

## Protected regulator has lowest dropout voltage

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Providing an output of 5 volts at 10 milliamperes for an input of only 5.012 v, this regulator is ideal for use in many micropower applications, such as regulating the output of lithium batteries that drive low-power detection and recording instruments in the field. The circuit is useful in high-current situations also, as it can deliver up to 1 ampere at 5 v for an input of only 6.0 v. Short-circuit protection in this instance is provided by a single V-groove MOS field-effect transistor.

Contributing to the low-dropout characteristic of the circuit is the 2N6726 output transistor, which has a large junction area that allows a lower emitter-to-collector drop than most other devices, including Darling-ton arrangements. Thus the input-to-output voltage differential, 12 millivolts, is 6% that of one of the best low-dropout regulators reported to date.<sup>1</sup>

The input-to-output differential is only 350 mv at a load current of 500 mA. The 2N6726 is physically a

small transistor but can dissipate 1 watt safely without a heat sink.

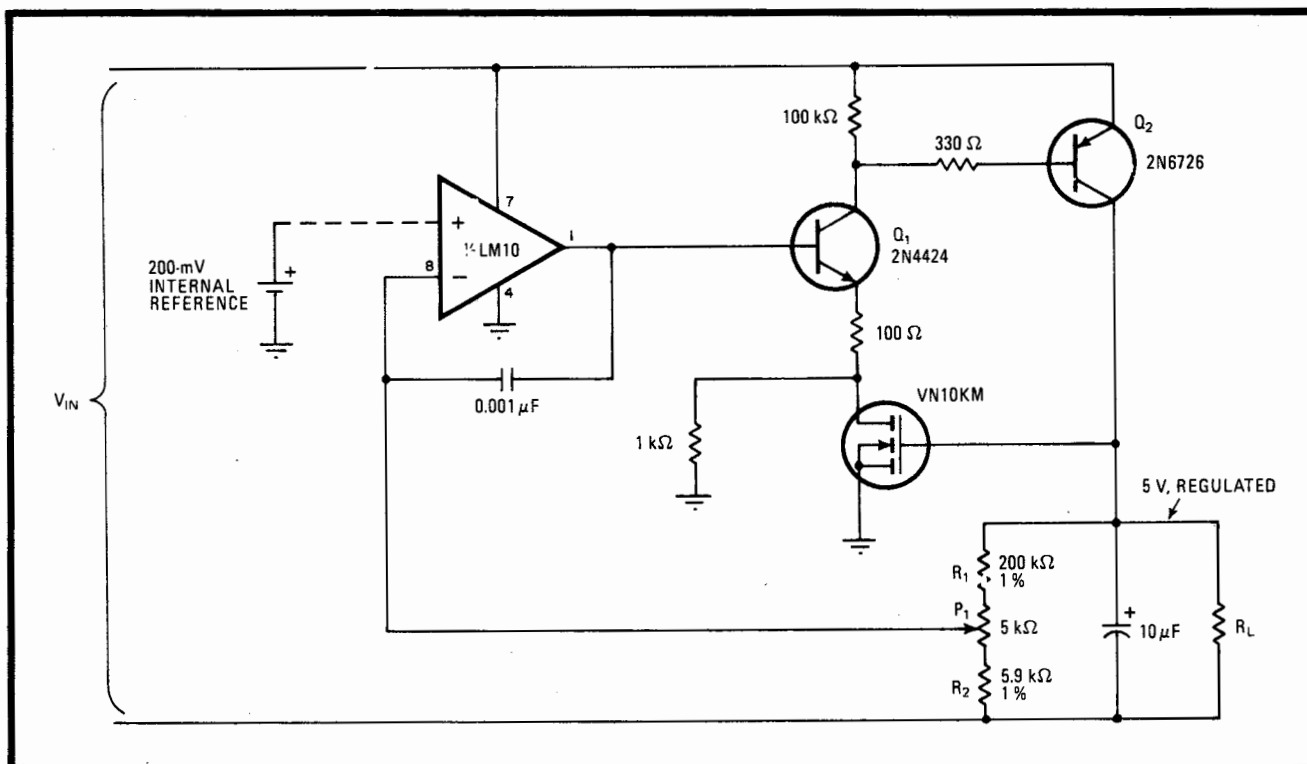
Short-circuit protection is provided by a Siliconix VN10KM, which presents a resistance of less than 10 ohms to the emitter circuit of the 2N4424 drive transistor under normal conditions. However, when the output is shorted to ground or excessive current is demanded, the drain-to-source resistance of the FET rises, safely shutting down the pass transistor. This characteristic can be used to advantage in adjustable current limiters, where the trip point is set by the input voltage. This method, incidentally, is more effective than any transistor foldback technique.

In operation, the LM10CH reference amplifier compares the voltage set by potentiometer P<sub>1</sub> to its internal 200-mV reference and through Q<sub>1</sub> acts to minimize voltage differences at the amplifier's input. With suitable selection of the component values in divider network R<sub>1</sub>-R<sub>2</sub>, the circuit will regulate over any voltage from 1 to 40 v. The operational-amplifier half of the LM10CH is available for other uses.

The load regulation is to within 0.3% for the range 0 to 100 mA and to within 1% for the range 100 mA to 1 A. The regulator's idle current is 320  $\mu$ A. □

### References

1. Kelvin Shih, "Micropower regulator has low dropout voltage," *Electronics*, April 12, 1979, p. 130.



**Dropout limit.** This low-power regulator, using output transistor operating in common-emitter configuration and having large junction area, can deliver 10 mA at 5 V for an input voltage only 12 mV higher and up to 1 A at 5 V for a 6-V input. Input-to-output voltage differential is only 650 mV at load currents of 750 mA. The V-MOS field-effect transistor provides short-circuit protection in such instances.