One-chip power amplifier controls dc motor's speed

by Kuang-Lu Lee and Dennis Monticelli
National Semiconductor Corp., Santa Clara, Calif.

Circuits for regulating the speed of small dc motors need not be expensive or complicated now that one-chip power operational amplifiers are available. In fact, using the power device (such as the LM13080) in a simple negative-feedback configuration provides better regulation than many speed controllers now on the market. In addition, common-mode rejection of power-supply transients is large.

As shown in (a), the circuit's reference voltage is established by D_2 and R_3 and filtered by R_5 and C_1. D_1 simply serves as a common-mode level shifter for the inputs of the op amp. Negative feedback around the op amp provides the contolled-voltage drive to the motor. Thus:

$$V_{motor} = (V_{D2} + I_m R_3)(R_2/R_1) + V_{D2}$$

where V_{D2} is the forward voltage drop of diode D_2 and I_m is the current through the motor.

As the motor load increases, I_m increases, and this results in a corresponding increase in V_{motor}. To accommodate large changes in load, V_{motor} varies considerably. The amp therefore needs a 10-volt source voltage to provide sufficient swing, current, and power dissipation for most small motors. Powered by such a source, the LM13080 will handle up to 2 watts in free air and can deliver 0.5 ampere.

The optimum settings for potentiometers P_1 and R_3 are those that provide stable regulation. They are found empirically with the actual motor to be used. P_1 is first adjusted experimentally so that the motor will provide slightly fewer than the desired number of revolutions per minute. R_3 is then increased until a minimal loss in speed is observed for a substantial increase in motor load. Note that excessive positive feedback via R_3 will cause instability. Because the adjustments of P_1 and R_3 interact, it will be necessary to readjust both until the best settings are obtained.

The circuit's performance for a small motor is shown in (b). Note its superior performance with respect to a popular configuration that drives the motor from a constant-voltage source. □

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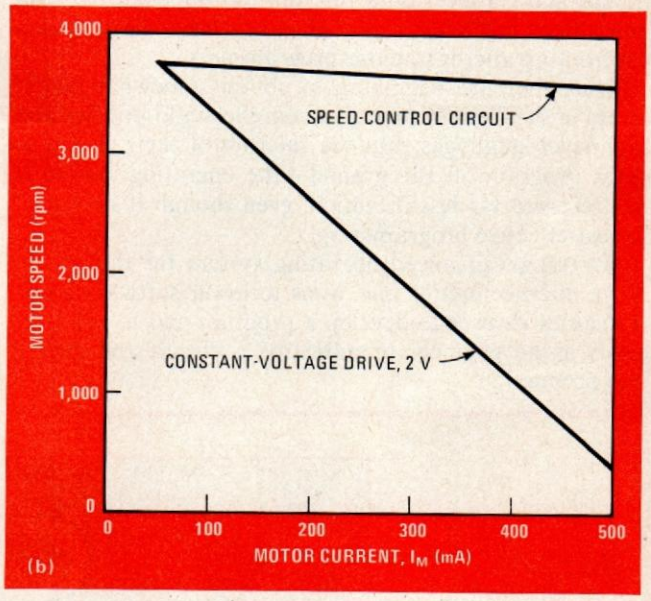

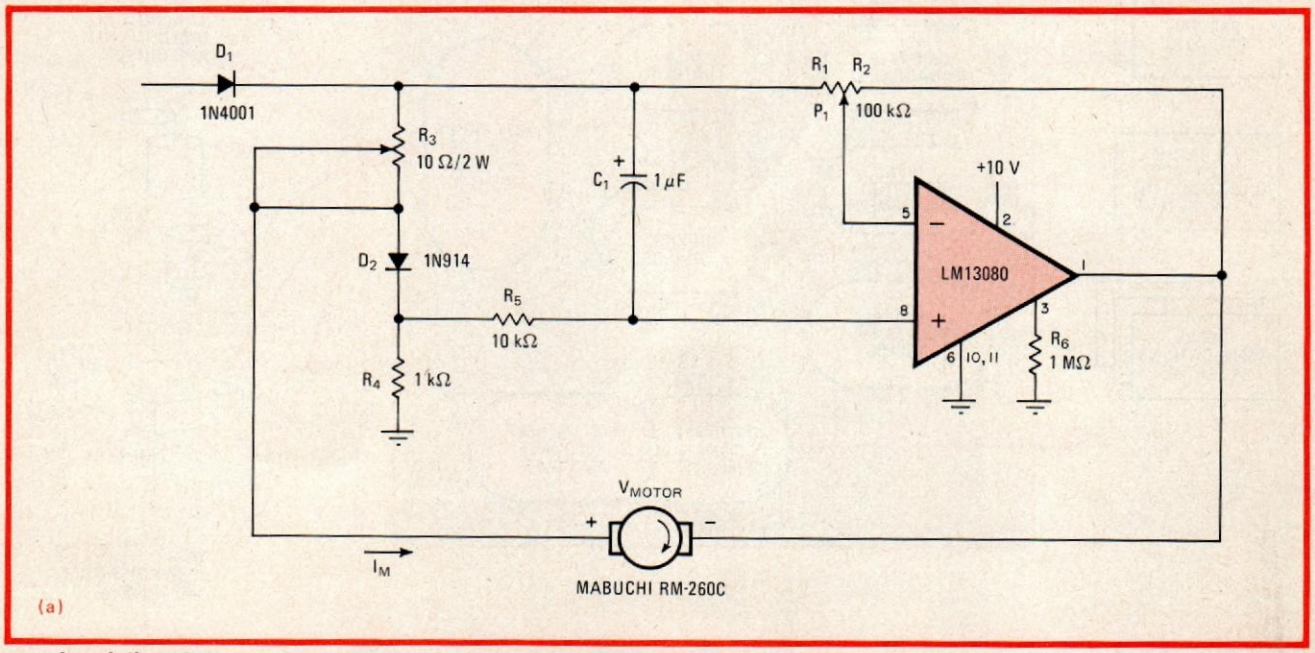

Speedy solution. One-chip power op-amp circuit (a) makes simple, low-cost speed control for small dc motors. Circuit affords excellent common-mode rejection. Controller's rpm-vs-load performance (b) is superior to that of circuits utilizing a constant-voltage drive.