BY GENE NELSON

AUDIO ALARM BACKS UP CAR WARNING LIGHTS OR METERS

Easy-to-build circuit sounds an alarm so you won't miss your car's visual warning.

PEOPLE often fail to notice immediately when a red indicator on the dashboard of a car lights to warn that service is required. The "Audible Car Protection Alarm" described here corrects this problem by simultaneously issuing an audio signal when a dashboard warning indicator is activated. It can spell the difference between a minor and a major car repair, or even save lives.

When any one or more of the warning indicators in your vehicle lights, the audio alarm sounds an insistent beeper. Then you can check the indicators to determine what service is required.

In addition to serving as an automatic fault monitor, the alarm can also remind you to turn off headlights and rear-window defogger. The system can easily be expanded to monitor dozens of points in a vehicle's or boat's electrical system.

About the Circuit. As shown in Fig. 1, triple three-input NAND gate *IC1* serves three separate functions. Section A operates as a conventional three-input NAND gate. If one or more of its normally high A, B, and C inputs goes low, the pin-10 output of this gate also goes high.

Section B, also used as a three-input NAND gate, has a 1500-Hz signal applied to its pin-2 input, a 1-Hz signal applied to its pin-1 input, and the output from section A of *IC1* applied to its pin-8 input. Hence, when the output from section A goes high, the circuit oscillates at 1500 Hz and is gated on and off at approximately half-second intervals.

Section C of *IC1* is configured as an inverting amplifier whose output is coupled back to its input via *R1* and oscillates at a frequency determined by the values of *R1* and *C1*.

The output of section B drives *Q1*, whose collector load is a conventional miniature 8-ohm loudspeaker. The combination of *C3, R2*, and *R3* functions as the system's 1-Hz oscillator. Capacitor *C3* charges through *R2* and discharges through *R3*. This capacitor must be initially charged before the circuit can os-

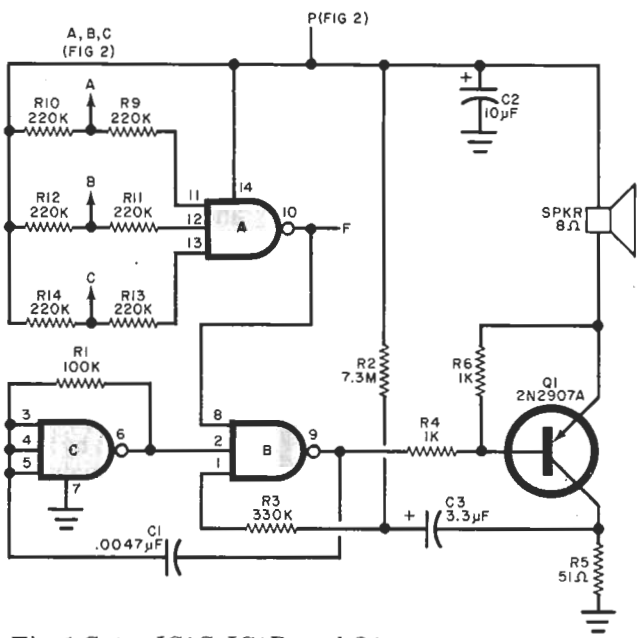

Fig. 1 Gates IC1C, IC1B, and Q1 form a 1500-Hz oscillator gated on and off by a 1-Hz signal.

PARTS LIST

C1—0.0047-µF Mylar
C2—10-µF, 16-volt electrolytic
C3—3.3-µF, 25-volt tantalum
D1 through D5—1N4148 or similar silicon diode
IC1—CD4023AE (RCA) CMOS triple three input NAND gate
LED1—Red light emitting diode
Q1—2N2907A or similar pnp transistor
The following resistors are ¼-watt, 10%:
R1—100,000 ohms
R2—5.1 and 2.2 megohms in series
R3—330,000 ohms
R4,R6,R15—1000 ohms
R5—51 ohms
R7—22 ohms
R8—2200 ohms
R9 through R14—220,000 ohms
SPKR—8-ohm, 100-mW loudspeaker
Misc.—14-pin DIP socket; plastic case; printed circuit or Wire Wrap board; splice-in connectors; hookup wire; solder; machine hardware; etc.
Note: A basic Autotel™ kit consisting of all parts except D1, D2, D4, D5, LED1, R13, R14, R15, is available for $4.95 plus $1.00 shipping and insurance from James Electronics, Box 822, Belmont, CA 94002.

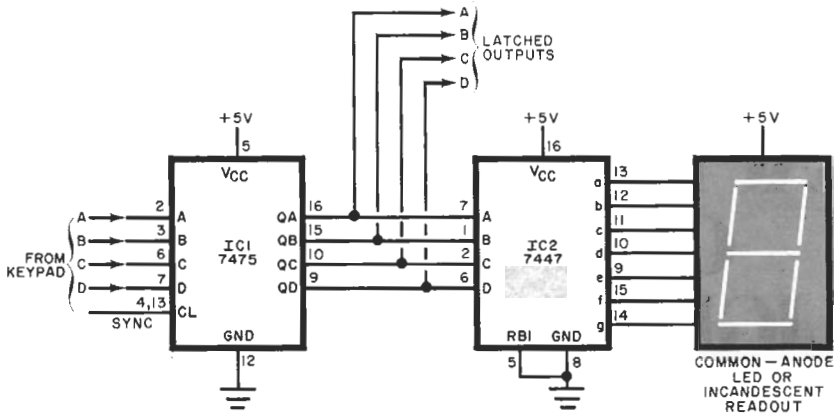

Fig. 11. Latched output for a keypad. Display is on a 7-segment LED readout.

added between the circuit and any external devices to be controlled. The actual circuit for the combination lock is shown in Fig. 10.

Operation of the lock begins with the reset mode. This is necessary because the reset can be initiated at any time in the event an incorrect digit is keyed. The output of a two-stage counter is decoded in the steering logic, and the BCD signals from the keypad are integrated into the counter's decoding logic so that a specific digit only can be passed through the enabling latches if both signals are coincident. It is mandatory that the four latches be set in the proper sequence (W,X,Y,Z) because any other combination will be defeated in the sequence detector.

A function table for the lock is given in Fig. 10. The 0 on the DEC IN line is the reset mode. The outputs of *FF1* and *FF2* assume a 0101 state. The *FF1* and *FF2* blocks are clocked flip-flops, with the clocking occurring on the trailing edge of the input pulse. The outputs of the keypad are fed to *IC4*, the outputs of which are selected to form the inputs to the associated NOR gates.

If the correct first digit is keyed in, line W goes to the high state, setting *IC5A/IC5B*. Both inputs to NOR gate *IC7A* are now low, setting the D input to *FF3* (*IC8A*) to high.

The sync pulse from the keypad has once more clocked the counter. If the second digit is correctly keyed in, line X goes high and sets the *IC5C/IC5D* latch. This clocks a low to one input of (*IC7B*). Once again, the keypad is operated with the correct digit to cause the associated latch to operate and placing a high on the Y line. This puts a low on the second input of *IC7B*. This sets the D input of *IC8B* to high.

The keypad is operated one more time with the final correct digit to set the Z line high. The Z latch clocks *IC8B* to change its output status. Either of the *IC8B* outputs can be used to interface to an external circuit.

If any of the four latches is set out of sequence, the clocking of *IC8A* and *IC8B* will be disrupted. The circuit is reset by operating the RESET switch.

Although the Fig. 10 circuit shows the use of a 1-to-10 decoder for the keypad input, a 1-of-16 decoder can be used for a hexidecimal input.

Switch Latch & Display. One difficulty with a keypad is that it is momentary. Once a key has been released, the action ceases. The addition of a quad latch, as shown in Fig. 11, will hold the switch outputs as long as dc power is applied. The *IC1* quad latch is used to drive BCD-to-7-segment decoder/driver *IC2* and a common-anode 7-segment LED display. This combination holds the last key depression and also produces a visible display of the digit depressed.

In Conclusion. In this article, we have described the major problems encountered when using mechanical switches—specifically keypad arrays—with digital circuits. We have offered some examples of how to deal with the problems and given hints on interfacing keypads with the electronic circuits. It is suggested that for further study and understanding of the material presented here you breadboard the circuits presented and do some experimenting on your own. ◇