An electronic musical instrument accessory with a difference. Novel programming capabilities give you unusual time signatures along with bridges and introductions.

JOHN S. SIMONTON, JR.

THE PROGRAMMABLE DRUM UNIT DEscribed in this article is used as an add-on to your hi-fi system. It produces percussive sounds that simulate a bass, tom, conga, snare, clave and a wood block. Also, the pattern and rhythm can be stored in memory and played back. But what makes this unit different from other programmable percussion synthesizers?

In the past, percussion units have had three major failings:

1. They do the same thing again and again.
2. They do the same thing again and again.
3. They have no provision for unusual time signatures.

If you wonder why paragraphs 1 and 2 are the same, here's an explanation:

First, except for choosing very generalized and idealized "classic" rhythm patterns, you have no control over the percussion score that is generated. Every time you punch up a tango pattern it will be just like the last tango pattern. Programmability is the obvious key here so that you can produce as many different tango patterns as you wish.

Second, the same pattern repeats, at best, every couple of measures. In real music there are introductions and bridges, etc. This unit takes care of that by providing a BRIDGE key. When this control is activated, instead of repeating the same pattern again, the unit switches to a separate pattern and repeats it as long as the BRIDGE key is activated. When this key is released, the unit shifts back to the first pattern and begins playing it again. The shifting from one pattern to another happens automatically at the repeat points (the end of the pattern), but it can be "forced" to happen anytime.

Every rhythm unit plays $^{2}/_{4}$ time and $^{4}/_{4}$ time with no problems. Some can also play $^{3}/_{4}$ time or $^{6}/_{8}$ time. But none has a provision for even $^{5}/_{4}$ time, which is a pretty common time signature. This new unit can be programmed for any conceivable pattern, no matter how unusual the time signature.

All the control squares on the front panel are nonmechanical touch switches. Even the slightest touch of the finger activates them.

Drum oscillators

Figure 1 shows a schematic drawing of the five drum oscillators, the voiced noise source and buffer amplifier. All eight current differencing amplifier stages used in this circuitry are contained in two quad amplifiers, IC1 and IC2.

All drum oscillators are parallel-T filter sections, typified by the Wood Block oscillator built up around IC1-a. The parallel-T filter section, consisting of R3, R4, R5, C1, C2 and C3, has a band-reject notch characteristic which, when placed in the negative feedback loop of the amplifier, produces a bandpass filter. Activating pulses from the memory are coupled to the oscillator (filter) by C4 and R8.

The sustain characteristic of the sound produced (or how long the sound persists) is a function of the gain of the entire section. In the case of the Wood Block oscillator, the gain is set by the secondary feedback loop through C5, R6 and R7. Trimmer resistor R7 sets the amount of signal that is fed back through this loop and, consequently, the sustain characteristic of the entire stage.

The remaining Clave, Tom, Conga and Bass oscillators are built around IC1-b, IC1-c, IC1-d and IC2-c, respectively. These operate in the same manner with different component values (or sustain control settings) to produce different drum sounds. All the drum oscillators share a common bias source consisting of R1, R2 and bypass capacitor C57.

The snare sound is generated by the noise voicing circuit comprising IC2-b, IC2-a and associated circuitry. Noise is produced by the avalanching reverse-biased base-emitter junction of transistor Q1 and coupled to gating amplifier IC2-b by R44 and C26. When not activated, the output of IC2-b is held at the upper supply voltage by the current flow into the noninverting input of IC2-b through

R47, R48 and R50. Under these saturated conditions, no signal can pass through the amplifier. A negative-going pulse applied to R49 activates the Snare output by causing C29 to discharge slightly. This results in a decreased current flow through R50 into the amplifier's noninverting input and allows the amplifier to come out of saturation. When the activating pulse ends, C29 slowly charges through R47 and R48 until the amplifier returns to a saturated condition. The noise signal is coupled to the filter section consisting of IC2-a and associated components where the low-frequency components are attenuated to simulate the snare sound.

The signals from all the drum oscillators and noise source are summed together by resistors R9, R17, R25, R41 and R53 and applied to the input of the buffering amplifier IC2-d. The buffer-amplifier output is the output of the drum unit.

The power supply is shown in Fig. 2. The 6-volt supply is decoupled from the digital portion of the circuitry by R126 and C56 and applied to the drum oscillator circuits IC1 and IC2. Power to all of the logic, with the exception of the memories, passes through D40, which provides a 0.7-volt drop, leaving slightly over 5 volts to power the logic. Similarly, power to memories IC14 and IC15 passes through D41, leaving slightly over 5 volts to power these IC's. Closing the SAVE switch allows a reduced keep-alive voltage to be applied to the memory IC's by way of diodes D42–D47, while turning off power to the remainder of the circuitry.

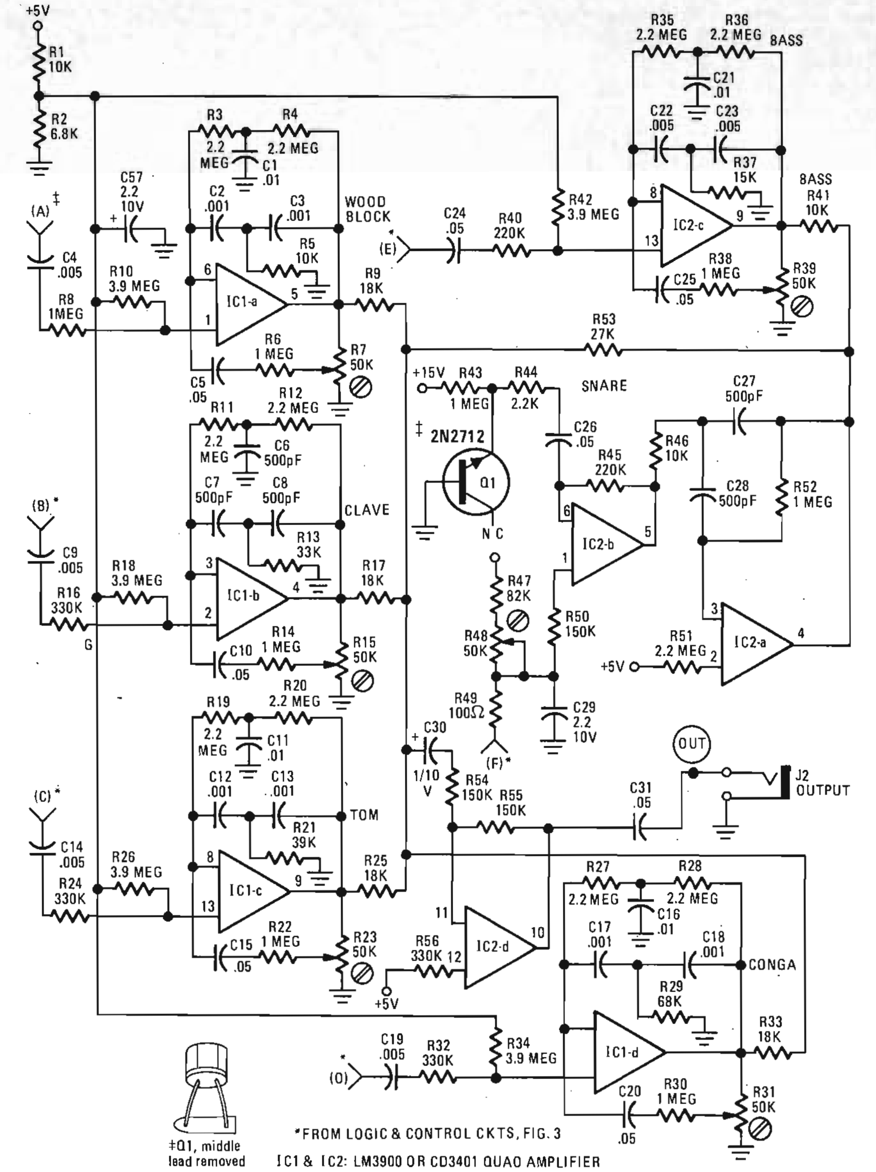


FIG. 1—DRUM OSCILLATORS. Transistor Q1 is selected for maximum noise.

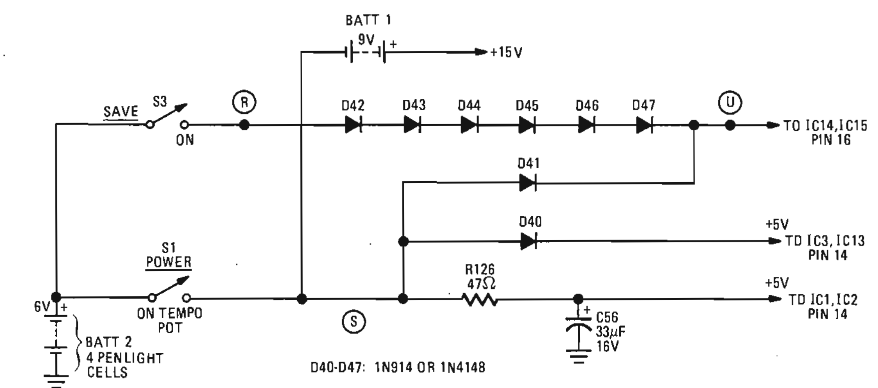


FIG. 2—POWER SUPPLY. Switch S3 permits the unit to be turned off without losing the contents of memory.

Touch switches

The bulk of the touch-switch circuitry is shown in Fig. 3. Two gates from CMOS quad NOR gate IC3 are connected together along with R68 and C34, to form an astable multivibrator that generates a 50 kHz squarewave. After being buffered by IC3-c these squarewaves serve as a common clock to all the touch-switch drivers, IC4, IC5, IC6, IC7, IC8 and IC9.

For example, when the SNARE switch is not activated, the squarewave signal from IC3-c is applied to the two inputs of gate IC8-a, which serves as an inverter. The resulting squarewave signal at the output of IC8-a charges C44 through D19. With this capacitor charged to the supply voltage, the output of inverter IC8-b is at a logic-low level—essentially ground—and the switch can be considered off.

Placing a finger on the SNARE touch pad at pin 6 of IC8 has the effect of placing a capacitor of several picofarads from this pin to ground. During the logic-high half-cycles of the squarewave clock, this capacitance is through D18, but during low half-cycles, the only discharge path for the capacitor is through R86. The net result is a charge build-up on IC8-a pin 6 that holds this pin at a logic-high level and, consequently, the output (pin 4) at a low level. With D19 now reverse-biased, C44 discharges through R87. The output of IC8-b then switches to a logic-high level. Removing your finger allows the output of IC8-a to once again switch at the clock rate, allowing C44 to charge and the IC8-b output to once again switch low.

The remaining stage of IC3 along with R69 and C35 forms a debounce circuit that momentarily turns off the clock buffer when a switch is released.

Memory-control logic

At the heart of the memory-control logic circuitry are the 2112-type memory

All resistors ½ watt, 10% or better, unless noted.
R1, R5, R41, R46, R58, R60, R62, R64, R67, R121, R127—10,000 ohms
R2, R65—6800 ohms
R3, R4, R11, R12, R19, R20, R27, R28, R35, R36, R51—2.2 megohms
R6, R8, R14, R22, R30, R38, R43, R52—1 megohm
R7, R15, R23, R31, R39, R48—50,000-ohm trimmer, PC mount
R9, R17, R25, R33—18,000 ohms
R10, R18, R26, R34, R42—3.9 megohms
R13, R108, R110, R112, R115, R117, R122-R125—33,000 ohms
R16, R24, R32, R56—330,000 ohms
R21—39,000 ohms
R29, R57, R61, R63—68,000 ohms
R37, R101-R104, R106, R107, R118—15,000 ohms
R40, R45, R114—220,000 ohms
R44, R113, R128, R129—2200 ohms
R47, R116—82,000 ohms
R49—100 ohms
R50, R54, R55, R119—150,000 ohms
R53—27,000 ohms
R66, R94-R100—47,000 ohms
R68, R105—4700 ohms
R69-R93—680,000 ohms
R109, R120—470,000 ohms
R126—47 ohms
R130—500,000-ohm log-taper potentiometer with SPST switch
C1, C11, C16, C21, C33, C48, C54, C55—.01µF, 50 volt, ceramic disc
C2, C3, C12, C13, C17, C18, C34, C52—.001µF, 50 volt, ceramic disc
C4, C9, C14, C19, C22, C23, C32, C35-C47, C49—.005µF, 50 volt, ceramic disc
C5, C10, C15, C20, C24-C26, C31—.05µF, 50 volt, ceramic disc
C6-C8, C27, C28—500 pF, 50 volt, ceramic disc
C29, C57—2.2µF, 10 volt, electrolytic
C30, C50, C51-1µF, 10 volt, electrolytic
C53-100 pF, 50 volt, ceramic disc
C56-33µF, 10 volt, electrolytic
D1-D47-1N914 or 1N4148
LED1, LED2-light-emitting diodes (Texas Instruments TIL209B or equal)
Q1-2N2712 specially selected noise transistor
Q2-Q8, Q11, Q12-2N5129
Q9, Q10-2N5139
IC1, IC2-LM3900 or CA3401
IC3-IC11-CD4001 quad NOR gate
IC12-CD4024 seven-stage counter
IC13-CD4013 dual-D flip-flop
IC14, IC15.-2112 256×4 RAM
S1-SPST switch ONR130
S2-SPST momentary-contact pushbutton
S3, S4-SPST slide switches
J1-insulated tip jack, red
J2-2-conductor phone jack
Misc.-two 9-volt battery clips, one battery holder for 4 penlight cells (Keystone type-182 or equiv.), one lug-type terminal strip (one lug grounded, two insulated).

The following are available from Paia Electronics, 1020 Wilshire, Oklahoma City, OK 73116:
Order No. 3750—Complete kit including all parts, case, step-by-step instructions. $79.95 plus $3.00 shipping.
Order No. 3750PC—Set of two etched, drilled and silkscreened circuit boards. $15.00 plus $1.00 shipping.
Oklahoma residents add state and local taxes as applicable.

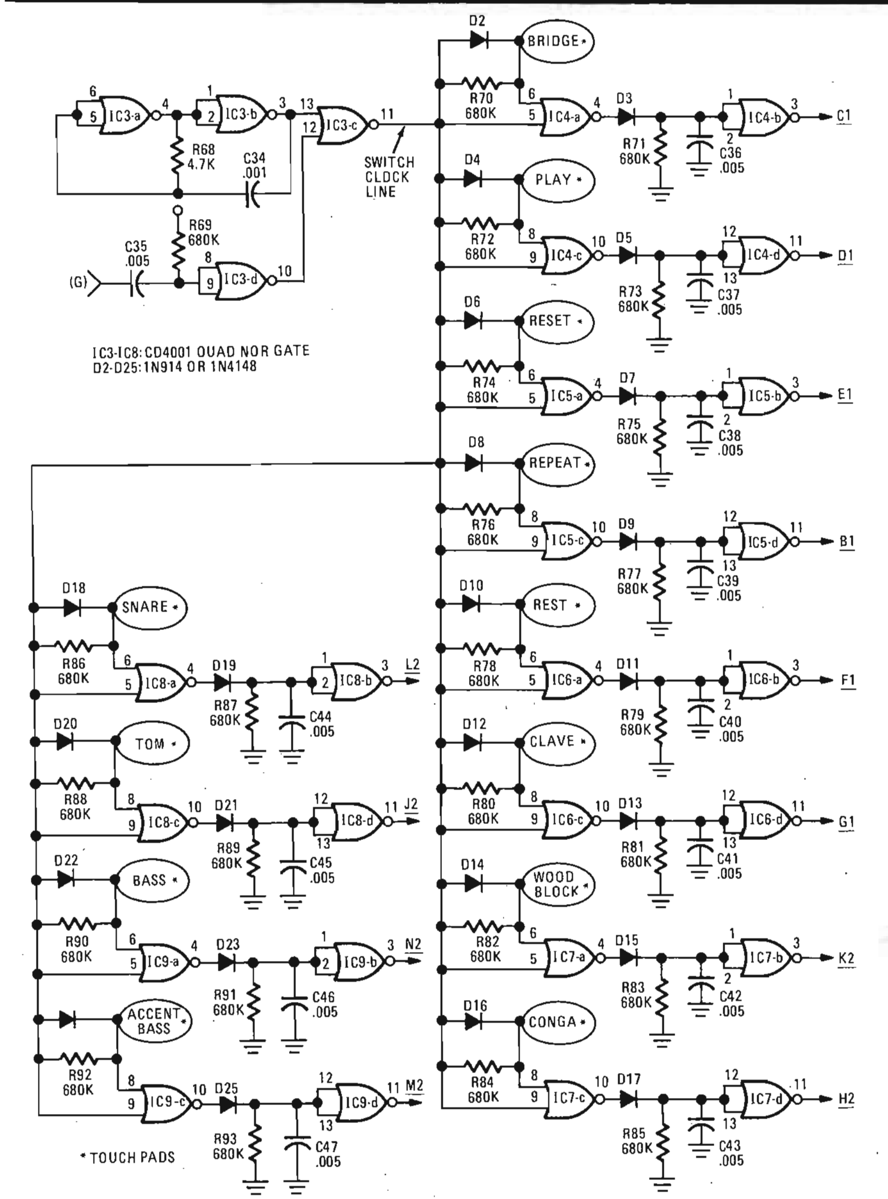


FIG. 3—TOUCH SWITCHES are capacitive sensitive. An earth ground must be provided for the unit for the switches to operate properly. This is usually provided by the shield of the output cable.

IC's 14 and 15. (See Fig. 4.) Each IC represents 1024 bits of memory organized as 256 4-bit words. The two IC's together, then, represents 256 8-bit words. Each bit in the word represents either a drum sound or a signal to reset the rest of the circuitry to the beginning of the pattern. A logic 1 stored in memory causes the corresponding drum to sound, and, if a logic 0 is written in a given memory location, then that location represents a rest.

Six address bits are supplied to the memory by counter IC12. The remaining two address bits are select lines that select one of four pages of memory. The first of these page-select lines originates at switch S4, while the second originates at bridge-select flip-flop IC13.

When the RESET pad is touched, several things happen simultaneously. The read/write (R/W) memory line goes high and the memory is in the read state. The address counter IC12 is also reset to address 000000. Flip-flop IC13-a is reset so that its $\overline{Q}$ output goes high keeping the tempo clock from running. Finally, a clocking pulse is applied to flip-flop IC13-b so that the current state of the BRIDGE-SELECT touch pad appears at the Q output of IC3-b.

Touching the PLAY pad causes the $\overline{Q}$ output of IC13-a to go low, which causes the tempo clock (IC10-a and IC10-b) to begin generating squarewaves at a rate set by TEMPO control R130. This clock signal is coupled by D38 to the input of inverter/buffer IC10-c, and in turn to address counter IC12, making it advance by one count for each cycle of the clocking waveform. Simultaneously, differentiating network R119, R120 and C52, buffered and inverted by IC10-d, produces a short pulse that activates the $\overline{CE}$ input pins of the memories. When taken to a logic-low level, these $\overline{CE}$ pins cause the data stored

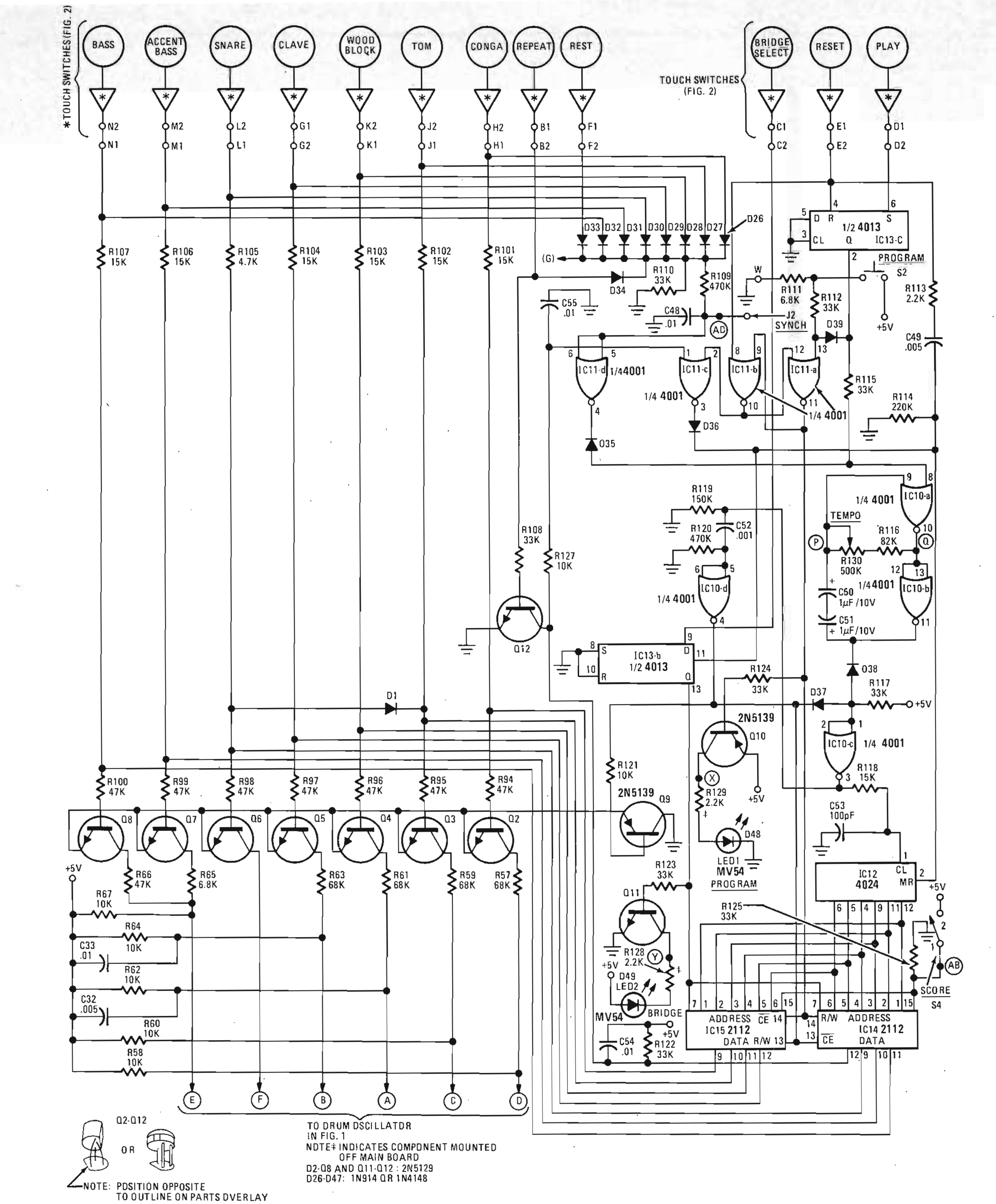


FIG. 4—LOGIC AND CONTROL circuitry. Memory is provided by two 2112-type RAM's.

in the memories at the location specified by the address lines to appear at the output of the memories and are fed to transistors Q2–Q8.

If the data stored is for a drum sound, one of the transistors Q2–Q8 is turned on, providing an activating pulse to the drum oscillators. If the data stored is a repeat, this data (a logic 0) is applied to the collector of Q12 (which will be cutoff under these conditions) and through R127 to one of the IC11-c inputs, causing this gate's output to go high. This produces the same effects as the RESET pad except that the Play flip-flop (IC13-a) is not reset.

If the BRIDGE-SELECT pad had been touched at the time the repeat data occurred, the output of bridge-select flip-flop IC13-b would have changed state, selecting the page of memory corresponding to the setting of the front-panel SCORE switch S4.

continued next month

BUILD

Part II—*An electronic musical instrument accessory with a difference. Novel programming capabilities give you unusual time signatures along with bridges and introductions.*

JOHN S. SIMONTON, JR.

LAST MONTH, AS WE BEGAN THE STORY ON this unique musical instrument accessory, we covered its applications, circuitry and theoretical operation. Now, we'll go forward with construction details. A PC board simplifies construction.

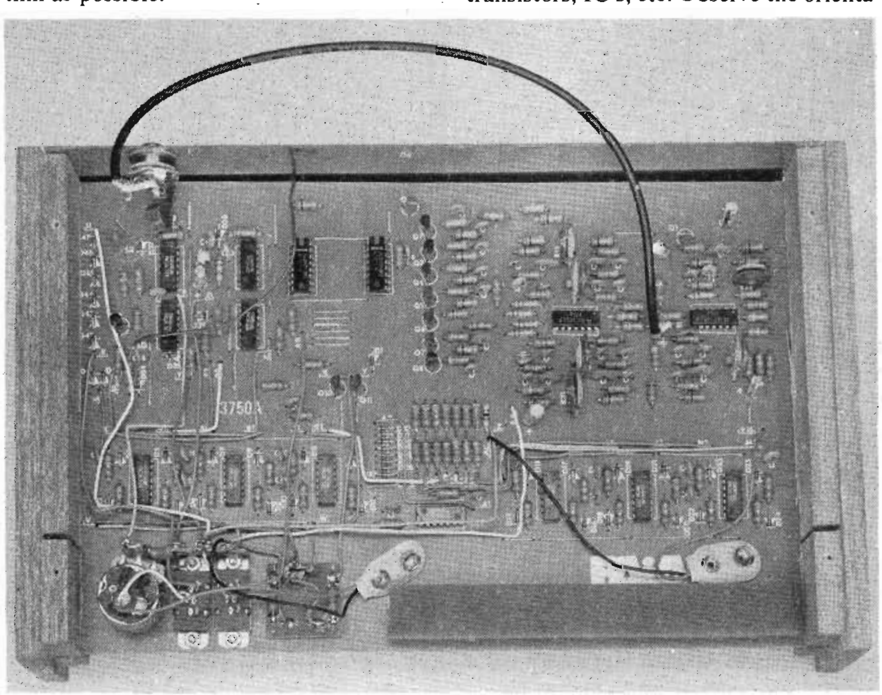
Assembly

For easy assembly, the drum set has been designed so that *everything,* except for the audio output jack and the sync input tip jack, mount directly on the circuit board. This minimizes point-to-point wiring (although there is still some) and produces an exceptionally easy unit to work on. For all practical purposes there are no wires tying the circuit board to panel-mounted controls; in fact, the case is simply a shell to hide the components.

A circuit board is mandatory. You can etch your own PC board using Fig. 5 as a guide. Boards are also available commercially, as are complete kits (see parts list.)

Note that the touch-switch pads that form the bulk of the unit controls are a part of the PC board. In the commercial version of this board, the touch pads are covered with a colored ink; contrasting color designates the control areas. If you make this board at home, transfer lettering can be applied directly to the touch pads and a strip of thin transparent tape applied over that. Since the touch switches do not require direct contact to operate, the insulating layer provided by the tape will suffice but it must be kept as thin as possible.

Once you have the board the way you want it, mount the parts: Resistors and capacitors first; then solid wire jumpers (note there are several of these, as indicated by the solid lines connecting points in Fig. 6); then semiconductors, diodes, transistors, IC's, etc. Observe the orienta-



INSIDE VIEW OF THE UNIT shows how parts are positioned on the circuit board. Note that this is a one-sided board.

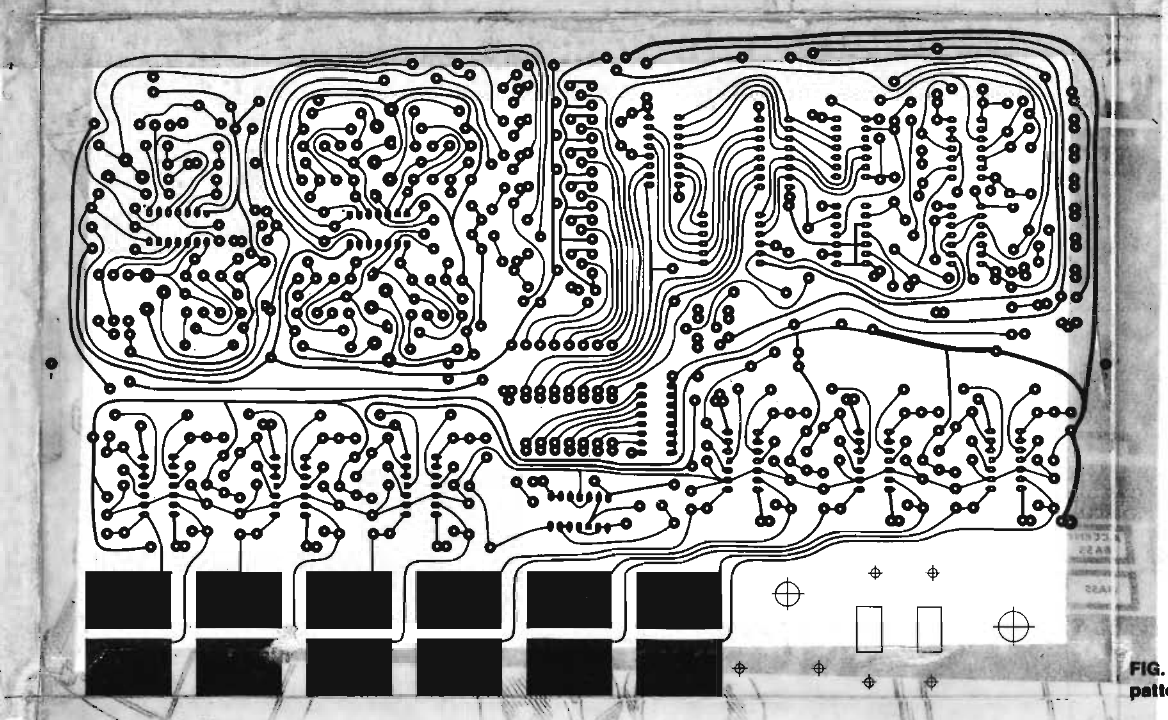


FIG. 5—MAIN PC BOARD foil pattern shown half-size.

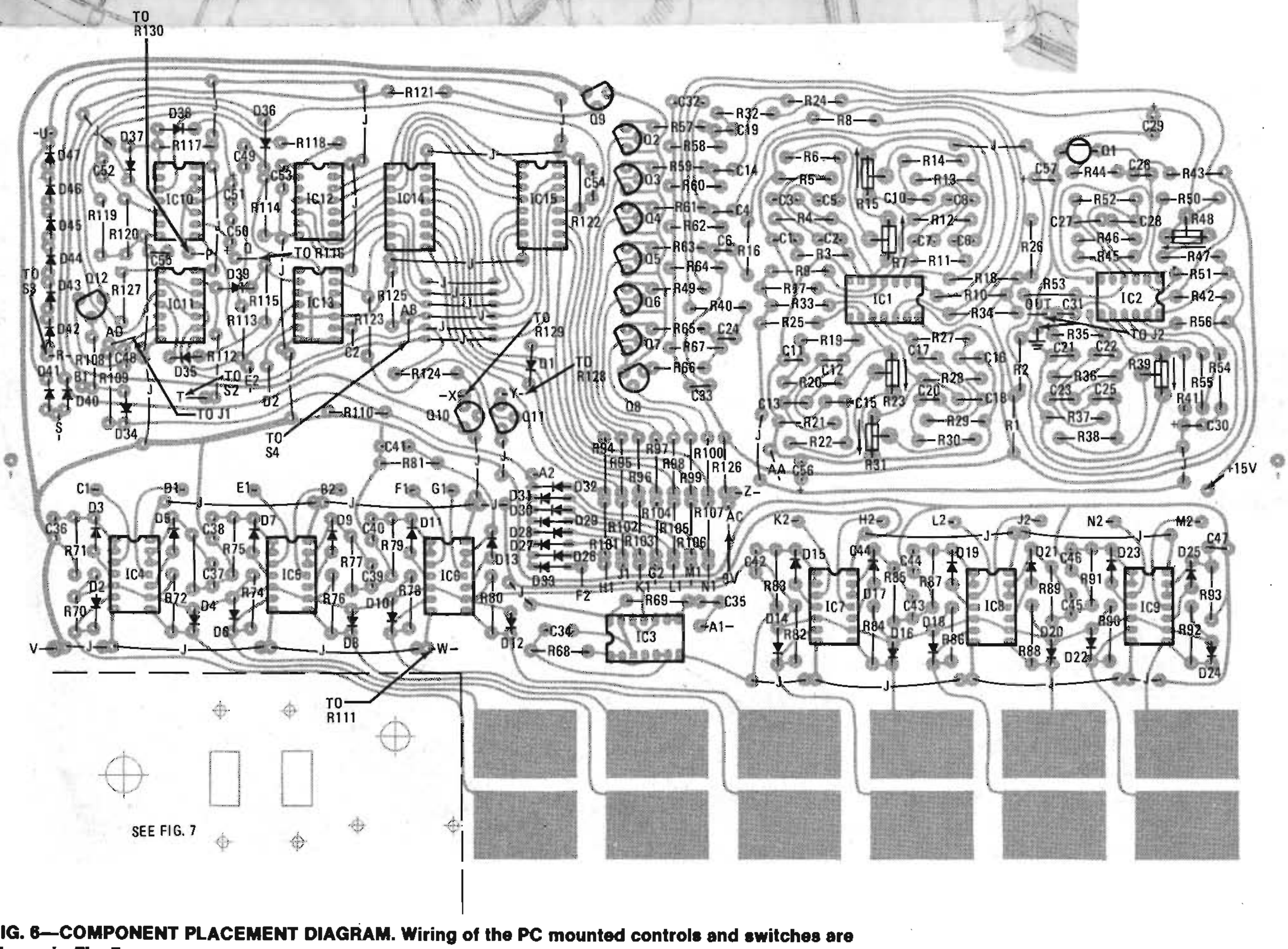


FIG. 6—COMPONENT PLACEMENT DIAGRAM. Wiring of the PC mounted controls and switches are shown in Fig. 7.

tion of electrolytic capacitors, semiconductors and IC's.

Because CMOS logic is used, the common rules of good practice must be followed when installing these parts. In general, avoid static build-up—Do not wear nylon clothes, use a grounded soldering iron and don't run across the carpet before picking up the parts.

After mounting all the electronic components, mount potentiometer R130 and slide switches S3 and S4. Mount a 3-lug tie strip somewhere in the vicinity of these controls (such as under one of the S4 mounting screws as shown in Fig. 7). Note that the two PROGRAM and BRIDGE LED's are mounted on their own circuit board. The foil pattern for the LED board is shown in Fig. 8. This board also mounts resistors R128 and R129 and is held in place by the mounting shaft of PROGRAM pushbutton S2, as shown in Fig. 9.

There are numerous connections that are made with stranded, insulated wire on the component side of the circuit board. Points with the same letter prefix are connected together (A1 to A2, etc.).

All resistors ½ watt, 10% or better, unless noted.
R1, R5, R41, R46, R58, R60, R62, R64, R67, R121, R127—10,000 ohms
R2, R65—6800 ohms
R3, R4, R11, R12, R19, R20, R27, R28, R35, R36, R51—2.2 megohms
R6, R8, R14, R22, R30, R38, R43, R52—1 megohm
R7, R15, R23, R31, R39, R48—50,000-ohm trimmer, PC mount
R9, R17, R25, R33—18,000 ohms
R10, R18, R26, R34, R42—3.9 megohms
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R47, R116—82,000 ohms
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R53—27,000 ohms
R66, R94-R100—47,000 ohms
R68, R105—4700 ohms
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R109, R120—470,000 ohms
R126—47 ohms
R130—500,000-ohm log-taper potentiometer with SPST switch
C1, C11, C16, C21, C33, C48, C54, C55—.01μF, 50 volt, ceramic disc
C2, C3, C12, C13, C17, C18, C34, C52—.001μF, 50 volt, ceramic disc
C4, C9, C14, C19, C22, C23, C32, C35-C47, C49—.005μF, 50 volt, ceramic disc
C5, C10, C15, C20, C24-C26, C31—.05μF, 50 volt, ceramic disc
C6-C8, C27, C28—500 pF, 50 volt, ceramic disc
C29, C57—2.2μF, 10 volt, electrolytic
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C53-100 pF, 50 volt, ceramic disc
C56-33μF, 10 volt, electrolytic
D1-D47-1N914 or 1N4148
LED1, LED2-light-emitting diodes (Texas Instruments TIL209B or equal)
Q1-2N2712 specially selected noise transistor
Q2-Q8, Q11, Q12-2N5129
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S1-SPST switch ONR130
S2-SPST momentary-contact pushbutton
S3, S4-SPST slide switches
J1-insulated tip jack, red
J2-2-conductor phone jack
Misc.-two 9-volt battery clips, one battery holder for 4 penlight cells (Keystone type-182 or equiv.), one lug-type terminal strip (one lug grounded, two insulated).

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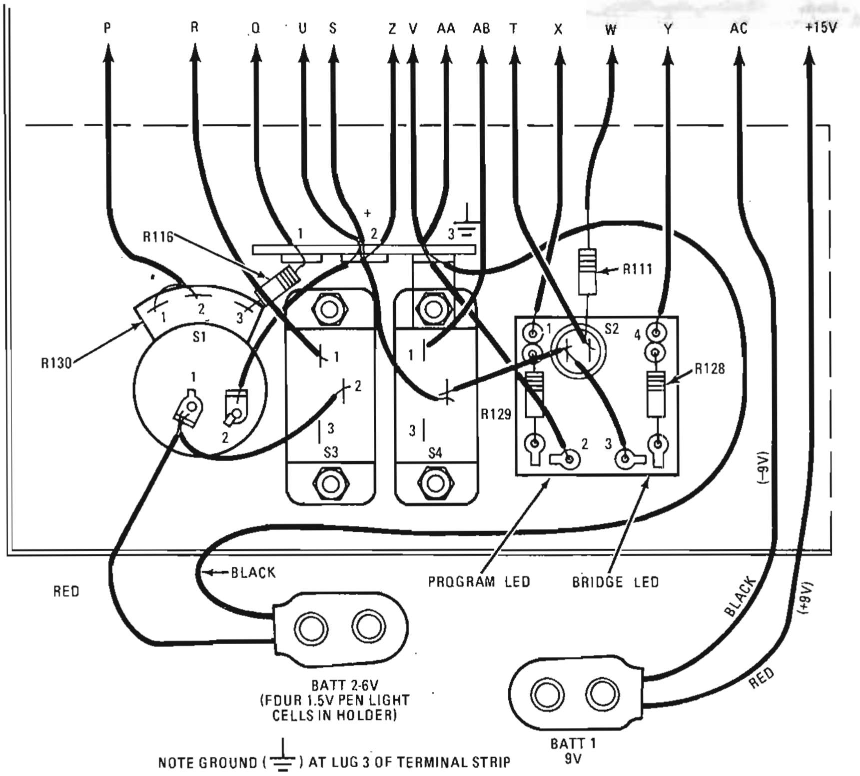

FIG. 7—CONTROLS AND SWITCHES are mounted on the main PC board. Point-to-point wiring to the main board is shown in Fig. 6.

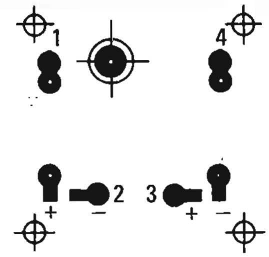

FIG. 8—LED BOARD foil pattern shown full size.

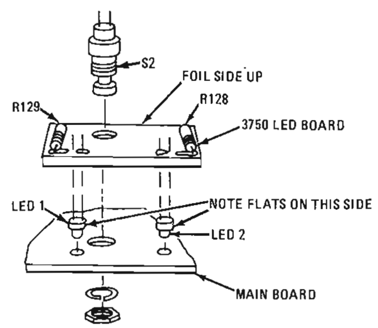

FIG. 9—LED BOARD is mounted directly to the main PC board. Point-to-point wiring to main PC board is shown in Fig. 7. Components are mounted on foil side of board.

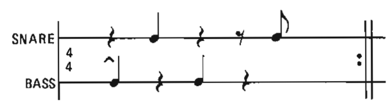

FIG. 10—FOX TROT is used as a programming example in text.

There are 13 pairs of these points, designated from A to N (except for I).

Finally, perform the wiring between the controls and the remaining designated points on the circuit board and install the battery snaps, as shown in Fig. 7.

Testing and calibration

The capacitive touch switches used in the programmable drum set require a moderate-quality earth ground to operate properly. In most cases, the ground established to the amplifier through the audio output cable will suffice.

After carefully checking for misplaced components, solder bridges and cold solder joints, turn the TEMPO control fully counterclockwise past the "click" and turn all six internal trimmer potentiometers (R7, R15, R23, R31, R39 and R48) to their minimum sustain position (*opposite* the direction of the arrows in Fig. 6). Place the SCORE switch in the 1 position and turn the SAVE switch off.

Load the 6-volt battery pack with four AA penlight cells, making sure to observe the orientation of the batteries. Connect this battery pack to the snap attached to the on-off switch on the TEMPO control. Connect another 9-volt transistor radio battery to the remaining snap (see Fig. 7).

Using a jumper cable, connect the phone-jack output of the drum set to an instrument amplifier or the auxiliary input of a hi-fi amplifier.

Turn the power on by advancing the TEMPO control clockwise. When the unit is first turned on, you may (if the volume of the amplifier is set high enough) hear a burst of noise lasting about one second. This is normal.

One or both LED's may also come on when power is first applied. Touching the RESET pad should extinguish these LED's.

To test the drum oscillator circuits sustained-oscillation capability, advance the internal trimmers one at a time in the sustain direction (the direction of the arrows) until the drum circuits start oscillating. Once you have established that an oscillator is capable of sustained operation, retard its trimmer control fully (*opposite* the direction of the arrow) before testing the next oscillator. *Note* that trimmer R48 is an adjustment of the noise source used in the snare drum circuits; it does not produce a tone but rather a steady hiss as it is advanced.

To adjust the drum sound oscillators, touch RESET and then press the PROGRAM button. The PROGRAM LED then indicates that you are in the program mode. Advance the TEMPO control clockwise approximately three-fourths of its total rotation.

At this point, pressing any of the drum sound pads should produce a repeating percussion sound in the amplifier's speaker. Adjust the rate at which this sound repeats with the TEMPO control.

With a finger on the WOOD BLOCK pad, adjust trimmer R7 in the sustain direction (the direction of the arrow) until the sound approximates that of a wood block.

Similarly, touch CLAVE and adjust R15; touch TOM and adjust R23; and touch CONGA and adjust R31. Touch ACCENT BASS and adjust R39; then touch BASS and confirm that the bass drum sound is heard, although at a lower volume level than ACCENT BASS.

Touch the SNARE pad and adjust R48 until the noise source approximates that of a snare drum. It may be necessary to adjust TOM control R23 to obtain the maximum realism from the SNARE generator.

Touch RESET and the PROGRAM LED goes off (this resets the unit's internal event counter to zero); then press PROGRAM again to reactivate the PROGRAM LED. Tap each drum sound control pads in turn, ACCENT BASS, TOM, CONGA, CLAVE, BASS, SNARE, WOOD BLOCK and REST. Do not hold these pads down long enough for the sound to repeat, only long enough for a single drum sound to be generated. Finally, touch the REPEAT pad (to indicate the point at which the pattern is to repeat) and, finally, the PLAY pad. At this point the drum set should begin playing back the entered pattern.

Having verified the unit's ability to store a program, you are ready to test the bridge pattern. Reset the unit, and while resting a finger on the BRIDGE pad, touch RESET again. (Note: The activation of the bridge circuit is sequence-sensitive; this can only be activated by touching RESET *while* the BRIDGE pad is being touched). The BRIDGE LED will come on, indicating that you are in the bridge mode. Push the PROGRAM button (observing that the PROGRAM LED lights), and you are ready to program the bridge.

Program some easily recognized pattern (such as four clave beats) then touch REPEAT and RESET.

Touch PLAY, and the test pattern of all drum sounds programmed previously should be heard. Allow this pattern to play for a couple of cycles, then touch BRIDGE. When the pattern playing reaches the repeat stage, the unit should switch to the bridge pattern (as indicated by the BRIDGE LED lighting) and, as long as the pad is touched, should continue to play. Release the BRIDGE pad. The BRIDGE LED may not immediately extinguish, and the unit may not immediately shift back to the main pattern. This shift should only occur at the point in the bridge pattern where it would ordinarily repeat.

Using the drum set

Before discussing the operation and use of the controls, the following points need mentioning:

1. Battery current drain is a significant 100 mA in full operation and 30 mA in the SAVE mode. Therefore, use the SAVE sparingly and turn the unit off when not in operation. The penlight batteries should be good for ten hours of intermittent operation, and the 9-volt transistor radio battery should have essentially shelf life.

2. There is a natural tendency to enter patterns "in tempo" by beating out the rhythm on the touch switches. *This is not the way that it is done.* Any pattern must have REST's entered with it for proper drum-beat spacing.

The operation of the controls is as follows:

- TEMPO—This knob, at the right-hand edge of the control panel, sets the tempo at which a programmed rhythm pattern plays back. Clockwise rotation of the control increases the tempo.

The power switch is a part of this control, and rotating the control fully counterclockwise past the "click" turns off the power. The power should be turned off any time that the unit is not being played or programmed.

The TEMPO control also sets the rate at which drum sounds are repeated during programming. In the program mode, continuously activating a drum pad will cause that sound to be repeated at a rate set by the TEMPO control. Each drum sound heard will also be entered into memory.

- SAVE—The SAVE switch holds a programmed pattern for short periods of time. Sliding the SAVE switch to the on position allows the TEMPO control to be rotated to the full-power off position without losing the scores currently programmed into memory. The SAVE switch should be left off any time it is not being used to actually save a score.
- SCORE—The SCORE switch allows two independent rhythm patterns (each with its own bridge pattern) to be programmed and selected for playback.
- PROGRAM—Pressing the PROGRAM pushbutton puts the unit into the programming mode for pattern entry or modification. The PROGRAM LED will light anytime the unit is in the programming mode.
- CONTROL—There are four touch pads: RESET, REPEAT, PLAY and BRIDGE. Get in the habit of touching the RESET pad every time before anything else is activated. This control resets the internal event counter that determines the next programmed event; it also takes the unit out of the program or bridge modes.

The primary function of the REPEAT pad is to enter into memory the point at which the currently programmed pattern is to repeat. This pad can also be used during playback to go back to the beginning of a pattern without stopping the unit entirely. This is useful for special effects, introductions, etc.

Touching the PLAY pad reproduces the programmed pattern selected by the SCORE switch at a rate set by the TEMPO control. This control pad latches so that a single tap will start the unit, which will then continue to play until stopped by touching the RESET pad.

The BRIDGE pad is used one of two ways, depending on whether you are programming a score or playing one back. To program the bridge, the following sequence must be followed: RESET (*always* reset before anything else), then while touching the BRIDGE pad, tap the RESET again (the BRIDGE LED should light, indicating the bridge mode); then push PROGRAM (the BRIDGE LED should still be on) and now the PROGRAM LED should light indicating the program mode. The bridge pattern can then be programmed in the same manner as a main score.

During playback, touching the BRIDGE pad *at the time of the repeat* will cause the drum circuitry to begin playing the bridge rather than the main score. The BRIDGE key does not latch, and you must touch it at the time of the repeat in order for the unit to shift to the bridge pattern. When the repeat point of the bridge pattern is reached, the unit will shift back to the main score unless the BRIDGE pad is still being touched, in which case the bridge pattern will be repeated.

- DRUMS—The eight touch pads on the left side of the panel control the drum sounds: BASS, ACCENT BASS (down-beat, etc.), TOM, SNARE, CONGA, WOOD BLOCK, CLAVE and, most important, REST.

continued on page 107

ELECTRONIC DRUMS
continued from page 48

A programming example

For example, Fig. 10 (See page 47.) shows a simple shuffle/fox trot tablature. The most basic principle is that since the shortest note that is used is an eighth note, and since the tempo clock, once set, pulls events out of memory as a constant tempo, each event from memory will represent an eighth note. The quarter-note accented bass will actually be entered into memory as an ACCENT BASS followed by a REST.

To prepare for programming, first touch RESET, press the PROGRAM button (acknowledged by PROGRAM LED), then enter the score on the drum pads like this:

ACCENT BASS/ REST / SNARE / REST / BASS / REST / REST / SNARE and, since this line must be repeated again and again, finish off by touching REPEAT.

Tricks & things

There is more versatility and power in the drum set than the control labeling tends to indicate. Here are some discoveries that we've made; other possibilities are only limited by the imagination of the user.

Using the bridge as an intro—You can begin playing with the bridge rather than the main score by placing the unit in the bridge mode then touching PLAY.

Playing a manual tempo—You can play a score to a manual tempo by tapping on the REST pad in the tempo that you want. Each tap advances the event counter and causes any programmed drum sounds to play. The REST pad can also be used as a nonlatching play key. Simply touch this pad continuously and the unit will play at the rate set by the TEMPO control.

Playing only a portion of a score—The REPEAT pad can be used in the PLAY mode to cause a pattern to begin again before the programmed repeat point is reached. Simply tap the pad. If you are touching the BRIDGE pad at the same time, the unit will switch to the beginning of the bridge.

Editing—Some limited editing is possible by single-stepping to the point to be changed using the REST pad. When you get to the event that is to be changed, put the unit in the program mode (in this case, *do not reset*—simply press the PROGRAM button) and alter the events desired.

External synchronization/manual play—The pin jack on the rear of the case provides a means of either foot-switch controlling the unit or synchronizing to external events. A 5-volt trigger applied to this input causes the clock to run at the rate set by the TEMPO control. If the triggers applied to this input are short, the event counter will advance one event for each pulse. **R-E**