Hee-haw siren for toy cars

Basic Electronics

by GERALD COHN

How about this for a natty idea? — it's a simple electronic circuit which, when fitted to a toy car or tricycle, will provide a realistic "hee-haw" siren sound and flashing lights. The circuit uses just two low-cost ICs and a handful of other components, and will only take about half an hour to build.

Of course, our new Hee-Haw Siren is not limited for use in toy fire engines and police cars. It can also be used in more serious applications, such as car or boat burglar alarm systems, or in any other situation that requires an attention-grabbing alarm sound. We're sure that many readers will already have their own application in mind.

In all fairness, though, we should give the reader a few words of warning. The sound produced by our Hee-Haw Siren is a true hackle-raising "hee-haw, hee-haw, hee-haw, hee-haw ..." It's absolutely guaranteed to turn even the most docile, peace-loving adult homo-sapien into a murderous Neanderthal in the space of five minutes (or less). Naturally, the kids will love it!

So unless you are a particularly tolerant type, we suggest that you fit a normally-off pushbutton switch in series with the supply rail to the siren. That way, the alarm will sound only when the child has his finger on the button. As well as providing you with some welcome intervals of peace, this feature will also serve to increase battery life.

How it works

Let's take a look at the circuit and see how it works. It's really very simple and consists of three audio oscillators (IC1a, IC1b and IC1c) which drive the LED display circuitry and a small audio amplifier. The two tone oscillators, IC1a and IC1c, are set to run at the desired audio frequencies to give the "hee" and "haw" sounds, while rate oscillator IC1b determines the switching rate of the two tones.

Each oscillator is based on a single inverter from a 74C14 hex Schmitt inverter IC package, together with two external components — a feedback resistor and a capacitor. These external components set the oscillator output frequencies.

So how does the oscillator work? Well, a Schmitt trigger is a device with two widely spaced trigger voltages — an upper trigger voltage and a lower trigger voltage. The output of the device changes state only when the upper trigger voltage is exceeded at the input, or when the applied input voltage drops below the lower trigger voltage.

Applied input voltages between the two trigger points cause no change at the output, an effect referred to as hysteresis. A Schmitt trigger exhibits a considerable amount of hysteresis, and it is this characteristic that enables the construction of an oscillator using just one inverter.

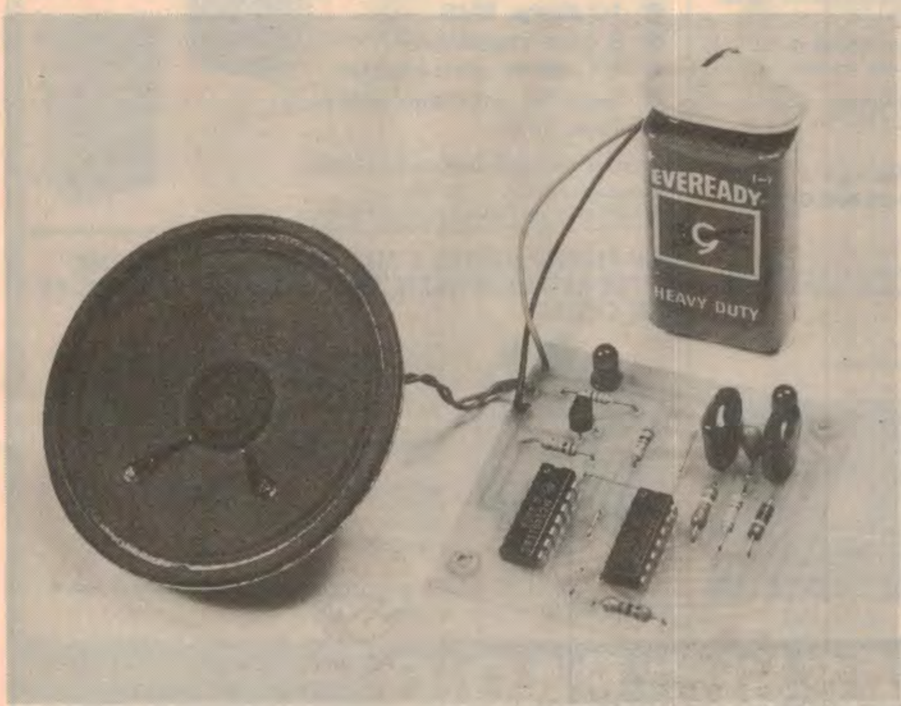
As can be seen from the circuit diagram the feedback resistor is connected between the input and output, while the capacitor is connected between the input and ground. What you have to remember now is that the input and the output of an inverter are always 180° out of phase; ie when the input is low the output will be high, and vice versa.

Let's initially assume that the input of the inverter is low and that the output is high. The capacitor on the input will now charge via the feedback resistor until it reaches the upper trigger voltage and switches the output of the inverter low. At this point, the capacitor discharges via the resistor into the output until its voltage reaches the lower trigger point. The inverter then switches over again, and so the process continues indefinitely.

As already mentioned, the resistor and the capacitor values set the oscillator frequencies. For the prototype, the values shown give a high tone frequency of 1kHz, a low tone frequency of 385Hz, and a rate frequency of about 2Hz. These frequencies result in a sound similar to that produced by a police siren.

You can change the various oscillator frequencies simply by changing the values of the feedback resistors. Some constructors may even prefer to replace the fixed value resistors with trimpots so that they can adjust the sound just the way they want it. Suitable trimpot values would be 100k for the two tone oscillators and 1M for the rate oscillator.

The output of the high tone oscillator is fed to one input of NAND gate IC2a while



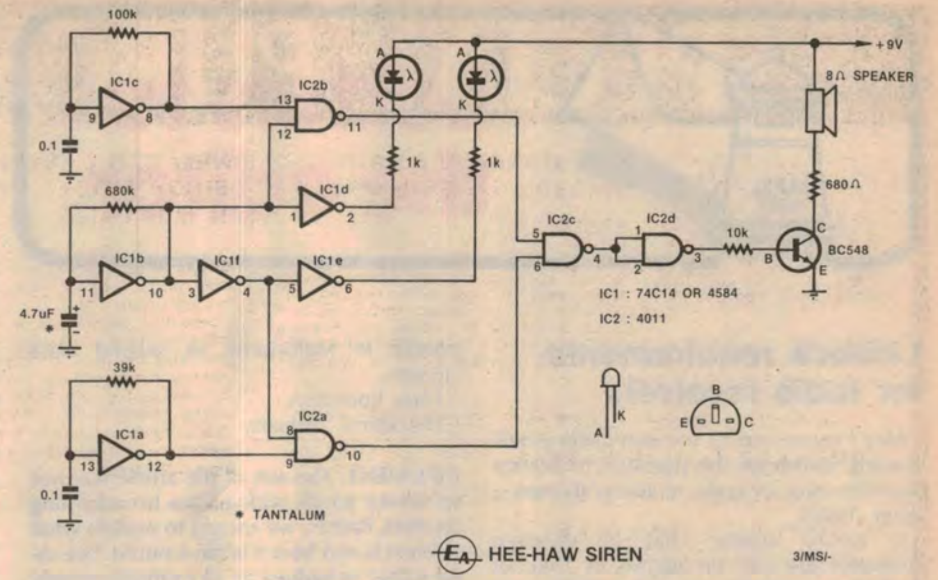
The Hee-Haw Siren can be fitted to a child's toy or used in a burglar alarm system.

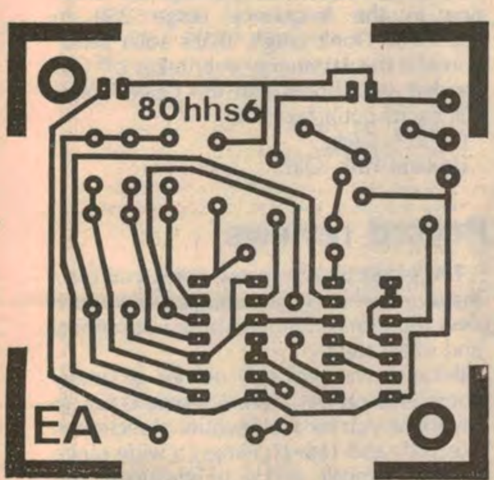
Hee-Haw Siren

NAND gate IC2b is fed by the low tone oscillator. The remaining input to each of these two gates is connected to the rate oscillator, directly in the case of IC2b and via inverter IC1f in the case of IC2a. Inverter IC1f ensures that only one tone is gated through at any given time.

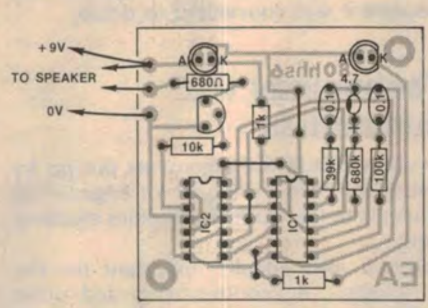
In practice, this means that the high tone oscillator output is gated through to IC2c during negative half cycles of the rate oscillator, and the low tone oscillator output is gated through during positive half cycles.

The output of the mixer gate, IC2c, is fed to both inputs of IC2d, used here as an inverting buffer, and from there to a small audio amplifier. Strictly speaking, IC2d is not really necessary. We have used it simply because it would otherwise be left spare and because it provides additional signal squaring for the following amplifier stage.





Actual size reproduction of the PC board.



This overlay diagram shows the PC board as viewed from the component side.

We estimate that the cost of components for this project, including the battery, is approximately

$8.00

This includes sales tax.

PARTS LIST

1 PC board, code 80hhs6, 59 x 56mm
1 74C14 or 4584 hex Schmitt inverter
1 4011 quad 2-input NAND gate
1 BC548 NPN transistor
2 red LEDs
1 type 216 9V battery and battery clip
1 miniature 8 ohm loudspeaker
1 on-off switch (optional)

CAPACITORS
1 x 4.7uF/16VW tantalum
2 x 0.1uF metallised polyester

RESISTORS
1 x 680k, 1 x 100k, 1 x 39k, 1 x 10k, 2 x 1k, 1 x 680 ohms.

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used provided they are physically compatible.

The amplifier is about as simple as you could get and consists of a single BC548 NPN transistor wired in common-emitter configuration. A 10k resistor limits the transistor base current, while a 680 ohm resistor and an 8 ohm loudspeaker form the collector load. Power output is less than 1mW but this should be sufficient for most purposes. If not, reduce the value of the 680 ohm resistor but remember that this will increase the current drain.

Finally, we have made for provision on the circuit for two LEDs which flash on and off in sympathy with the rate oscillator. These are driven from the output of the rate oscillator via the two remaining inverters in the 74C14 package, IC1d and IC1e. Thus, whenever the output of the rate oscillator goes high, the output of IC1d will go low and the LED corresponding to the low tone will be turned on. Similarly, when the rate oscillator output goes low the LED corresponding to the high tone will be turned on.

Construction

Construction of the unit is simple and straightforward. As can be seen from the photograph, the unit is built up on a small PC board coded 80hhs6 and measuring 59 x 56mm. This board accommodates all of the circuitry except for the battery and the speaker.

Commence construction by fitting all components except the two ICs to the PC board. Don't forget the three wire links and watch the orientation of all polarised components. Included here are the 4.7uF tantalum capacitor, the two LEDs, and the BC548 transistor.

Note that although we have shown the two LEDs mounted directly on the board, there is nothing to stop you from connecting them via short lengths of hook-up wire. In fact, it will probably be necessary to do this if the unit is to be installed in a toy car.

The two ICs are CMOS devices and should be left till last. When soldering them into circuit, earth the soldering iron barrel to the earth track on the board using a small clip lead and solder the power supply pins (pins 7 and 14) first. These precautions are to prevent possible damage to the ICs by static charges. Make sure that you solder the ICs into circuit the right way round.

Once construction is complete the unit can be switched on and tested for correct operation. The low tone should be heard from the speaker the moment that power is applied to the circuit. After a short time the siren will switch over to the high tone, at which point the circuit will settle down to the proper switching frequency for the rate oscillator. Note that the switch-on tone lasts longer than subsequent tones because the 4.7uF capacitor is initially completely discharged.

Assuming that all is well, it only remains to fit the unit to that toy fire engine or police car. Happy hee-hawing!