Circuits drive single-coil latching relays

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A single-coil latching relay is a relay with memory, usually with a magnetic structure that provides two stable positions for the armature that holds the movable contacts. A permanent magnet provides the force holding the armature in these stable positions. An application of electrical current to the relay coil moves the armature from one position to the other, which in turn changes the contact positions.

Applying to the coil a current pulse in one direction, of longer duration than the specified minimum for that relay type, sets the relay to the first of two stable positions, and it remains in that position after the current ceases to circulate. Current in the opposite direction resets the relay to the other position, which is also stable with no current. The relay then indefinitely remains in that position until a new current pulse toggles it to the other position.

The electronic circuitry to drive one of these relays from logic signals can be a half-bridge if dual supply voltages are available or a full bridge—that is, an H-type power driver—if only a single supply voltage is available. The need to generate reversible-current pulses through the two-terminal coil imposes the use of these bridge topologies. Because the relay itself does not consume power under static conditions, the driving circuitry should also consume minimal power under the same conditions.

Figure 1 illustrates a variety of driving circuits, depending on the input-signal-logic levels, their coding, and the magnitude of the available supply voltages. The circuits in figure 1a through figure 1c drive relays for voltages of 4 to 15V. The circuit in Figure 1c requires two separate control lines: The set line sets the relay, and the reset line resets it. You can code the set and reset signals as positive (active high) or negative (active low). You must use the same logic convention for both inputs in this circuit.
Figure 1 These five relay-driver circuits accommodate a variety of control signals and supply-voltage levels. One operates from CMOS-logic levels (a), and another operates from TTL levels (b). Another circuit requires two control lines to set and reset the relay (c). Two other circuits have a supply-voltage range of 2.7 to 5.5V and a maximum quiescent current of only 50 nA (d and e).

The widths of the set and reset signals must be longer than the minimum time required for the relay to operate—typically, 3 to 5 msec. For proper operation, you should apply only one signal at a time; while applying one, the other should remain at the nonactive-logic value. Using positive logic, for example, the signal must go high for 3 to 5 msec, and the other input must remain low until the first signal pulse ends. The choice of IC determines the logic level: TTL (transistor-to-transistor logic) or power-supply-level CMOS (Figure 1c).

The circuits in figure 1a and figure 1b operate from a single on/off-signal line, generating a coil-current pulse with each transition of the input signal. The polarity of the coil-current pulse depends
on the polarity of the input-signal transition that generates it (figure 1a, figure 1b, and figure 1d).
The circuit in Figure 1a operates from CMOS-logic levels, and the one in Figure 1b operates from TTL levels. After each transition, the signal must remain stable for longer than the relay’s minimum operating time. The circuits in figure 1a and figure 1c typically draw quiescent currents of 40 µA, and the one in Figure 1b typically draws approximately 50 µA. The circuits in figure 1d and figure 1e are similar to those in figure 1a, figure 1b, and figure 1c, but their supply-voltage range is 2.7 to 5.5V, and their maximum quiescent current is only 50 nA.

Because the single-coil latching relay has a memory of its own, you must initialize its position after power-up to a known state, either by exercising the input logic or by analyzing and responding to a signal from the contacts’ circuitry. Any of these circuits can deliver as much as several hundred milliamps in either polarity while pulse-driving a relay coil. You can find technical information and data sheets for the ICs in these circuits at Maxim Integrated Products.

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