# Use a transistor as a heater

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It is common to use transistors for driving resistive heating elements. However, you can use the heat that a power transistor dissipates to advantage in several situations, eliminating the need for a separate heating element because most transistors can safely operate at temperatures as high as 100°C. A typical example is in a biological laboratory, in which the need for maintaining the temperature of samples in microliter-sized cuvettes is a common requirement. The space/geometry constraint and the less-than-100°C upper-temperature limit are the basic factors of the idea.

You can use an N-channel IRF540 MOSFET to directly heat and control the temperature of a biological sample from ambient to 45°C. **Figure 1** shows a simple on/off-type control circuit in which an LM35, $IC_1$, is the temperature sensor, whose output a DPM (digital panel meter) can display. $IC_2$ compares the voltage that $VR_1$ sets with the output of the LM35 to turn on $Q_2$ accordingly, with the positive feedback through $R_9$ providing a small amount of hysteresis. $S_1$ switches the DPM between a set value and the actual temperature readout. You derive the reference voltage from a TL431 shunt regulator (not shown). The LED lights up when $Q_2$ is on.

$IC_1$ and $Q_2$ thermally mount on the metal block that forms the sample holder; use thermal grease on both components for maximum heat transfer. Note that the mounting tab of the TO-220 package electrically connects to the drain, and you may need to insulate it from the cuvette with a thermal pad. Setting bias control $VR_3$ for a $Q_2$ current of 270 mA is sufficient to hold the cuvette at 45°C.

Be sure to set $VR_3$ to minimum power during initial power-up; if you set it for maximum power, you could apply 24V to $Q_2$'s gate-to-source voltage, which is rated for a maximum of only 20V. You can extend the temperature range by changing the voltage divider comprising $R_1$, $R_2$, and $VR_1$. The design includes a safety cutoff circuit (not shown) in case the temperature gets too high.

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Various other options are also possible applications for this circuit. These applications include linear control, pulse-width modulation, and the use of a PID (proportional-integral-derivative) controller, to name a few. EDN

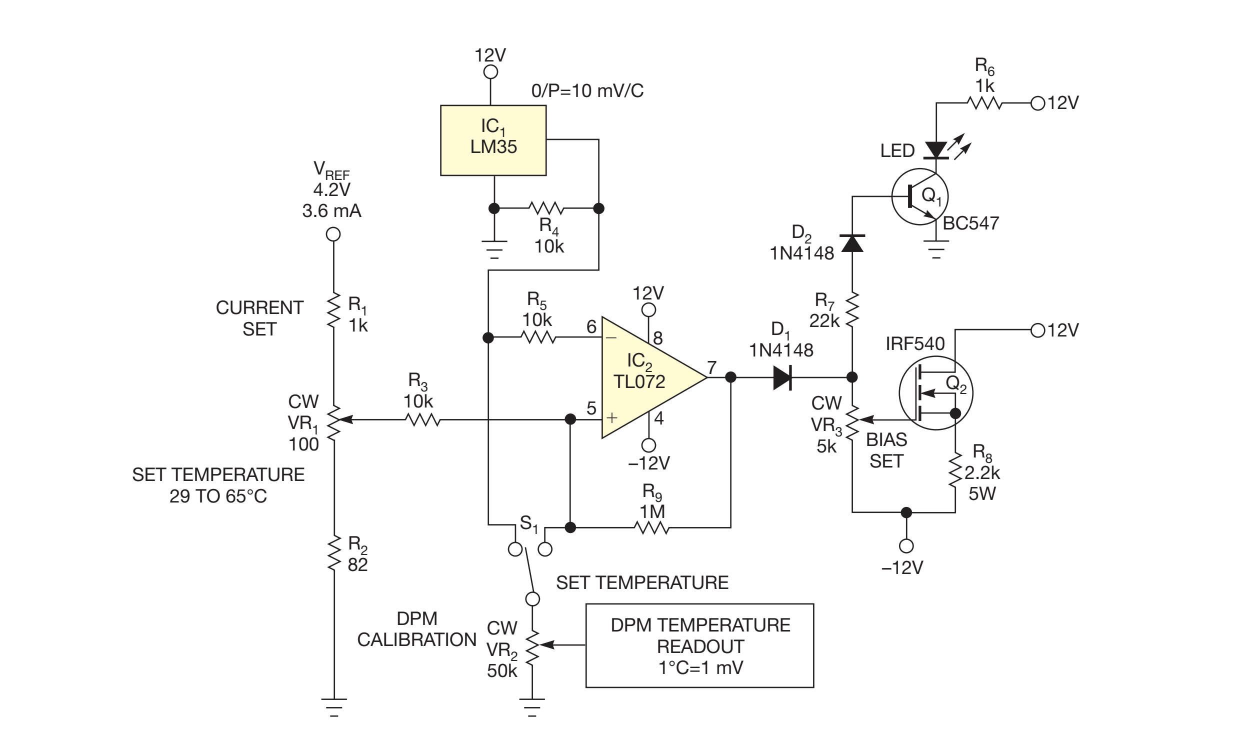


Figure 1 $IC_1$ senses the temperature of the item that $Q_2$ heats, and the temperature remains at the level that $VR_1$ sets.