Several different brands of CPUs fall into Intel® VRM8.5 category. Depending upon clock frequency and computation power, these CPUs consume different levels of supply current ranging from several amperes to 30A. The newly released LTC3720 single-phase PWM controller is designed for CPUs that consume up to 20A. It features a valley current control architecture that speeds up the VRM response to step load changes, two on-chip high current gate drivers for N-channel power MOSFETs, a current sensing mechanism that does not require an additional sense resistor and a 5-bit VID table that is compatible with Intel VRM 8.5. The resulting VRM 8.5 design has a small size and a fast transient response.

The LTC3720 also achieves a minimum on-time below 100ns and a wide input range from 4V to 36V. These are important characteristics for notebook CPU applications where the input-to-output ratio is usually high. Other LTC3720 features include a programmable current limit, an output overvoltage soft latch, a capacitor-programmable soft start, an

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Figure 1. A 20A VRM8.5 design using the LTC3720

Figure 2. Better than 80% efficiency is achieved over a 1A–20A load range.

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occurs to maintain regulation. Efficiency in pulse skipping mode is lower than Burst Mode operation at light loads, but comparable to Burst Mode operation when the output load exceeds 50mA.

1.8V/600mA Step-Down Regulator Using All Ceramic Capacitors

Figure 1 shows an application of the LTC3406/LTC3406B-1.8 using all ceramic capacitors. This particular design supplies a 600mA load at 1.8V with an input supply between 2.5V and 5.5V. Ceramic capacitors have the advantages of small size and low equivalent series resistance (ESR), making possible for very low ripple voltages at both the input and output. For a given package size or capacitance value, ceramic capacitors have lower ESR than other bulk, low ESR capacitor types (including tantalum capacitors, aluminum and organic electrolytics). Because the LTC3406/LTC3406B’s control loop does not depend on the output capacitor’s ESR for stable operation, ceramic capacitors can be used to achieve very low output ripple and small circuit size. Figures 2 and 3 show the transient response to a 50mA to 600mA load step for the LTC3406-1.8 and LTC3406B-1.8, respectively.

Efficiency Considerations

Figure 4 shows the efficiency curves for the LTC3406-1.8 (Burst Mode operation enabled) at various supply voltages. Burst Mode operation significantly lowers the quiescent current, resulting in high efficiencies even with extremely light loads.

Figure 5 shows the efficiency curves for the LTC3406B-1.8 (pulse skipping mode enabled) at various supply voltages. Pulse skipping mode maintains constant-frequency operation at lower load currents. This necessarily increases the gate charge losses and switching losses, which impact efficiency at light loads. Efficiency is still comparable to Burst Mode operation at higher loads.