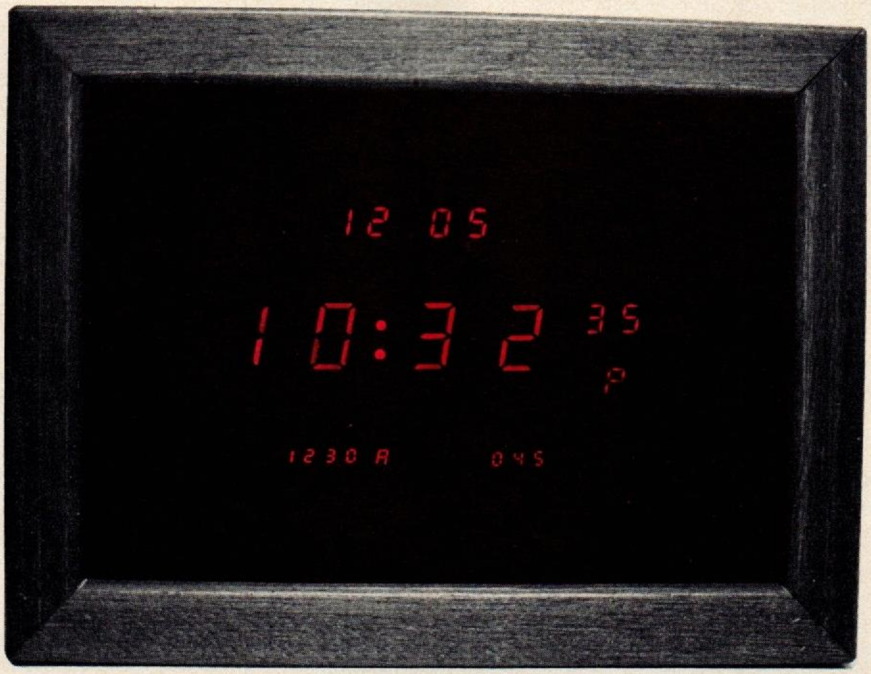
Build This



10 Function Digital Clock

Part II. *Construction details for a multi-function digital clock that provides a simultaneous display of the time, date, alarm and countdown timer*

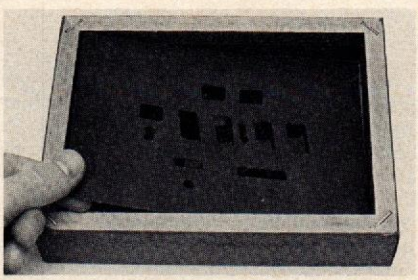
JEFFREY G. MAZUR

LAST MONTH, IN THE FIRST PART OF THIS article, we provided the complete schematic diagram and a detailed description of how the circuit worked. This month, the article concludes with the foil patterns and construction details.

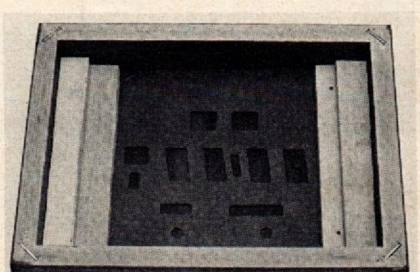
Construction

The clock is built on two separate printed circuit boards. A double-sided board holds all the clock circuitry, and a single-sided one contains the readouts. The foil patterns for the main board are shown in Figs. 5 and 6. The foil pattern for the display board is shown in Fig. 7. The two boards are connected by a 32-conductor cable. Since there are many connections on both sides of the clock board as well as feed-through holes for interconnecting the two sides, plated-through holes are a must on this board.

Mount the power transformer directly on the clock board or, for a slimmer package, use a wall-type AC adapter transformer. If the adapter is used, the



AFTER MOUNTING red plastic to the front of the frame, add a piece of black cardboard with cutouts for the displays.



MOUNT SUPPORTS for the two PC boards for the proper spacing.

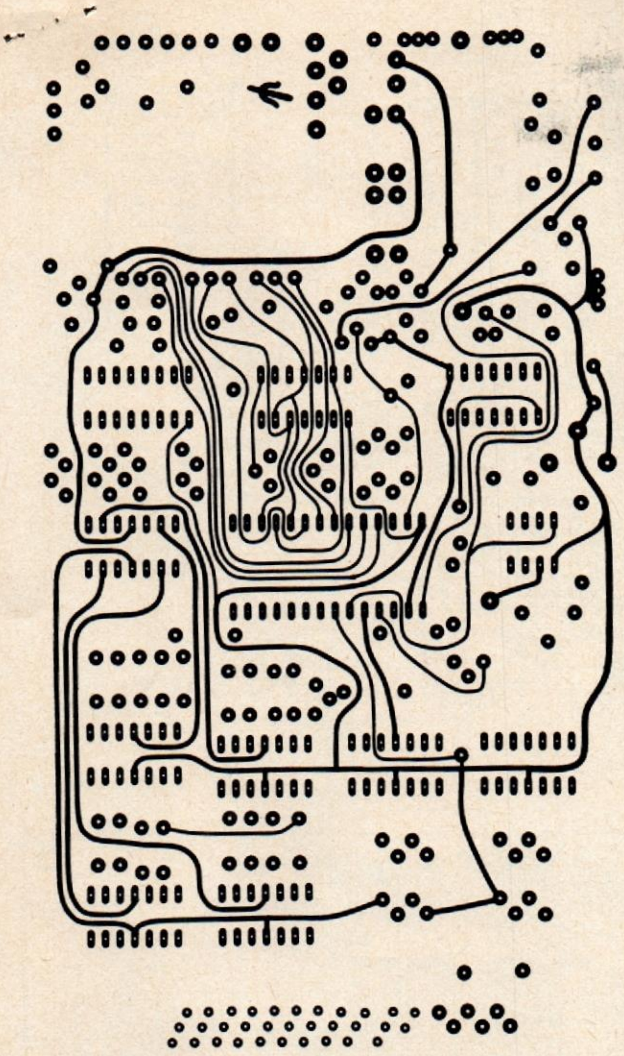


FIG. 5—FOIL PATTERN of component side of double-sided clock board. Actual board measures 7 × 4 inches.

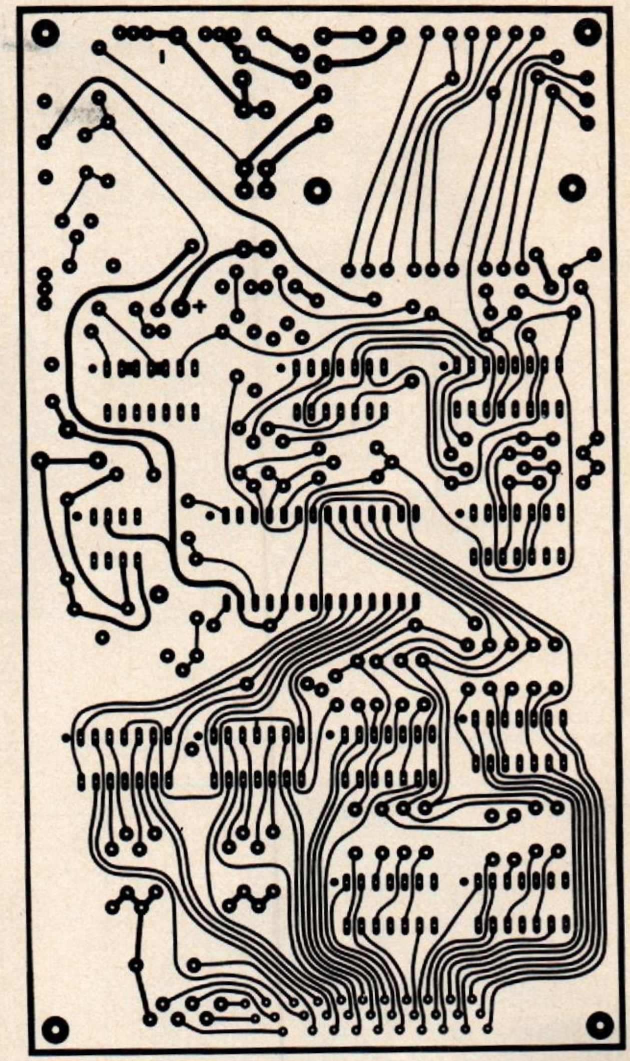


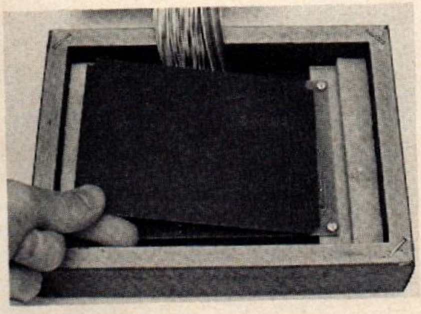
FIG. 6—FOIL PATTERN of bottom side of double-sided clock board.

two boards fit neatly into a standard 5 × 7-inch picture frame.

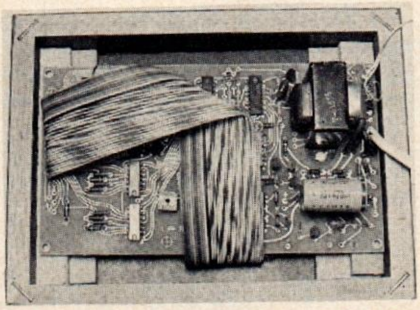
Before starting construction, decide on which options will be used. If a 24-hour format is desired, install D28. (See Fig. 8.) Resistors R17, R18, R26, transistor Q2 and the AM/PM digits can then be omitted if desired. For crystal timebase operation, omit R1, D1 and C2. If the power-line frequency (50 or 60 Hz) is going to be used as the timebase, *do not* install IC12. For 50-Hz operation, add D29. Temporarily place a jumper where resistor R5 would normally go. The component placement diagram for the display board is shown in Fig. 9. Mount the small alarm and timer displays on Molex pins to raise them up to the same height as the other displays. This gives a uniform appearance and reduces parallax problems when mounting the board behind the front panel. Make the front panel by cutting holes in a piece of black cardboard and mounting it to a solid piece of red plastic.

Mount the remaining components, including the 28-pin socket for IC11. Do not install IC11 at this time. Connect the display board to the clock board using ribbon cable. Then wire up all switches, being careful to install the diodes connected to them properly. Mount the TIME SET/DATE SET switch on the back or where it won't be accidentally moved. Mount the rest of the switches on the front, back or sides.

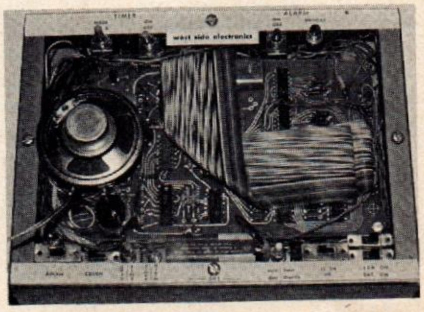
Check the boards carefully for shorts and proper component polarity. When everything looks in order, remove IC11 from its protective carrier and carefully install it in its socket. Then apply power. The display may register all 8's; this is a



INSULATE the back of the display board with a piece of cardboard.



CLOCK BOARD is mounted over the display board.



REAR VIEW of completed clock with clear plastic rear cover.

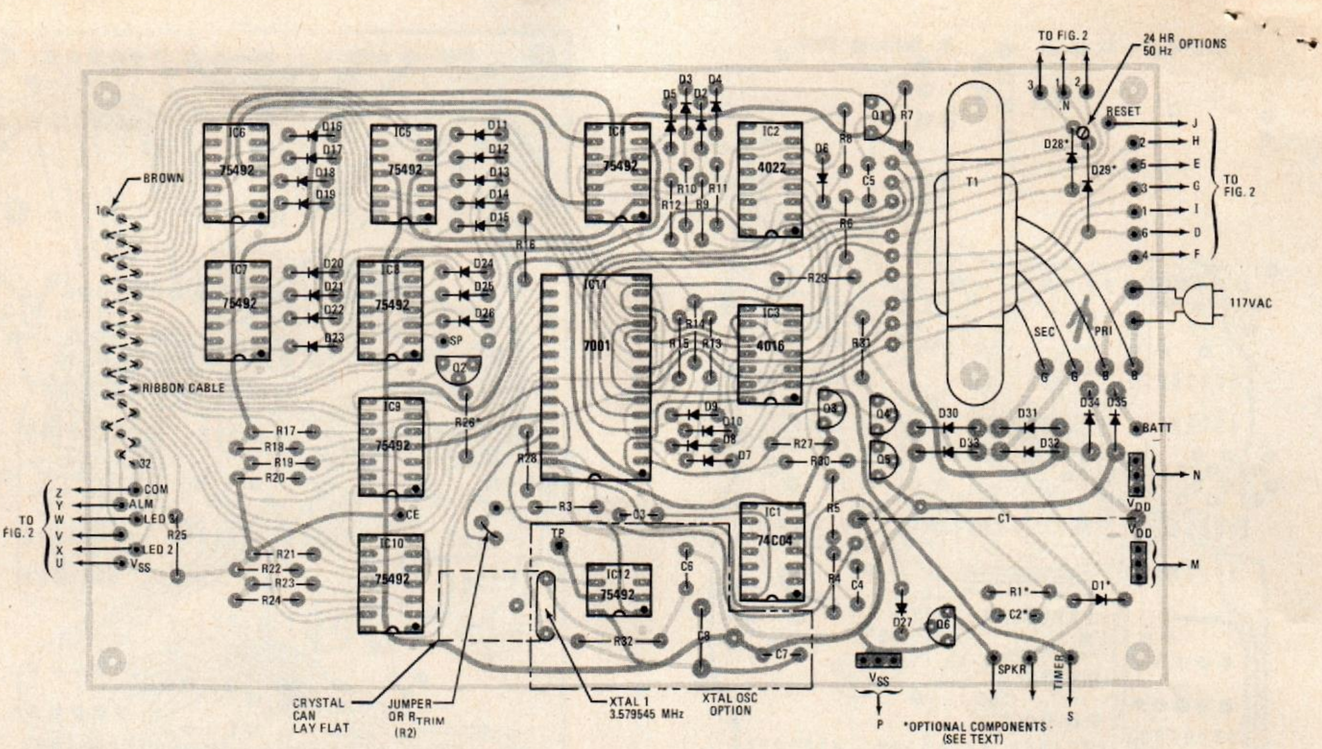


FIG. 8—COMPONENT PLACEMENT diagram of clock board.

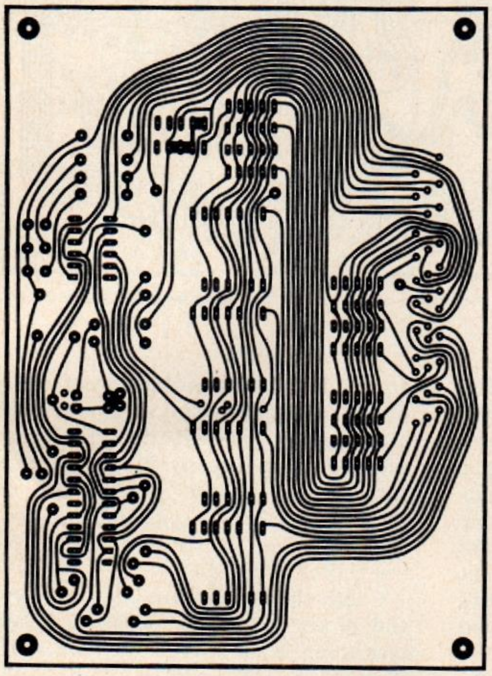


FIG. 7—FOIL PATTERN of single-sided display board. Actual board measures 4 × 5½ inches.

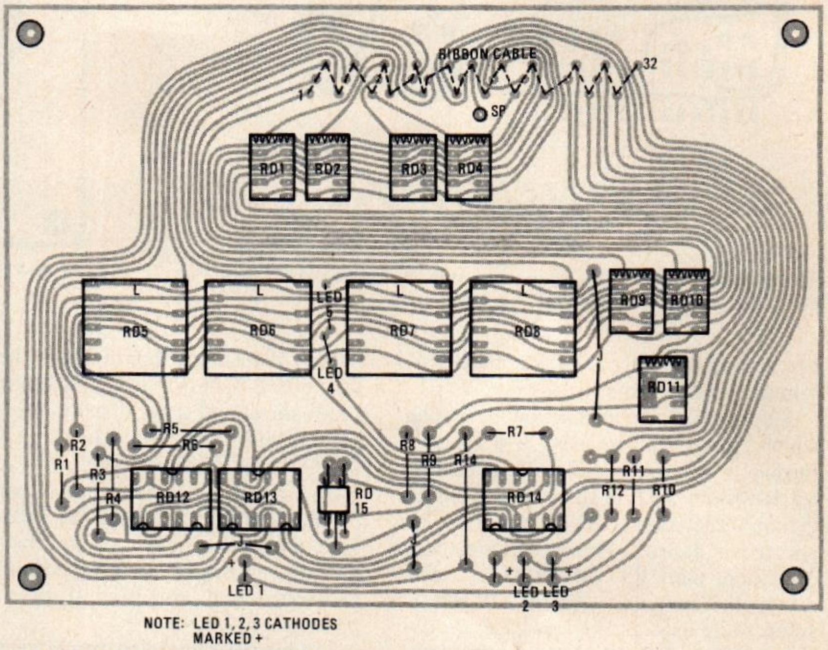


FIG. 9—COMPONENT PLACEMENT diagram of display board.

normal reaction. Set the date, time, alarm and timer displays using the SET and MINUTES/HOURS advance switches. Setting the time will automatically set the seconds to zero. The seconds will hold at zero until switching to another mode. This permits you to synchronize the clock to a standard time source such as the phone company. When setting one of the functions (time, alarm, date, etc.), all but the time display will be blanked.

If there is any flicker in the display or in certain segments, the external multiplexing frequency or the blanking time may be off. The output of the scanning oscillator (IC1) should be about 140 Hz. If this checks OK, then increase the value of capacitor C5 (blanking time) until no misreading occurs.

If the crystal timebase option is not used, the clock will revert to its internal backup oscillator in case of a power failure. This oscillator can be adjusted by replacing the jumper at R5 with a 5K potentiometer or a selected resistor. The value of R5 should be such that the D1 output of the 7001 (pin 8) is 1.05 kHz for 60-Hz or 875 Hz for 50-Hz operation. For short power interruptions (up to several hours), use a 9-volt battery. For longer protection, use eight AA-cells or a 12-volt lantern battery depending on available space. If rechargeable cells such as Ni-Cad's are used, then a trickle charge can be obtained by adding a resistor across D35. For DC operation in a car, boat, etc., connect the power across C1 (omit T1). Use a 9-volt backup battery to take over if the vehicle battery drops too low, for instance during starting. **R-E**

next month

OCTOBER 1977

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ELECTRONIC THERMOMETER

continued from page 35

ance voltmeter to read the voltage with respect to ground at pin 2 of IC3. Adjust R14 until you get a 0-volt reading on the voltmeter's most sensitive scale.

The second part of the calibration, the adjustment of C12 requires a 16.7K, 1% metal-film resistor. As before, connect the precision resistor into the circuit in place of RT1. Adjust C12 so that the display just changes from "99" to "0."

If you neither have nor want to buy a 16.7K precision resistor, the following procedure can be followed: Using a standard, accurate thermometer as a reference, fill a large bowl with hot and cold tap water to 99°F, stir carefully during this process. Plug the thermistor assembly into the thermometer, and immerse the waterproofed thermistor in the water. Adjust C12 to obtain a reading of "99." The thermometer is now ready to be used. At temperatures below 0°, the display will remain at 0. On the other hand, a temperature of 105°F appears as "5." However, the thermometer's accuracy is rapidly degraded as the temperature rises above 100°. **R-E**

RF SIGNAL GENERATORS

continued from page 93

receivers are tested for overload and intermodulation distortion.

Accuracy

Output amplitude accuracy at any particular attenuator setting is specified as plus-minus a number of decibels. Common values for this specification are ±3 dB for the very poorest of generators to better than ±1 dB for extremely good generators. It is well to remember that while ±1 dB sounds like a good figure, it is equivalent to saying ±10%, and ±3 dB is a little less than ±30%. High accuracy attenuations at UHF and substantial amounts of attenuation at UHF are extremely difficult to obtain, and even more difficult to validate.

Accuracy of the output amplitude is even further influenced by other parameters. One of these is accuracy of the output leveling circuitry. Once again, the accuracy of output leveling is usually given as plus-minus a number of decibels. If the signal generator does not use automatic leveling, then the output attenuator is only accurate if the signal generator has been "red-lined." [*Red-lining is manually leveling the generator, usually by adjusting an output amplitude control until the output level meter needle is resting on a reference mark (red line).*]

Output impedance

Output impedance is given in ohms and indicates the characteristic impedance of transmission line the generator is intended to drive. Almost all generators are 50 ohms, with the exception of those designed for television work, which are 75 ohms. The output impedance specification may include a VSWR (*V*oltage *S*tanding *W*ave *R*atio) specification, indicating the accuracy of the 50-ohm spec. If the generator load is a pure resistance at the characteristic impedance of the transmission line, the VSWR of the generator output is of little or no significance. Most generators, due to attenuator design, only specify output amplitude accuracy when the generator is driving a non-reactive load at the specified output impedance.

Leakage

The leakage specification should, in many ways, be combined with the output attenuator specification. It is the leakage specification that indicates the ultimate level below which reducing the output attenuator may produce no further decrease in the signal supplied to the load. Frequently the output leakage specification is rated in μV, as it indicates the ability of the generator to make receiver sensitivity measurements. For example, a generator may be specified as being able to make 0.1 μV measurements.

In the case of an extremely low-cost generator, although the attenuator and variable level control may be set for less than 1-μV output, the leakage specification indicates the generator can only make receiver sensitivity measurements of 5 μV or greater.

There may be a high degree of attenuation beyond which the attenuator itself may no longer supply increased attenuation. This is to say, some signals directly bypass the attenuator and appear at the output. This problem is different than a leakage problem.

A leakage specification only indicates the presence of signals in the area of the generator. A receiver may be a substantial distance from the generator, fed signals through a long coaxial cable, having known loss and good shielding, and receiver sensitivity measurements can be made.

to be continued