Portable 60-Hz "CLOCK" OSCILLATOR

Crystal-controlled time base for field use.

BY CHARLES F. SMITH

MOST digital clocks and sports timers are energized by the ac line—not so much for power as for the 60-Hz frequency that is used as the time base. This means that such digital devices cannot be used in vehicles or boats or for timing outdoor events that are not near an ac power outlet.

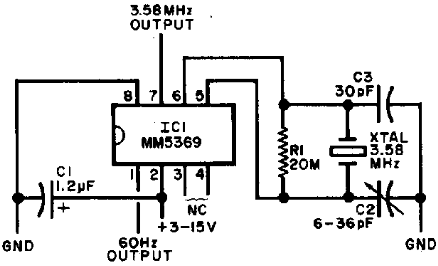


Fig. 1. Schematic of circuit.

PARTS LIST

C1—1.2-µF, 35-V tantalum capacitor
C2—6-36-pF trimmer capacitor
C3—30-pF capacitor
IC1—MM5369 programmable oscillator/divider, for use with a 3.58-MHz crystal (National)
R1—20-megohm ¼ watt resistor
XTAL—3.579545-MHz color-TV crystal
Note: The following are available from Bill Godbout Electronics, Box 2355, Oakland Airport, CA 94614: etched and drilled pc board (068) at $2.50; complete kit of parts, including board at $5.95. California residents, please add 6% sales tax.

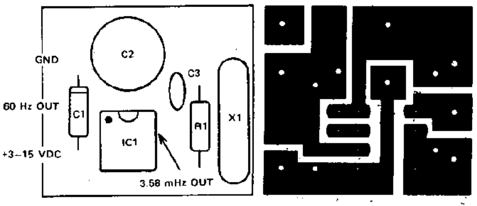
The 60-Hz crystal-controlled time base described here (Fig. 1) can be powered by any dc supply between 3 and 15 volts. It has low power consumption, is stable within 2 parts per million and is small enough to fit inside the case of many digital clocks and timers.

How It Works. The integrated circuit used in this time base is an MM5369, a recently introduced 17-stage, mask-programmable oscillator/divider. Although masking options are available for use with almost any crystal frequency, the IC used operates with a low-cost, readily available 3.58-MHz color-TV crystal and delivers 60 Hz at its output pin. Trimmer capacitor C2 allows for exact frequency adjusting, and a buffered 3.58-MHz output is available. Current drain is approximately 1.2 mA with a 10-volt supply.

Construction. Because of the high frequencies involved, a small pc board (or perforated board) such as that shown in Fig. 2 should be used. Figure 2 also shows component installation. Since the IC is a MOS type, take the usual precautions when installing.

Adjustment. If you have a frequency counter, or a calibrated oscilloscope, check for the presence of 3.579545 MHz at pin 7 of the IC. You can adjust trimmer capacitor *C2* for the correct value. If you do not have a frequency counter, use the Lissajous-figure approach with a scope, with the output of a conventional 6-volt transformer as the horizontal sweep and the output of *IC1* pin 1 for the vertical signal. Adjust *C2* until a very slow-moving square appears on the scope. If you have neither a counter nor a scope and are planning to use the clock with a portable timing device, use some form of accurate time signals such as those from WWV, CHU, etc., to start the timer at a one-minute "beep" and stop it at the next minute "beep." Adjust *C2* to obtain the correct time interval. ◇

Fig. 2. Actual-size etching and drilling guide (far right) and component layout. Components are mounted on nonfoil side.



Standby crystal time base backs up line-powered clock

by William D. Kraengel, Jr.
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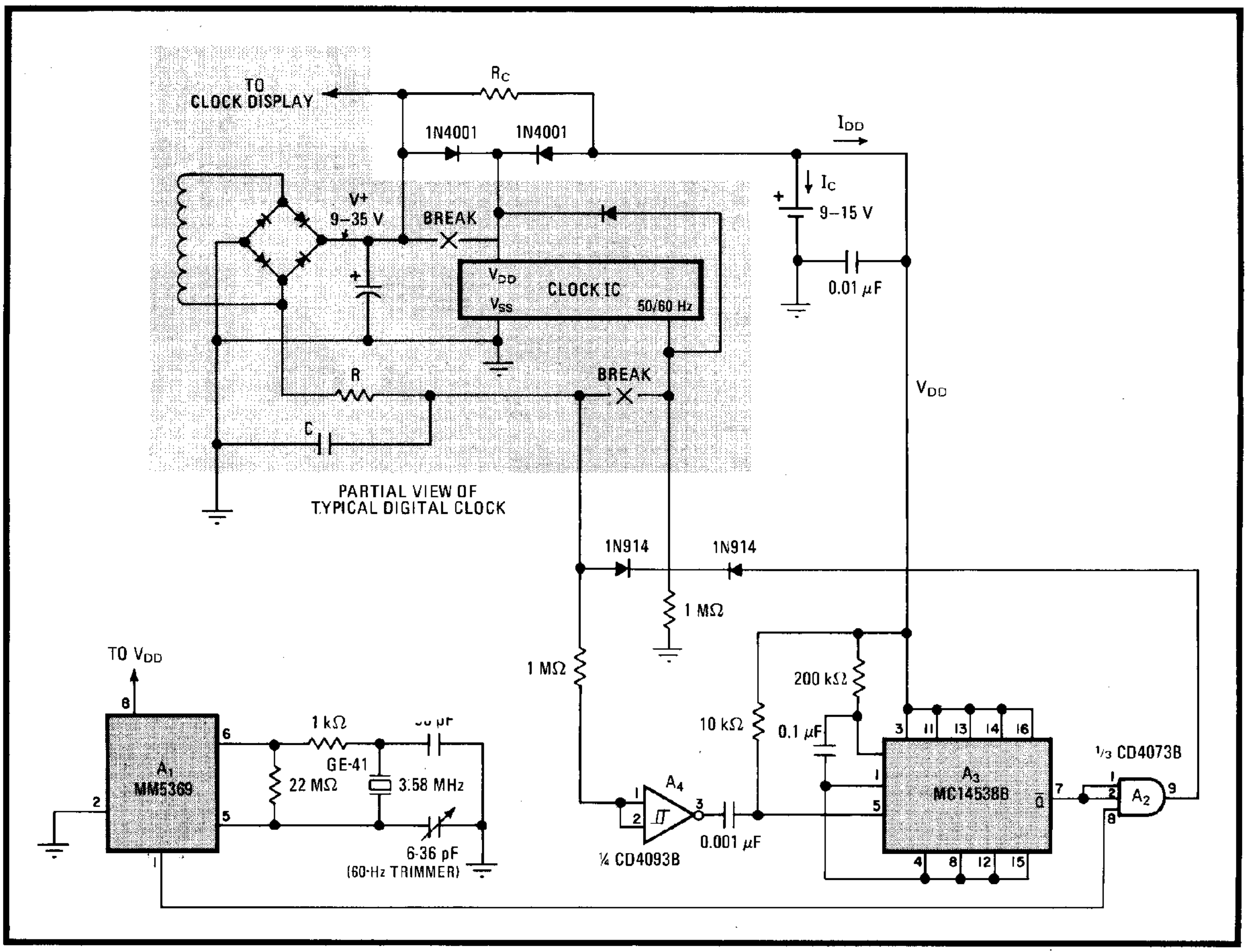
This battery-powered, crystal-controlled time base provides accurate and glitch-free performance when it takes over as the 60-hertz frequency standard that drives a digital clock during a power outage. The cost of the unit is about $7.

More long-interval timing circuits would probably use the ac power line as a time base because of its long-term average-frequency accuracy (1 part in 10^7), were it not



Standby standard. Battery-powered, crystal-controlled time base, having sufficient accuracy for most short-term applications, takes over clock-driving duties of digital chronometer in event of ac power loss. Unit uses 3.58-MHz oscillator, which is divided down to 60 hertz.

for the transients and blackouts that occur frequently. This back-up time base takes over smoothly in such instances and has sufficient accuracy over a period of several hours to satisfy all but the most demanding applications.

The standby time base uses a low-cost crystal oscillating at 3.58 megahertz, which is generally the frequency required for the color-burst circuits in standard television receivers. The frequency produced by the crystal's programmable oscillator-divider chip, A_1, is 60 hertz. This signal is fed to one input of an AND gate, A_2, which is activated if line power is lost.

During normal operation, the battery is trickle-charged (I_c) by the clock's supply through R_c, at a rate of 0.01 C, where C is the capacity of the battery in ampere-hours. R_c is equal to $(V^+ - V_{bat})/(I_c + I_{DD})$, where I_{DD} = 2.5 milliamperes. The digital clock must be modified slightly, as shown, in order to lengthen the charge life of the battery. Thus the digital clock's display will be blanked while the battery is the power source.

Meanwhile, one-shot A_3, configured as a missing-pulse detector, is triggered by Schmitt trigger A_4 at the beginning of each cycle of the ac input.

The one-shot's pulse width is 20 milliseconds, slightly longer than the period of the 60-Hz line input. Thus, A_3 is continually retriggered, and so A_2 is disabled.

With a loss of line power, the battery takes over the supply chores. A_3 times out, and then A_2 is enabled, so that the 60-Hz signal derived by the crystal circuit drives the digital clock's timing chip. The maximum length of time between the power outage and the first clock pulse from the standby unit is 8.3 milliseconds.

Almost the reverse action occurs when the ac line power is restored. When the filter capacitor in the clock's power supply recharges enough for the line pulses to rise above the set threshold of the Schmitt trigger, the one-shot is triggered, and the AND gate is disabled. As the voltage across the filter capacitor rises further, the power source duties revert back to the digital clock's power supply. □