Keywords: boost, controller, step-up, step up, DC-DC, PFM, efficiency

APPLICATION NOTE 1054

Simple Change Improves PFM Boost-Controller Efficiency

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Abstract: Modification to the standard PFM boost-controller circuit provides a 5% efficiency improvement at medium and light loads.

A simple modification to the standard application circuit for a high-efficiency PFM boost controller (**Figure 1**) yields even higher efficiency. By increasing the value of R_{SENSE} and connecting the output filter capacitor to the current-sense pin (CS) instead of ground, the circuit's current limit is made dependent on load current. The result is lower I^2R loss (in the inductor, MOSFET, and output-capacitor ESR), which gives better efficiency for light-to-medium loads.

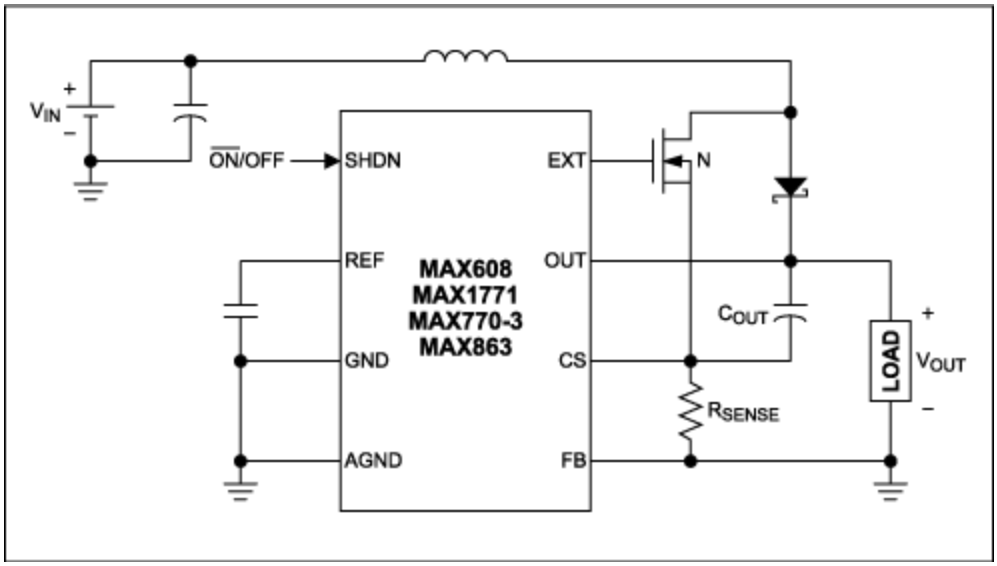

Figure 1. Connecting the C_{OUT} capacitor to CS instead of ground causes load-dependent current limiting, which reduces I^2R loss.

Connecting the filter capacitor to CS allows R_{SENSE} to monitor the inductor current constantly-via the MOSFET during t_{ON} and via the diode and filter capacitor during t_{OFF}. During t_{ON}, the filter-capacitor voltage drives load current in a loop (C_{OUT}/LOAD/R_{SENSE}) that opposes the inductor current through R_{SENSE}. In effect, the CS node subtracts load current from inductor current during this interval. Thus, as load current increases, the higher level of inductor current required to produce 100mV across R_{SENSE} extends the $_{ON}$ interval and raises the current limit:

$I_{LIM} = (100mV/R_{SENSE}) + I_{LOAD}$.

This modification does not affect the quiescent current and requires no additional circuitry, but the voltage waveform at CS couples through C_{OUT} to the output, increasing the output ripple about 100mV for light to medium loads. To obtain a lower peak current and higher efficiency for light to medium loads, the value of R_{SENSE} should be increased as necessary to obtain the same current limit at maximum load as that provided by the standard application circuit. **Figure 2** shows the effect of a load transient on the inductor current and output ripple, and **Figure 3** shows efficiency gains over the standard connection.

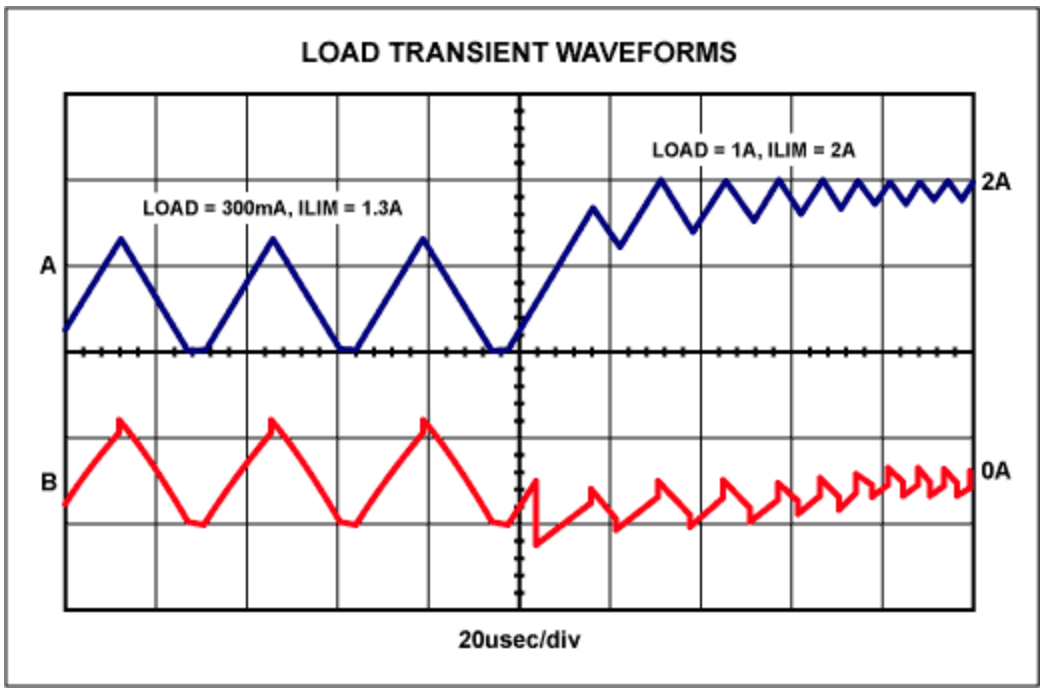

Figure 2. An abrupt change in load current (300mA to 1A) causes changes as shown in the inductor current (top trace, 1A/div) and V_{OUT} ripple (ac-coupled bottom trace, 100mV/div).

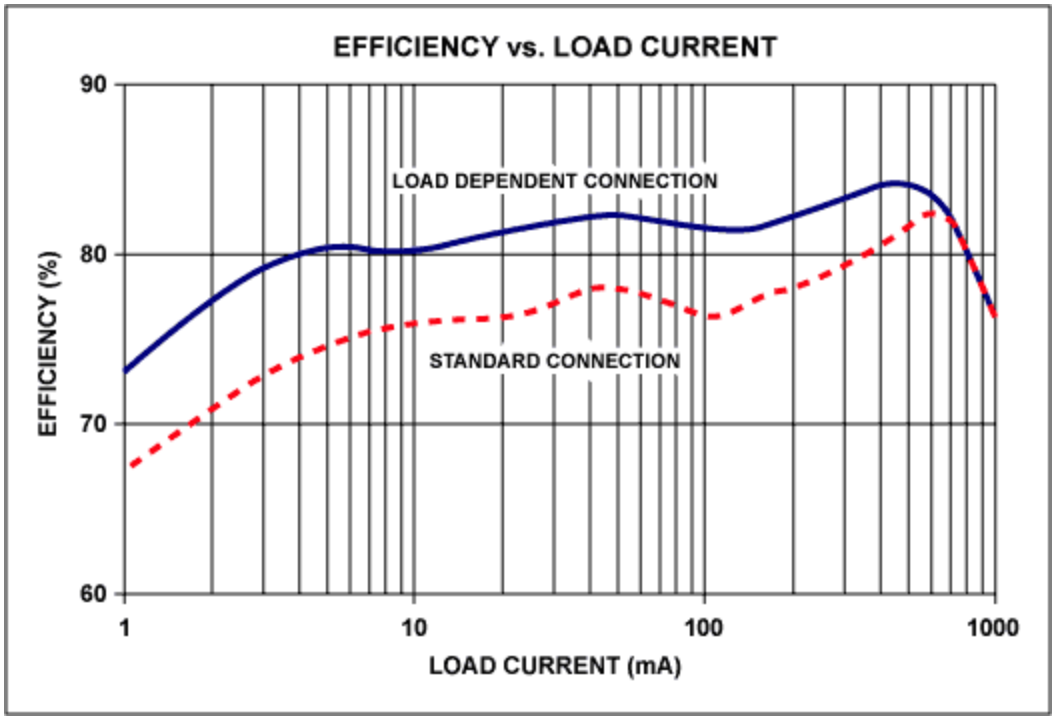

Figure 3. Efficiency for the Figure 1 circuit is 4-5% better than that of a standard connection.

Related Parts		
MAX1771	12V or Adjustable, High-Efficiency, Low I_Q, Step-Up DC-DC Controller	Free Samples
MAX608	5V or Adjustable, Low-Voltage, Step-Up DC-DC Controller	Free Samples
MAX863	Dual, High-Efficiency, PFM, Step-Up DC-DC Controller	Free Samples

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