

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, IC₁, is the temperature sensor, whose output a DPM

(digital panel meter) can display. IC₂ compares the voltage that VR₁ sets with the output of the LM35 to turn on Q₂ accordingly, with the positive feedback through R₉ providing a small amount of hysteresis. S₁ 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 Q₂ is on.

IC₁ and Q₂ 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 VR₃ for a Q₂ current of 270 mA is sufficient to hold the cuvette at 45°C.

Be sure to set VR₃ to minimum power during initial power-up; if you

set it for maximum power, you could apply 24V to Q₂'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 R₁, R₂, and VR₁. 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**

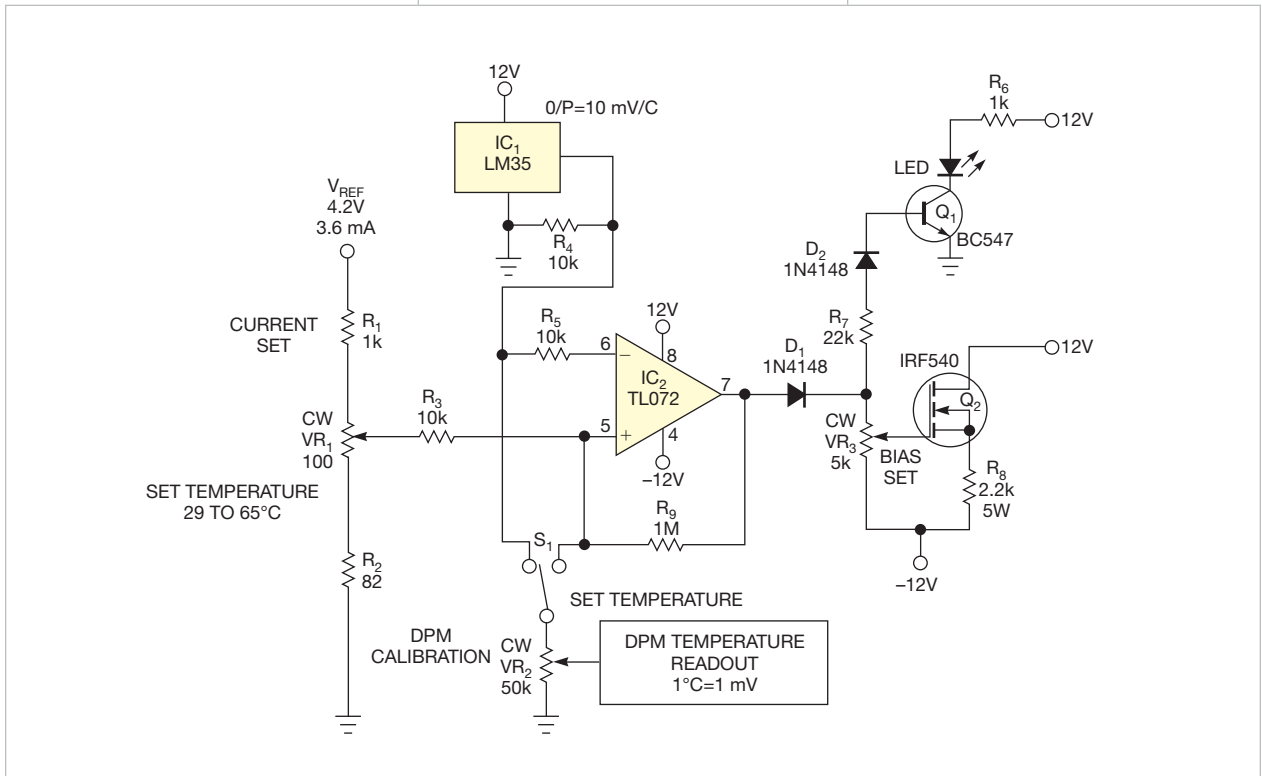


Figure 1 IC₁ senses the temperature of the item that Q₂ heats, and the temperature remains at the level that VR₁ sets.