BUILD THE
DOOR MINDER

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Do you have a frequently used door in your home or business that needs to be closed when not in use? If so, then maybe you need the Door Minder described in this article. The Door Minder is a device that uses a magnetic reed switch to determine if the monitored door is open or closed. The unit has a built-in delay period that keeps it silent for up to about 24 seconds after the door has been opened to allow normal use of the monitored door. But if the door is not closed within the 24-second period, the alert tone sounds until the door is closed. The alert signal emitted by the Door Minder sounds like an electronic chime, and is struck once per second. That sound was chosen because it is too annoying to ignore, but not harsh enough to startle anyone. The prototype was assembled on a small section of perfboard using point to point wiring and was installed in a small speaker enclosure that was originally used with a personal stereo. The speaker in the enclosure was used as the project's speaker.

How It Works. A schematic diagram of the Door Minder is shown in Fig. 1. While the circuit may look complicated at first glance, a closer inspection reveals that it is actually comprised of several smaller circuits. Integrated circuit U1-a along with R1 and C1 form a simple delay timer. When C1 is discharged through the closing of door switch S1, the output at pin 7 goes high. That turns on transistor Q1 and prevents transistor Q2 from receiving any base drive. But, as soon as S1 is opened, C1 begins to charge through R1. When the voltage on C1 exceeds the reference voltage at pin 3 of U1-a (approximately 4 volts as established by R4 and R5), the output at pin 1 goes low, turning off Q1, which now allows Q2 to be activated by the striker signal. Since the reference voltage is roughly half of the supply voltage, the formula for determining the delay time is:

\[
\frac{R_1 \times C_1}{2} = \text{time}
\]

where R1 is resistance in ohms and C1 is capacitance in farads. For example: 470,000 \times 0.00001 = 47/2 = 23.5 seconds.

The "striker" oscillator, which is built around U1-b and configured as an astable multivibrator, outputs a narrow positive-going pulse once a second. Resistor R3 provides just enough gain for the op-amp to oscillate. The reference voltage at pin 5 of U1-b is also set to approximately 4 volts through R4 and R5. Capacitor C2 is tied directly to the inverting input of U1-b and to that IC's output through R2 and D1. When the voltage on C2 is below the reference voltage at pin 5, pin 7 is forced high and immediately charges C2 through D1. Since the voltage on C2 is now higher than the reference voltage, pin 7 switches low and begins discharging C2 through resistor R2. As soon as the voltage on C2 dips below the reference voltage, the cycle repeats.

Op-amp U1-c is configured as a voltage follower. It simply prevents C3 and other associated components from affecting the operation of the striker oscillator. Capacitor C3 changes the narrow positive-going pulse generated by the striker oscillator into somewhat of a spike pulse to imitate the abrupt striking of a real chime.

When transistor Q2 is turned on, its collector is pulled low, thereby pulling the base of Q3 low through resistor R7. That activates Q3 and causes it to output almost 8 volts on its collector lead. Resistor R6 is included in the circuit to ensure that Q3 turns off when Q2 does. The voltage output from the collector of Q3 is fed to C4 and R8. Their values determine the decay rate of the chime, which as configured is 0.47 second. Resistor R9 is used to buffer the voltage and limits the current to Q4.

Op-amp U1-d is configured as a phase-shift oscillator, which produces a sinewave-output signal of approximately 1200 hertz, but only when Q4 is on. To make the audio tone as stable as possible, a second voltage divider—comprised of R13, R14, and filtered by C8—was added to help isolate the audio-tone oscillator from possible voltage fluctuations created by the striker oscillator. The audio-tone output at pin 14 of U1-d is capacitively coupled to an LM386 audio amplifier (U2), which is configured for a voltage gain of 20.

With the exception of U2—which is powered directly from an unregulated 12-volt source—the entire circuit is powered from a well regulated 8-volt supply built around an LM78L08 (100 mA) or LM7805 (1-amp) 8-volt regulator. Pinouts for those two devices are shown in Fig. 2.

If an 8-volt regulator is unavailable, a 5-volt unit, such as the LM7805 or LM7805 5-volt regulators may be