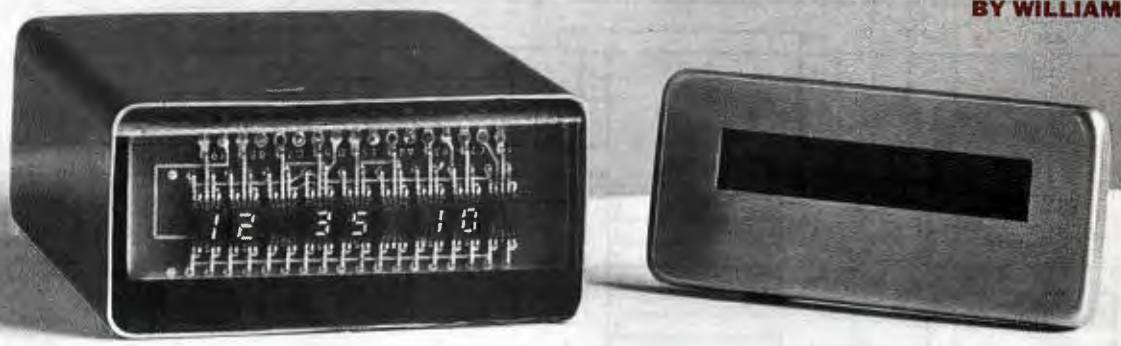
BY WILLIAM GREEN



A Digital Clock for Vehicles

Six-digit, crystal-controlled LED clock keeps accurate time in hostile environment.

CLOCKS with digital readouts are seemingly omnipresent today. However, you seldom see one in a car, camper, or boat. The clock project described here can change this. You can construct a low-cost 6-digit clock that is powered from a 12-volt dc source on anything from a pick-up truck to a cabin cruiser.

Obviously, such a clock is required to keep accurate time in a very hostile environment (including temperature extremes) and with a very noisy electrical supply. Also, since the clock must run continuously to maintain the correct time, it must require very little current. To avoid calling attention to itself when strangers look into an empty car or boat, the display should be darkened except when the ignition key is inserted. The mobile clock discussed in this article meets all of these requirements.

The 6-digit, 12-volt clock requires nominally 13 mA with the display off. Thus, if a 50-ampere-hour battery is used, battery life in excess of five months without recharging can be expected for the clock.

Circuit Operation. Timing for the clock (Fig. 1) is derived from a crystal-controlled oscillator operating at 6.5536 MHz. This is part of *IC2*. Also in *IC2* is a 16-stage binary counter that delivers an output of 100 Hz at pin 1. Trimmer capacitor *C5* is used to adjust the frequency (hence clock time keeping) for the desired accuracy. The 100-Hz output of *IC2* drives a divide-by-two flip-flop in *IC3* whose output at pin 1 is 50 Hz, the frequency needed to drive clock chip *IC1*.

The clock chip contains the counting, dividing, display drive and multiplexing, and time-setting circuits. Some of the outputs energize the segments of the display, while others energize *Q1* through *Q6* to multiplex the display. Capacitor *C1* and resistor *R1* determine the multiplex frequency. Switch *S1* controls the slow set and *S2* controls the fast set.

Zener diodes *D2* and *D3* (with *C2* and *C3*) protect the IC's from potentially damaging voltage spikes. They also eliminate false counting due to noise from the ignition. Diode *D1* protects the circuit from wrong voltage connection.

Construction. Although any type of construction can be used, a printed circuit board (Fig. 2) is recommended to keep the size down. The IC's are protected against static discharge, but care must be used in handling and installing them.

Install all of the jumpers except for the one between *IC1* pin 16 and *IC3* pin 1. Then install all of the components as shown in Fig. 2. Be sure to observe the polarities on capacitors, diodes, and IC's. Sockets can be used for the IC's, if desired.

Solder a short length of bare wire into each hole in the bottom edge of the display board. The wire should protrude from the back side of the board and, after soldering, should be trimmed flush with the front side. Place the main board on a working surface with the foil side down. Then position the display board with the readouts face up and the bare leads facing the front of the main board (toward the line of holes). Slip the leads from the display board into their mating holes on the main board and bend the display board up so that it forms a 90-degree angle to the main board. The two should be just barely touching. Keeping the display board perpendicular to the main board, carefully solder all of the interconnecting leads. Connect the insulated jumper between *IC1* pin 16 and *IC3* pin 1. Use short lengths of insulated wire to connect *S1* and *S2* to their respective pads on the board. Connect longer lengths of insulated wire to the power, ground, and display control pads.

Select a small metal case that will accommodate the assembly with the digits close to the front. The two set switches should be installed on the rear of the case, with the three leads (power, ground, and display control) coming out through a grommetted hole on the rear. If desired, the front panel can be cut so that a red plastic window magnifier (similar to those used in calculators) can be used over the numerals. The magnifier can be cemented in place on the inside of the front cover.

Checkout and Calibration. Connect the power and ground leads to a source of 11 to 14 volts dc observing the correct polarity. The display will come on when the control lead is connected to the positive supply. Operat-

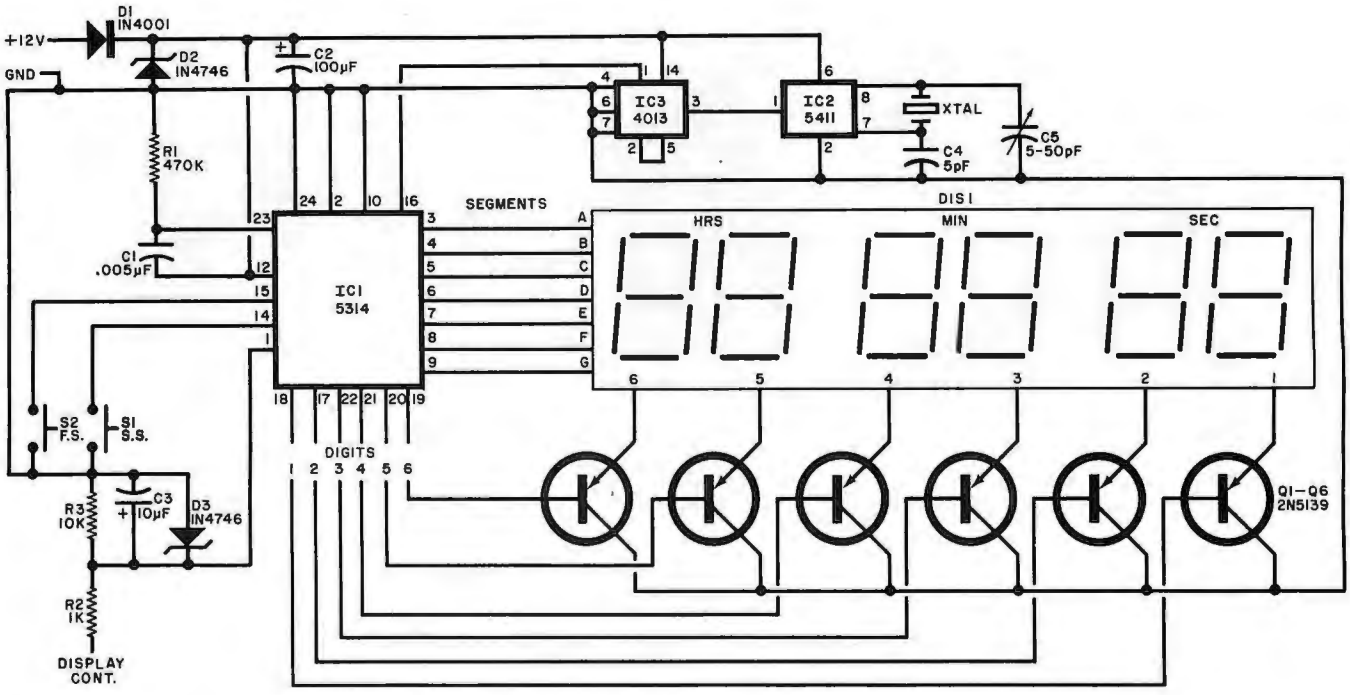


Fig. 1. Crystal oscillator is counted down by IC2 and IC3 to drive clock circuit in IC1.

PARTS LIST

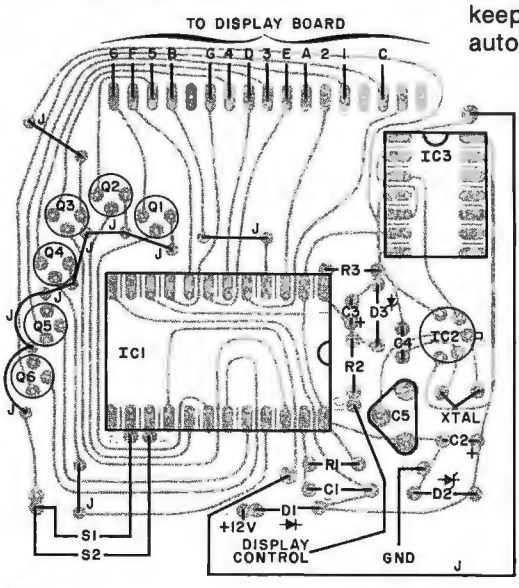
C1—0.005-µF 16-V disc capacitor
C2—100-µF, 16-V electrolytic capacitor
C3—10-µF, 16-V electrolytic capacitor
C4—5-pF ceramic disc capacitor
C5—5-to-50-pF trimmer capacitor
D1—1N4001 diode
D2,D3—1N4746 zener diode
DIS1—9-digit, 7-segment board (only 6 digits used) See Note.
IC1—MM5314 clock module (National)
IC2—SCL5411 oscillator-16-stage binary divider (Solid State Scientific)
IC3—4013 dual D flip-flop (only one used)
Q1 through Q6—2N5139 transistor
R1—470,000-ohm, ¼-W resistor
R2—1000-ohm, ¼-W resistor
R3—10,000-ohm, ¼-W resistor
S1,S2—Spst, normally open, pushbutton switch
XTAL—6.5536 MHz crystal
Misc.—Suitable enclosure, red plastic magnifier, cement, double-sided tape, mounting hardware, etc.

Note: The following are available from Alpha Electronics (Texas), Box 64726, Dallas, TX 75206: complete kit of parts less case (AC-1) at $29.95 plus $2.50 postage and handling; crystal at $7.50; aluminum case with cover and magnifier (C-1) at $4.50; etched and drilled pc board (140576) at $5.00; assembled display board (AE-9) at $4.95.

ing the slow set switch, *S1*, should cause the seconds to "run" rapidly and the minutes to operate at a faster speed than normal. The fast set switch, *S2*, causes the seconds to stop and the minutes and hours to run rapidly. Operation of both switches can be used to set the time.

To adjust the accuracy, and if you have a frequency counter, connect the latter between *IC2* pin 7 and ground. Then adjust trimmer capacity *C5* for a reading of 6,553,600 Hz. If you don't have a frequency counter, adjust *C5* periodically by trial and error. Even if *C6* is off slightly, the clock should still keep better time than most standard automotive clocks.

Installation. The clock can be installed under the dash or in any other convenient location. Connect the ground wire to any ground point on the vehicle and the +12-volt line to any point that is fused and is "live" even when the ignition key is removed. Connect the display control lead to any +12-volt line that is live when the ignition key is inserted. ◈



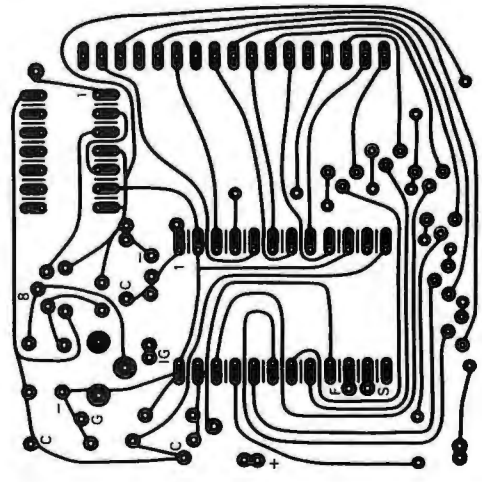


Fig. 2. Actual-size etching and drilling guide (right) and componant layout (left) for digital clock. Holes at top of board align with those on the display board.

Out of Tune

In "A Digital Clock for Vehicles" (October 1976), the hookup from the main to the display board is in error. Connections A and 2 should be moved one pad each to the right, connection 1 two pads to the right, and connection C one pad to the right (see Fig. 2 component layout diagram).

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