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APPLICATION NOTE 1114

High-Power Boost Converter Switches Modes Automatically and Maintains Light-Load Efficiency

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Abstract: In this design idea a synchronous boost converter, the MAX1703, uses a high-side current-sense monitor, the MAX4173, to shift automatically between high- and low-power modes. The boost converter maintains high efficiency for light loads and a wide range of load current.

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The high-power, synchronous boost converter MAX1703 has two operating modes: low-power PFM for low output currents (to 250mA), and full-power low-noise PWM for currents up to 1.5A. (PFM stands for pulsed-frequency modulation; PWM stands for pulse-width modulation.)

Normally, the IC's operating mode is set by digital control of its CLK/SEL input (high for high-power mode; low for low-power mode). For systems without this control capability, the **Figure 1** circuit provides a simple and inexpensive method for switching automatically between the low- and high-power modes of operation. As a result, it maintains relatively high efficiency for all load currents (**Figure 2**).

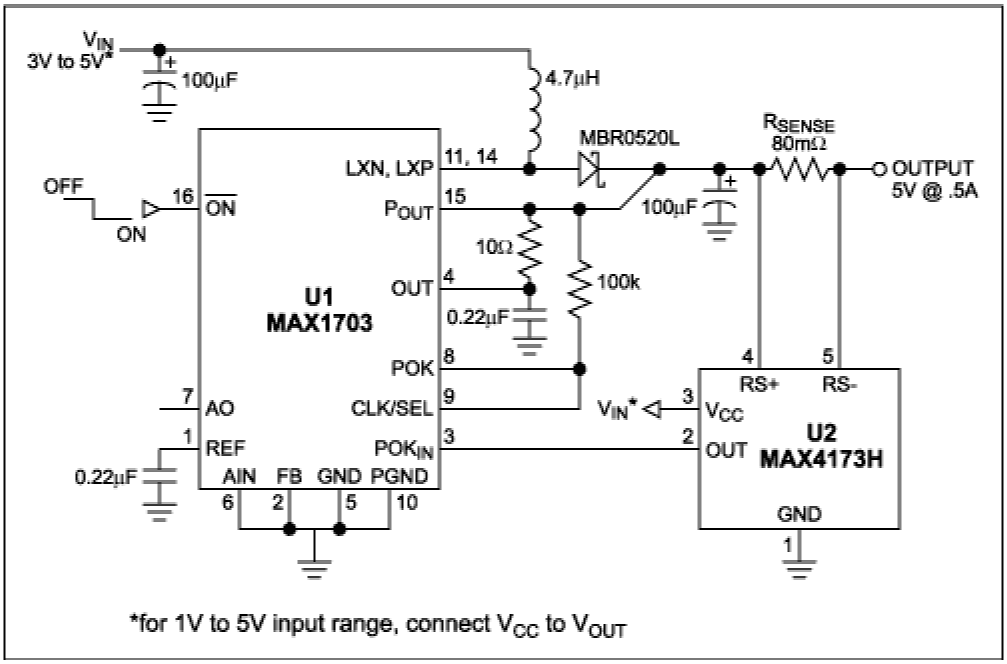

Figure 1. Using a high-side current monitor (U2) to generate a proportional feedback voltage, this synchronous boost converter (U1) shifts automatically between its high-power and low-power modes of operation.

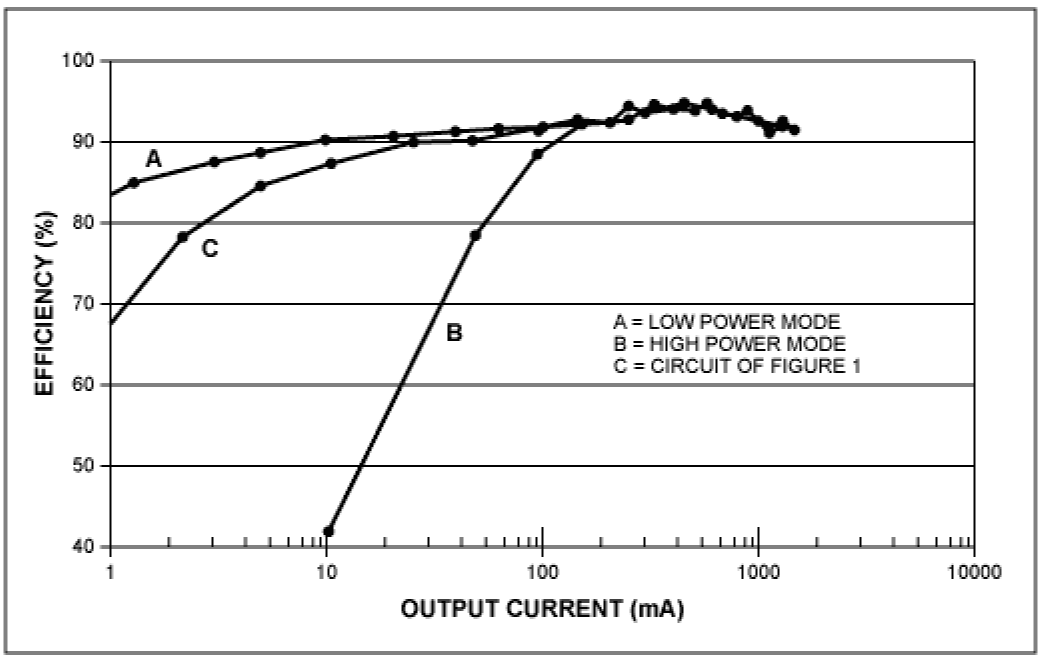

Figure 2. The Figure 1 circuit's conversion efficiency (C) remains high for a wide range of load current.

U2 is a high-side current-sense monitor whose OUT terminal produces a voltage proportional to the converter's load current (sensed by the 80mΩ resistor R_{SENSE}). Applying this voltage to U1's POKIN terminal completes a feedback loop for controlling its operating mode. POKIN is the inverting input of the "power OK" comparator. Its open-drain output sinks current whenever the POKIN voltage falls below the comparator's reference voltage (1.25V).

Because U1's low-power and high-power efficiencies converge for an output current near 150mA, you should choose component values that cause the mode switchover to occur near 150mA. First, calculate the required sense resistor: $R_{SENSE} = V_{REF}/(GAIN \times I_{SWITCH})$, where V_{REF} is U1's internal reference voltage (1.25V), GAIN is U2's internal gain level (user-selectable as 20V/V, 50V/V, or 100V/V), and I_{SWITCH} is the load current at which mode switchover occurs.

Because U1 can deliver high output currents, GAIN is set at 100V/V to minimize the sense-resistor value and its IR loss. To switch modes at 150mA, R_{SENSE} is calculated at 80mΩ. Measurements indicate that switchovers occur at 158.6mA for increasing currents and at 157.0mA for decreasing currents. The POK comparator's 1% hysteresis prevents "chattering" between modes when the load current is passing slowly through the switchover threshold.

U2 is powered directly from the input to improve the circuit's light-load efficiency. U1 can operate with input voltages below 1V, but U2 requires a minimum V_{CC} of 3V. To allow operation over U1's full input range (with a slight penalty in light-load efficiency), simply power U2 from U1's output voltage.

Related Parts		
MAX1703	1-Cell to 3-Cell, High Power (1.5A), Low-Noise, Step-Up DC-DC Converter	Free Samples
MAX4173	Low-Cost, SOT23, Voltage-Output, High-Side Current-Sense Amplifier	Free Samples

More Information
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