Dual 8A DC/DC µModule Regulator Is Easily Paralleled for 16A

by Eddie Beville and Alan Chern

Two Independent 8A Regulator Systems in a Single Package

The LTM4616 is a dual input, dual output DC/DC µModule regulator in a 15mm × 15mm × 2.8mm LGA surface mount package. Only a few external components are needed since the switching controller, MOSFETs, inductor and other support components are integrated within the tiny package.

Both regulators feature an input supply voltage range of 2.375V to 5.5V and an adjustable output voltage range of 0.6V to 5V with up to 8A of continuous output current (10A peak). For higher output current designs, the LTM4616 can operate in a 2-phase parallel mode allowing the part to deliver a total output current of 16A. The default switching frequency is set to 1.5MHz, but can be adjusted to either 1MHz or 2MHz via the PLLLPF pins. Moreover, CLKIN can be externally synchronized from 750kHz to 2.25MHz. The device supports output voltage tracking for supply rail sequencing. Safety features include protection against short circuit, overvoltage and thermal shutdown conditions.

Simple and Efficient

The LTM4616 can be used as completely independent dual switching regulators with different inputs and outputs or paralleled to provide a single output. Figure 1 shows a typical design for a 5V common input and two independent outputs, 1.8V and 1.2V. Figure 2 shows the efficiency of the circuit at both 5V and 3.3V inputs.

Few external components are needed since the integrated output capacitors can accommodate load steps to the full 8A. Each output voltage is set by a single set resistor from FB1 (or FB2) to GND. In parallel operation, the FB pins can be tied together with a single resistor for adjustable output voltage.

Parallel Operation for Increased Output Current

You can double the maximum output current to 16A by running the two outputs in parallel as shown in Figure 3. Note that the FB pins share a single voltage-set feedback resistor that is half the value of the feedback resistor in the usual two output configuration. This is because the internal 10k top feedback resistors are in parallel with one another, making the top value 5k.

It is preferred to connect CLKOUT1 to CLKIN2 when operating from a single input voltage. This minimizes the input voltage ripple by running the two regulators out of phase with each other. If more than 16A output current is required, then multiple LTM4616 regulators can be configured for multiphase operation with up to 12 phases via the PHMODE pin. Figure 4 shows the expected efficiency of the parallel system at 5V and 3.3V inputs to 1.8V output. Note that the

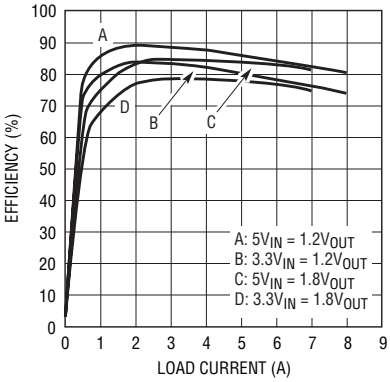

Figure 2. LTM4616 efficiency: dual output

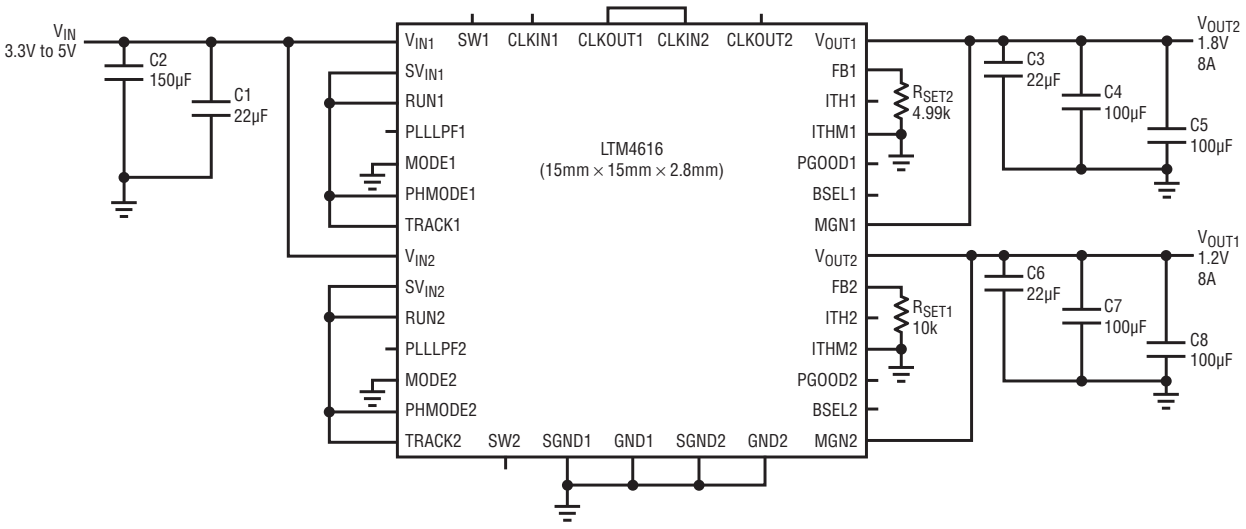

Figure 1. Dual output LTM4616 for a single 3.3V to 5V input, independent 1.8V and 1.2V outputs at 8A each

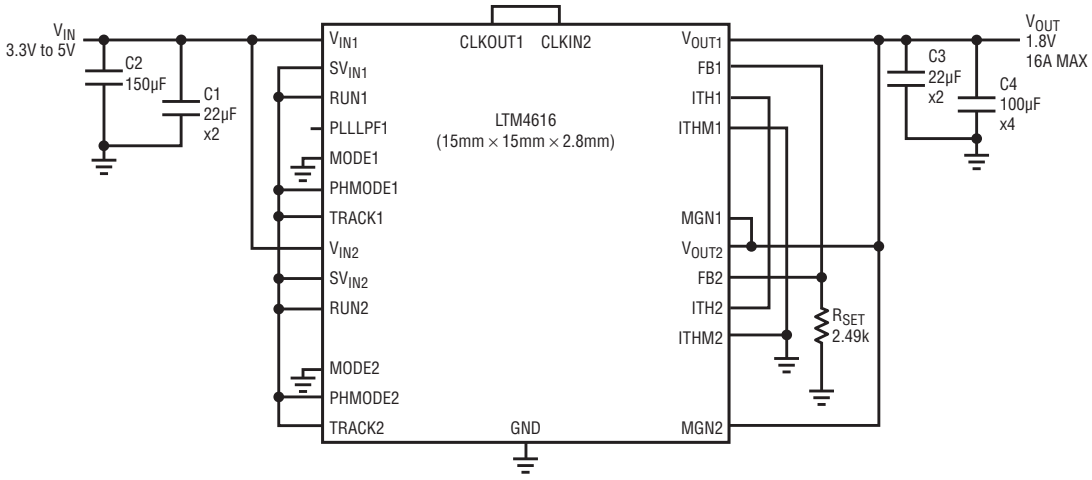

Figure 3. LTM4616 with 16A parallel operation

two regulators drive equal output current even during soft-start, as shown in Figure 5.

Conclusion

Whether you require a single 16A high current output or dual 8A outputs with sequencing, the LTM4616 provides a simple and efficient solution.

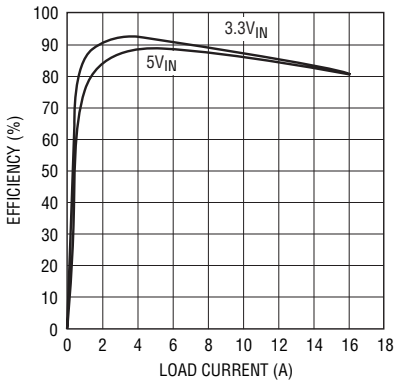

Figure 4. Efficiency: single 1.8V output

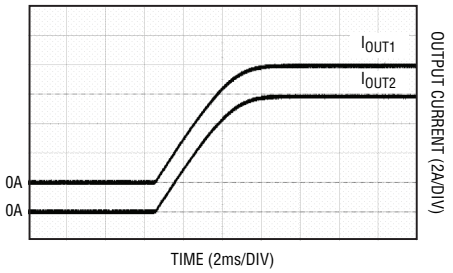

Figure 5. Balanced current sharing for even heat dissipation [$5V_{IN}$ to $1.8V_{OUT}$ at 16A]

LT3519, continued from page 36

high efficiency, small inductor and capacitor size, and high PWM dimming capability while avoiding frequencies in the AM broadcast band. A small inductor with about 750mA saturation current rating, a few ceramic capacitors and several tiny resistors are all that are needed to complete the design. As shown in Figure 2, the tiny PWM dimming MOSFET can be used to provide over 1000:1 pwm dimming at 120Hz using the integrated LT3519 PWM dimming architecture and an extremely low leakage integrated Schottky diode.

A 1000:1 dimming ratio at 120Hz is exceptionally high for a 400kHz switching regulator. It can be tempting to bump up the dimming ratio by choosing a higher frequency driver, since in general, higher switching frequency corresponds to higher PWM dimming ratios. In this case, avoiding the AM band means jumping to 2MHz, which in the end reduces the maximum duty cycle and the efficiency. The 400kHz switching frequency of the LT3519 does what 2MHz converters cannot do: it provides high duty cycle for operation down to $6V_{IN}$ with $38V_{LED}$ and as high as 89% efficiency at $12V_{IN}$. If PWM dimming is not needed, the MOSFET M1 can be removed and the analog dimming (CTRL) pin can be used to adjust the regulated LED current below 100mA for simple brightness control.

2.4W SEPIC LED Driver

When the LED string voltage is within the input rail voltage range, a SEPIC topology is called for. The SEPIC produces a high PWM dimming ratio and also gives short-circuit protection. The SEPIC in Figure 3 drives 16V LEDs at 150mA from a 4V to 24V input range. Since the anode of the integrated catch diode (ANODE) is made available at a pin independent of the npn power switch emitter (SW), the coupling capacitor is easily inserted between the two. The maximum voltage that the SW pin sees is a little above the input voltage plus the output voltage, so the 45V 750mA integrated power switch is a perfect match for these specifications.

Conclusion

The 400kHz LT3519 is a 4W LED driver that integrates a number of required components, including a 45V, 750mA power switch, a low leakage Schottky diode and compensation components. It also features PWM dimming, overvoltage protection and $\overline{\text{OPENLED}}$ fault detection, making it a small, simple, and efficient choice for automotive, avionic, industrial and other LED driver applications.