Electronic Percussion Instruments

By CHARLES MULLER, K2UHF

Construction details on battery-powered circuit that produces sound of drum, tom-tom, bongo, and blocks at press of a button.

Fig. 1. A meter case, which measures about 6½ by 5¼ by 2¼ inches, houses 5-transistor, 4-push-button electronic percussion circuits.

THE simple electronic device described here allows anyone to accompany a recording or live music with four different instruments, individually or even simultaneously. The little battery-powered box shown in Fig. 1 can produce the sound of a drum, a tom-tom, a bongo drum, and blocks simply by pressing the right button. It is only necessary to connect the audio output of this unit to a good sound system and the beat of these four percussion instruments can be heard. Each time a button is depressed, the beat of the corresponding instrument is produced, regardless of how long the button is held down. If several or all buttons are depressed simultaneously, all four instruments will be heard. One does not have to have the skill of the drummer, or the tom-tom, bongo, or block player to be able to accompany any kind of music. One merely has to have the right rhythm and the ability to press a button.

The circuits are quite simple and easy to build, there is no critical layout, and all of the components can either be found in a well-stocked junk box or are readily obtainable from any electronics distributor. The unit is particularly suitable for accompanying electronic organs, pianos, or guitar amplifiers, for it supplies the rhythmic beat that enhances the music. When used for more serious purposes, the device is excellent for dubbing drums, tom-toms, or bongos to one's own tape recording of other instruments. This is particularly effective with a stereo tape recorder to add space effects to a mono recording. In addition, the unit can be used to judge the frequency response of audio amplifiers, speakers, and similar devices.

Circuitry

The unit uses four oscillators which are identical, except for the individual component values that make up the frequency-determining and shaping *RC* circuits (Fig. 2). A single transistor with base-to-collector feedback acts as a one-shot twin-T oscillator. This transistor can be a 2N404, 2N107, 2N109, or some similar type. Its collector and base are connected to a − 18-volt source supplied by two 9-volt transistor batteries wired in series. These batteries will last quite a long time since the oscillator draws practically no current, except during the period when it generates its tone output.

The fixed and variable resistors in the emitter serve to control the circuit gain and are adjusted to prevent continuous oscillation. Once *R*4 is set, it need not be adjusted again unless the transistor is replaced. *C*1 is a coupling capacitor and *R*5, *R*6, and *C*2 are the audio output *RC* filter. The actual frequency-determining circuit is composed of the twin-T networks consisting of *R*7, *R*8, *C*3, *C*4, *C*5, *R*9, and *R*10.

The "B−" voltage charges *C*7 through *R*12 until the push-button is depressed. This discharges *C*7 through *R*13 and sets up a brief oscillation in the twin-T networks. The duration depends upon many factors but is primarily determined by the time constants of resistors *R*13, *R*11, and *R*10 and capacitors *C*6 and *C*7. To make the different sounds of the drum or the blocks, for example, not only the duration but also the frequency content of the oscillation must be altered. The latter is accomplished by changing the values of the twin-T components, while duration is controlled as described above. This basic circuit is used four times with different component values, as shown in the parts list of Fig. 2, to produce the four different sounds.

To make the unit versatile enough for almost any audio system, the author decided to add a single stage of preamplification. As shown in Fig. 3, this is a 2N107, simply because this was the handiest type around, although any audio transistor will work equally well. All four oscillator outputs are connected to the summing resistor *R*14. If it is decided not to use an audio amplifier, the same summing resistor should be used as output load for the combined four oscillators. The volume control shown in Fig. 3 is not essential

but very convenient, since it permits the player to use his thumb to control the loudness of his drum, tom-tom, *etc.* while playing along.

The switches and volume control were positioned so that this unit could be played with either hand and the volume control adjusted with the thumb without missing a beat. An inexpensive push-button switch was used which requires about ⅛ inch travel to make contact. If this is too long for fast playing, the spring arm can be adjusted so that the lightest touch makes contact. The plastic box which houses the unit was found at a local electronics distributor but any convenient metal box will do just as well.

The author did not have the facility for making his own printed wiring board, so all parts were mounted on perforated board and wiring was done on the reverse side. (See Fig. 4). To facilitate wiring and debugging, we have laid out each individual oscillator in exactly the same way, side by side with its companions.

Before mounting the components, the board should be fitted to the box. After the board is cut to the right size (approximately 4½ by 6½ inches in the illustrated unit), it is aligned with four spacers which will hold it against the back cover. It is suggested that the circuit for the drum be built first so that the others can be simply copied. The oscillator which generates the sound of the blocks does not use *R6*, *R11*, and *C2*, and this space was used for the preamplifier. We suggest that the drum oscillator and preamplifier wiring be completed first; then connect the wires to the button switch and volume control respectively.

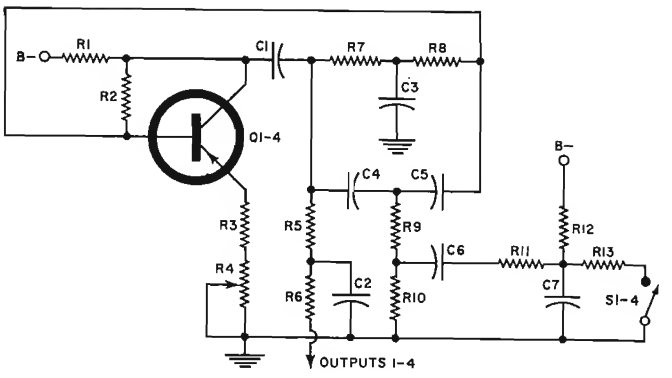
While any two 9-volt batteries can be used, the author prefers the inexpensive type 146 which is also the standard for most transistor radios. Battery clips are connected to the batteries and they are held against the case with a simple clamp made of an aluminum strip, screw, and nut.

Testing

Each of the four circuits can be tested individually. It is necessary to connect this unit to a good audio system since the quality of the audio amplifier and speaker has a great influence on how natural and true the electronic percussion instruments will sound. This is especially true of the drum which will sound really good when the hi-fi system has good low-frequency response.

To begin with, the volume control (*R18*) should be set approximately one-third above ground, and the volume and tone controls of the hi-fi system should be fixed at their mid-range positions. The emitter control (*R4*) of every oscillator should be adjusted for maximum resistance. Repeatedly depressing the button switch of the oscillator under test will permit setting the volume control of the preamplifier and of the hi-fi system to a suitable level—loud enough to simulate the respective instrument but not loud enough to overload the hi-fi system. Next, emitter conrtol *R4* is adjusted gradually until the sound is clearly recognizable. Advancing this control further will cause continuous oscillation regardless of the switch action. Once a good position for emitter *R4* has been found, this pot should not require any further adjustment. A little adjustment of bass and treble controls or the balance controls in stereo systems may help make the sound more realistic.

After the four oscillators have been adjusted and tested, the first practice session can start. The reader who has enjoyed building and using this device may want to experiment with some variations of it. It is possible, for example, to generate a series of drum beats by using a number of counter stages or a separate multivibrator to simulate the roll of a drum. In effect, this employs an electronic circuit to actuate the switch rapidly in succession. By varying component values, the sounds of other percussion instruments can be produced. Different types of drums, cymbals, and even bells can be electronically simulated under push-button control and played through the hi-fi system. ▲

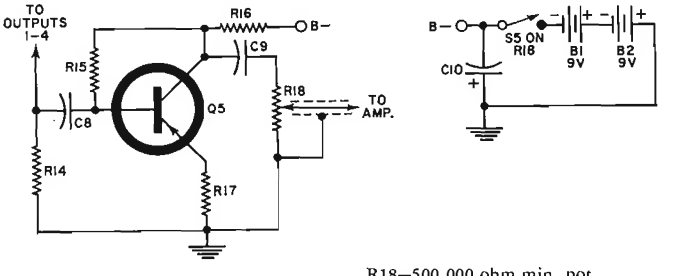


R1—68,000 ohm resistor
R2—1.2 meg resistor
R3—100 ohm resistor
R4—5000 ohm min. pot
R7, R8—56,000 ohm resistor

	DRUM	TOM-TOM	BONGO	BLOCKS
R5—	22,000	82,000	82,000	330,000 ohm res.
R6—	10,000	82,000	82,000	(Not used) ohm res.
R9—	2700	6800	6800	6800 ohm res.
R10—	2200	2200	2200	2200 ohm res.
R11—	82,000	22,000	27,000	(Not used) ohm res.
R12—	1 meg	0.56 meg	1 meg	1 meg ohm res.
R13—	2700	2700	2700	6800 ohm res.
(Note: All resistors are ½ watt, 10%.)				
C1—	.1	.047	.047	.047 μF cap.
C2—	.1	.01	.01	(Not used) μF cap.
C3—	.1	.047	.033	.01 μF cap.
C4—	.1	.027	.015	.0033 μF cap.
C5—	.1	.027	.015	.0033 μF cap.
C7—	.1	.1	.01	.1 μF cap.

C6—0.015 μF capacitor
(Note: All capacitors are dipped Mylar, 100 V.)
S1-4—Push-button switch (Switchcraft 961 or equiv.)
Q1-4—2N404, 2N107, or 2N109 transistor

Fig. 2. Four of these one-shot twin-T oscillators are used.



R14—4700 ohm, ½ W resistor
R15—1.2 meg, ½ W resistor
R16—22,000 ohm, ½ W resistor
R17—100 ohm, ½ W resistor
R18—500,000 ohm min. pot
C8, C9—0.1 μF, 100 V cap.
C10—100 μF, 25 V elec. cap.
B1, B2—9 V transistor battery
Q5—2N107 transistor

Fig. 3. Output of this single-stage preamplifier can be applied to one of the inputs of a musical-instrument amplifier.

Fig. 4. All parts are mounted on perforated board. Components in one of the four identical oscillators and in the preamplifier stage have been called out in this particular illustration.