



# Circuit Bending

Now the actual slides...

# Circuit Bending

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# Information Dump



<http://jimmieprodgers.com/hopetalk2010/>

# First, what is circuit bending?

The modification of things such as electronic toys, effects pedals, and synthesizers.

# Useful Books to Have

Handmade Electronic Music: The Art of Hardware  
Hacking

By: Nicolas Collins

Circuit-Bending : Build Your Own Alien  
Instruments

By: Reed Ghazala

# Common Bends

Easy to add to most things

Timing Circuit

Voltage Drain

Audio Output

Power Switch



# More Advanced Bends

Not Always Available

Patch Bays

Glitch Configuration

Crash Configuration

Changing Crystal

Changing Capacitors

Midi Controllable

# What to look for

Battery powered!

3v safe to poke around with bare wires

4.5v probably safe to poke around

6v+ should use protection

9v+ definitely use protection!

# What to look for

## Toys with fun Sound Samples

Play with it to get an idea of how it works.

Often limited to just a few exploits,  
but can be worth it.

Great for sampling, or background noise.

# What to look for

Ones with Audio input

Input for microphone(usual) or other instruments/toys?

Does it have a built in amp?

Does it have a built in Mic?

Are there effects?

# What to look for

## Age of toy

Mid-nineties to early two thousands are great

In early 00's electronics got cheaper on a small scale runs of manufactured goods

New toys may be entirely chip on board with brownout protection (un-bendable)

# What to look for

Other things to look for

Novelty

Existing audio output

Room for bends

How small/new/nice is the toy?

# Where to find toys

Second-hand Stores

Flea Markets

Ebay

After Holiday Sales

Big Box Stores

# Tools of the Trade

Things for opening things

Various resistance based stuff

Alligator clips

Wire

Soldering iron

Solder

Drill or drill press

Multimeter



Best tool ever

Tapered Hand Reamer



And now, how to bend...

# Play with your toy

How does the toy respond?

Does it make sounds you like?

Do all the buttons work?

Can you get it to crash regardless of bending?

# Open up and explore the toy

Use your hands first

Look for resistors for the quick stuff

Take notes along the way

I like to solder a little bit of wire to  
interesting points

# Using protection to explore

Alligator clips with a 1M linear pot in series

Keep reducing by 1/2

Tie pins to ground with pot in series

Try random pins with pot in series, gradually stepping down

Just because it stops making sound  
doesn't mean it is dead

1. pull out the batteries
2. make sure the circuit is still completed
3. reset switch can be important!

# Tuning the resistance

1. Circuits need to be complete to make sound
2. Keep reducing resistance till it stops working
3. Disconnect the pot and measure
4. Measure the original resistor (optional)  
and take it out
5. explore with the resistor now gone

# Decide controls based on behavior

Pots are good for huge voltage changes,  
or for specific control

Photo resistors are fun, but harder to control  
Depends on lighting conditions

Touch contacts are fun and easier to learn  
specific controls for performances



# Further Tuning

You may need to put a resistor in series

Pick a pot based off of where  
the controls get less interesting

Big pot, big changes, hard to hit sweet spots

Smaller pots can miss out on the full range

Either find a balance, or use two pots

# Audio out is important

For low voltage circuits,  
just tie to the speaker

It's easy to use an audio 10k pot to give  
yourself volume control

Cutoff jacks can be useful

# Audio Input is great if present

If the toy has a jack, you are good to go

If it uses a pre-amp, even better

Try adding input across the mic pins

And now the advanced stuff...

# These take much more time

## Patch Bays

Exploring with caps, or changing them out

Exploring with diodes (LEDs are great)

## Video bending

# Triggering button presses

Good for looping and sequencing

Sometimes you can get away with a transistor

Opto-isolators work the rest of the time

# Midi Control

Opto-isolators for button presses

Digital pots for resistance changes

Square-wave output for timing circuit

Arduino midi library FTW!

# Great resources on the web

<http://www.getlofi.com/>

<http://www.casperelectronics.com/>

<http://www.circuitbending.com/>

<http://www.bentfestival.org/>



# Workshop Sunday at 13:00

\$25, includes Easy Button and access to my part bins. (these are not a joke)

Register online, I only have 11 Easy Buttons.

BYOEB - \$20

Same access, you just bring your own Easy Button, no per-registration required.

# Questions?



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