BUILDING ***A SIMPLE BAT DETECTOR*** **BLACKLETTER WORKSHOP**
31st Oct 2007
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Echolocation

"Very little was known about how bats found their way around in the dark until the 1950's when Donald Griffin discovered echolocation. All bats can see, there is no such thing as a blind bat, but some can see better than others and the Microchiropteran bats (the Sub-order that Irish bats belong to) use a form of sonar to enable them to fly in darkness. They make high-pitched squeaks and listen for the echoes that bounce off obstacles in their way, or off prey insects, gauging distances by the amount of time taken for the echoes to return. Echolocation calls are made at a frequency (pitch - measured in kilohertz (kHz)) too high for humans to hear so bat workers use bat detectors to listen in on echolocating bats. " Bat conservation Ireland, link below
Humans can hear sounds with frequencies between 20 hz and 20 khz, but in practice most of us hear only up to 16 khz. In contrast, bats commonly emit echolocation ultrasounds at frequencies between 12 khz and 100 khz. Some bat species can hear up to 160 khz.

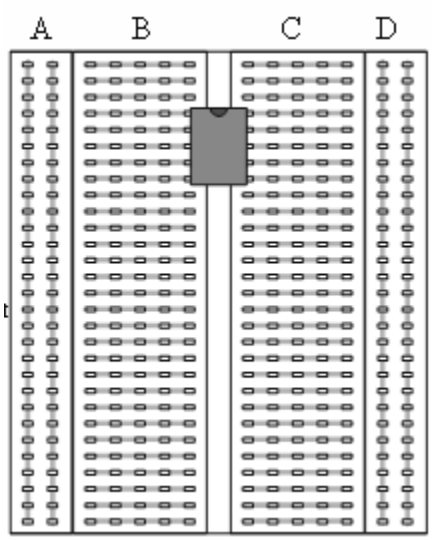
Some Irish Bat Species

Common pipistrelle *Pipistrellus pipistrellus* 44kHz and **Soprano Pipistrelle** *Pipistrellus pygmaeus* 55kHz **Daubenton's Bat** *Myotis daubentonii* 45kHz **Leisler's Bat** *Nyctalus leisleri* 25kHz

What you will need to start building the detector:

In this workshop we will be building a prototype style detector and will be using a breadboard to base our components. This bat detector and workshop notes are based on the detector created by Tony Messina see link below…thanks..

List of components
10k ohm pc mount variable resistor / potentiometer (audio level control) x 1
Breadboard x 1
Ultrasonic transducer (mic) x 1
Integrated Circuit (IC) LM368N-1(audio amp) x 2
IC CD4024 (digital divider) x 1
3.5 phone jack x 1
Ceramic earphone x 1
9volt clip x 1
.05 uf capacitor (mylar film capacitor) x 1
10 uf 16v polarized electrolytic capacitor x 1
470 uf 16v polarized electrolytic capacitor x 1



The Prototyping Board
For this workshop we will be using a solderless prototyping board known as a proto-board or breadboard. Breadboards allow us to connect circuits by plugging in components and wires without soldering. As indicated by the gray lines, horizontal rows of connectors in areas B and C are internally connected. When a chip is plugged into the board as shown, these strips give you four connections to each of the IC pins. The connections in regions A and D are intended as power and ground buses. As indicated by the gray lines, the columns in these regions are tied together vertically.

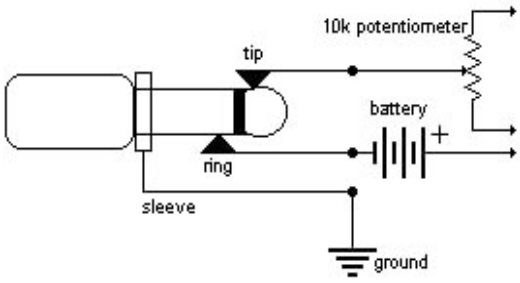
The breadboards are fairly robust; however they are susceptible to damage from wires that are too large. Do not use wires larger than 28 gauge. Components with leads that are too large can damage the breadboard as well.

Building Instructions

1 Ultrasonic transducer
The most important component of the detector is the transducer. This picture shows the front and back of a common, metal cased ultrasonic transducer. To get the best performance from the detector, it is essential to observe the polarity of the leads on the transducer.

Note that the lead on the lower left of the transducer back is soldered to the ***ground*** lead. The other lead, the ***hot*** lead, is electrically isolated from the case by a plastic insulator.

2 Wiring the jack and schematic
The circuit you are building is using a two circuit plug, the earphone, with a 3 circuit jack. The tip circuit connects the earphone hot lead to the audio from the level control. The sleeve circuit provides a ground connection for the earphone AND the battery. The battery, being connected to the ring segment of the jack, is connected to ground - the sleeve segment of the jack, by the long sleeve of the 2 circuit plug. This provides the power switching for the project.

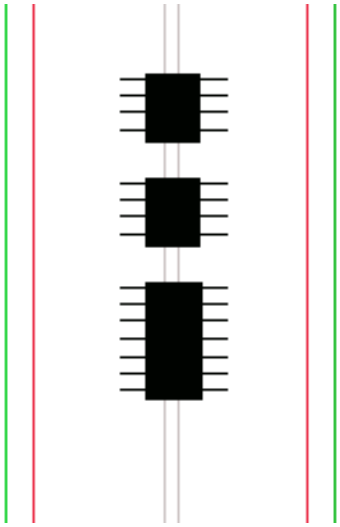


When wiring your project make sure to properly identify the tip, ring, and sleeve connections of the jack.

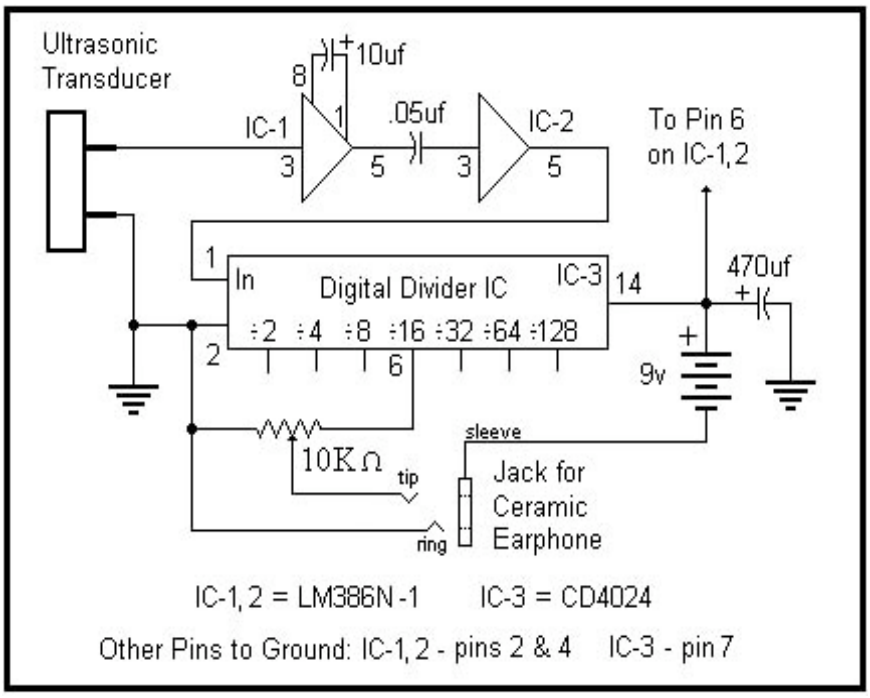
3 Solder leads to the potentiometer
Then then place it on the breadboard connecting the correct leads to other components – see left

4 Fit the components to the breadboard
Follow the diagram to the right and schematic on page 3

IC 1 – 10uf pin 1 to pin 8
IC 1 - .05uf pin 5 to IC 2 pin 3
IC 2 - pin 5 to IC 3 pin 1
IC 1+2 – pins 2 & 4 to ground (gnd)
IC3 - pin 7 to ground



Circuit schematic



Testing the detector

October is a little late in the year to find bats in Ireland. Usually Irish bats will commence hibernation once the weather goes below 6 degrees centigrade. It has been quite warm this year so you may be lucky. The best times to find bats are dusk and dawn. At sunset bats leave their roosts to find insects to eat and may forage all night. They return to the roost before sunrise. If you venture to a roost location during the summer months at around 4am you may be lucky to witness a bat swarm. Birthing season is May/June or when the weather is warm enough, this is the best time to detect bats as they are on a feeding frenzy to feed their young.

Good places in Dublin to search for bats are Bushy Park, the Dodder, Herbert Park, Stephens Green. If you wish to try and locate bats yourself …try under old bridges, parks with ponds, wooded areas, lakesides with some trees etc…Other Wicklow National Park, Killarney National Park.
Lets go to the Zoo where there are fruit bats to test the detectors?

Jangling keys, rubbing your hands together, snapping your fingers or rubbing a nylon jacket all make sounds your detector should pick up.

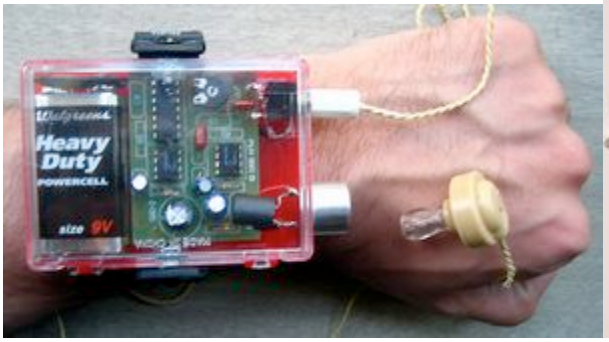
How the *SIMPLE BAT DETECTOR* works...

"The *Simple Bat Detector* is a *frequency division* type device. Frequency division type detectors allow you to hear ultrasonic sound by digitally scaling the frequency down into the human hearing range. A pipistrelle bat emits ultrasonic sound in the range of 45 to 91 kHz. If you divide that frequency by 16, the new frequency range is 3.3 to 5.7 kHz, easily within our hearing range. Because the division is done digitally, all *amplitude* information is lost. Ultrasonic sources processed by the detector convert to sounds like geiger-counter clicks and chirps.

The basic circuit of the *Simple Bat Detector* is shown in the schematic diagram above. It is essentially composed of 3 integrated circuits, or ICs. The signal from an ultrasonic transducer is fed to IC-1, an LM386 audio amplifier, which is configured to provide a signal gain of 200. The signal is coupled to IC-2, a second LM386, by a .05 uf capacitor. IC-2 is configured to provide an additional gain of 20, for a total system gain of 4,000. The output of IC-2 is direct coupled to the input of IC-3, a 7 stage CMOS digital divider circuit. The input stage of the divider acts as a zero crossing detector, triggering on the negative transition of the signal from IC-2. The divide by 16 output is connected to a potentiometer, which serves as an audio level control. A high impedance ceramic earphone is connected to the output of the level control. The 10K level control is a small printed circuit pot that is set and forgotten. The detector circuit is powered by a nine volt battery. (The numbers next to the IC nodes refer to the pin numbers of the IC's. Note the additional pins listed at the bottom of the schematic that need to be tied to ground.)

A major advantage of a *frequency division* detector is that it is a wide band device ... that means it will let you hear all detectable bat sounds without the need to *tune* the detector to any particular frequency. *Heterodyne detectors*, which process ultrasonic sound in the *analog* domain, only convert a small range of frequencies at any given time - you must select which frequencies to listen to. If you tune up around 60 kHz to listen for a pipistrelle, you may not hear the big brown bats flying nearby. The *frequency division* detector works in the *digital* domain, converting the full spectrum of sound that the transducer is able to detect. So you get to listen to all of the ultrasonic sounds around you, without missing anything due to unfortunate tuning choices. I feel this *no-knobs-needed* characteristic of the *frequency division* detector makes it a great choice for the casual bat observer, and student."
http://pw1.netcom.com/~t-rex/BatDetector.html Building a simple bat detector notes **Tony Messina - Las Vegas, NV**

Design your own case for the *Simple Bat Detector*



Bat and electronic links

http://pw1.netcom.com/~t-rex/BatDetector.html Building a simple bat detector notes **Tony Messina - Las Vegas, NV**
http://www.makezine.com/blog/archive/2006/09/make_podcast_weekend_projects_7.html the enhanced simple bat detector..a little more complicated
http://user.itl.net/~kypfer/BatDetector/
http://bertrik.sikken.nl/bat/index.html Bat detector page
http://www.btinternet.com/~mr.pentops/bat.htm *D.I.Y. BAT DETECTOR* transistor radio

http://www.batsound.com/ Pettersson Elektronik AB (professional detectors to buy)
http://www.alanaecology.com (professional detectors to buy)

http://itp.nyu.edu/physcomp/Tutorials/SolderingAPerfBoard how to solder a perf board
http://tigoe.net/pcomp/basic-elec.shtml Basic electronic definitions
http://www.talkingelectronics.com/ learning electronics

Bats!
http://www.batconservationireland.org/ join up and go on bat surveys and walks…
http://www.biosonar.bris.ac.uk/contentss.htm Biosonar (seeing with sound) explained
http://www.bats.org.uk/nbmp_tutorials/tutorial1.htm Bat Conservation uk - tutorials on finding bats
http://www.batcon.org/home/default.asp Bat Conservation International
http://www.batworld.org/main/main.html
http://www.lubee.org/ saving bats
http://www.life.umd.edu/faculty/wilkinson/honr278c/ biology and mythology of bats
http://www.bats.org.uk/ Bat conservation Trust UK
http://homepage.tinet.ie/~knp/index.htm Killarney National Park

Components
http://www.radionics.ie located on Herberton Rd, Rialto, D.8
http://www.rapidonline.com/
http://www.farnell.com/
http://www.maplin.co.uk/ go elsewhere if you can – located on Jervis St. D.1 or at Blanchardstown shopping center

http://www.bathouseproject.org/aboutus/partners/jeremy-deller/ check out artist organized bat project…