Keywords: switch-mode DC-DC controller, step-down DC-DC controller, temperature monitor

APPLICATION NOTE 260

Miniature Temperature Monitors Drive 3-Speed Fan Controller

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Abstract: This design note shows how a switch-mode DC-DC controller and two low-cost temperature monitors produce a three-speed fan controller. The circuit controls a fan, and lowers noise and power consumption. The MAX1626 DC-DC controller is featured.

A similar idea appeared in the February 22, 1999 issue of *Electronic Design*.

Combining a switch-mode DC-DC controller with two low-cost temperature-monitor ICs produces a 3-speed fan controller (**Figure 1**). Useful in many applications, this circuit cuts noise and power consumption in computers, temperature controllers, and alarm systems.

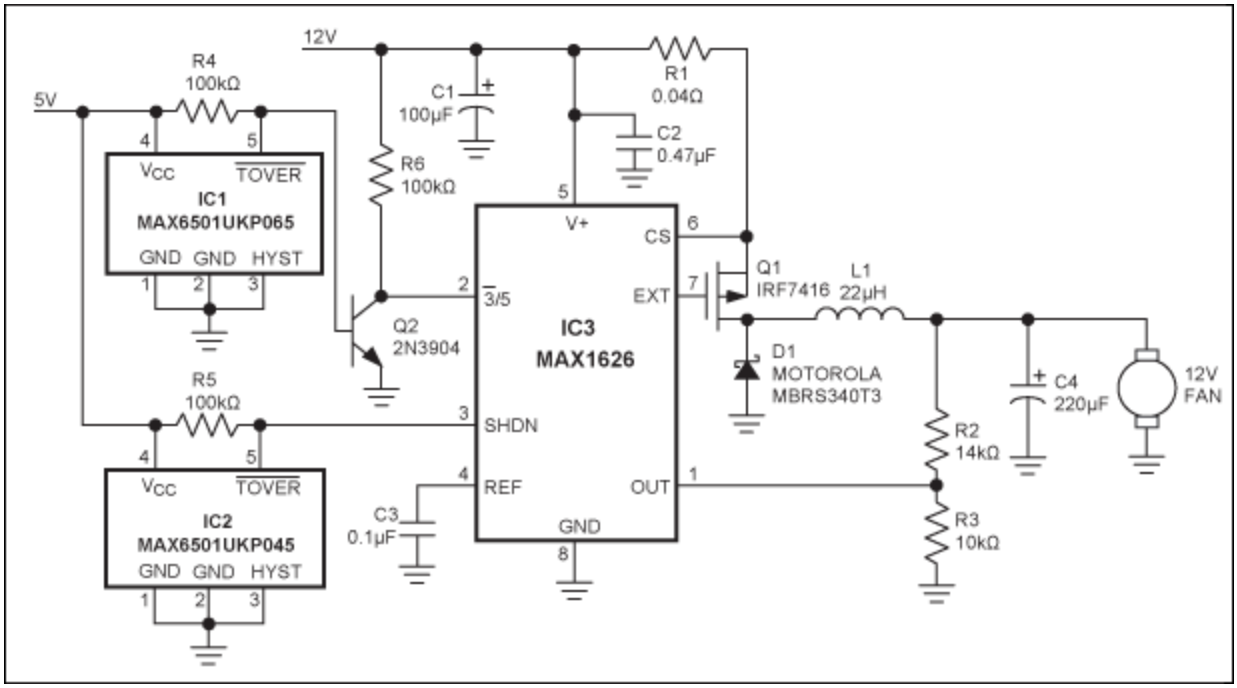

Figure 1. Controlled by the temperature monitors IC1 and IC2, this switch-mode DC-DC controller (IC3) applies either 0V, 8V, or 12V to the fan.

The idea is made possible by IC3's pin-selectable shutdown and output-voltage capabilities. The logic levels applied to those inputs (active-low 3/5 and SHDN), along with properly valued feedback resistors

(R2 and R3) set the output-voltage levels (available one at a time) at 0V, 8V, and 12V. In general, the lower voltage (V_{OUT1}, which equals 8V in this case) is determined by the R2/R3 divider, and the higher voltage (V_{OUT2}) (which equals 12V in this case) is determined by the product of V_{OUT1} and an internal ratio:

$V_{OUT1} = 3.3\ [(R2+R3)/R3]$

$V_{OUT2} = V_{OUT1}(5/3.3)$

The temperature monitors (IC1 and IC2) have open-drain outputs (active-low TOVER) that are pulled low when the ambient temperature exceeds a factory-programmed internal threshold. The monitors come in tiny SOT23-5 packages, with dedicated thresholds in the +35°C to +115°C range. When the temperature exceeds the threshold of IC2 (+45°C in this example), that device turns on IC3 by pulling its SHDN terminal low. IC3's active-low 3/5 input remains low, producing 3.3V at OUT (and 8V at the fan), until the temperature rises to +65°C. At that time, the IC1 output pulls low, turning off Q2 and allowing R6 to pull the active-low 3/5 input high, which applies 12V to the fan. Q2 is necessary for signal inversion and for meeting the active-low 3/5 input's logic-high threshold (V+ - 0.5V).

IC3's ability to produce 100% duty cycles enables a very low dropout voltage for this application—about 150mV at 1A load. The conversion efficiency is independent of output voltage but varies with output current, ranging from 85% and 96% for currents between 10mA and 1A. The average efficiency is 90%. At low temperatures for which a fan is not required (below +45°C), the switching regulator shuts down and lowers the supply current in this circuit to about 100µA.

Related Parts		
MAX1626	5V/3.3V or Adjustable, 100% Duty Cycle, High-Efficiency, Step-Down DC-DC Controllers	Free Samples

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