Circuit protects system from overheating

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The two-chip circuit in Figure 1 provides fan control and overtemperature warning and shutdown signals to protect systems from excessive heat. The circuit monitors the temperature of the pc board and the die temperature of a CPU, an FPGA, or another IC with an on-chip temperature-sensing transistor. IC₁ is a temperature detector and fan driver for cooling fans with nominal operation of 250 mA. At low temperatures, the cooling fan is off, minimizing noise and fan wear. When the system temperature increases to more than 45°C, IC₁’s factory-programmed temperature comparator causes the FAN OUT fan-drive pin to go active, pulling the fan’s lower power-supply terminal to ground, thus providing low-side drive to the fan. The fan can accommodate supply voltages as high as 24V. After the fan activates, the system temperature normally either continues to rise at a slower rate or drops somewhat. If the temperature drops far enough, the fan turns off. To avoid causing the fan to continuously turn on and off, IC₁ provides hysteresis of 1, 4, or 8°C, which you can set by the HYST pin.

If a thermal problem, such as excessive power dissipation or blocked ventilation paths, exists, system temperature may continue to increase. IC₁ has two outputs that detect this condition. WARN becomes active when the temperature exceeds 60°C, and the OT output becomes active when the temperature exceeds 75°C. You can use OT as a system-shutdown signal. While IC₁ monitors board temperature, IC₂ monitors the die temperature of another chip—typically, a CPU, an FPGA, or an ASIC. The target IC must have a small-signal p-n junction, usually a substrate pnp, for temperature measurement. IC₂ forces current through sense junction, measures the resulting voltage, and calculates the temperature of the junction. IC₂ then compares this temperature with a preset threshold. When the junction temperature exceeds the threshold, 125°C in this case, IC₂’s output pin goes active; you can use it to shut down the system.

The open-drain shutdown outputs of IC₁ and IC₂ connect to a common pullup resistor and to the power supply's shutdown terminal. If either the board temperature or the chip temperature exceeds the maximum safe rating, the system shuts down before damage can occur. IC₁ should be in a location that allows it to measure the temperature of interest. Depending on the system, this location could be near a "hot spot" or in the cooling fan's airflow path. The traces between IC₂ and the remote-sensing junction should be reasonably short and separated from high-speed data traces.