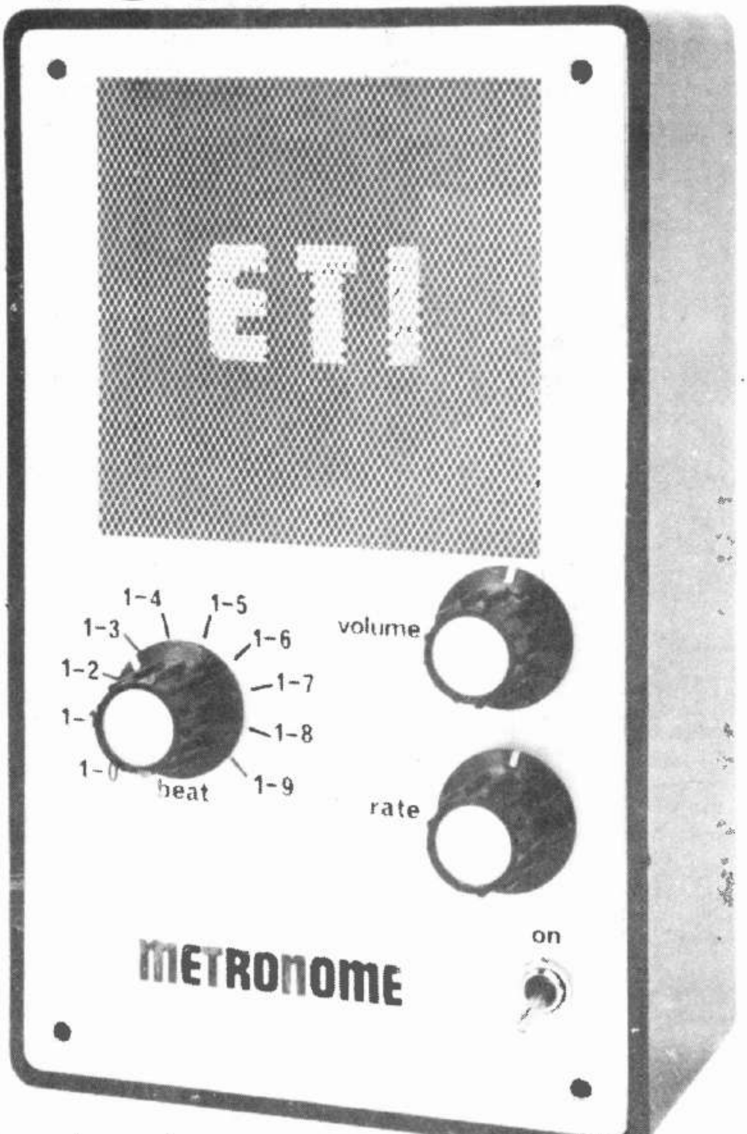
ACCENTUATED BEAT METRONOME

This metronome design accentuates one beat out of every bar to help with complex rhythms



THE THOUGHT of yet another metronome circuit is probably enough to bring tears to the eyes of anyone who has read ETI, or, if you must, any of the other Electronic Magazines over the past few years. The design we present here is, though, a cut above the run of the mill projects that have gone before.

The major advantage of this new circuit is that it will accentuate any particular beat in a bar. Our metronome is designed to help those starting out in music, in whom a sense of rhythm is often lacking.

Accent On Design

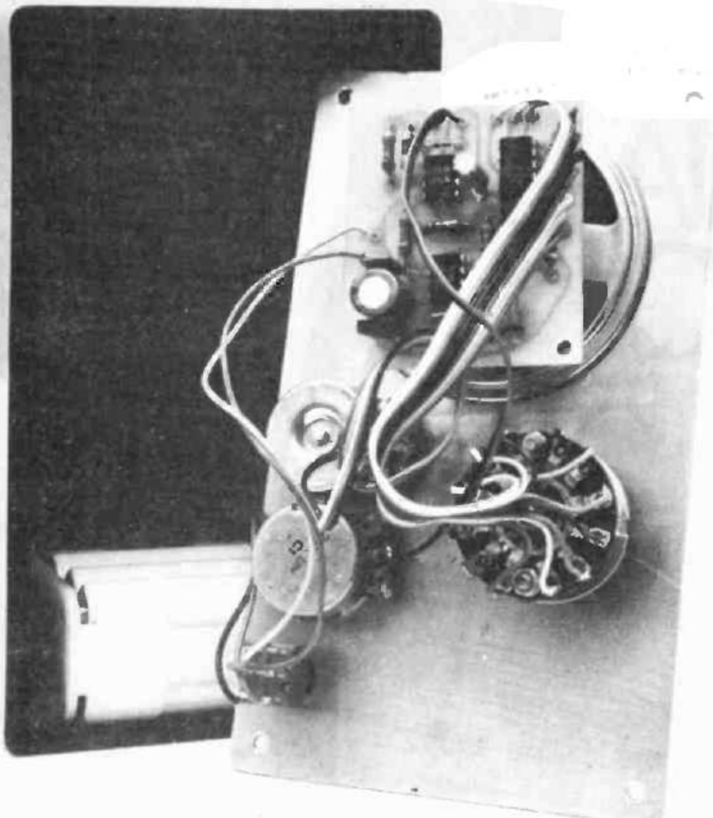
The method employed to produce the beats is to produce a tone burst for each, rather than the simple DC pulse often employed in other designs. The only way to change the sound output in this latter type of circuit, to give the required accentuation, is to change the pulse's amplitude. We found this to be unsatisfactory — hence the tone burst.

Initially we tried a pulsed LC network which, while producing excellent results was a little too complex and expensive so we eventually decided on a pair of 555 timers. For those of you who wonder why we used a pair of 555s instead of the 556 dual timer, just look at the prices of these two devices. For some reason that we cannot understand the 556 is more than twice the price of a pair of 555s. Add to this is the fact that if one half of a 556 is destroyed the whole device is useless, and in most applications and you see why 555s are the best buy.

When faced with the PCB design for this project we considered mounting the wafer switch directly to the board. We finally decided against this approach because of the large ▶

SPECIFICATION

Rate	1 / sec. to 15 / sec.
Beat	Off, 1–1 to 1–9
Output power 9 volt supply	8 watts peak
Output frequency	800 Hz, 2 500 Hz
Power supply	6 – 15 volts DC



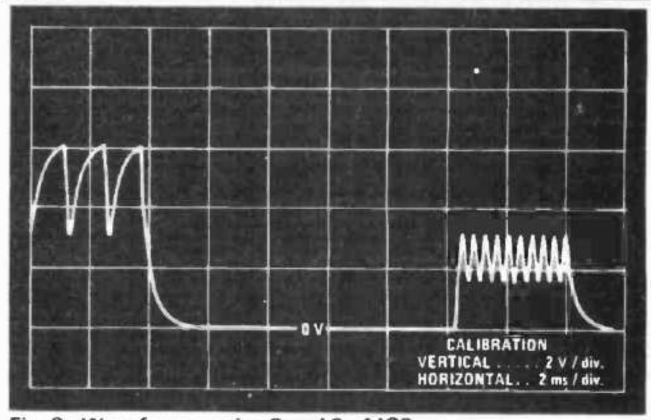


Fig. 2a Waveform on pins 2 and 6 of IC3.

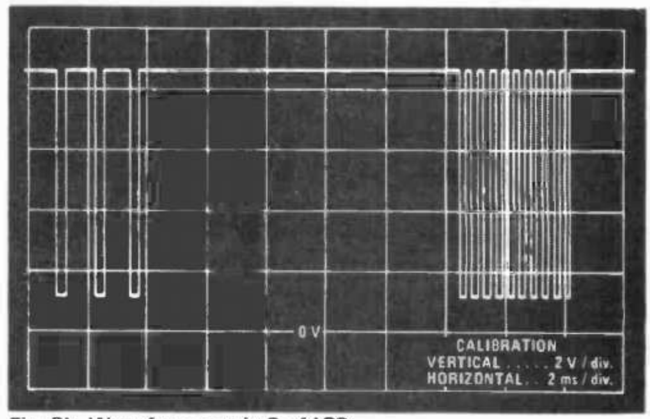


Fig. 2b. Waveform on pin 3 of IC3.

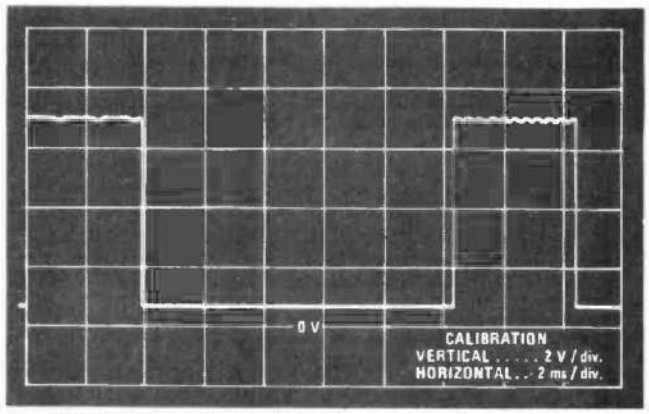


Fig. 2c. Waveform on pin 3 of IC1.
On these waveform diagrams the beat rate has been increased to show the two different outputs available.

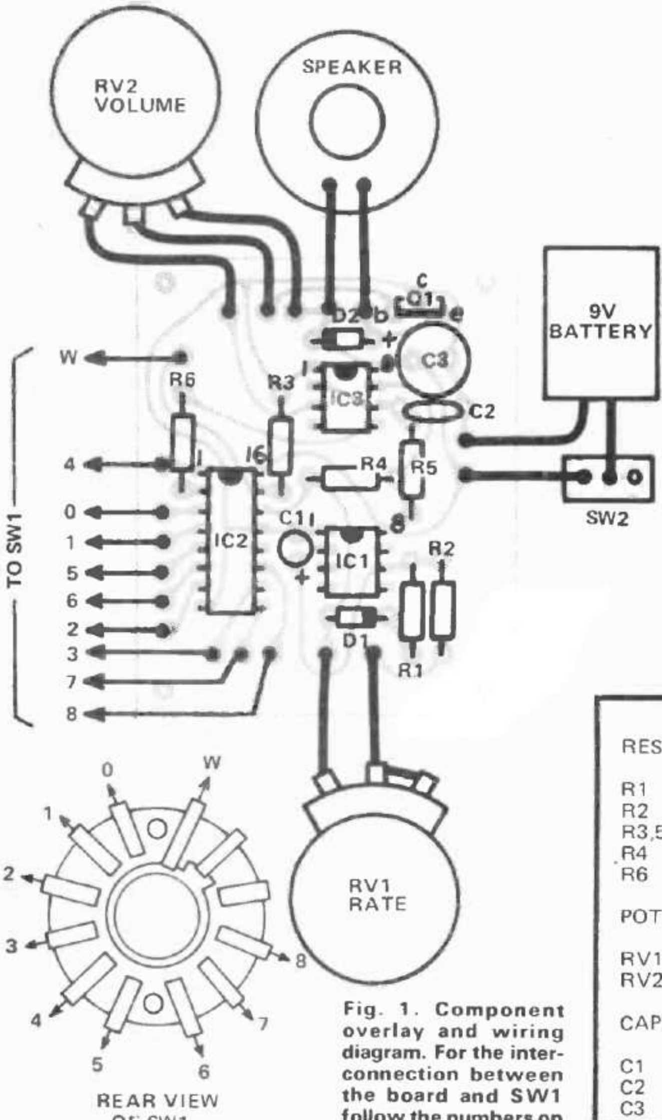


Fig. 1. Component overlay and wiring diagram. For the interconnection between the board and SW1 follow the numbers on each end.

PARTS LIST

RESISTORS all ½ W 5%

R1	2k2
R2	47k
R3,5	15k
R4	1k
R6	4k7

POTENTIOMETERS

RV1	1M lin rotary
RV2	500R lin rotary

CAPACITORS

C1	1u 16 V
C2	22n polyester
C3	100u electrolytic

SEMICONDUCTORS

IC1,3	555
IC2	4017
Q1	BD140
D1,2	1N4004

SWITCHES

SW1	single pole 11 position switch
SW2	single pole toggle switch

MISCELLANEOUS

PCB as pattern, speaker, plastic box, batteries plus holder to suit, 3 knobs.

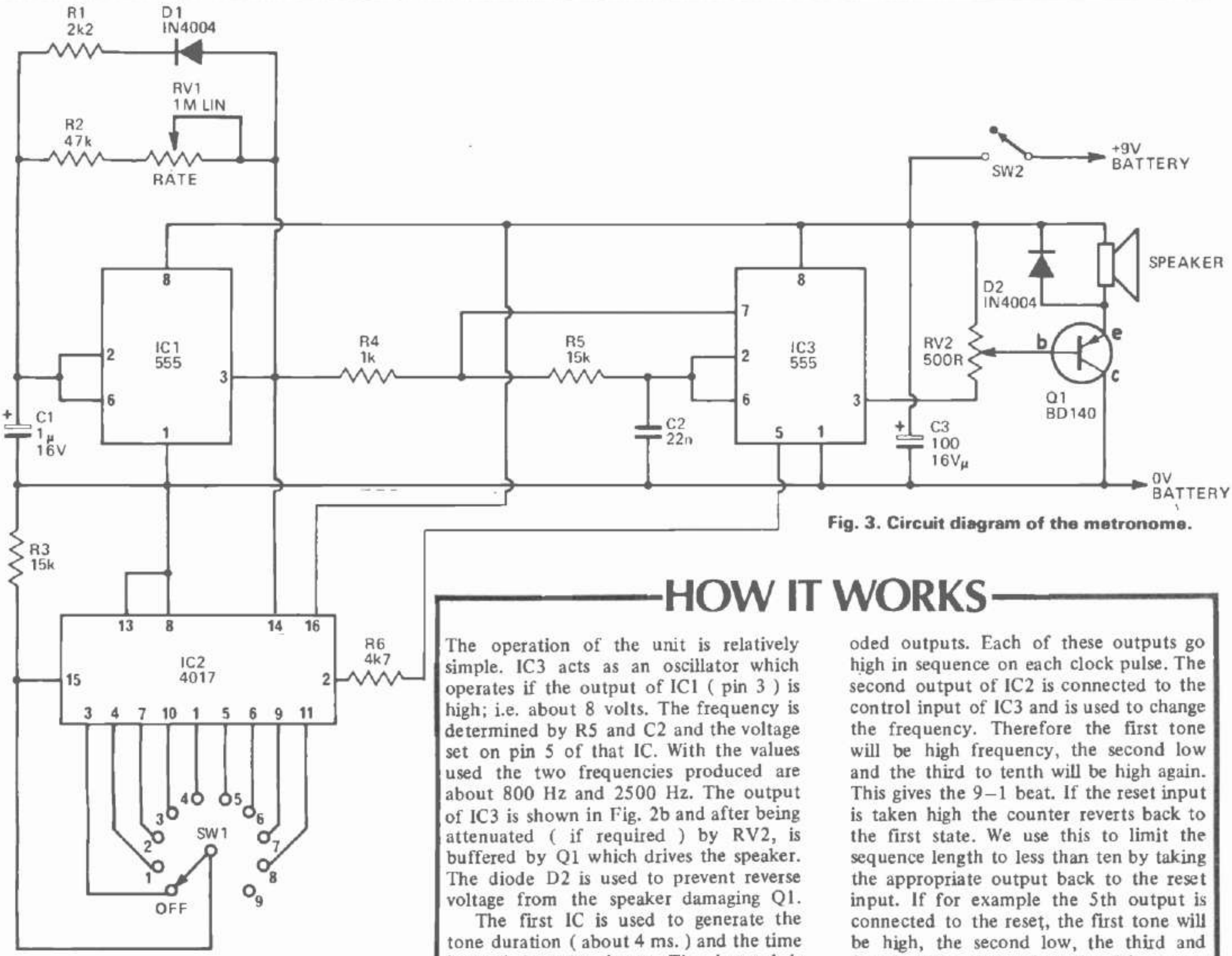


Fig. 3. Circuit diagram of the metronome.

HOW IT WORKS

The operation of the unit is relatively simple. IC3 acts as an oscillator which operates if the output of IC1 (pin 3) is high; i.e. about 8 volts. The frequency is determined by R5 and C2 and the voltage set on pin 5 of that IC. With the values used the two frequencies produced are about 800 Hz and 2500 Hz. The output of IC3 is shown in Fig. 2b and after being attenuated (if required) by RV2, is buffered by Q1 which drives the speaker. The diode D2 is used to prevent reverse voltage from the speaker damaging Q1.

The first IC is used to generate the tone duration (about 4 ms.) and the time interval between beats. The interval is adjustable by RV1 while the tone duration is set by R1. Diode D1 isolates R1 in the interval period. The output of IC1 is shown in Fig. 2c.

The output of IC1 also clocks IC2 which is a decade counter with ten decoded outputs. Each of these outputs go high in sequence on each clock pulse. The second output of IC2 is connected to the control input of IC3 and is used to change the frequency. Therefore the first tone will be high frequency, the second low and the third to tenth will be high again. This gives the 9–1 beat. If the reset input is taken high the counter reverts back to the first state. We use this to limit the sequence length to less than ten by taking the appropriate output back to the reset input. If for example the 5th output is connected to the reset, the first tone will be high, the second low, the third and fourth high, then when the 5th output goes to a '1' it resets it back to the first which is a high tone. We then have 3 high and one low tone or a 3–1 beat. Actually the 5th output goes high only for about 100 ns. while the counter resets.

BUYLINES

All of the components used in this project should be generally available from your local component shop or from most of the mail order firms advertising in ETI.

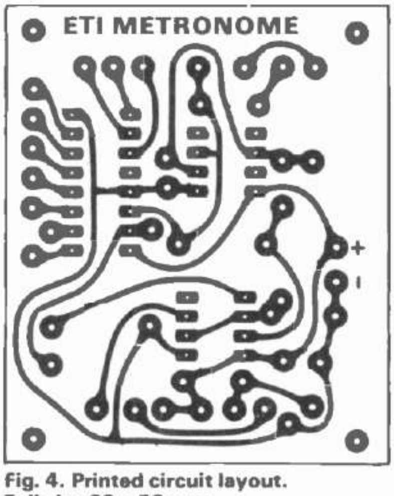


Fig. 4. Printed circuit layout. Full size 60 x 50 mm.

number of different switches available, each with their own connection pattern.

Construction

Assembly of the metronome should cause no problems if the PCB is used. Mount all the components according to the overlay diagram, taking care to orientate the transistors, ICs, diodes and polarised capacitors correctly. We recommend that the 4017 be mounted in an IC socket and that it be the last component installed.

We built the unit into a plastic box with potentiometers, switches and speaker mounted on the front panel. The photographs of the prototype show clearly the layout we adopted.

Beat In Time

Upon switching on the rate and beat controls should be adjusted to provide the required rhythm. The volume control enables the output power to be adjusted over a wide range.

Hopefully the metronome will soon make itself redundant as a sense of rhythm is acquired by our aspiring musician — keep it handy though, because as we said earlier it will be able to help with the more complex of beats tackled at a later stage. ETI