

APPLICATION NOTE 1054

# Simple Change Improves PFM Boost-Controller Efficiency

*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.

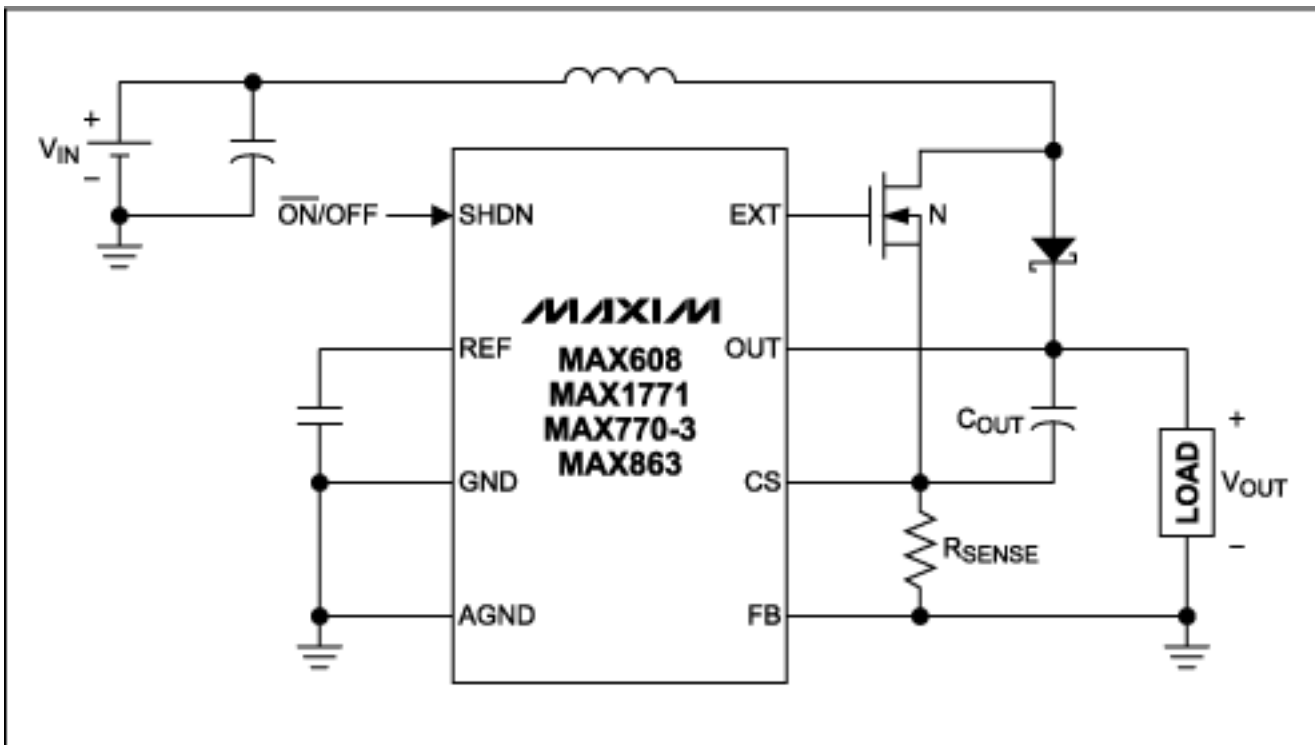


Figure 1. Connecting the  $C_{OUT}$  capacitor to CS instead of ground causes load-dependent current limiting, which reduces  $I^2R$  loss.

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  $t_{ON}$  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.

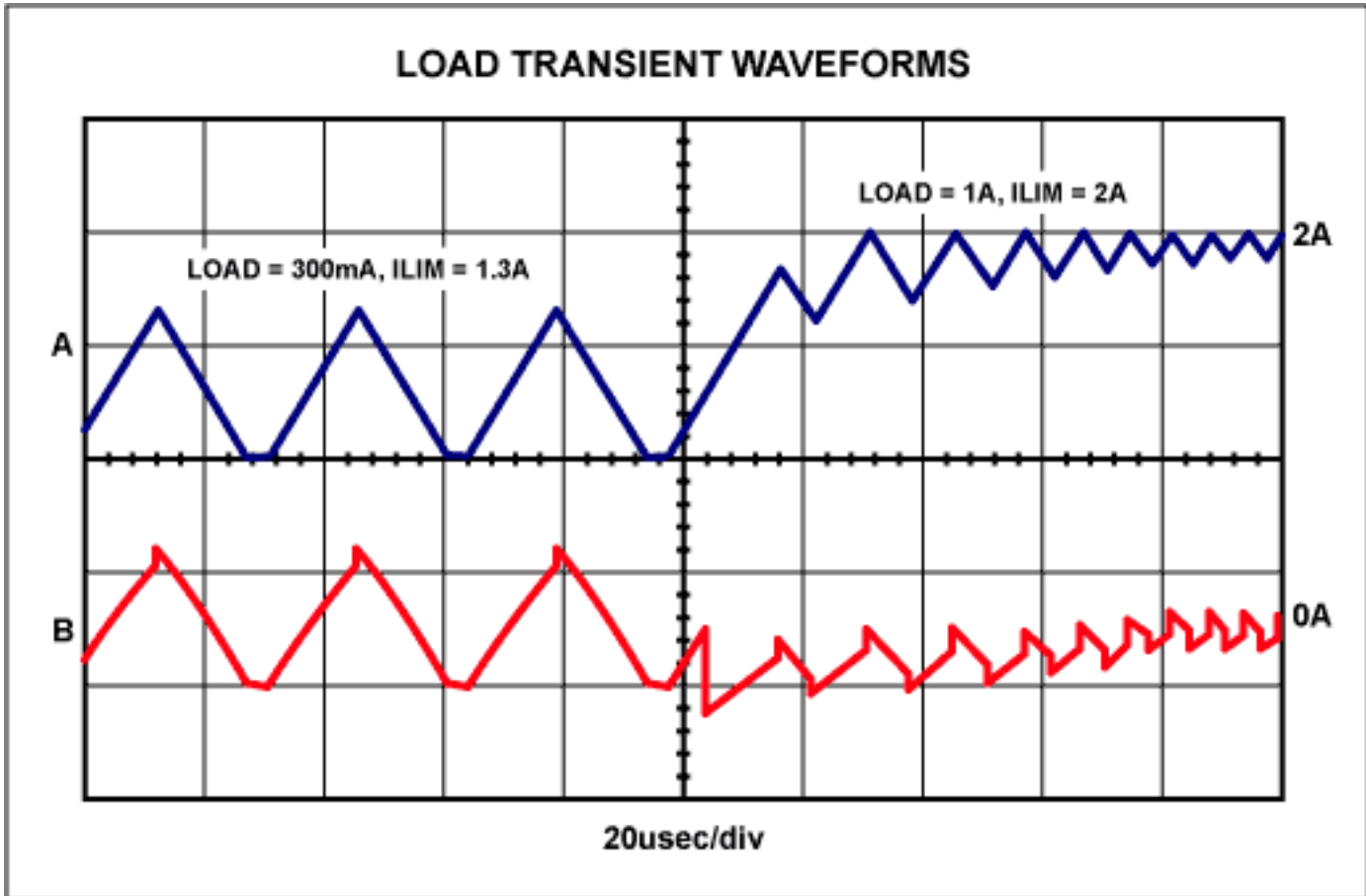


Figure 2. An abrupt change in load current (300mA to 1A) causes changes as shown in the inductor current (top trace, 1A/div) and  $V_{OUT}$  ripple (ac-coupled bottom trace, 100mV/div).

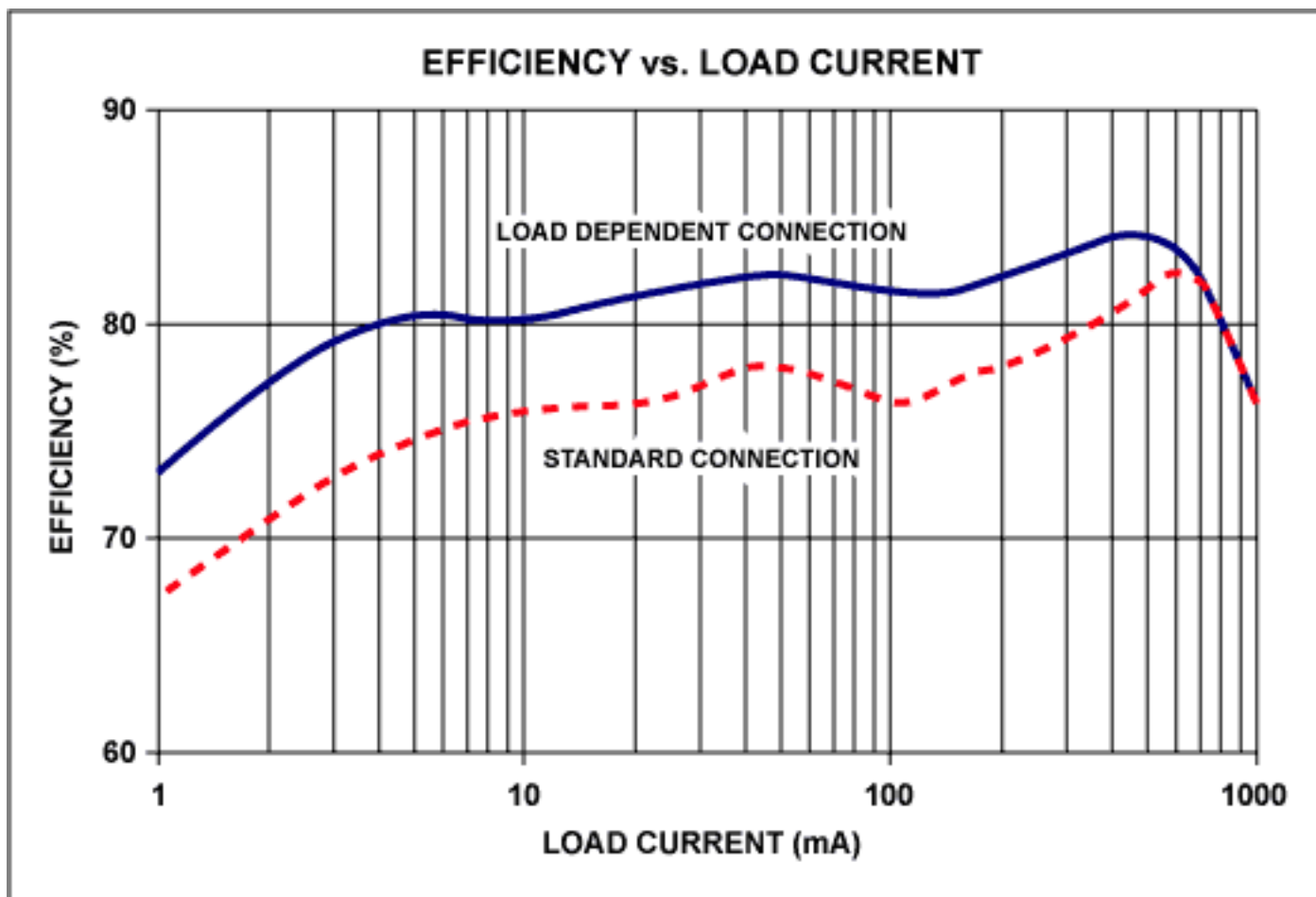


Figure 3. Efficiency for the Figure 1 circuit is 4-5% better than that of a standard connection.

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