

One-chip tachometer simplifies motor controller

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Setting and stabilizing the angular velocity of a dc motor by means of a charge pump and a servoamplifier, one-chip tachometers such as National Semiconductor's LM2917 serve well as a simple but elegant motor-speed controller. Such an arrangement is preferable to the widely used scheme in which both positive and negative feedback is utilized to keep the motor's back electromotive force, and thus its speed, constant by generating a voltage that is proportional to a given load.

As shown in the figure, a magnetic pickup coil detects the angular velocity of a motor-driven flywheel and feeds the low-amplitude pulses, whose frequency is proportional to the motor speed, to the LM2917's charge pump. As a result, the pump generates a current, I_1 , whose average value is directly proportional to the input frequency.

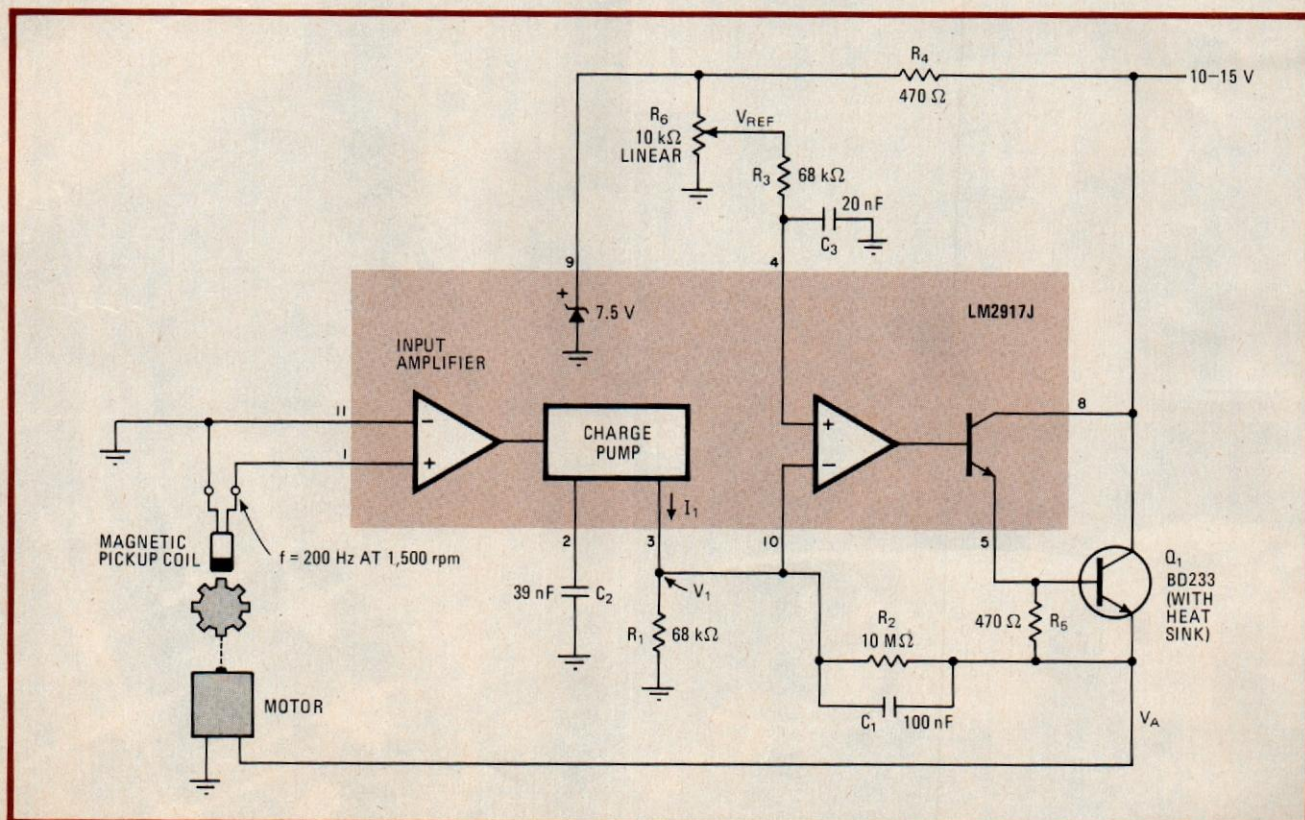
The operational amplifier that follows compares this voltage to a user-set reference and, through power trans-

istor Q_1 , generates a voltage for the motor's armature of $V_A = (R_2/R_1)(V_{ref} - I_1 R_1)$. Thus, potentiometer R_6 sets the motor's speed, for when $V_1 > V_{ref}$, voltage V_A decreases, and vice versa.

In this application, the gain of the operational amplifier, determined by resistors R_1 and R_2 , has been set at approximately 150. The greater the gain, the lower the variation of motor speed with changes in load resistance. However, the setting of very high gains should be avoided, because there will be a reduction in the gain and phase margins—that is to say, a loss of stability in the feedback control loop.

As for the selection of other components to meet any particular application, note that capacitor C_1 serves a double purpose: it integrates pulsed current I_1 , thereby performing a smoothing function, and it sets a low-frequency pole for the amplifier, thereby ensuring stability. C_2 sets the conversion factor of the tachometer and should be increased for low-speed motors. R_3 minimizes the offset due to the amplifier's bias currents at pins 4 and 10. Finally, C_3 functions as a noise filter.

As seen, the LM2917's tachometer conversion factor will be almost independent of its supply voltage, as a consequence of the zener diode connected at the device's supply port. The supply voltage should not fall outside the range of 10 to 15 volts, however. □



Setting speed. LM2917J tachometer, which is basically a frequency-to-voltage converter, sets and stabilizes motor speed. Few RC components are required, thereby simplifying circuitry. Power transistor Q_1 is the only external active element needed.