Technical Article
Powering High-current Broadcom Networking Processors in Ethernet Switches

TEXAS INSTRUMENTS

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Broadcom networking processors such as the StrataXGS Tomahawk family enable high density and performance in Ethernet switches (Figure 1 is a block diagram of an Ethernet switch; the switch ASIC could be the StrataXGS processor).
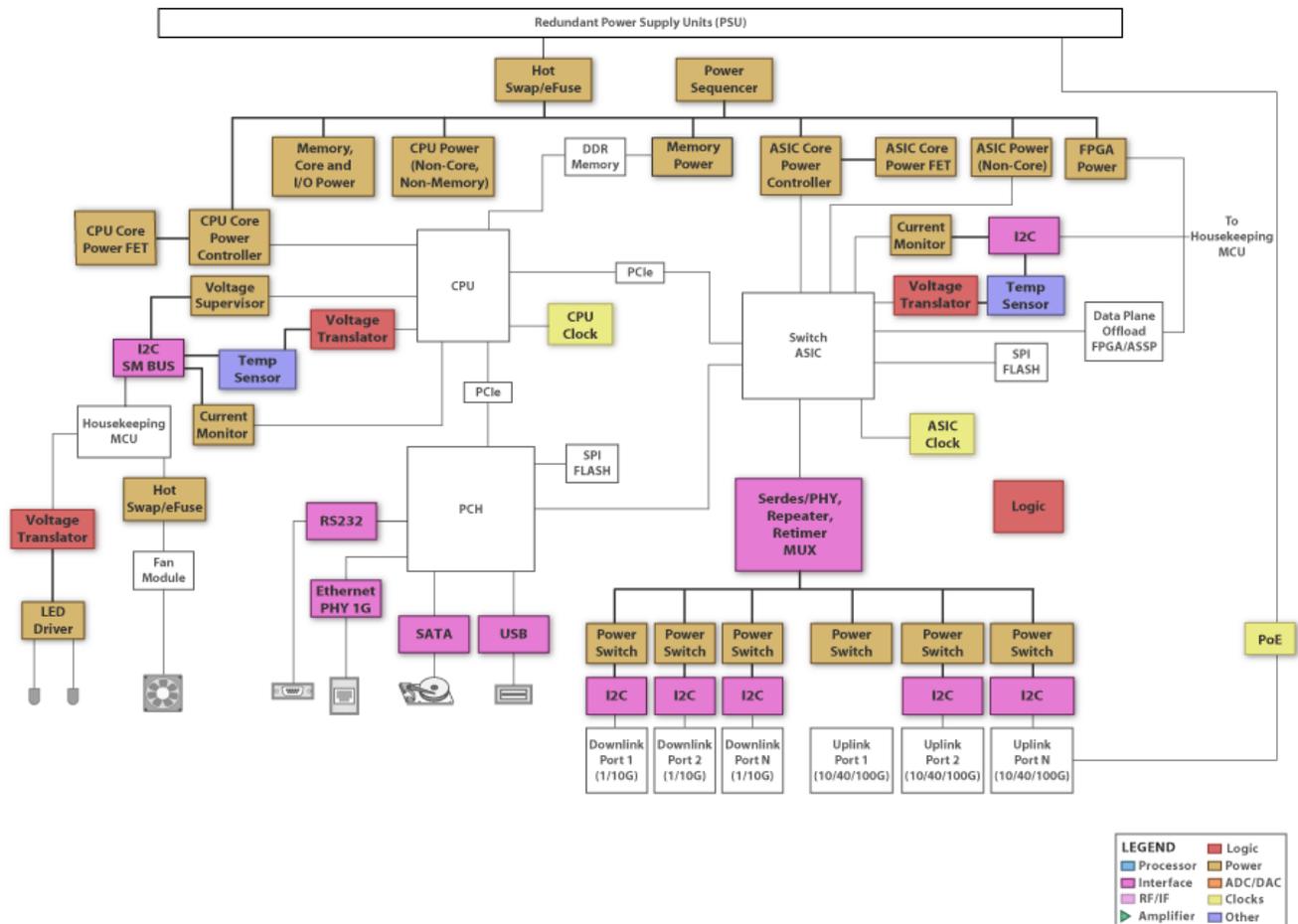
Figure 1. Ethernet Switch

These processors require high current at low voltages, so their associated power solutions must provide tight load regulation, high power density, excellent thermal performance and fast load-transient response. Multiphase buck regulators power the core rail. Multiphase buck DC/DC design requires operating several buck stages in a staggered fashion out of phase.

The TPS53681 6+2 PMBus buck pulse-width modulation (PWM) controller works with the CSD95490 power stages to meet StrataXGS requirements. This driverless PWM architecture uses the TPS53681 controller and power stages. The power stages combine a high-current metal-oxide semiconductor field-effect transistor

(MOSFET) gate driver and a high- and low-side MOSFET in one package. TI's proprietary PowerStack™ package enables easy printed circuit board (PCB) layout, simplified heatsinking and better overall thermal management.

This driverless PWM + power stage approach also enables higher switching frequencies, higher power density and lower noise compared to controllers with integrated MOSFET gate drivers and external MOSFETs.

With the dual-output configuration, you can power both the core rail and a secondary rail from a single chip: six phases for the core rail, two phases for the secondary rail. Additionally, the TPS53681 has a PMBus interface that enables you to set the power-supply functions via registers on-chip, reducing the external component count. You can fully customize parameters such as output voltage/margining, current limit, soft start and transition rate between voltage steps, as well as monitoring of input and output voltage, current, power, and temperature.

The TPS53681 enables fast load-transient response due to its DCAP+™ control mode, as shown in Figure 2.
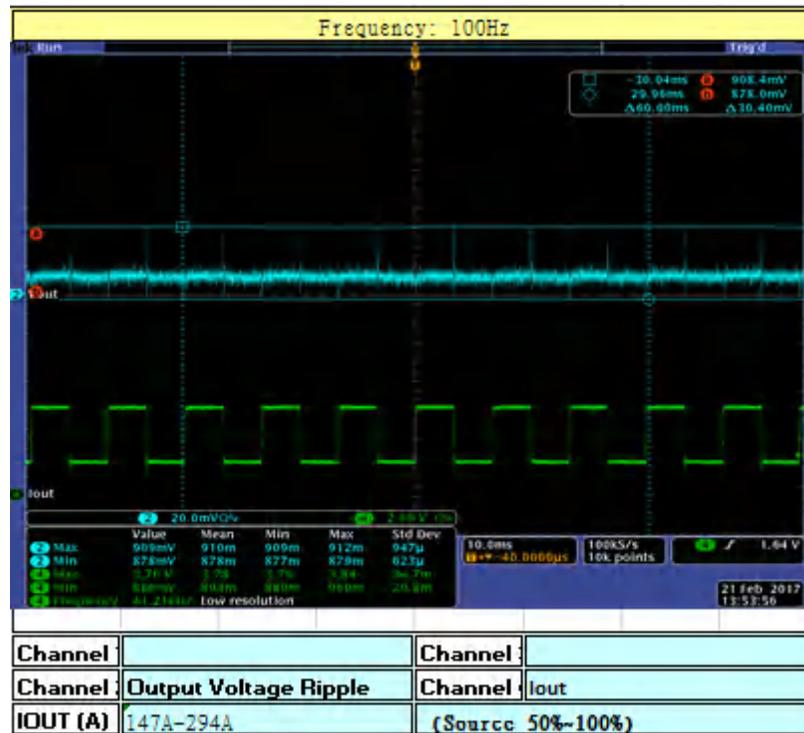
Figure 2. TPS53681 Load Transient Response, 147A to 294A Load

The TPS53681 offers latch-off overcurrent protection (shutting the device off upon the detection of overcurrent) to protect the StrataXGS processor. When the output current encounters an overcurrent warning and limit PMBus flags are set, the output current and voltage will shut down, as shown in Figure 3.

Figure 3. Output Current Overcurrent Response – Warning at 252A, Latch off at 315A

The TPS53681 and CSD95490 six-phase buck design can achieve >87% efficiency at 300A of load current, as shown in Figure 4.
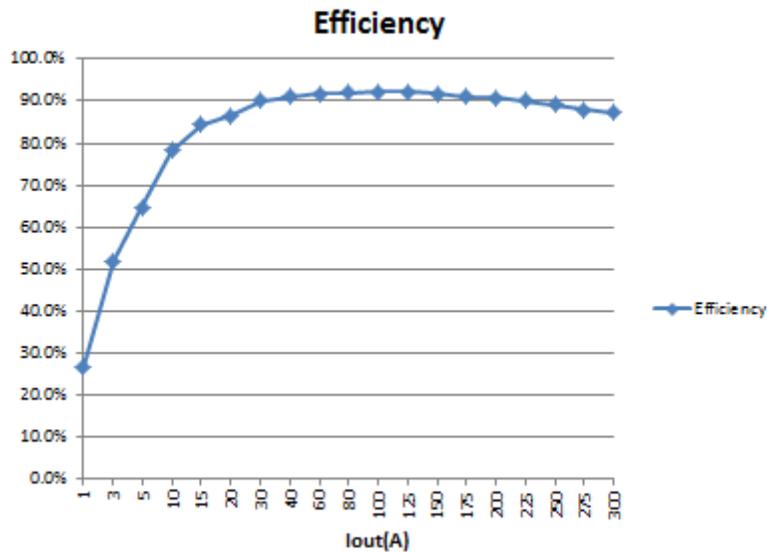
Figure 4. TPS53681 Design Efficiency: 12V Input, <1V/300A Output

TI's Fusion Digital Power Designer™ graphical user interface (GUI) can monitor the power-supply temperature, as well as the input voltage, input current and output current via PMBus, as shown in Figure 5.

Figure 5. PMBus Monitoring of the TPS53681'S Input Voltage, Input Current, Output Current and Temperature

If you are designing with Broadcom's StrataXGS processors for Ethernet switches, the TPS53681 6+2 controller and CSD95490 power stages enable a high-performance, high-power-density design with full capabilities of customization and system monitoring.

Additional Resources
• For more details about multiphase buck DC/DC design, download the application report, "Multiphase Buck Design from Start to Finish."
• Review TI's PMBus controller power portfolio on the digital power portal.

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