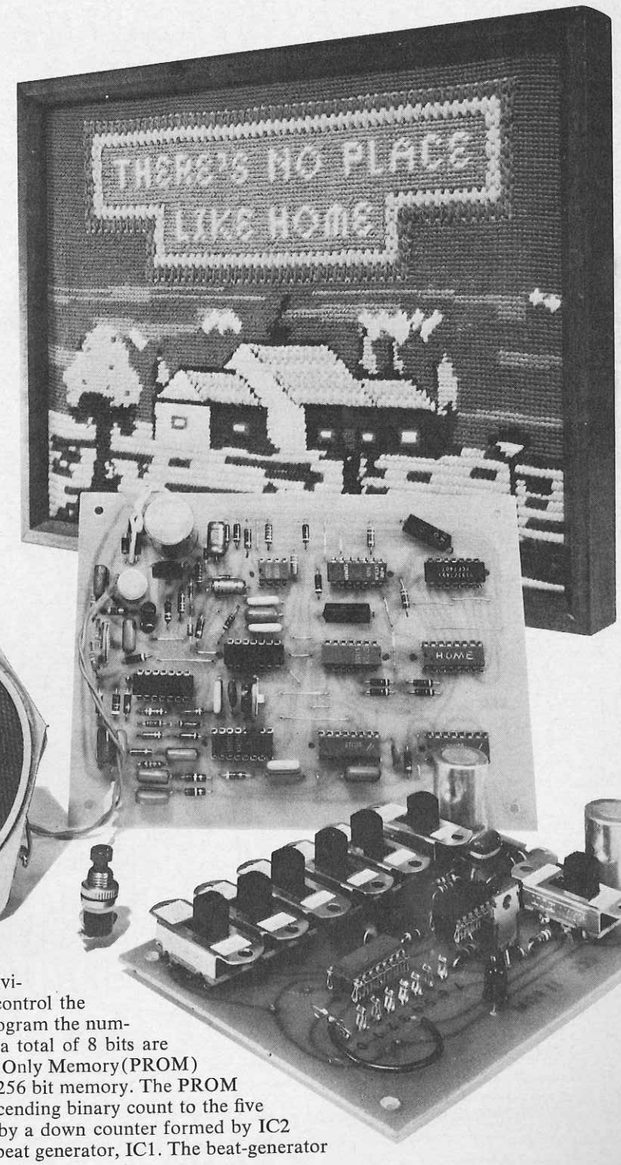
IC Doorbell Plays Your Song

You can program your own tune into this device and connect it to your doorbell. It features a PROM with a 32-note capacity

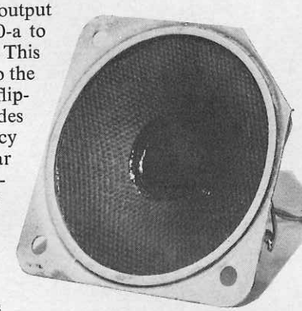
by RALPH E. COUSINO



MUSIC CAN RECALL A PLEASANT MEMORY ESPECIALLY if it's your favorite melody. This article describes an electronic music box that you can build and program to play your favorite tune. Use it in place of your doorbell or as a wakeup alarm on your digital clock. The electronic music box can be used for any audible signalling application. It provides a full range of two octaves for a total of 24 notes including tremolo. Momentarily closing the start circuit, the unit plays its programmed tune, through a maximum of 32 notes, one at a time, with a hold of up to 4 beats-per-note. It automatically shuts off at the end.

Circuit operation

A complete schematic of the electronic music box is in Fig. 1. The twelve notes for one full octave are generated by frequency division of a master oscillator formed by IC10-b. This 21,560-Hz master oscillator is frequency modulated for tremolo by a phase shift oscillator using operational amplifier IC5-d. Frequency division of the master oscillator ouput is done by cascaded programmable counters IC8 and IC9. After division by IC8 and IC9, the narrow output pulse is fed to IC10-a to form a wider pulse. This pulse is connected to the clock input of J-K flip-flop IC3-b that divides the input frequency by two, if the clear input is high, thereby generating the next lower octave. The tone can be muted by driving the clear input of IC10-a low. This is done by making the four inputs to NAND gate IC7-b high.



Programming IC8 and IC9 for frequency division requires 5 bits. Another bit is required to control the frequency divider. Two more bits are used to program the number of beats a note should be held. Therefore, a total of 8 bits are required for each note. The Programmable Read Only Memory (PROM) IC6 provides an 8-bit by 32-word memory or a 256 bit memory. The PROM is stepped through each word by applying an ascending binary count to the five address lines. The ascending count is delivered by a down counter formed by IC2 and IC3-a. The address counter is clocked by a beat generator, IC1. The beat-generator

PARTS LIST

All resistors are ¼-watt, 10%, unless noted

R1, R12—6.8 megohms, 5%
R2, R27, R28—100,000 ohms
R3, R6, R16, R18, R21, R30, R31, R32, R33, R34, R35, R36, R37, R39—1,000 ohms
R4, R5—330 ohms
R7, R19, R20—10,000 ohms, 5%
R8—500,000 ohms trimmer potentiometer
R9—27,000 ohms
R10, R11, R38—470,000 ohms, 5%
R13—820,000 ohms, 5%
R14, R24—4.7 megohms, 5%
R15, R25—2.7 megohms, 5%
R17—3.9 megohms, 5%
R22—4,700 ohms
R23—50,000 ohms trimmer potentiometer
R26—2.2 megohms
R29—33,000 ohms, 5%
C1, C3, C11, C18—.047 μF polyester film
C2, C6, C7, C10, C13, C14, C15, C20—.1 μF polyester film
C4, C5—2 μF, 10 volt electrolytic
C8—220 μF, 10 volt electrolytic
C9—300 pF ceramic
C12—.0047 μF polyester film
C16—2,200 μF, 16 volt electrolytic
C17, C19—20 μF, 10 volt electrolytic
IC1—555 timer
IC2—7493 TTL
IC3—7473 TTL
IC4—7405 TTL
IC5—3900 linear quad amplifier
IC6—8223 PROM (un-programmed)
IC7—7420 TTL
IC8, IC9—74193 TTL
IC10—74123 TTL
D1, D2, D3, D4—1N4148
D5—1N751A
D6, D7, D8, D9—1N4002
Q1—2N3394
Q2—2N3638
Q3—2N5296
T1—117-volt primary, 6.3-volt @ 0.6A secondary
F1—¼-amp fuse
Misc.—fuse holder, line cord, 8-ohm speaker, cabinet, printed circuit board, wire, solder, hardware.

The following parts may be ordered from Cousino Circuit Company, 3313 Brace Street, Burbank, CA 91504

#K11-EMB—Kit of all items in Electronic Music Box parts list, except miscellaneous items, fuse and transformer. Includes PC board and un-programmed PROM. $36.95 postpaid within USA.

#KHS11-EMB—Same as #K11-EMB except PROM is pre-programmed with "Home Sweet Home" melody. $39.95 postpaid within USA.

#11-EMB—Drilled glass epoxy printed circuit board for Electronic Music Box. $6.95 postpaid within USA.

#K11-PGM—Kit of all parts in parts list for PROM Programmer except miscellaneous items. Includes printed circuit board and programming data for several melodies. $21.95 postpaid within USA.

#11-PGM—Drilled glass epoxy printed circuit board for PROM Programmer. $5.95 postpaid within USA.

California residents add sales tax.

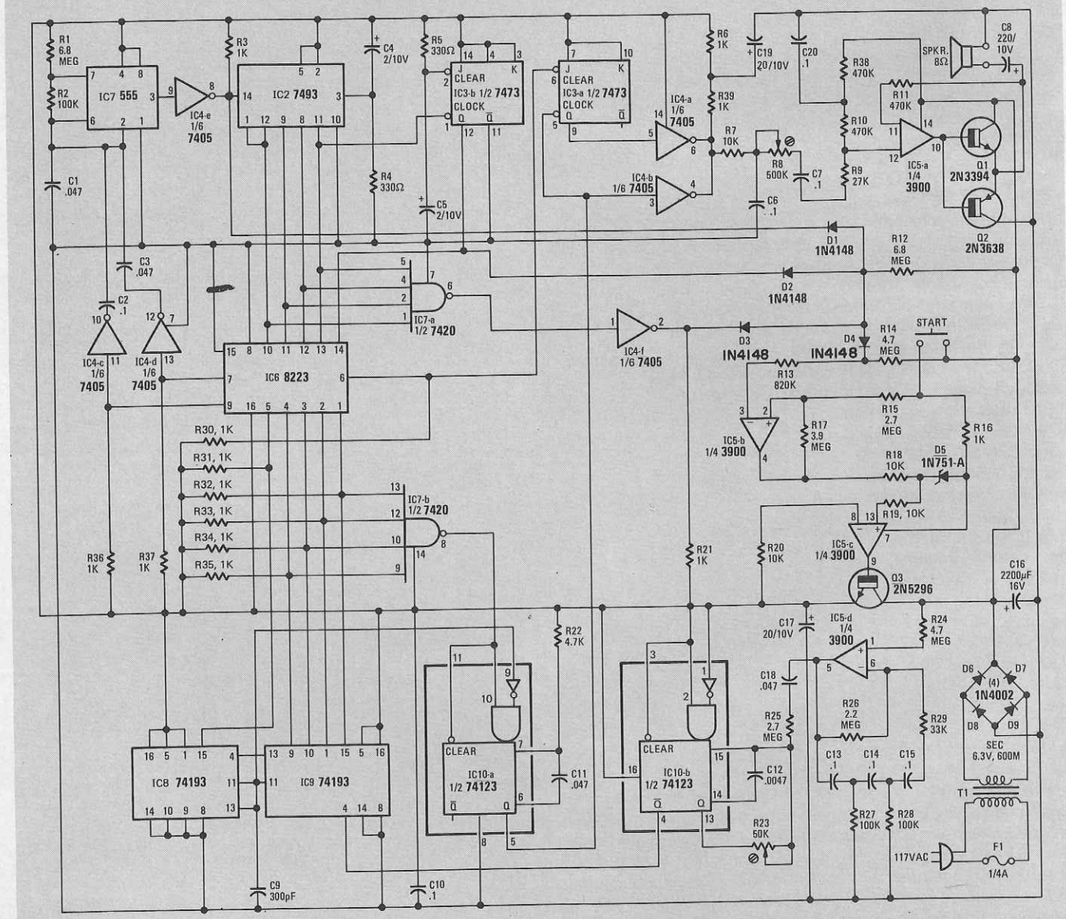


FIG. 1—ELECTRONIC MUSIC BOX schematic diagram.

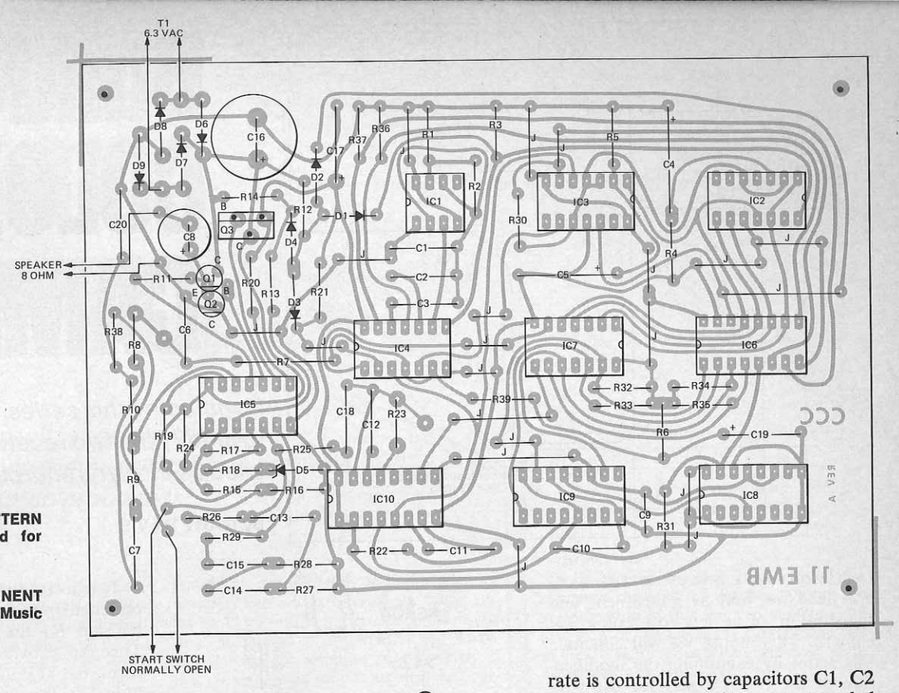
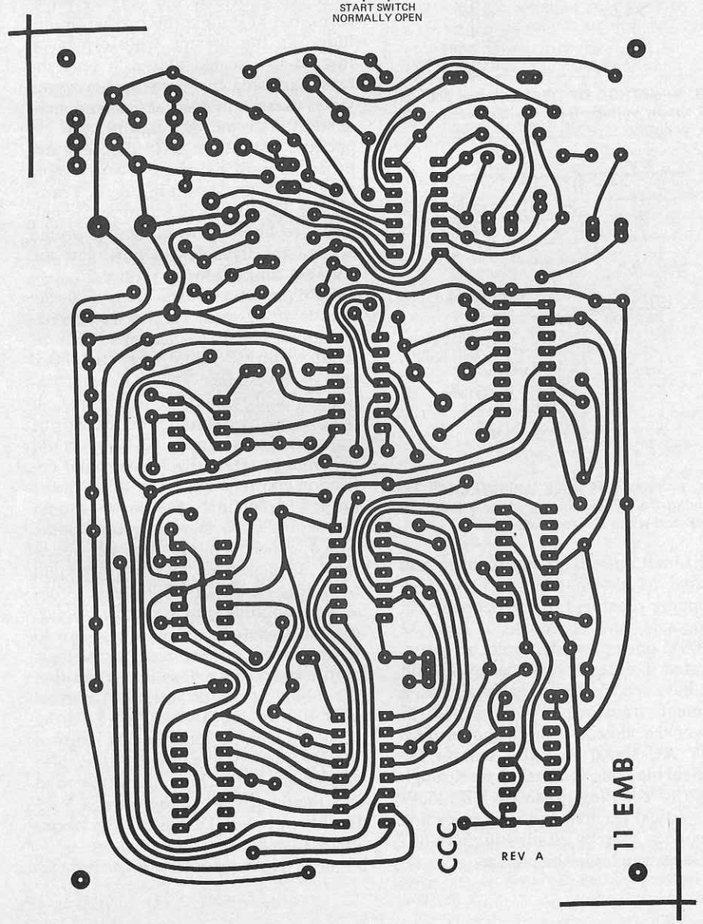


FIG. 2 (below)—FOIL PATTERN of printed circuit board for Electronic Music Box.

FIG. 3 (right)—COMPONENT LAYOUT for Electronic Music Box.



rate is controlled by capacitors C1, C2 and C3. These capacitors are grounded by IC4-c and IC4-d depending upon PROM programming. This controls the duration of time each note is held.

Inverters IC4-a and IC4-b provide an output pulse whether frequency divider IC3-b is enabled or not. This pulse is delayed by R7 and C6, and fed to operational amplifier IC5-a through a volume control R8. This amplifier drives a complimentary transistor pair that is coupled to the output speaker by C8.

Voltage for all IC's is supplied by the regulator consisting of transistor Q3 and operational amplifier IC5-c. The operational amplifiers are connected to the unregulated input voltage and are therefore always on. Operational amplifier IC5-b is connected as an R-S flip-flop. Closing the start circuit drives the output of IC5-b high turning on the voltage regulator supplying 5 volts to the IC's. When the program is finished, all address lines of the PROM go high. The address lines on IC7-a with inverter IC4-f reverse bias diode D3. This along with D2 reverse biased plus the positive going beat pulse on diode D1, causes the IC5-b flip-flop to reset, shutting the unit off.

Construction

In view of the circuit complexity, printed-circuit boards are a must. The PC board layout is shown in Fig. 2 and component location is detailed in Fig. 3. Insert and solder components and jumpers as shown using care to observe the polarities of diodes and capacitors.

(continued on page 104)

Circle 98 on reader service card

ELECTRONIC DOORBELL

(continued from page 35)

ground. Install IC5 with a temporary ground at the junction of D4 and R12. Apply power to the transformer—then press the start button and measure the voltage on emitter Q3. This voltage should be between 4.75 and 5.25 volts. Lift the temporary ground and the voltage should drop to under 0.9, the off condition. Disconnect power and install the remaining IC's, paying particular attention to orientation. The total current drain should not exceed 400-mA on and 10-mA off. Reapply power, press the start button and adjust R23 for a frequency of 21,560 HZ at the Q output of IC10-b. This can also be accomplished by listening to the melody as it is played and adjusting R23.

If you desire your melody played without tremolo, remove R25. Tremolo may also be increased or decreased by a corresponding reduction or increase in resistance of R25. The beat tempo may be changed faster or slower by decreasing or increasing capacitors C1, C2, and C3, respectively. Always maintain the capacitance ratio such that C1 = C3 = C2/2.

(continued next month)

Circle 99 on reader service card

Circle 101 on reader service card