# Cudlipp Cricket: the electronic bug

**Bug your friends, office or home. This electronic insect-like gadget is completely harmless to humans but is sure to gain a lot of attention as it reacts to every sound that you make. We have named it "Cudlipp".**

**by COLIN DAWSON & LEO SIMPSON**

"Where did you get such a crazy name as 'Cudlipp'?" you might ask. Well, why not? Cudlipp is an electronic novelty, so he has a whimsical name.

It is probably better not to refer to Cudlipp the electronic cricket, as a bug. After all, the word "bug" has nasty, emotive connotations. And while Cudlipp may be similar to eavesdropping bugs, Cudlipp is intended to draw attention to itself whereas the usual eavesdropping variety is not. No, Cudlipp is meant to be fun. You can make him up to look very "insect-like" and he will function as an excellent conversation piece.

So what does Cudlipp actually do? He responds to every brief sound with a short "cricket-like" chirp. If you shut up, he shuts up. If you make a noise he makes a noise. If you make a long and continuous racket, he will accompany you with a continuous series of chirps. And whenever he chirps, Cudlipp flashes his two LED eyes in a most fetching manner.

In this sense Cudlipp is quite unlike an ordinary "real life" cricket which makes its incessant chirping until you come to investigate and wreak possible vengeance. Then it lies "doggo" and you've Buckley's chance of finding it and bashing it insensible.

So if you're the unwitting victim of Cudlipp or his many brothers (and we are sure that many people will be when this article is published), his chirping and eye-flashing will lead you unerringly to his hiding place where you may, if you really wish, disable him harmlessly by disconnecting his battery (which would be sad).

Cudlipp listens to the outside world by means of an electret microphone and its tail produces its incessant chirping response by means of a crystal earpiece.

Actually, this project was first featured in the December, 1981, issue of the American magazine "Radio-Electronics". Their original version used some parts which are unobtainable in the land of Oz, so we took their intriguing little beastie and mutated it for local conditions.

## Circuit Operation

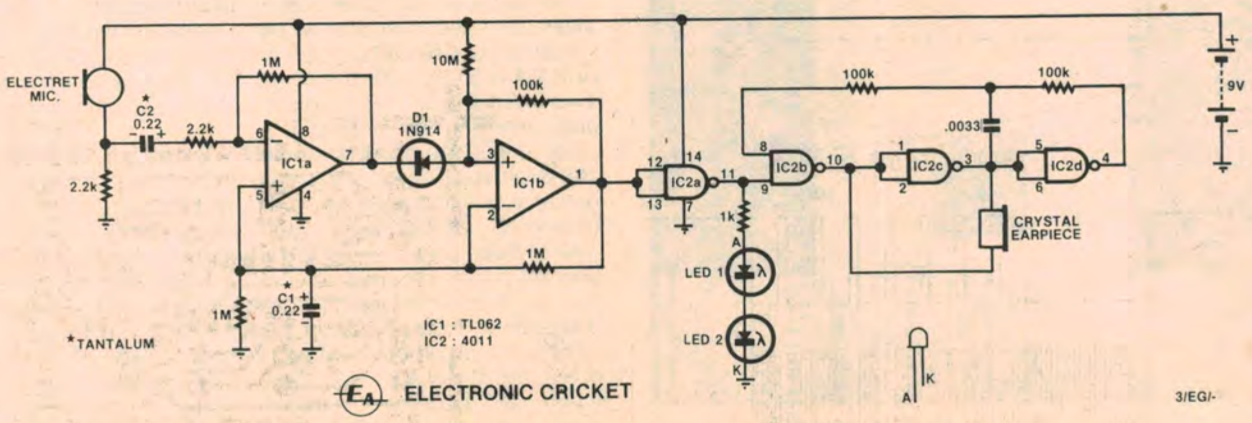
The circuit is really quite ingenious and uses two op amps and a CMOS quad two-input NAND gate package. The two op amps are used in several modes as amplifier, comparator and oscillator while the CMOS package forms a simple gated oscillator. IC1 is a TL062, a dual low-power FET-input op amp which is used principally because of its very low current drain, which is typically less than 0.5 millamps for the whole package.

There are two modes of operation. In the first, the electronic cricket listens for a noise via its electret microphone. In the second, the response mode, the microphone is effectively disconnected and the cricket emits a brief burst of "cheep" noise which is quite like a real cricket.

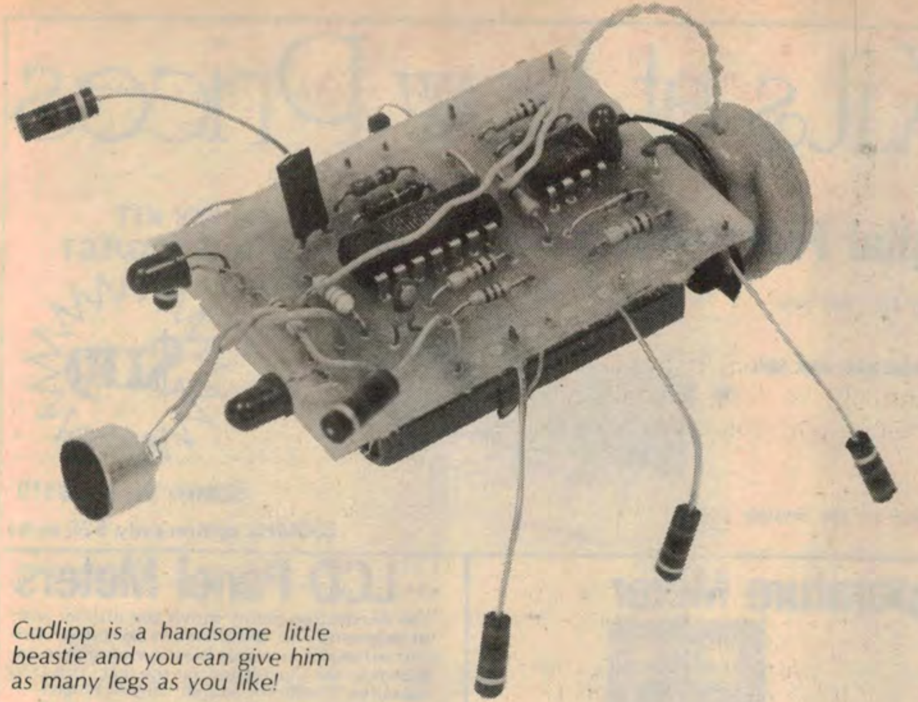
In the listen mode, IC1a functions as an inverting amplifier with a gain of about 450 for the electret microphone. The electret microphone is a conventional two-terminal model which has an internal FET acting as a buffer. The electret is fed from the 9V supply and drives a 2.2kΩ resistor which acts as a load for the internal FET. The signal from the electret is coupled to IC1a via a 0.22μF capacitor, C2.

IC1a is biased to the half-supply point by the voltage-divider consisting of two 1MΩ resistors, one of which is connected to the output of IC1b which is normally latched high, ie, at close to 9V.

The same voltage divider biases the inverting (-) input of IC1b while its non-inverting input is normally tied about 0.7 volts above the half-supply point by diode D1 and a 10MΩ and 100kΩ resistor. Thus, IC1b is a comparator which is latched high (as already mentioned) in the listening mode.




*Cudlipp consists of two op amps (IC1a and IC1b) and simple CMOS gated oscillator (IC2).*



*Cudlipp is a handsome little beastie and you can give him as many legs as you like!*

We estimate that cost of parts for this project is approximately

**$12.50**

including sales tax.

When the microphone "hears" a sound, the resulting signal is amplified by IC1a and fed to D1 which rectifies it. This tends to pull the non-inverting input of IC1b low and, if the signal is large enough, causes IC1b to change state, from high to low.

IC1 now enters the second mode whereby it produces a brief series of pulses from the output of IC1b. When IC1b first changes state, from low to high, it drops the voltage at its non-inverting input, pin 3, to a little less than 1V. The output of IC1b will then remain low until the inverting input, pin 2, drops below pin 3. And this is exactly what starts to happen as C1, the capacitor shunting the voltage divider which feeds pin 2 and pin 5, starts to discharge.

This does two things. First, because pin 5 of IC1a is now held below pin 6 (which is held at around 4V because of the charge remaining on C2), IC1a's output goes low and effectively ties pin 3 low via diode D1. Second, as C1 discharges it drops pin 2 just below pin 3 which causes IC1b to change state from low to high which enables C1 to begin charging up again. But since pin 3 is tied low by the output of IC1a, IC1b again changes state as soon as pin 2 goes slightly above pin 3.

So while ever the output of IC1a is forcing pin 3 low via diode D1, IC1b produces a string of pulses which are about 1.5 milliseconds long and about 22 milliseconds apart, ie, at a repetition rate of 45Hz.

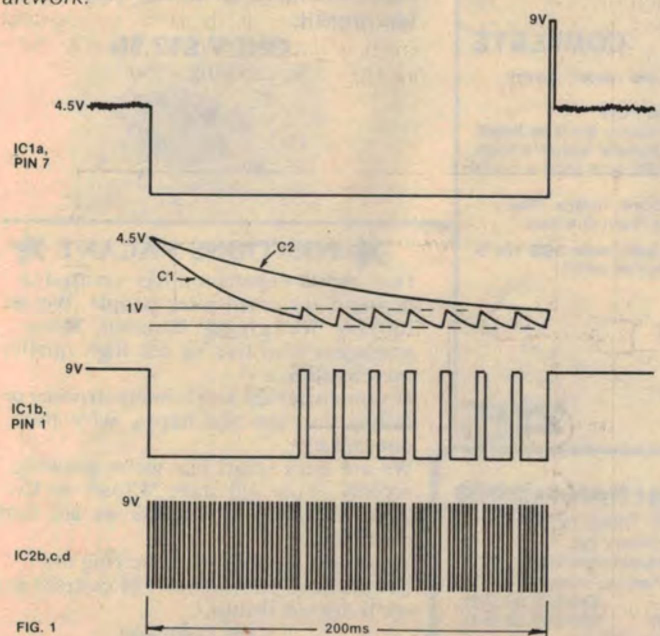
The output of IC1a remains low until C2 discharges sufficiently to let pin 6 drop below pin 5. When this happens, IC1a's output goes high, which effectively stops pin 3 from being forced low. This means that as soon as IC1b again changes state from low to high, the oscillatory mode is stopped and normal bias is restored to pins 2 and 5 so that the circuit again reverts to the listen mode.

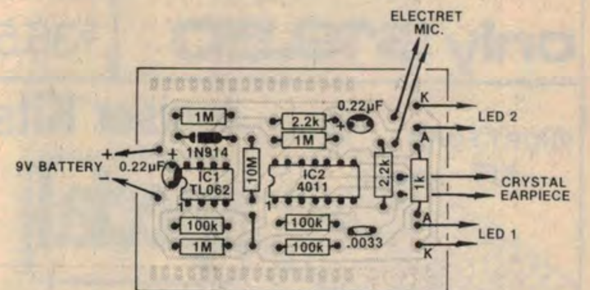
The length of the response mode is set by the time-constant formed by C2 and the associated feedback resistors around IC1a. So the duration of the train of pulses from IC1b is about 200 milliseconds.

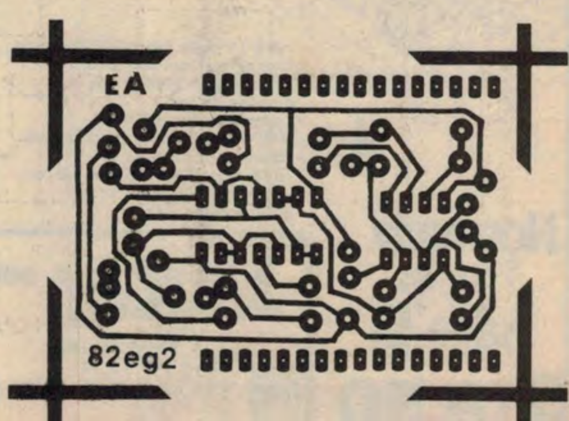
## CMOS Oscillator

By contrast with IC1, IC2 is quite a straightforward circuit. Three of the two input NAND gates are connected to form a conventional three-inverter oscillator which works in the following way. If the output of IC2a is high, then, since inverters 2b, 2c and 2d are in series, the input of IC2b, pin 8, must be low. The .0033$\mu$F capacitor now begins

*Fig 1 (below) shows the waveforms produced at various points on the circuit as Cudlipp operates. At right is the component overlay, while below right is an actual size PC artwork.*



to charge via the 100kΩ resistor connected to pin 4, until the voltage across it exceeds the threshhold voltage at pin 8, which causes all the inverters to change state and the capacitor then begins to charge in the opposite direction.

The natural frequency of the CMOS oscillator is about 1350Hz and this is enabled by IC2a which inverts the output pulses from IC1b. Thus, when IC1 is in the listen mode, the high output of IC1b disables the CMOS oscillator. When the output of IC1b goes low the oscillator is turned on, so that in effect, IC2 oscillates for about 200 milliseconds at 1350Hz during which it is turned off for 1.5ms every 22ms. Fig. 1 shows the waveforms.

The sound is emitted by a crystal earpiece which is connected across inverter IC2c so that it effectively has about 9 volts RMS applied to it during each chirp.

## PARTS LIST

*1 PC board measuring 61 x 43mm, 82eg2*
*1 electret microphone insert*
*1 crystal earpiece*
*1 9V battery, type 216 and snap connector*
*1 TL062 low current op amp*
*1 4011 quad two-input NAND gate*
*2 LEDs*
*1 1N914, 1N4148 silicon diode*
*2 0.22 tantalum capacitors*
*1 .0033µF metallised polyester capacitor (greencap).*

*RESISTORS*
*(¼W, 5% tolerance)*
*1 x 10MΩ, 3 x 1MΩ. 3 x 100kΩ. 2 x 2.2kΩ, 1 × 1kΩ*
*Plus assorted 1W resistors for decoration.*

This may seem an unconventional and somewhat severe use for a crystal earpiece but remember that the alarm devices in all those clever digital watches uses the same sort of piezoelectric device and it does have a decided advantage in producing quite an audible noise for negligible current drain.

Finally, the two LEDs which form Cudlipp's eyes are driven in series via a 2.2kΩ resistor by IC2a, the same gate which enables the CMOS oscillator.

So, to sum it all up, the circuit uses just two ICs. IC1 functions as a microphone amplifier, dual comparator, oscillator and timer while IC2 functions as a gated oscillator and LED-cum-earpiece driver. What a clever little cricket Cudlipp really is!

### Construction

Cudlipp is built on printed circuit board which measures 61 x 43mm and is coded 82eg2. The PC board carries all the components including the 9V battery which is slung underneath to form Cudlipp's belly.

Install the passive components first, taking due note of the polarity of the tantalum capacitors. Then install the LEDs and electret mic insert, again with due regard to polarity. Then wire in the earpiece, which should have the clear plastic ear insert removed to increase the sound output. Make sure that the earpiece you have is not a dynamic type which usually has a resistance of about 8Ω. The crystal type should measure open-circuit with a multimeter switched to the "ohms" ranges.

Finally solder in the two ICs, leaving the CMOS 4011 till last. When soldering this you should solder pins 14 and 7 first, with the soldering iron barrel connected to the 0V track on the PC board via a clip lead. When all is complete, check your work thoroughly and then connect a battery. You should now be greeted by a cheerful chirp every time you make a sound.

### Is Cudlipp Stillborn?

If Cudlipp does not immediately spring to life when you connect a battery, you can give him a checkup in the following way. First, to check the CMOS oscillator, short pin 1 of IC1b to the 0V line. This should light the two LEDs and cause the earpiece to sound continuously, without any modulation. If not, there is probably something amiss with IC2.

Second, short the output of IC1a, pin 7, to the 0V line. This should cause IC1b to oscillate continuously and thus modulate IC2 which will give a slightly "burbly" sound from the earpiece. Finally, connect the junction of C2 and the 2.2kΩ resistor to 9V and the same sould should be produced. If this is the case, then you have checked all components except the microphone. If this does not work, check that you have not connected it the wrong way around.

Note that if you are unable to obtain the low current TL062 you may use the standard TL072 or TL082 Fet-input op amps from Texas Instruments or the LF353 from National Semiconductor, although these have a current drain which is about 10 times the figure for the TL062. To be specific, the typical current drain of the TL062 is about 0.5mA and that of the complete circuit in the listen mode is about 1mA. When in the response mode the current rises to about 9mA which is mainly due to the LEDs.

When the circuit is complete and going you can dress it up. Fit a wire sling underneath the PC board to hold the battery, remembering to place a sheet of cardboard between battery and PC board, to stop shorts. Then you can fit sundry 1W resistors to the PC board to provide legs and antennae.

We are sure that you will have a lot of fun with Cudlipp!