Electronic

How about an amusing (although your victims may not agree) circuit that you can use to play a trick on your friends or family, or to get rid of your mother-in-law? A handful of electronic components can create a cricket-like chirping sound every few minutes or so. You should hide this electronic poltergeist such that it's difficult to find, but can still be heard clearly. It is guaranteed to drive people mad! i-TRIXX shows you how to build this irritating circuit. Read on...

- *Did you hear that?* - What? - *That chirping noise.*
- Chirping noise? - *Yes, I think there's a cricket somewhere in the room.* - I didn't hear anything!
- *Well, it's stopped now!*

A bit later: - *There it is again! Did you hear it?* - I heard nothing, go back to sleep! - *I'm not going mad am I? I'm sure there's a cricket around somewhere! We have to get rid of it, otherwise I won't be able to sleep!*

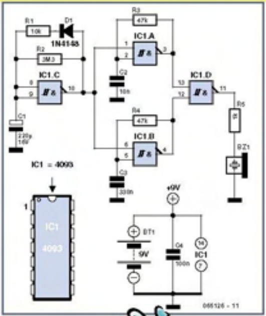
This could be a possible conversation in the bedroom where you've hidden the electronic poltergeist. But before you can create all this mischief you'll have to use your soldering iron. You'll be pleased to hear that the construction of this circuit won't give you sleepless nights, as long as you work carefully.
At the heart of the circuit is an old favourite IC, the 4093. This chip contains four NAND gates, each of which has two inputs. These NAND gates have Schmitt triggered inputs (more on this later) and are ideal for use in this particular application. Three of the gates are used as oscillators. The oscillator built around IC1A produces a high-pitched sound similar to that made by crickets when they rub their wings together. A second

poltergeist

oscillator (IC1B) is used to interrupt this noise at regular intervals. The third oscillator (IC1C) is used to turn on the chirping noises for a short while, with a few minutes silence in between.

So how do these oscillators work? We'll take IC1A as an example. The output of this binary NAND gate will only be a logic low (virtually equal to 0 Volts) when both inputs are at a logic high level (typically just over half the supply voltage). Each input has a Schmitt trigger circuit so that slowly changing input signals can be also be dealt with. The Schmitt trigger makes the gate switch state suddenly when the input is slowly increasing and reaches the point where it could be considered at a logic high state. Inputs that are hesitating somewhere between low and high are effectively given a helping hand upwards. When the supply voltage (a 9 V battery) is first connected to the circuit, the input at pin 2 is at a logic low level (since capacitor C2 has not yet charged up). This means that the output of the NAND gate at pin 3 will be at a logic high level. Capacitor C2 is now charged up via the output at pin 3 and resistor R3 until the Schmitt trigger decides that the voltage level at pin 2 has increased enough for it to be at a logic high level. The output of the gate now switches over to a logic low level, assuming that the input at pin 1 is at a logic high level. Capacitor C2 will now be discharged by the output at pin 3 via R3, which causes the input at pin 2 to become low again, and the whole cycle repeats itself. The speed (frequency) at which this charging and discharging takes place depends on the values of R3 and C2.

The oscillator built around IC1C works in a slightly differently way. In this case a diode (D1) causes capacitor C1 to charge via both R1 and R2, which is much quicker than when C1 discharges via R2 only. This causes the poltergeist to be quiet for three minutes (the slow discharge) and only make a noise for a second or so (the fast charge).



The fourth gate (IC1D) is used to combine the two oscillators (IC1A, which makes the high-pitched sound of the wings rubbing together and IC1B, which imitates the periodic movement of the wings) and drive the sounder.

It is possible to change the frequencies at which gates IC1A to IC1C operate by varying the values of resistors R1 to R4. A lower value results in a higher frequency, and a higher value lowers it. You could also consider reducing the volume of the sounder by increasing the value of R5; this will make it even more difficult to find the circuit.

The current consumption of our prototype was under 300 µA during the time it was silent, which rose to about 1.3 mA when the circuit was producing sounds (this only lasts 1 second). With an ordinary 9 V battery this circuit can operate for several (irritating) months, and there won't be many people who could put up with that!