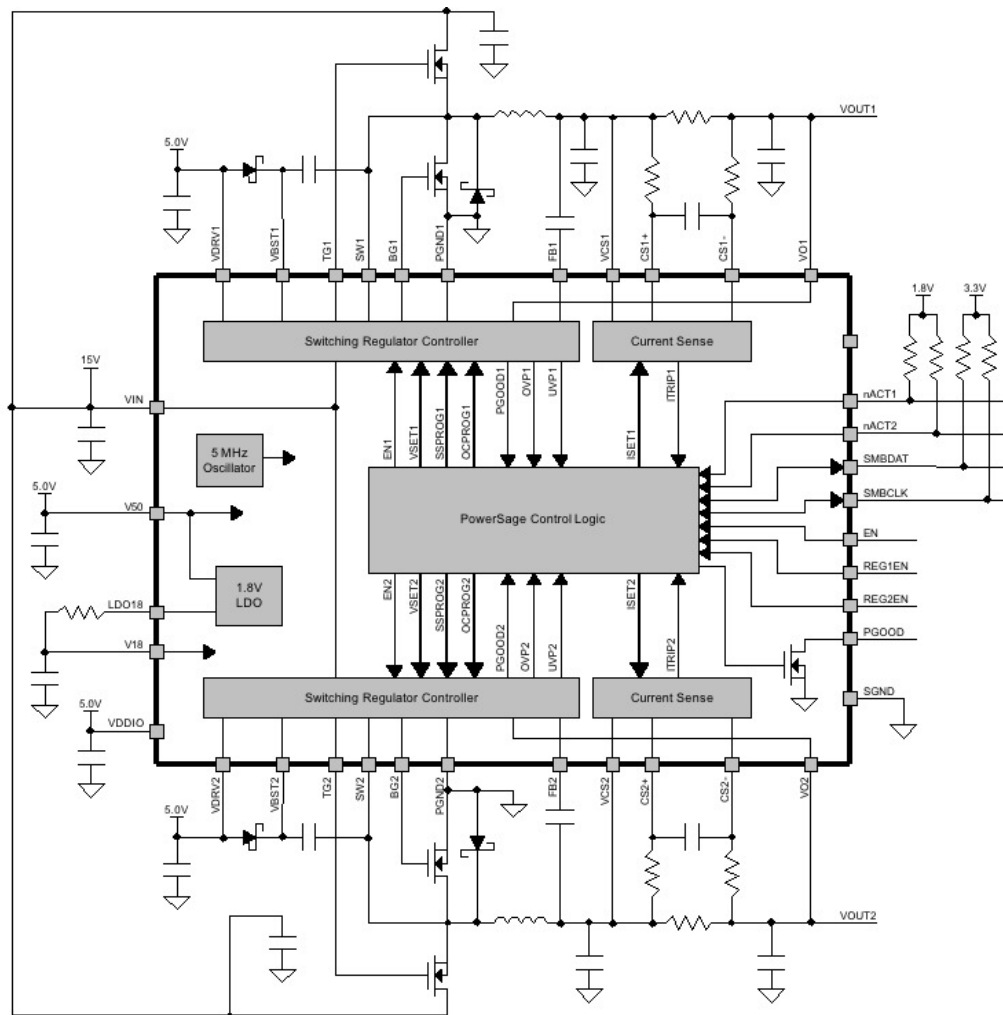


Figure 3: PSG5220 Typical Application - Two Channel Operation

## 8 Contact Info

Packet Digital's world-wide engineering support team will assist you in enabling PSG5220 on the Elk Hill 2 CRB design. Please contact Packet Digital with any questions.

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