Simple circuit triggers electronic system to close garage door after selected time period.

AN AUTOMATIC GARAGE-DOOR CLOSER

HE STANDARD electrically powered radio-controlled carage-door opener has a drawback. It can be falsely triggered by a CB or amateur radio transmitter or other actuating signal, or the user can forget to send a signal command to close the coor. In either case, an open garage door could invite thieves to remove valuable equipment—bicycles, lawn mowers, etc. The "Auto Closer" described here overcomes this probem. It automatically commands the system to close the door after a preselected time interval, providing improved security and convenience The automatic function can be disabled by the user, too, in the event that it is desirable to keep the garage door open.

About the Circuit. The Auto Closer is shown schematically in Fig. 1. Switch S1 is the door-position sense switch; it remains open as long as the garage door is closed. The open switch prevents the Auto Closer circuit from drawing current from the power supply and keeps it isolated from the rest of the door opener circuit. When the sense switch closes as the door opens, 24 volts ac from the main opener power supply is applied to the Auto Closer, Diode D5 rectifies the ac into pulsating dc which is filtered by C1 and R3. Zener diode D1 provides +15 volts regulated for IC1, a CMOS 4020 14-stage binary counter.

When power is first applied to the Auto Closer, R1 and C2 momentarily keep pin 11 of IC1 high, ensuring that the counter is reset as the timing cycle begins. A 60-Hz signal from the opener power supply is coupled by R2 to the counter's clock input This clocking signal is peak limited by diodes D2 and D3, thereby protecting the counter IC from

excessive input levels. The outputs of the tweifth, thirteenth and fourteenth counter stages are available at pins 1, 2, and 3, respectively. When the counter is clocked by a 60-Hiz signal, the periods of the square waves at these three outputs are 68 seconds (pin 1), 136 seconds (pin 2) and 272 seconds (pin 3). Each output is high for one-half of its square-wave period.

The time interval that the Auto Closer will hold the door open before automatically closing it is selected by connecting R4 to one of the output pins of IC1. If, for example, R4 is connected to pin 1, no base current will flow into Q1 for 34 seconds and the garage door will remain open. At the end of that time, pin 1 will go high and source base current for Q1 through: R4. When Q1 begins to conduct, the coil of reed relay K1 becomes energized.

This causes the contacts of K1 to place diode D4 across the 24-volt ac line. The negative half-cycle of the ac control input is shorted out by the diode. This not only triggers the control circuit to close the door, but also allows the Auto Closer circuit to remain active until the door closes far enough to reopen sense switch S1. Capacitor C3 is connected across the coil of K1 to keep the relay from chattering and to protect Q1 from inductive transients. When S1 reopens, R5 discharges the Auto Closer capacitors and effectively resets the circuit after a few seconds to ready it for another cycle. Cutout switch S2 allows you to keep the garage doo; open for extended periods of time by effectively deactivating the Auto Closer.

Two other time periods are available.

If R4 is connected to pin 2, the garage door will be cicsed after 68 seconds



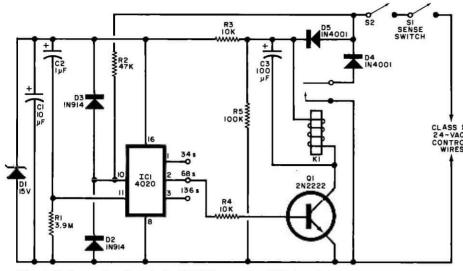


Fig. 1. Schematic of circuit. CMOS counter IC1 develops the delay interval from the 60-Hz line frequency.

PARTS LIST

C1-10-µF, 25-volt electrolytic

C2-1-µF, 25-volt electrolytic

C3-15-µF, 25-volt electrolytic

D1-15-volt, 400-mW zener diode

D2, D3-1N914 switching diode

D4, D5-IN4001 rectifier

IC1-CD4020 or MC14020 14-stage CMOS ripple counter

K1-12-volt reed relay (Arrow-M DA-1A or equivalent)

Q1-2N2222 npn silicon switching transistor The following are 1/4-watt, 10% tolerance carbon-composition fixed resistors:

R1-3.9 megohms

R2-47,000 ohms

R3, R4-10,000 ohms

R5-100 000 ohms

S1-SPST spring-loaded, normally open lever switch or other suitable door sense switch (see text)

S2-SPST toggle switch

Misc.-Printed circuit or perforated board, IC socket or Molex Soldercons, suitable enclosure, hookup wire, solder, machine hardware, etc.

Note-The following are available from William Vancura, 4115 35th Avenue, Moline, Illinois 61265: kit of parts, less enclosure and switches \$15 plus \$1 postage and handling; 12-V reed relay, \$5 plus \$1 P&H; etched and drilled pc board, \$4 with SASE.

have elapsed. Connecting the resistor to pin 3 results in a 136-second delay. The latter interval is enough time for one person to move two cars out of the garage and into the driveway. A delay of 68 seconds is enough time to open the trunk, place a package in it, close the trunk, enter the car, buckle up, start the car once or twice and coax the car into the driveway. A 34-second delay is ideal for an efficient individual who moves quickly but is a cautious driver. Any time delay less than 34 seconds increases the possibility of hitting the door.

The Door Opener. A typical garage door opener employs a "Class 2" wiring system. Basically, this means that the control system comprises a low-voltage supply (usually 24 volts ac derived from a step-down transformer), a control relay which applies power to the motor, and one or more activating switches, The low-voltage power supply cannot cause any serious accidental shocks and permits the use of relatively inexpensive bell wire in connections to the activating switches and relay. A typical system schematic is shown in Fig. 2.

DOOR OPENER/CLOSER MANUAL CLASS-2 WIRING RADIO CONTROLLED MOTOR CONTROL CIRCUITS AUTO-CLOSER

Several activating switches can be and usually are wired in parallel across the opener's control input terminals. The system schematic shows a manual pushbutton switch, a radio-controlled switch, and the Auto Closer so connected. Normally, the control circuit is designed to be able to supply power to several low-power switching devices via the Class 2 control wiring itself. This is how both the Auto Closer and radio-controlled switch's receiver are powered.

Construction. Wire-Wrap, point-topoint or printed-circuit techniques can be employed in the construction of the Auto Closer. Parts placement and lead dress are not critical. Although the printed circuit board (see Fig. 3) has been designed to accommodate a reed relay. a perf-board version of the project could use a standard low-power relay such as the Radio Shack No. 275-003.

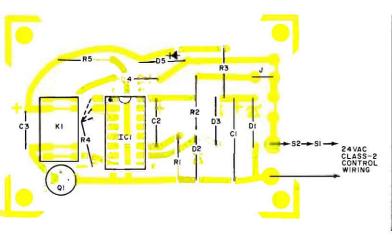
In any event, use an IC socket or Molex Soldercons with the CMOS counter. Do not insert the IC into its socket at this time. Select the delay period suitable for your application and connect the lead of R4 to the corresponding pin of the IC socket. Be sure to observe polarities and pin basing of semiconductors and electrolytic capacitors.

The Auto Closer should be housed in a metallic or plastic enclosure approximately 4" x 21/4" x 21/4" (10.2 x 5.7 x 5.7 cm). An on/off switch (S2) should be mounted on the enclosure if a remote power switch is not used. The mounting of the sense switch depends on how the door-open condition is to be sensed. One possibility is to install the switch in the Auto Closer enclosure and attach a lever arm to it. The arm can be extended to the door to sense the door-up position. Alternatively, you can replace the travel-limit switch of the motor control circuit with one that has an extra set of contacts. The normally open contacts can be used as sense switch S1.

If your garage door opener applies low voltage dc across the control lines instead of 24 volts ac, the Auto Closer circuit should be modified as follows. Replace Q1, C3, D4 and K1 with a 1ampere SCR. The anode of the SCR should be connected to the anode of D5 and the pole of S2. The cathode should be connected to pin 8 of IC1, the bottom leg of R5, etc. The gate should be connected to R4, whose value and that of R3 should be changed to 1000 ohms. Instead of connecting one end of R2 to the D5S2 node, apply 60-Hz CMOS-compatible square waves between it and pin

Fig. 2. Class 2 wiring of a typical garage door opener.

POPULAR ELECTRONICS



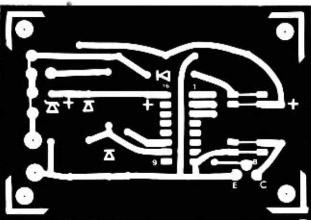


Fig. 3. Etching and drilling and parts placement guides for a suitable pc board.

8 of *IC1*. Zener diode *D1* can be eliminated if the dc control voltage is greater than (or equal to) 12 volts and less than 15 volts.

Checkout. After the Auto Closer has been assembled, but before the CMOS counter has been installed in its socket, temporarily connect one end of a convenient length (about 4 to 6 feet or 1.2 to 1.8 m) of hookup wire to pin 8 of the IC socket. Connect one end of a similar length of hookup wire to the anode of D5. Next, attach the two free ends to the Class 2 control wiring of the garage door opener and measure the ac voltage between the anode of D5 and pin 8 of the IC socket. You should obtain a reading of about 24 volts. Measure the dc voltage between pins 16 and 8 of the IC socket. It should be about + 15 volts. Finally, measure the voltage between pins 10 and 8. The meter should read about +15 volts in the dc mode and slightly more in the ac mode. If you have an oscilloscope, look at the signal waveform. You should see a sine wave clipped at 0 and 15 volts.

Momentarily clip a jumper between

pins 16 of the IC socket and that to which R4 is connected. The relay coil should become energized and the door opener activated. Removing and replacing the jumper should cause the door opener mechanism to reverse its direction. If the relay chatters while the jumper is connected, the door will jerk back and forth and the Auto Closer will not reliably close the door. This problem can be caused by a defective C3 or one with insufficient capacitance.

When the Auto Closer is working reliably, it is time to install IC1 in its socket. The normal precautions should be taken when handling this CMOS device. Disconnect the Auto Closer from the Class 2 wiring and place the circuit board on a 10" x 10" (25.4 x 25.4 cm) sheet of aluminum foil. Also, place the IC (still in its protective foam carrier) and both hands on the foil, which should be grounded. Keeping the heels of both hands on the foil, remove the IC from its protective carrier and insert it into the socket, paying close attention to pin locations. Then permanently install the circuit board in the project enclosure. Reconnect the Auto Closer to the Class 2 control wiring.

If all is well, the door (after having been opened) will begin to close only after the selected delay has elapsed. When the door begins to close, momentarily disconnect the Class 2 control wires from the Auto Closer so that the relay drops out. Each time the Auto Closer is disconnected, the counter will reset itself. Complete the wiring of the sense and power switches and verify the operation of both.

Installation. The Auto Closer is now ready for permanent installation. If a remote sense switch is used, the Auto Closer can be mounted in any convenient location. Just be sure that the control and sense switch wires are positioned so that they do not interfere with the proper operation of the door opener mechanism.

Two methods of mounting an Auto Closer equipped with a built-in lever sense switch are shown in Figs. 4A and 4B. The latter installation is less sensitive to minor variations in the stopping position of a door riding on tracks beside the sense switch lever. A slight bend at the tip of the lever arm prevents the door from snagging and damaging itself. The mounting method shown in Fig. 4B allows the project enclosure to be mounted easily on the door track using a 4" (10.2-cm) hose clamp. The ceiling mount (Fig. 4A) will work equally well with either a single-piece trackless door or a multi-section tracked door.

In Conclusion. You will surely find the Auto Closer to be a great convenience and an effective security device. Keep in mind, however, that you can very easily lock yourself out of the house should you forget your keys, the opener's pocket transmitter, or to disable the Auto Closer!

