Two-channel audio amplifier drives stepper motor

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Although relatively expensive, monofilar-wound, bipolar stepper motors provide strong torque for a given physical size. However, each of the motor's two windings requires eight driving transistors connected in groups of four in an H-bridge configuration. Each transistor must withstand and quickly recover from overloads and short-circuit conditions, and a driver must consequently include complex and large discrete-component protective circuitry.

As an alternative, Figure 1 shows a motor-driver circuit based on Maxim's MAX 9715, a tiny, surface-mount, 2.8W Class D audio amplifier, which typically drives 4 or 8Ω speakers. Each of IC1's two outputs consists of a MOSFET H-bridge that drives a pair of output lines, OUTR+ and OUTR– and OUTL+ and OUTL–, that connect to the stepper motor's A and B windings, respectively. Each pair delivers a differential-pulse-width-modulated signal with a nominal switching frequency of 1.22 MHz. The circuit's low-interference design eliminates the requirement for output-line filters.

Capacitors C1, C3, C4, and C6 provide bypassing for IC1's power input and bias pins, and C5 and C7 provide bulk-holdup capacitance for the Class D power amplifiers' outputs. Capacitors C8 and C9 limit the amplifiers' input bandwidth to 16 Hz, and L2 and L3 suppress electrical-noise pickup by the long input cables. Comprising C11, C12, and ferrite bead L1, a pi-section noise filter suppresses noise on IC1's power-supply input. A suitable controller feeds digital pulses to IC1's A_Step and B_Step inputs, which respectively drive the motor's right and left channels. Internal short-circuit and thermal protection guards the amplifier against overcurrent and short circuits caused by the stepper motor or its connecting leads.

Table 1 illustrates the A_Step and B_Step pulse sequence that rotates a typical stepper motor in one direction by continuous application of steps 0 through 4. Step 4 returns the motor's shaft to its starting position and completes its 360° rotation. To reverse the motor, begin at the bottom of the table to reverse the pulse pattern and work upward. You can disable both of the amplifier's channels by applying a logic-low signal to Pin 8, IC1’s active-low SHDN input. Figure 2 illustrates the circuit's input and output waveforms.