Circuit Playground Combadge

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https://learn.adafruit.com/circuit-playground-combadge

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Overview

What's a Combadge?

The combadge is a prop from Star Trek (originally appeared in The Next Generation) that is a combination of a badge and communicator. It is used to communicate with Starfleet personnel on-board the ship. When activated, it makes a distinctive "Chirp" sound.

DIY Combadge

In this tutorial, you'll learn how to turn an Adafruit Circuit Playground into a Star Trek Combadge! When tapped, it'll make the "chirp" sound effect! It won't make any actual phone calls, but it does make a pretty sweet prop for cosplay!

If you do want to make actual phone calls (along with a monthly bill) we made a functional [Star Trek Communicator](https) :-)

How Does It Work?

The on-board accelerometer can sense being tapped, triggering a sound to the on-board mini speaker. No soldering is required! All of the components are already on the board. All you need to do is upload the code, plugin a battery, and tap!
Make It How You Want

This tutorial utilizes some special tools like CNC mills and 3D Printers. We understand, those might be hard to come by, but you can totally make the combadge out of any material. Foam, resin, cardboard, whatever you have access to - The point of this tutorial is to learn how to use the Circuit Playground board to make the "guts" of the combadge.

Parts

- Circuit Playground (http://adafru.it/3000)
- 100mAh Lithium Ion Polymer Battery (http://adafru.it/1570)
- 2x DX01-N52 Neodymium Disc Magnet ()

Tools & Supplies

- 3D Printer () & Filament (http://adafru.it/2080)
• **CNC Milling Machine** ([http://adafru.it/2323](http://adafru.it/2323))
  - 1/8" Flat-End Mill
  - 1/32" Flat-End Mill
  - 80° Engraving Bit

• **360 Brass**, **6061 Aluminum**

• Dremel Rotary Tool
  - Polishing Wheels

• **Scotch** double-sided tape
• **Nitto** double-sided tape

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**Upload Code**

Follow the [Circuit Playground Lesson #0 to get your board set up](http://adafru.it/2323), then come back here once you know its all good!

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**Get Combadge Sketch**

Grab the sketch by going to File > Examples > Adafruit Circuit Playground > comm_ba
dge.
Choose Combadge Sound

Goto line 9 and add two "//" characters, essentially commenting out this line. Then, remove the two "//" from line 10. This tells the code which sound effect to use. The first one is a Mario coin sound, the second being the communicator sound we want.

```c
void setup() {
  CircuitPlayground.begin();

  // Configure accelerometer for +4G range, use the tap interrupt
  // feature to call myFunction() automatically when tapped.
  CircuitPlayground.setAccelRange(LIS3DH_RANGE_4_G);
  CircuitPlayground.setAccelTop(1, 64);
  attachInterrupt(digitalPinToInterrupt(7), myFunction, RISING);
}
```

Adjust Sensitivity

If you find the sensitivity of the accelerometer is too low, you can easy change it! Increase the sensitivity of the accelerometer by lowing the sensitivity value.

On line 28, change "127" to a lower value. I personally found "64" work well for this project.
Upload Code

Under the file menu Tools, select Board > Adafruit Circuit Playground. Then, Port > /dev/cu.usbmodem1421 (or similar).

Now you can upload the code by going to menu Sketch > Upload. You should see a progress bar indicating the upload.

3D Printing

Circuit Playground Mount

We'll need a mount to attach the Circuit Playground board to the combadge. The mount has four standoffs with little pegs that snap into the holes of the Circuit Playground. The standoffs will provide clearance to the base plate, since some of the components are tall.

3D Printing

The mount is pretty small, thus it should print on most FDM style, desktop 3D printers. It's a simple part with no overhangs, so no support material is needed. We suggest using PLA material, since it's the most friendly and doesn't require a heated bed.

Silce Settings

Here are some suggested slice settings for 3D printing. We used the Printrbot Play for this part.

- 40% Infill
- 2 Shells / Perimeters
- 4 Top/Bottom Layers
- 210C Extruder
- 60-80mm/s Print Speed
Tolerances

The pegs on the standoffs should be able to snap into the holes of the Circuit Playground board easily. If you find them too tight, you may need to tweak your slice settings. Lowering the "Extrusion Width" or the "Wall Thickness / Wall Line Count".

Proto-Pasta Magnetic Iron PLA

Use this filament to print the mag-mount.stl part. This filament is attracted to magnets and will be used to attach the combadge to your shirt. The filament doesn't require any special slice settings or a heated bed (standard PLA settings work just fine).

CNC Milling

Othermill Desktop CNC

The parts for the combadge were machined using the Othermill Desktop CNC, but they should be machinable on other mills, such as the Carvey, X-Carve or Shapeoko.

This portion of the tutorial will be specifically on using the Othermill.

Download Fusion 360 Source
Stock Materials

We suggest getting the material from the Othermachine.co website because they're pre-cut and ready to machine. In this project, we used the following stock.

- **360 Brass** - 4" x 4" x 0.25"
- **6061 Aluminum** - 4" x 4" x 0.125"

Measure Stock Thickness

Use a caliper to measure the thickness of the brass and aluminum and note them down. If they are really close to the specified thickness, then you won't need to regenerate the GCODE. If they're off by +/-0.05in, then we recommend regenerating the GCODE.

CAM and GCODE

Since stock material thickness tend to vary, you may need to regenerate GCODE for each part. If you're new to Fusion 360 and using CAM tools, don't worry! We'll guide you through the process.

Install Othermill Fusion 360 Tool Library

The Othermill Tool Library makes it easy to get started with CAM in Fusion 360. You'll need to download and import the file. To do so, we suggest following the guide on the Othermachine website. This will walk you through the process.
Changing Tools

Otherplan will prompt you when to change out tools. For this project, you'll need the following tools.

• 1/8" Flat-End Mill
• 1/32" Flat-End Mill
• 80° Engraving Bit
GCODE for Brass and Aluminum

Open up the Combadge Fusion 360 Archive and goto the CAM workspace. Right click on "Brass" under the Setups dropdown in the Browser panel. Then, in the Setup:Brass panel, goto the Stock tab. Look for the Height (Z) label and type in the thickness of the brass you measured with your calipers. Then, click "OK". Next, right-click on the "Brass" setup and choose "Generate Toolpath".

Click on the arrow next to the "Brass" setup, you'll see several items (Face1, 2D Pocket, 2D Contour, etc.). Now you can right-click on each item and select "Post Process". In the Post Process panel, choose othermill.cps in the Post processor section. Then, click OK. Rename the file, relative to the tool (ie. brass-face-1-8.nc). You can tell which sized tool is being used when you right-click to edit the item (ie. Face1) and see under the Tool tab. Do this for each item (export via post process).

Repeat this process for Aluminum.
Import GCODE into Otherplan

Open Otherplan and select the Generic profile under Material. Under the size dropdown, type in the width, height and thickness of the stock. Under placement, set the X and Y to "0". For Z, measure the thickness of your double-sided tape and input that here. This will effectively "raise" the material to compensate for the extra thickness.

Under plans, select Open Files and choose the brass-face-1-8.nc file. Under tool, select Set or Change and choose the 1/8" flat-end mill. The Otherplan will then walk you through the tool changing process. Under the brass-face-1-8.nc plan, select the 1/8" flat-end mill tool under Milling Tools. Now you're ready to secure the stock to the spoilboard.
Secure Stock to Spoilboard
We suggest using Nitto tape (1) to secure the stock to the spoilboard. 3 strips is plenty! Apply strips to surface of the stock and peel back the protection layer. Then, line up the corner of the stock with the lower left corner of the spoilboard. Firmly apply pressure to the spoilboard to secure the stock in place. Now you're ready to mill!

Milling Checklist

Before starting the job, make sure you run through the following checklist:

• Ensure 1/8" flat-end mill is installed correctly.
• Ensure material size and placement is set correctly.
• Ensure Brass is firmly secured to spoilboard.
• Ensure GCODE file is loaded.

If everything check outs, then you’re ready to mill! Click the "Start Milling" button under the GCODE plan.

Order of GCODE

The order of milling gcode files is very important. We suggest following the order below.
Removing Parts from Stock

Do not remove the stock from the spoilboard until all of the GOCDE jobs have been preformed. Once they're complete, you can use a thin spatula to get underneath the stock to pry it loose. Be careful when doing this! Remove slowly. Once you've taken it off the bed, you should be able to remove the part from the stock.

Polishing Parts

When the parts have been milled, you'll notice they have patterns on the surface. These lines are results from the machining process. You can optionally remove them using a rotary tool and polishing wheels.

A few minutes with a scotchbrite wheel will remove the machining lines. A buffing wheel can give the surface a mirror like finish.
Assembly

Secure Metal Pieces
The base part has cut notches on the lip. The triangle shape should be able to fit in the notches. Use a piece of double-sided Scotch tape to secure the aluminum triangle piece onto the brass base.

Attach Mount to Circuit Playground Board
Place the 3D printed mount over the top of the Circuit Playground board - the notch cutout should be over the JST connector. Press the standoffs down so the pegs are fitted into the holes on the board.
Attach Mount to Combadge
Add a strip of double-sided tape to the back of the combadge. Then, secure it to the back front of the Circuit Playground mounting place. Firmly press the two together to secure them in place.

Connect Battery
Plugin the male JST connector from the 100mAh lipo battery into the female JST connector on the Circuit Playground board.
Secure Metal Backing
Add some strips of double-sided tape to the surface of the 3D printed metal backing, then stick it onto the back of the Circuit Playground board.
Mount Battery
Use a piece of double-sided tape or mounting putty/tack to the back of the battery and stick it on the back of the Circuit Playground board.

Add to Shirt!
Now you can add place the neodymium magnet underneath your shirt and place the combadge over it!