Logic circuit converts synchronous motor to stepper

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A simple circuit that is compatible with transistor-transistor-logic circuits can convert a two-coil synchronous motor to a synchronous stepping motor. Since circuits that perform this conversion are not available commercially, the designer is usually forced to use relays or come up with his own stepper control circuit.

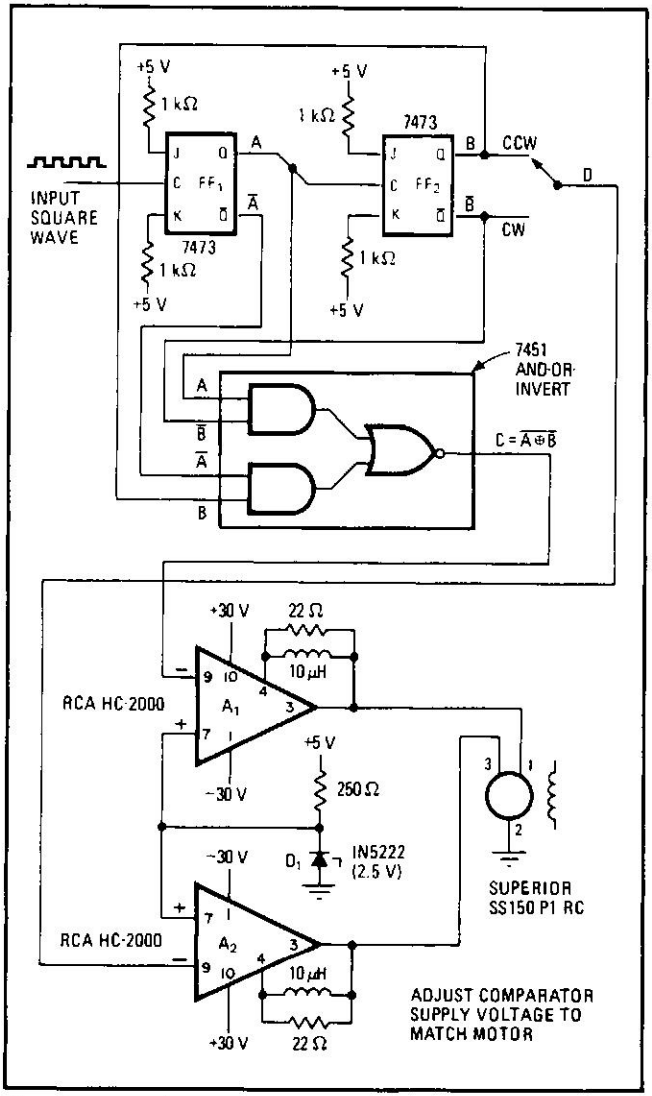
The problem of conversion generally arises when a variable-speed synchronous motor is needed that is capable of delivering up to 1,800 inch-ounces of torque, or when a variable-speed adaptor is required for a motor that is already installed. The converter, therefore, must be a high-current, high-voltage, variable-frequency circuit that can drive a two-phase 115-volt ac motor.

A variable-frequency square wave, which can be supplied by TTL integrated circuits, drives the converter and establishes motor stepping speed. Motor-speed accuracy depends on how accurate the input square-wave frequency is. The size of the step and the maximum stepping speed are determined by the motor used.

Flip-flops FF_1 and FF_2 are connected as a repeating two-bit counter, which has its output decoded by an AND-OR-INVERT circuit. This arrangement provides the four states, which are noted as A, B, C, and D in the diagram, needed to make the motor step properly.

The position of the switch at the output of FF_2 determines the direction of rotation. As can be seen from the figure, the D state simply represents the switch-selected B or $\bar{B}$ states.

Output states C and D are fed to the inverting inputs of high-power comparators A_1 and A_2, respectively. The voltage levels of these two states are then compared to the reference voltage established by the 5-v supply and zener diode D_1. Each comparator drives a separate motor coil and can develop a 75-v 100-watt output. □



Stepping a synchronous motor. Logic circuit plus high-power comparators step two-phase synchronous motor in clockwise or counterclockwise direction. Frequency of input square wave determines motor stepping speed. Two-bit counter formed by flip-flop pair and AND-OR-INVERT circuit produce four logic outputs (A, B, C, and D) that control motor. Each comparator output supplies one motor coil.