Build this No-Digit Digital Wall Clock

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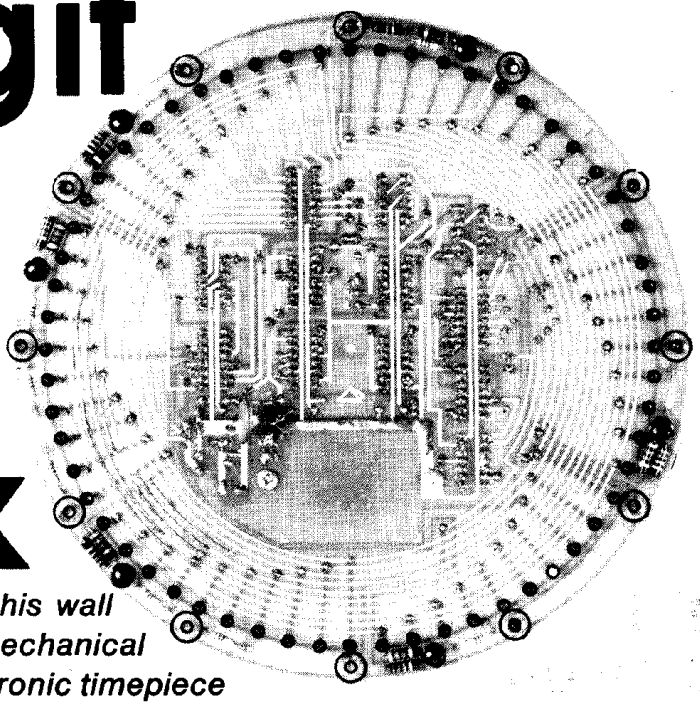


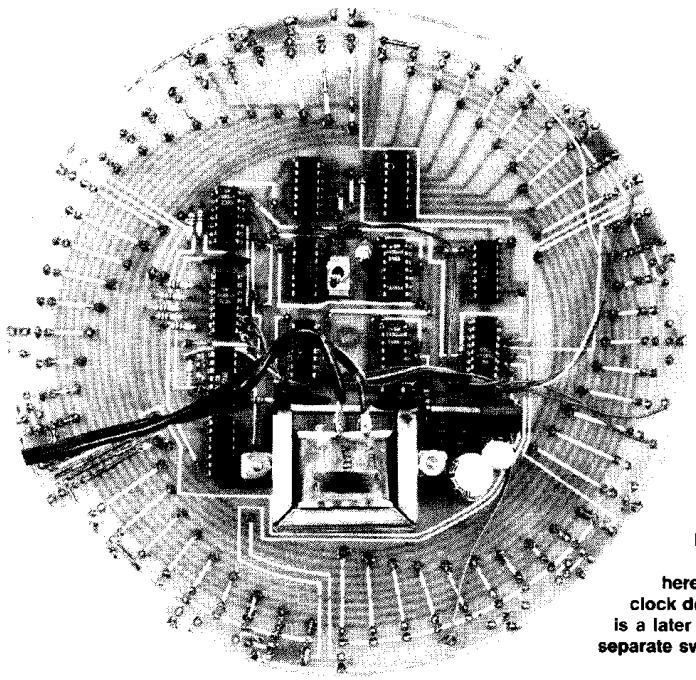
Using discrete LED's and a round face, this wall clock displays time much like a standard mechanical clock and has the accuracy of the all-electronic timepiece

HAVE YOU EVER STOPPED TO THINK THAT IN twenty years or so, not many people will remember how to "tell-the-time" when they come face to face with one of those antique mechanical clocks? With so many digital clocks and watches appearing on the market, our children will learn to "read" the time from the familiar digital display. The clock described here however, combines the traditional round face with the accuracy of the all-electronic clock.

The face of the clock consists of a circle of 12 green LED's that are located at the hour positions. A circle of 60 red LED's displays the minutes. The 60-Hz line frequency is divided down and decoded to drive the proper LED's corresponding to the conventional hour and minute hands. Thus the electronic clock is read in the same manner as the mechanical clocks with the hour and minute hands.

How it works

The schematic is shown in Fig. 1. Transistor Q1 converts the signal from the power supply transformer to a TTL compatable 60-Hz squarewave. IC1 divides the frequency by 10 and IC2 divides it by 6, so that a 1-Hz signal appears at pin 8 of IC2. IC3 and IC4 divides the 1-Hz signal by 60 to produce a pulse every minute.



REAR VIEW of clock. The clock shown here is a prototype. The clock described in the article is a later version that includes separate switches for setting the hours and minutes.

To minimize the parts count, a multiplex technique is used to individually light each of the minute LED's. IC5 divides the one-minute signal by ten and IC6 decodes the BCD output of IC5 to one-of-ten outputs. IC7 divides IC5's once-every-ten-minutes output by 6. This signal is decoded by IC8 to one of six outputs. When pin 1 of IC8 is low, Q2 conducts. This provides power to LED1 through LED10. IC6 counts through its ten numbers and turns on LED1 through LED10 in consecutive order to display each of the first ten minutes. During the second ten minutes, pin 1 of IC8 goes high and pin 2 goes low. This supplies power through Q3 to LED11 through LED20, and IC6 turns these LED's on in consecutive order just as the first ten. This method is used to turn on each of the 60 LED's in order. Then the count begins again at the top of the dial.

The output of IC7 provides a pulse

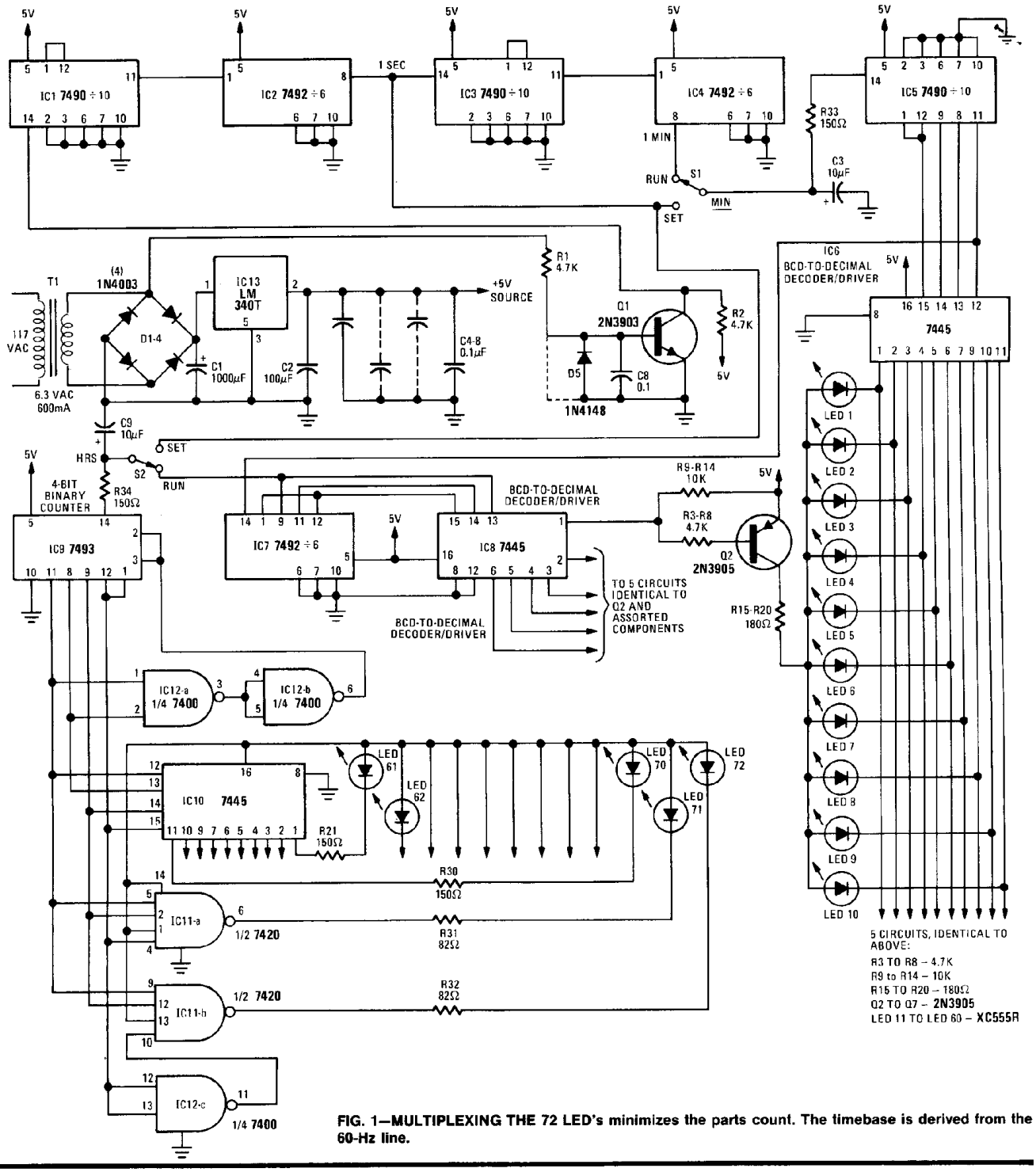


FIG. 1—MULTIPLEXING THE 72 LED's minimizes the parts count. The timebase is derived from the 60-Hz line.

PARTS LIST

All resistors ¼-watt 10%, unless noted

R1-R8—4700 ohms
R9-R14—10,000 ohms
R15-R32—180 ohms
R33, R34—150 ohms
C1—1000 μF, 16-volt electrolytic
C2—100 μF, 16-volt electrolytic
C3, C9—10 μF, 16-volt electrolytic
C4-C8—0.1 μF, 50-volt ceramic disc
LED1-LED60—discrete red LED; 0.1-inch lead spacing, 20 mA. (Xciton XC555R, Monsanto MV5053, or equal.)
LED61-LED72—discrete green LED; 0.1-inch lead spacing, 20-mA. (Xciton XC555G, Monsanto MV5253, or equal.)
D1-D4—1N4003
D5—1N4148
Q1—2N3903
Q2-Q7—2N3905 or 2N3638
IC1, IC3, IC5—7490 Decade Counter
IC2, IC4, IC7—7492 Divide-By-Twelve Counter
IC6, IC8, IC10—7445 BCD-To-Decimal Decoder/Driver
IC9—7493 4-Bit Binary Counter
IC11—7420 Dual 4-Input NAND Gate
IC12—7400 Quad 2-Input NAND Gate
IC13—LM34OT-5 or MC7805PC; 5-volt 3-terminal positive voltage regulator
T1—power transformer; 117-volt primary, 6.3 volt 0.6-amp secondary (Triad F-13X or equal.)
S1, S2—SPDT toggle switch, PC board mount
Misc.—PC board, case, hardware, wire, solder, etc.

The following parts are available from Cheops Electronics, 3780 Coronado Way, San Bruno, CA 94066: A complete kit of parts, excluding case, $47.50. An etched and drilled PC board, $12.00. California residents add state and local taxes as applicable.

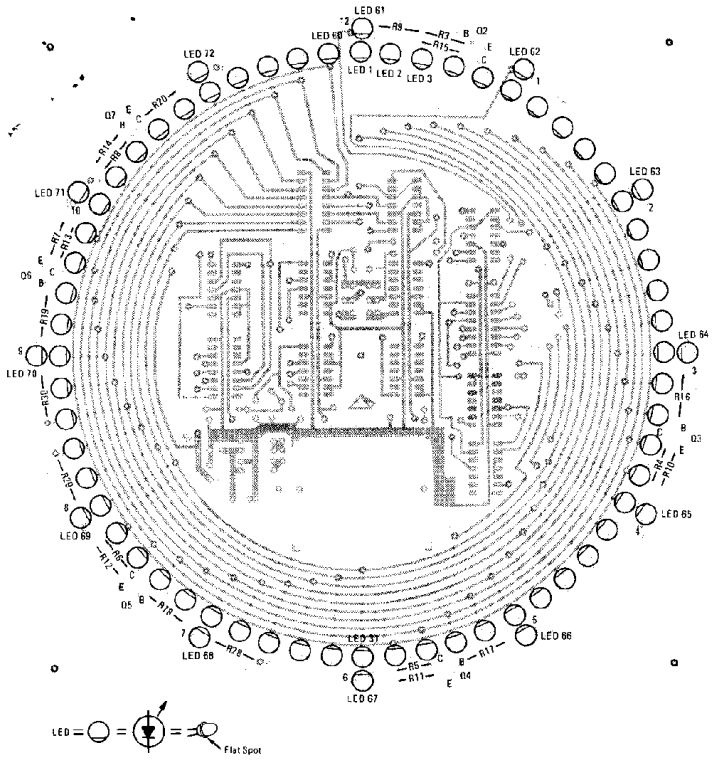


FIG. 4—COMPONENT PLACEMENT for front of PC board.

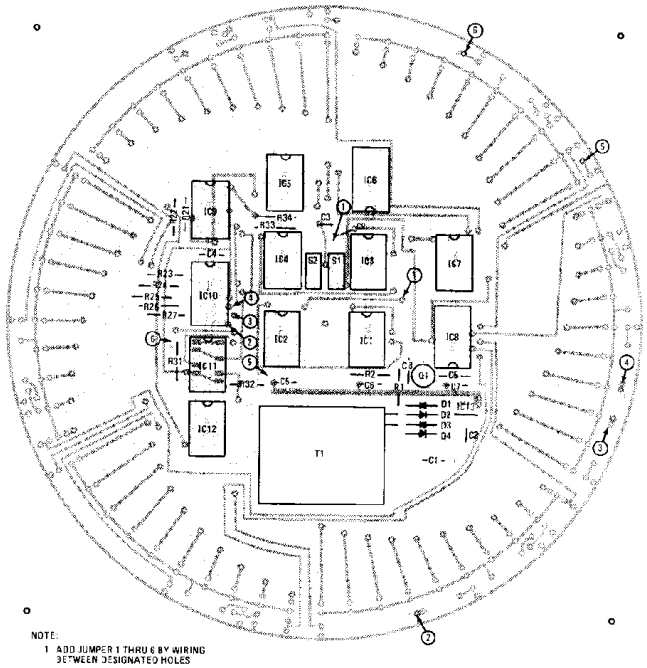


FIG. 5—COMPONENT PLACEMENT for rear of PC board.

each hour. This signal is sent to the input of IC9, pin 14. IC9 is wired through IC12-a and IC12-b to function as a divide-by-twelve counter. The BCD output of IC9 is decoded by IC10 to one-of-ten outputs to display each of the first ten hour-positions. Since IC10 has only ten outputs, it is necessary to use IC11-a and IC12-c as decoder/drivers for the last two numbers.

Switch S1 is used to set the minutes.

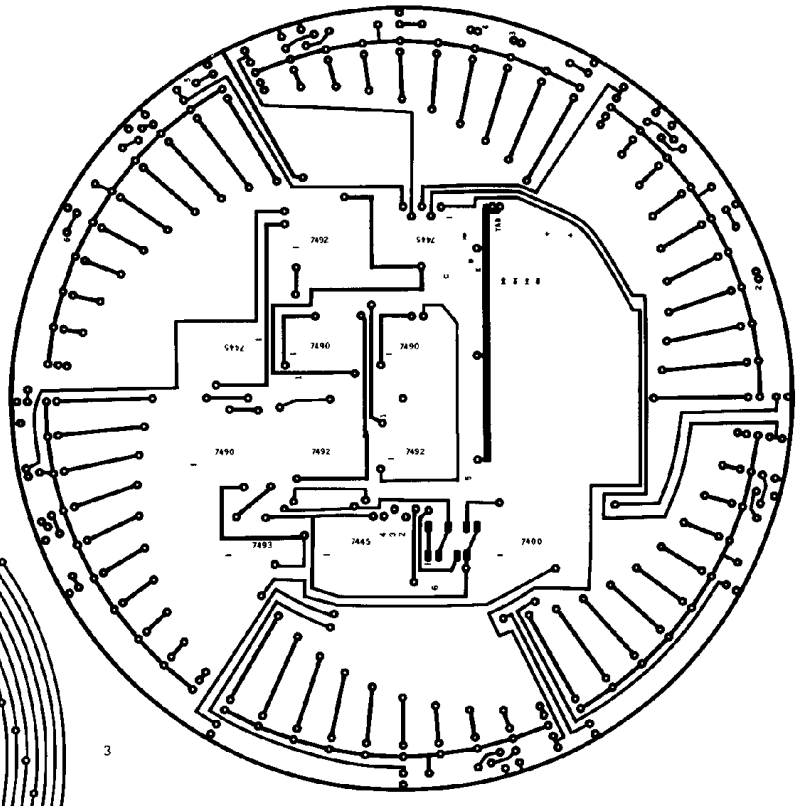


FIG. 3—REAR FOIL PATTERN of double-sided PC board shown half size.

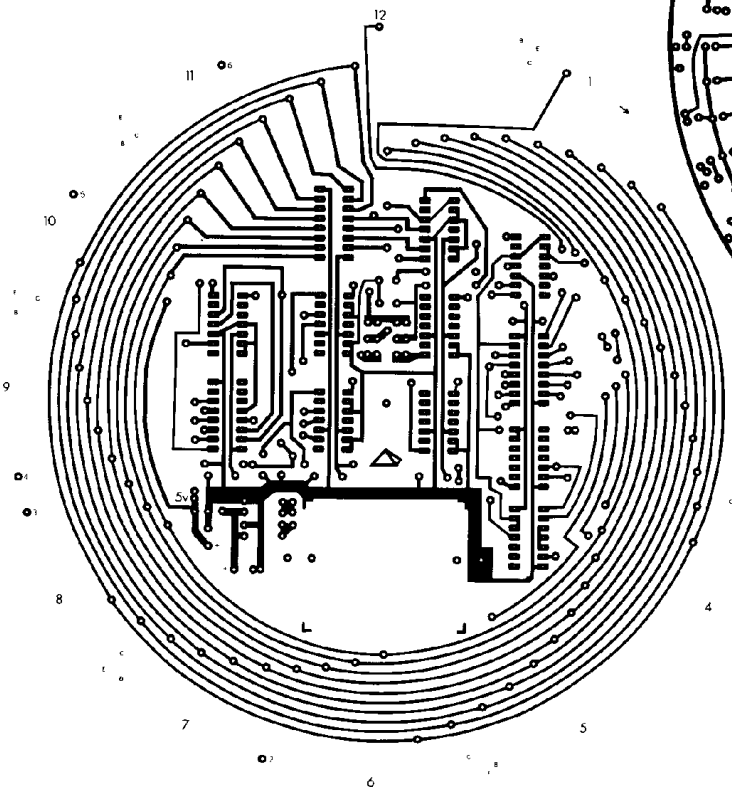


FIG. 2—FRONT FOIL PATTERN of double-sided PC board shown half size.

To accomplish this, a faster signal is used to trigger IC5. The signal at pin 8 of IC2 is a 1-Hz squarewave that runs the minute "hand" around the face of the clock as if it were a second hand when S1 is in the SET position. When the correct minute is displayed, S1 is returned to the RUN position. Switch S2 is used to sweep the hours LED's at a 1-Hz rate. As you look at the rear of the

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clock, both switches are in the RUN position with the switch bats down. If you should overshoot the correct time when setting, let the hand sweep around again.

Construction

Although the actual circuit is simple, the wiring can get complex. Multiplexing to the 72 LED's necessitates the use of a double-sided printed circuit

board. The foil patterns for the PC board are shown in Figs. 2 and 3. If the board is square, the clock can be mounted by the corners in a square enclosure or if cut round, it can be mounted by a single screw in the center of the round case.

The LED's and driver transistors are mounted on the face side as shown in Fig. 4 and the balance of circuitry mounts on the rear as shown in Fig. 5. Care should be taken when mounting the LED's to insure that they are of equal height and are aligned to give an even display.

The clock can be mounted in a number of different cases. The one shown here is a clear plastic tube with a clear front. The hour positions are indicated by white plastic squares glued to the front. The old fashioned octagonal wall clock cases can also be used. This makes for an interesting combination of old craftsmanship and modern technology. **R-E**