# BLE Buzzy Box

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https://learn.adafruit.com/ble-buzzy-box

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# Table of Contents

# Overview

## BLE Notifications

Get your Apple Notifications with a Buzz! This project showcases how to use Adafruit Feather Sense nRF52840 and the DRV2605L haptic motor controller to trigger and display lights with Apple Notification Center Service (ANCS).

## Modular Case Design

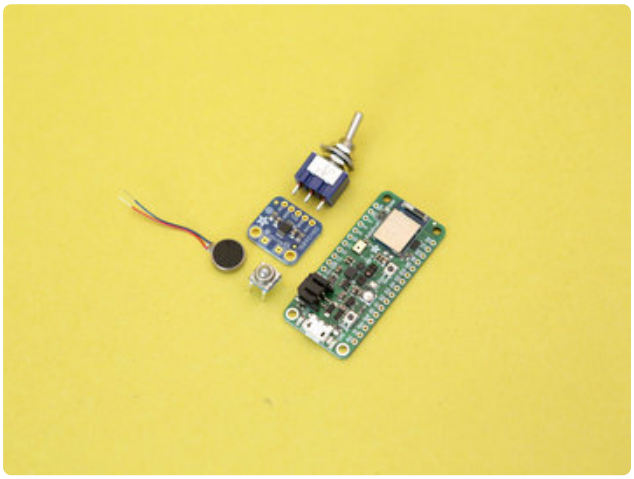
Inspired by the FREKVENS Ikea portable speaker (https://adafru.it/L6c), the enclosure pieces snap fits together and feature a modular design. Internal PCB mounting plate allows for swapping components and reusing enclosure pieces. The top cover pops open allowing for direct access to internal components.

## Prerequisite Guides

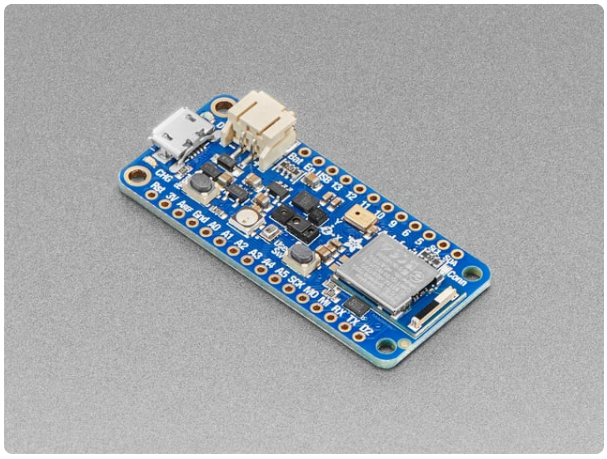
The following learn guides will provide additional information and demo code.

- DRV2605L Learn Guide (https://adafru.it/jDA)
- Adafruit Feather Sense Learn Guide (https://adafru.it/L6d)
- Getting Started with CircuitPython and BLE (https://adafru.it/FxH)

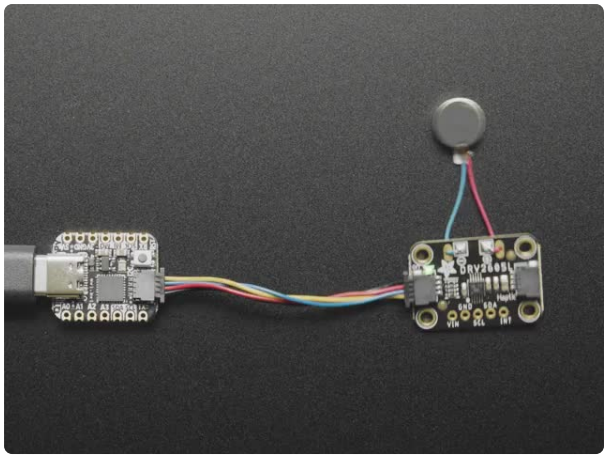
## Parts



Adafruit Feather Sense nRF52840 (http://adafru.it/4516)
DRV2605L Haptic Motor Controller (http://adafru.it/2305)
Vibration Mini Motor Disc (http://adafru.it/1201)
3.7v 500mAh Battery (http://adafru.it/1578)
Metal Ball Button (http://adafru.it/3347)
Mini Toggle Switch (http://adafru.it/3221)
10-wire Silicone Ribbon Wire (http://adafru.it/3890)



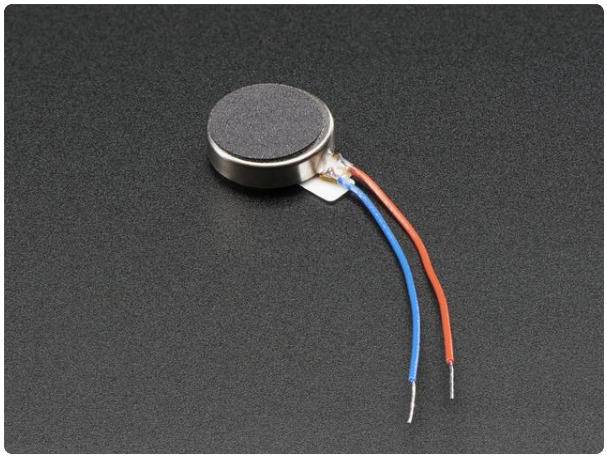
Adafruit Feather nRF52840 Sense
The Adafruit Feather Bluefruit Sense takes our popular Feather nRF52840 Express and adds a smorgasbord of sensors...
https://www.adafruit.com/product/4516



Adafruit DRV2605L Haptic Motor Controller - STEMMA QT / Qwiic

The DRV2605 from TI is a fancy little motor driver. Rather than controlling a stepper motor or DC motor, its designed specifically for controlling haptic motors -...

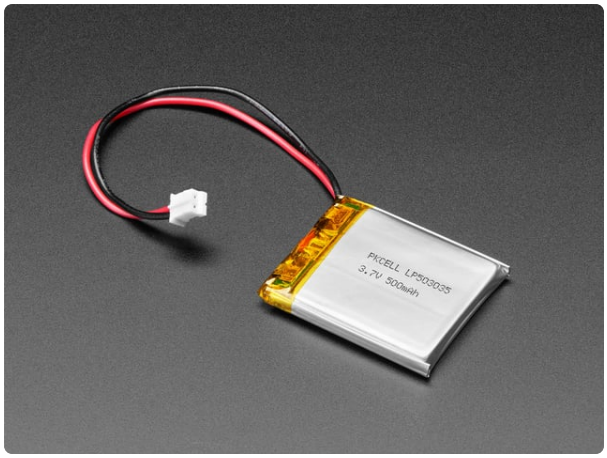
https://www.adafruit.com/product/2305



Vibrating Mini Motor Disc

*BZZZZZZZZZZ* Feel that? That's your little buzzing motor, and for any haptic feedback project you'll want to pick up a few of them. These vibe motors are tiny discs,...

https://www.adafruit.com/product/1201



Lithium Ion Polymer Battery - 3.7v 500mAh

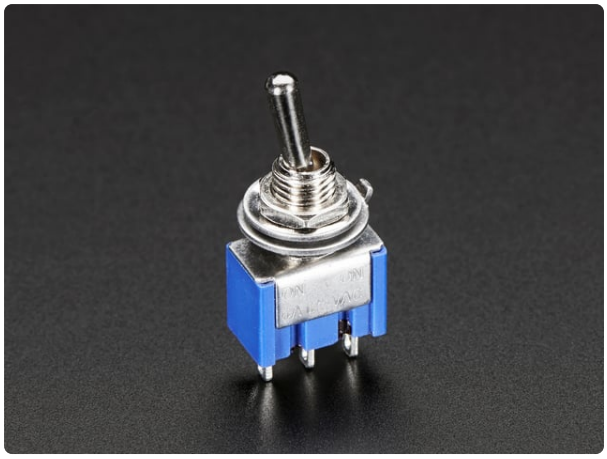
Lithium-ion polymer (also known as 'lipo' or 'lipoly') batteries are thin, light, and powerful. The output ranges from 4.2V when completely charged to 3.7V. This...

https://www.adafruit.com/product/1578

Metal Ball Tactile Button (6mm) x 10 pack

Add some steely elegance to your project with these Metal Ball Tactile Buttons. They've got a nice industrial shine to them along with a light blue...

https://www.adafruit.com/product/3347



Mini Panel Mount SPDT Toggle Switch
This or that, one or the other, perhaps or perhaps not! So hard to make decisions these days without feeling like you're just going back and forth constantly. Deciding whether or...
https://www.adafruit.com/product/3221

## Hardware

List of screws and nuts required to build this project.

- 4x M2.5 x 18mm
- 6x M2.5 x 8mm
- 10x M2.5 Hex Nuts

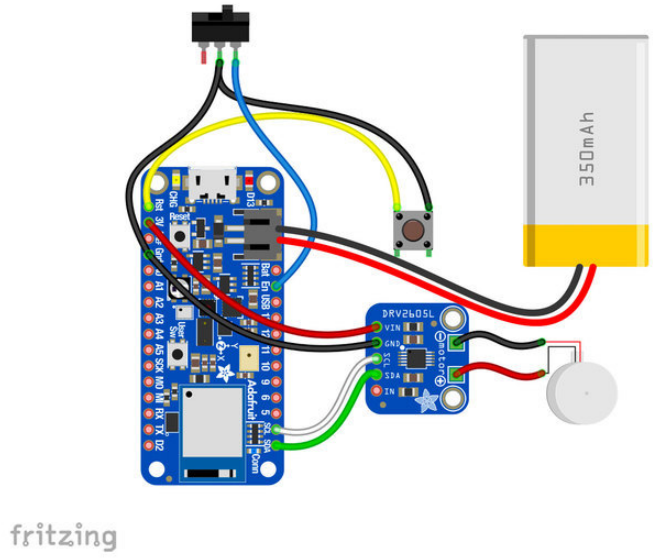
---

# Circuit Diagram

The diagram below provides a visual reference for wiring of the components. This diagram was created using the software package Fritzing (https://adafru.it/oEP).

## Adafruit Library for Fritzing

Use Adafruit's Fritzing parts library to create circuit diagrams for your projects. Download the library or just grab individual parts. Get the library and parts from GitHub - Adafruit Fritzing Parts (https://adafru.it/AYZ).




## Wired Connections

- **VCC** from DRV2605L to **VCC** on Feather
- **GND** from DRV2605L to **GND** on Feather
- **SCL** from DRV2605L to **SCL** on Feather
- **SDA** from DRV2605L to **SDA** on Feather
- Switch to **GND**
- Switch to **EN**
- Button to **RESET** on Feather
- Button to **GND** on Feather
- Motor to **GND** on DRV2605L
- Motor to **VCCC** on DRV2605L

## Powering

The Adafruit board can be powered via USB or JST using a 3.7v lipo battery. In this project, a 420mAh lipo battery is used. The lipo battery is rechargeable via the USB port on the board. The switch is wired to the **enable** and **ground** pins on the board.

# 3D Printing

## Parts List

STL files for 3D printing are oriented to print "as-is" on FDM style machines. Parts are designed to 3D print without any support material. Original design source may be downloaded using the links below.

buzz-mount.stl
buzz-control-box.stl
buzz-back.stl
buzz-cone.stl
buzz-diffuser.stl
buzz-speaker-cover.stl

**Download Fusion 360 Source**

https://adafru.it/L2d

**Download CAD files from Thingiverse**

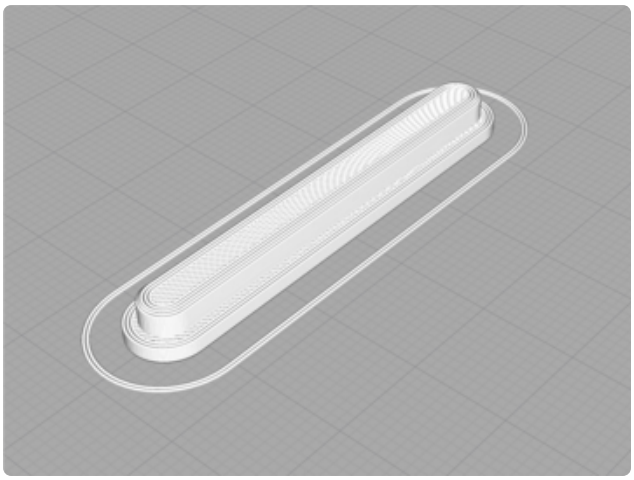
https://adafru.it/L2e

**Download CAD files from Prusa Printers**

https://adafru.it/L2f

## CAD Assembly

PCBs are secured to a mounting plate with M2.5 hardware. The mounting plate is secured to the speaker cover using M2.5 x 16mm long screws and hex nuts. A toggle switch and tactile button are panel mounted to the back cover. The speaker cover snap fits onto the back cover. A diffuser is press fitted into the opening on the top cover. The top cover snap fits onto both of the covers.

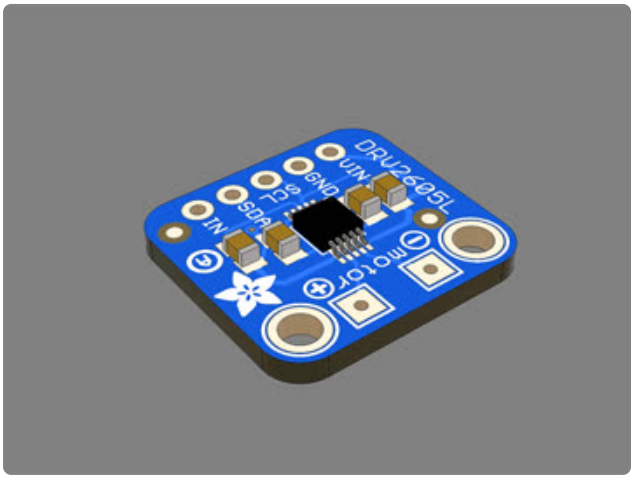


## Slicing Parts

No supports are required. Slice with setting for PLA material. Use white or translucent filament for the diffuser.

The parts were sliced using CURA using the slice settings below.

PLA filament 220c extruder
0.2 layer height
10% gyroid infill
60mm/s print speed
60c heated bed




## Design Source Files

The project assembly was designed in Fusion 360. This can be downloaded in different formats like STEP, STL and more. Electronic components like Adafruit's board, displays, connectors and more can be downloaded from the Adafruit CAD parts GitHub Repo (https://adafru.it/AW8).

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# CircuitPython on Feather Sense

CircuitPython (https://adafru.it/tB7) is a derivative of MicroPython (https://adafru.it/BeZ) designed to simplify experimentation and education on low-cost microcontrollers. It makes it easier than ever to get prototyping by requiring no upfront desktop software downloads. Simply copy and edit files on the **CIRCUITPY** drive to iterate.

The following instructions will show you how to install CircuitPython. If you've already installed CircuitPython but are looking to update it or reinstall it, the same steps work for that as well!

## Set up CircuitPython Quick Start!

Follow this quick step-by-step for super-fast Python power :)

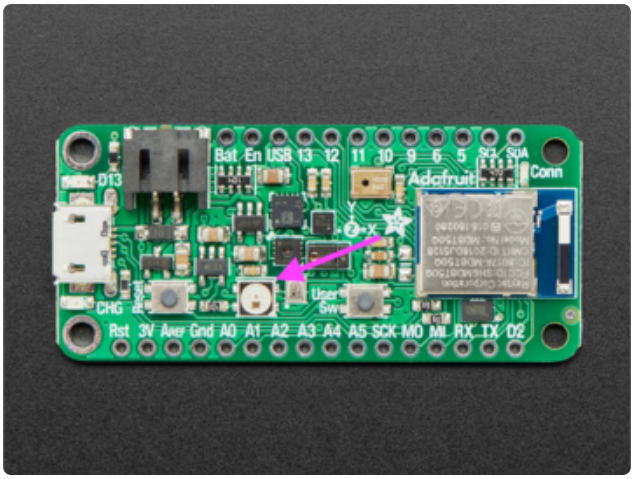
**Download the latest version of CircuitPython for this board via circuitpython.org**

https://adafru.it/JqE


**Click the link above to download the latest UF2 file.**

Download and save it to your desktop (or wherever is handy).

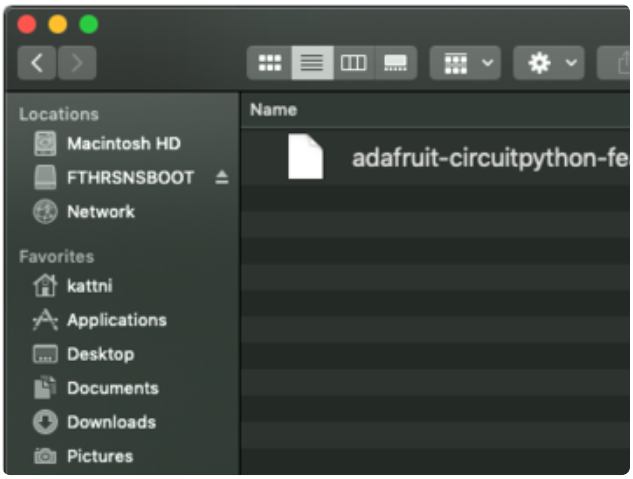
Plug your Feather Sense into your computer using a known-good USB cable.



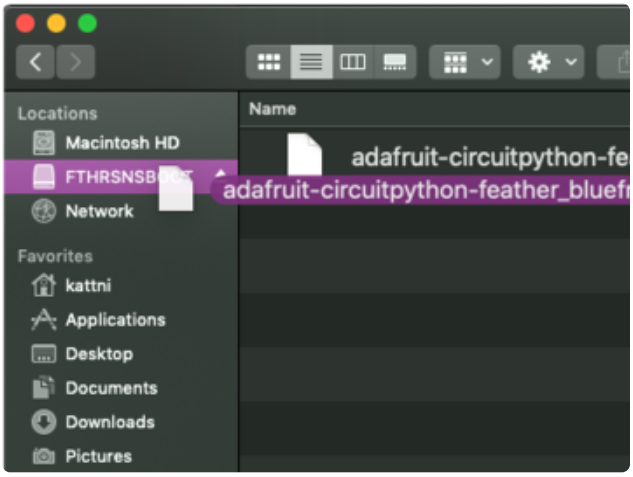
**A lot of people end up using charge-only USB cables and it is very frustrating! So make sure you have a USB cable you know is good for data sync.**

Double-click the **Reset** button next to the USB connector on your board, and you will see the NeoPixel RGB LED turn green (identified by the arrow in the image). If it turns red, check the USB cable, try another USB port, etc. **Note:** The little red LED next to the USB connector will pulse red. That's ok!

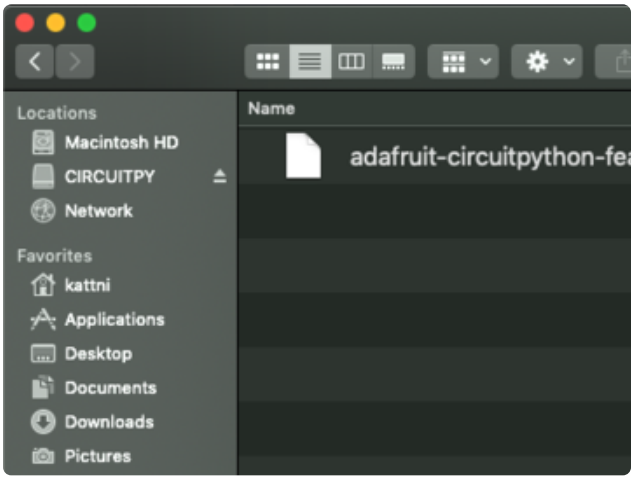
If double-clicking doesn't work the first time, try again. Sometimes it can take a few tries to get the rhythm right!




You will see a new disk drive appear called **FTHRSNSBOOT**.




Drag the **adafruit_circuitpython_etc.uf2** file to **FTHRSNSBOOT.**




The LED will flash. Then, the **FTHRSNSBOOT** drive will disappear and a new disk drive called **CIRCUITPY** will appear.

That's it, you're done! :)

Note: Some early release Sense boards had the drive named FTHR840BOOT. You can still copy .UF2s to the board, just copy to the board name appearing when the board is plugged in.

# Coding the Buzzy Box

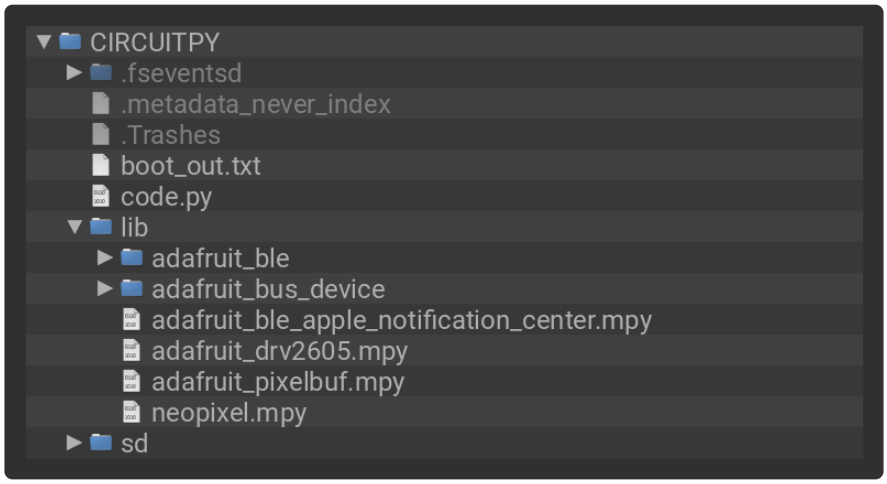
# Adding Libraries

## Installing Project Code

To use with CircuitPython, you need to first install a few libraries, into the lib folder on your **CIRCUITPY** drive. Then you need to update **code.py** with the example script.

Thankfully, we can do this in one go. In the example below, click the **Download Project Bundle** button below to download the necessary libraries and the **code.py** file in a zip file. Extract the contents of the zip file, open the directory **BLE_Buzzy_Box/** and then click on the directory that matches the version of CircuitPython you're using and copy the contents of that directory to your **CIRCUITPY** drive.

Your **CIRCUITPY** drive should now look similar to the following image:




```
# SPDX-FileCopyrightText: 2020 Liz Clark for Adafruit Industries
#
# SPDX-License-Identifier: MIT

import time
import board
import busio
import neopixel
import adafruit_drv2605
import adafruit_ble
from adafruit_ble.advertising.standard import SolicitServicesAdvertisement
from adafruit_ble.services.standard import CurrentTimeService
from adafruit_ble_apple_notification_center import AppleNotificationCenterService
from digitalio import DigitalInOut, Direction

#  setup for onboard NeoPixel
pixel_pin = board.NEOPIXEL
num_pixels = 1
```

```
pixel = neopixel.NeoPixel(pixel_pin, num_pixels, brightness=0.3, auto_write=False)

#  setup for haptic motor driver
i2c = busio.I2C(board.SCL, board.SDA)
drv = adafruit_drv2605.DRV2605(i2c)

#  onboard blue LED
blue_led = DigitalInOut(board.BLUE_LED)
blue_led.direction = Direction.OUTPUT

#  setup for BLE
ble = adafruit_ble.BLERadio()
if ble.connected:
    for c in ble.connections:
        c.disconnect()

advertisement = SolicitServicesAdvertisement()

#  adds ANCS and current time services for BLE to advertise
advertisement.solicited_services.append(AppleNotificationCenterService)
advertisement.solicited_services.append(CurrentTimeService)

#  state machines
current_notification = None #  tracks the current notification from ANCS
current_notifications = {} #  array to hold all current notifications from ANCS
cleared = False #  state to track if notifications have been cleared from ANCS
notification_service = None #  holds the array of active notifications from ANCS
all_ids = [] #  array to hold all of the ids from ANCS
hour = 0 #  used to track when it is on the hour for the mindfulness reminder
mindful = False #  state used to track if it is time for mindfulness
vibration = 16 #  vibration effect being used for the haptic motor
blue = (0, 0, 255) #  color blue for the NeoPixel
purple = (255, 0, 255) #  color purple for the NeoPixel
red = (255, 0, 0) #  color red for the NeoPixel
clear = (0, 0, 0) #  allows for NeoPixel to be turned 'off'

#  function for blinking NeoPixel
#  blinks: # of blinks
#  speed: how fast/slow blinks
#  color1: first color
#  color2: second color
def blink_pixel(blinks, speed, color1, color2):
    for _ in range(0, blinks):
        pixel.fill(color1)
        pixel.show()
        time.sleep(speed)
        pixel.fill(color2)
        pixel.show()
        time.sleep(speed)

#  function for haptic motor vibration
#  num_zzz: # of times vibrates
#  effect: type of vibration
#  delay: time between vibrations
def vibe(num_zzz, effect, delay):
    drv.sequence[0] = adafruit_drv2605.Effect(effect)
    for _ in range(0, num_zzz):
        drv.play()  # play the effect
        time.sleep(delay)  # for 0.5 seconds
        drv.stop()

#  start BLE
ble.start_advertising(advertisement)

while True:

    blue_led.value = False
    print("Waiting for connection")
```

```
#  NeoPixel is red when not connected to BLE
while not ble.connected:
    blue_led.value = False
    pixel.fill(red)
    pixel.show()

print("Connected")

while ble.connected:
    blue_led.value = True #  blue LED is on when connected
    all_ids.clear()
    for connection in ble.connections:
        if not connection.paired:
            #  pairs to phone
            connection.pair()
            print("paired")
        #  allows connection to CurrentTimeService
        cts = connection[CurrentTimeService]
        notification_service = connection[AppleNotificationCenterService]
    #  grabs notifications from ANCS
    current_notifications = notification_service.active_notifications

    for notif_id in current_notifications:
        #  adds notifications into array
        notification = current_notifications[notif_id]
        all_ids.append(notif_id)

    if current_notification and current_notification.removed:
        # Stop showing the latest and show that there are no new notifications.
        current_notification = None
        pixel.fill(clear)
        pixel.show()

    if not current_notification and not all_ids and not cleared:
        #  updates cleared state for notification
        cleared = True
        #  turns off NeoPixel when notifications are clear
        pixel.fill(clear)
        pixel.show()

    elif all_ids:
        cleared = False
        if current_notification and current_notification.id in all_ids:
            index = all_ids.index(current_notification.id)
        else:
            index = len(all_ids) - 1
            notif_id = all_ids[index]
        #  if there is a notification:
        if not current_notification or current_notification.id != notif_id:
            current_notification = current_notifications[notif_id]
            #  parses notification info into a string
            category = str(notification).split(" ", 1)[0]
            #  haptic motor vibrates
            vibe(2, vibration, 0.5)
            #  all info for notification is printed to REPL
            print('-'*36)
            print("Msg #%d - Category %s" % (notification.id, category))
            print("From app:", notification.app_id)
            if notification.title:
                print("Title:", notification.title)
            if notification.subtitle:
                print("Subtitle:", notification.subtitle)
            if notification.message:
                print("Message:", notification.message)
            #  NeoPixel blinks and then stays on until cleared
            blink_pixel(2, 0.5, purple, clear)
            pixel.fill(purple)
            pixel.show()
```

```
        #  if it's on the hour:
        if cts.current_time[4] == hour and not mindful:
            print(cts.current_time[4])
            print("mindful time")
            #  haptic motor vibrates
            vibe(5, vibration, 1)
            #  NeoPixel blinks and then stays on
            blink_pixel(5, 1, blue, clear)
            mindful = True
            pixel.fill(blue)
            pixel.show()
            print("hour = ", hour)
        #  if it's no longer on the hour:
        if cts.current_time[4] == (hour + 1) and mindful:
            #  NeoPixel turns off
            mindful = False
            pixel.fill(clear)
            pixel.show()
            print("mindful time over")

    #  if BLE becomes disconnected then blue LED turns off
    #  and BLE begins advertising again to reconnect
    print("Disconnected")
    blue_led.value = False
    print()
    ble.start_advertising(advertisement)
    notification_service = None
```

---

# CircuitPython Code Walkthrough

## Inspiration

The code for this project is based on two previous projects on the Adafruit Learn System: John Park's Bluefruit TFT Gizmo ANCS Notifier for iOS (https://adafru.it/IIB) and Becky Stern's Buzzing Mindfulness Bracelet (https://adafru.it/jDC). Be sure to check out both of those Learn Guides for additional project inspiration.

## Setup

### CircuitPython Libraries

The CircuitPython code begins by importing the libraries.

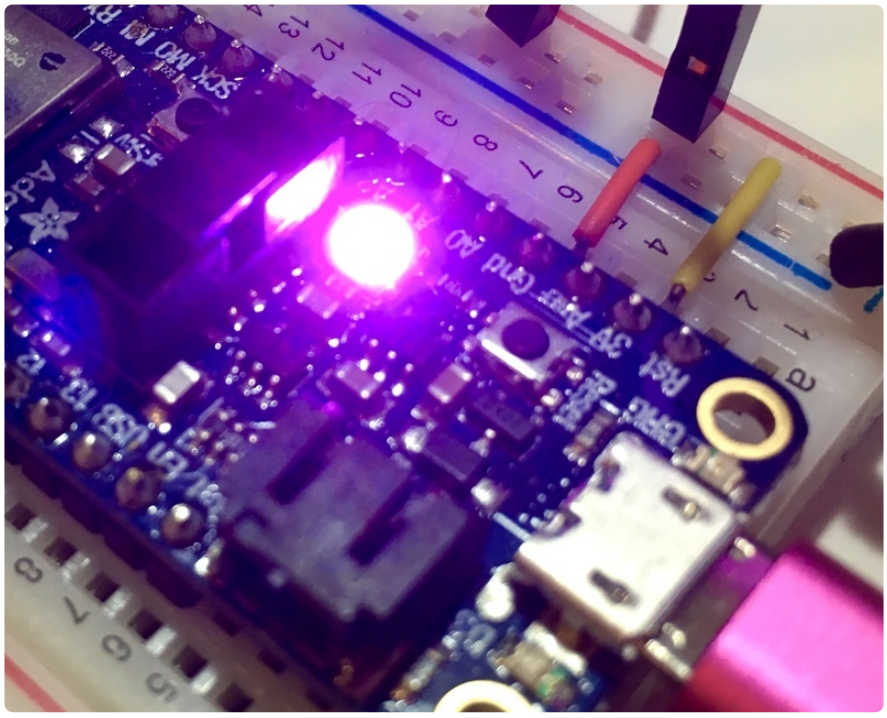
```
import time
import board
import busio
import neopixel
import adafruit_drv2605
import adafruit_ble
from adafruit_ble.advertising.standard import SolicitServicesAdvertisement
from adafruit_ble.services.standard import CurrentTimeService
from adafruit_ble_apple_notification_center import AppleNotificationCenterService
from digitalio import DigitalInOut, Direction
```

## LEDs and Motors

After the libraries are imported, the onboard NeoPixel is setup as `pixel_pin`. This NeoPixel will serve as the visual notifier on the Buzzy Box.

```
pixel_pin = board.NEOPIXEL
num_pixels = 1

pixel = neopixel.NeoPixel(pixel_pin, num_pixels, brightness=0.3, auto_write=False)
```



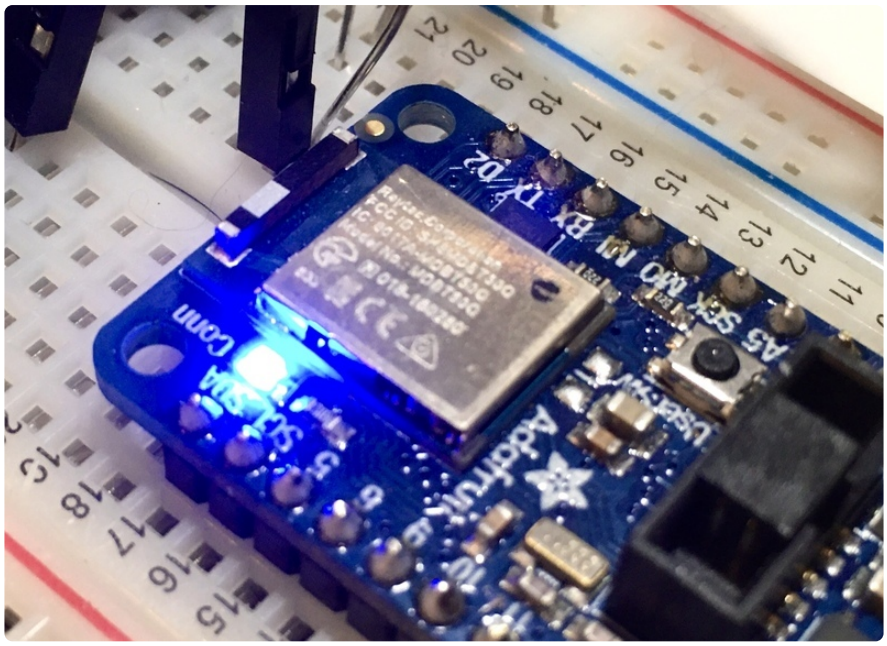
Up next, the DRV2605L driver breakout is setup to communicate over I2C. This driver is what powers the haptic motor to make the Buzzy Box buzz.

```
i2c = busio.I2C(board.SCL, board.SDA)
drv = adafruit_drv2605.DRV2605(i2c)
```

**For more information on the DRV2605L, check out this Learn Guide**

https://adafru.it/jDA

In addition to the onboard NeoPixel, the onboard blue LED on the Feather Sense is also used for this project. This LED is located towards the back of the Feather, next to the nRF52840 chip. Later in the code, it will indicate whether or not your iOS device is connected to BLE.



```
blue_led = DigitalInOut(board.BLUE_LED)
blue_led.direction = Direction.OUTPUT
```

## Setting Up BLE

Next in the setup is BLE, allowing for BLE connectivity and functionality to be accessed via the `adafruit_ble` library.

```
ble = adafruit_ble.BLERadio()
if ble.connected:
    for c in ble.connections:
        c.disconnect()
```

There are a lot of ways to use BLE, but in this project the Apple Notification Center Service (ANCS) and Current Time Service are used. These two services are called out to be connected to when a BLE connection is established.

```
advertisement = SolicitServicesAdvertisement()

advertisement.solicited_services.append(AppleNotificationCenterService)
advertisement.solicited_services.append(CurrentTimeService)
```

## State Machines

Following the setup are state machines that will be used in the loop. Their purpose is comment below in the code.

```
current_notification = None #  tracks the current notification from ANCS
current_notifications = {} #  array to hold all current notifications from ANCS
cleared = False #  state to track if notifications have been cleared from ANCS
```

```
notification_service = None #  holds the array of active notifications from ANCS
all_ids = [] #  array to hold all of the ids from ANCS
hour = 0 #  used to track when it is on the hour for the mindfulness reminder
mindful = False #  state used to track if it is time for mindfulness
vibration = 16 #  vibration effect being used for the haptic motor
blue = (0, 0, 255) #  color blue for the NeoPixel
purple = (255, 0, 255) #  color purple for the NeoPixel
red = (255, 0, 0) #  color red for the NeoPixel
clear = (0, 0, 0) #  allows for NeoPixel to be turned 'off'
```

## Putting the "Fun" in Function

There are two functions that will be called in the loop to control the Feather's NeoPixel and the haptic motor.

`blink_pixel()` allows you to blink the NeoPixel with parameters for how many time you want it to blink ( `blinks` ), how fast you want it to blink ( `speed` ) and then the two colors that the NeoPixel will blink between ( `color1` and `color2` ).

If you were to discretely code multiple blinks for the NeoPixel line by line it could get really long. This lets you blink it as many times as you want with one line of code in the loop.

```
def blink_pixel(blinks, speed, color1, color2):
    for _ in range(0, blinks):
        pixel.fill(color1)
        pixel.show()
        time.sleep(speed)
        pixel.fill(color2)
        pixel.show()
        time.sleep(speed)
```

`vibe()` does something similar to `blink_pixel()` but for the haptic motor. It allows you to vibrate the motor multiple times with parameters for  the number of times you want the motor to vibrate ( `num_zzz` ), the motor effect type ( `effect` ) and the length of the delay between each vibration ( `delay` ).

```
def vibe(num_zzz, effect, delay):
    drv.sequence[0] = adafruit_drv2605.Effect(effect)
    for _ in range(0, num_zzz):
        drv.play()
        time.sleep(delay)
        drv.stop()
```

Finally, the setup is wrapped up with BLE starting to advertise its signal for your iOS device to connect to.

```
ble.start_advertising(advertisement)
```

# The Loop

## Waiting for BLE

The loop begins with some visual notifications to let you know that BLE is not connected. If BLE is not connected, the onboard NeoPixel will be red and the onboard blue LED will be off. "`Waiting for connection`" will also print out to the REPL. Once BLE is connected, "`Connected`" will print to the REPL.

```
while True:

    blue_led.value = False
    print("Waiting for connection")
    while not ble.connected:
        blue_led.value = False
        pixel.fill(red)
        pixel.show()
        pass
    print("Connected")
```

## BLE Setup: Apple Notification Center Service and CurrentTimeService

A few other things occur once a BLE connection is established. The onboard blue LED will turn on and the NeoPixel will turn off.

The Feather nRF52840 will also pair with your iOS device in order to have access to the Apple Notification Center Service (ANCS).

`notification_service` holds the connection to ANCS. These notifications are stored in an array. Additionally, `current_notifications` holds the current notifications that are active in ANCS.

```
while ble.connected:
        blue_led.value = True
        all_ids.clear()
        for connection in ble.connections:
            if not connection.paired:
                connection.pair()
                print("paired")
            cts = connection[CurrentTimeService]
            notification_service = connection[AppleNotificationCenterService]
        current_notifications = notification_service.active_notifications
```

## Tracking Notifications

In this `for` statement, `notification` is setup to hold the notification ID's in an array for the current notifications in ANCS. The notification ID has all of the information

about the notification: the time stamp, the app name, the information in the notification, etc. The notification ID's are also added to the `all_ids` array.

```
for notif_id in current_notifications:
            notification = current_notifications[notif_id]
            all_ids.append(notif_id)
```

## Dismissing Notifications

Next, two `if` statements take care of handling what happens when a notification has been cleared and is no longer active.

In the first `if` statement, `current_notification` is reset to `None` and the NeoPixel, which functions as a visual cue that you have a notification, is turned off.

```
if current_notification and current_notification.removed:
            # Stop showing the latest and show that there are no new notifications.
            current_notification = None
            pixel.fill(clear)
            pixel.show()
```

The second `if` statement, checks that `current_notification` is inactive and that `all_ids` is empty. If that is correct, then `cleared` is updated to `True` to demonstrate that all of the notifications in ANCS are currently cleared.

```
if not current_notification and not all_ids and not cleared:
            cleared = True
            pixel.fill(clear)
            pixel.show()
```

## Indexing Notifications

The next portion revolves around what happens if a notification is active in ANCS.

First, `cleared` is updated to `False` and then the notification ID's are indexed. This allows for new notifications to trigger the Feather's NeoPixel and the haptic motor even if older notifications have not been cleared. The newest notification is then stored in `notif_id`.

```
elif all_ids:
  cleared = False
  if current_notification and current_notification.id in all_ids:
    index = all_ids.index(current_notification.id)
  else:
    index = len(all_ids) - 1
    notif_id = all_ids[index]
```

## Notification Alerts with Haptic Motors and NeoPixels

The following `if` statement is where the action is for a notification triggering the Feather NRF52840.

If the state of `current_notification.id` does not match the notification index that was just stored in `notif_id`, then the code knows that a new notification is present.

`current_notification` is updated to hold this new notification and `category` holds all of the metadata for the notification as a string. Storing it in this way allows it to be printed to the REPL and also accessed in the code.

```
if not current_notification or current_notification.id != notif_id:
  current_notification = current_notifications[notif_id]
  category = str(notification).split(" ", 1)[0]
```

The haptic motor vibrates to alert you to the new notification. This is done with the `vibe()` function.

Following the haptic motor, the notification's metadata is printed out to the REPL. The information included is the ID number, category of notification, app name, title, subtitle and the message in the notification. The notifications are separated by 36 dashes.

```
vibe(2, vibration, 0.5)
print('-'*36)
print("Msg #%d - Category %s" % (notification.id, category))
print("From app:", notification.app_id)
if notification.title:
      print("Title:", notification.title)
if notification.subtitle:
      print("Subtitle:", notification.subtitle)
if notification.message:
      print("Message:", notification.message)
```

After the information has been printed to the REPL, the onboard NeoPixel will blink purple with the `blink_pixel()` function and then stay on until the notifications are cleared, just in case you aren't around to notice the haptic motor or blinking.

```
blink_pixel(2, 0.5, purple, clear)
pixel.fill(purple)
pixel.show()
```

That wraps up the ANCS notification portion of the loop. Beyond notifications though, you may want to keep track of time while you're deep in emails, video games or Fusion360. Luckily, there's BLE functionality to help with that too.

## Mindfulness

Using the `CurrentTimeService` BLE library, you can access your connected device's clock to sync up with the Feather NRF52840.

In this instance, you'll use `CurrentTimeService` to check when a new hour begins (9:00, 10:00, 11:00, etc). If it's on the hour, the haptic motor will vibrate and the NeoPixel will blink to alert you. This can help remind you to get up and stretch or to be reminded of the time without having to look at a clock or your devices.

The information from `CurrentTimeService` is stored in `cts` after being setup earlier in the loop. The information is stored as an array, with all of the time data separated in their own entries. The minutes for the hour is indexed as `4` in the array. You can check a predetermined value, in this case `hour`, to see if it matches the current time being held by `cts`.

In the case of the code, if `cts.current_time[4]` matches with `hour`, which is set to `0`, then the current time is printed to the REPL along with the string "`mindful time`". The haptic motor vibrates with the `vibe()` function and the onboard NeoPixel blinks using the `blink_pixel ()` function, this time in blue.

```
if cts.current_time[4] == hour and not mindful:
    print(cts.current_time[4])
    print("mindful time")
    vibe(5, vibration, 1)
    blink_pixel(5, 1, blue, clear)
```

The `mindful` state is set to `True` and the onboard NeoPixel will remain blue for the duration of the minute.

```
mindful = True
pixel.fill(blue)
pixel.show()
print("hour = ", hour)
```

Once one minute after the hour occurs, the `mindful` state is reset to `False` and the onboard NeoPixel is turned off. The string "`mindful time over`" is also printed to the REPL. This process will occur every hour alongside the ANCS notifications.

## Dropped Signals

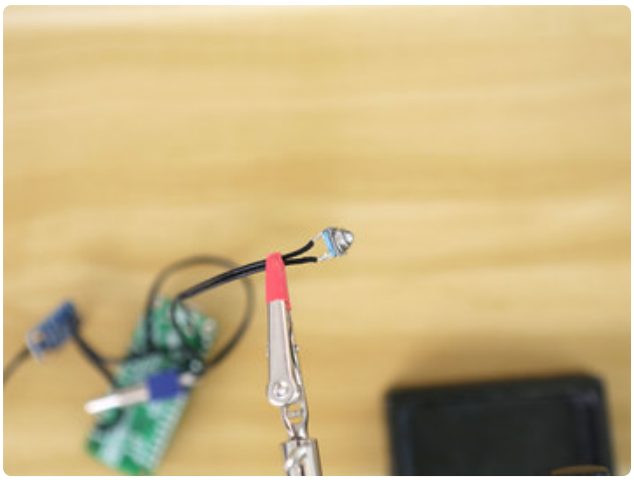
The code closes with a safety net for lost BLE connections. If the Feather becomes disconnected from your iOS device, "`Disconnected`" will be printed to the REPL and the onboard blue LED will turn off. The nRF52840 will begin advertising the BLE

connection again and `notifcation_service` will be reset to `None`. The loop will go back to the beginning to reconnect.

```
print("Disconnected")
blue_led.value = False
print()
ble.start_advertising(advertisement)
notification_service = None
```

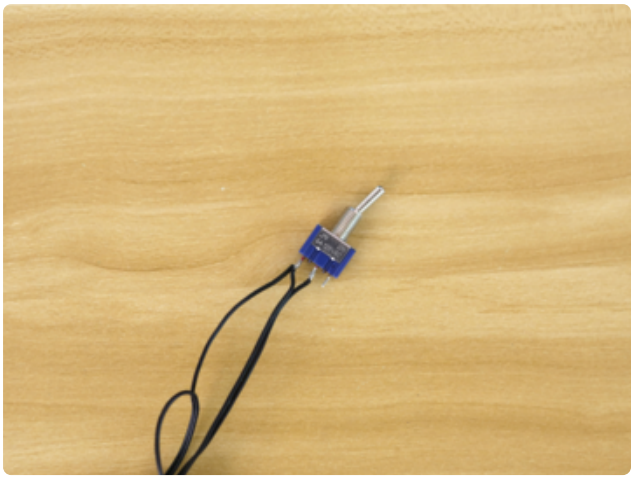
---

# Wiring



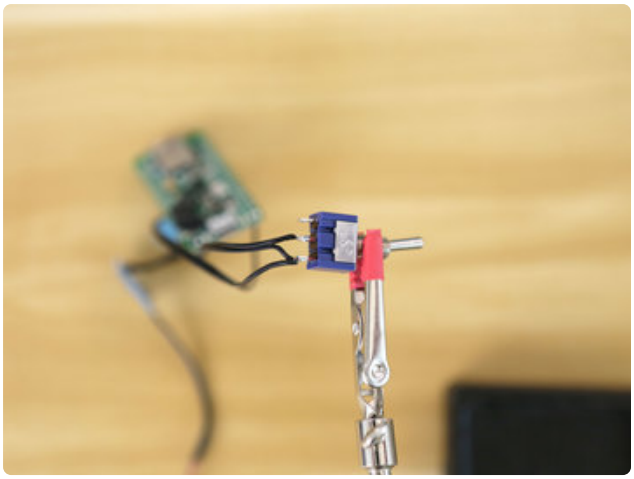
## Button Wiring

Use a 2-wire ribbon cable with 90mm of length. Solder the wires to the pins that are not linked/shared. Reference the photo for the correct pins.



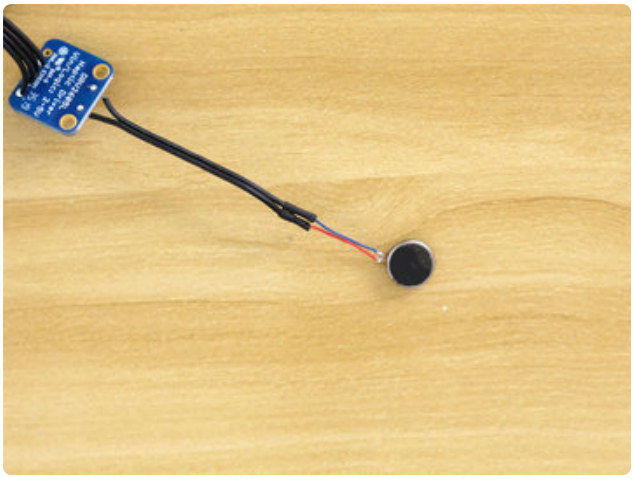
## Switch Wiring

Use a 2-wire ribbon cable with 90mm of length. Solder to the middle pin and either the farthest pin on the left or right.



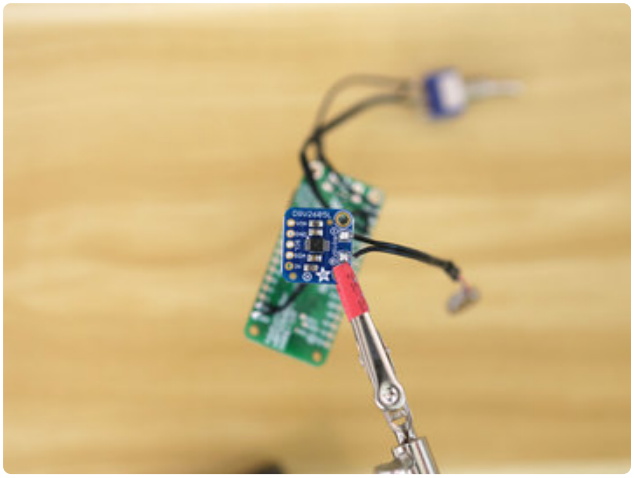
## Shared Common Ground

The ground wire from the button is wired to the ground pin on the switch.



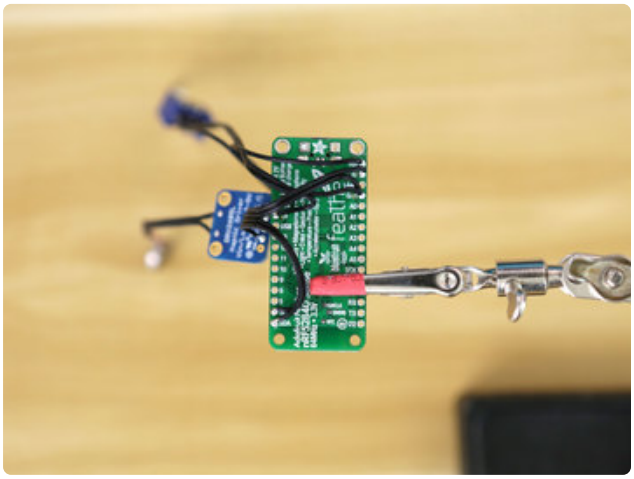
## Vibrating Motor Wiring

The mini motor disc includes wires that are very thin and fragile. To avoid damage from handling, extend the wiring using a 2-wire ribbon cable 46mm in length. Use heat shrink tubing to insulate any exposed wire.



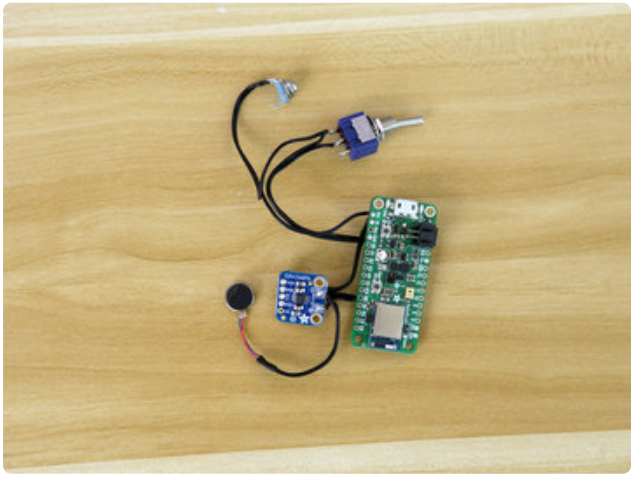
## DRV2605L Wiring

Solder the wires from the motor disc to the motor pins on the DRV2605L breakout. Use a 4-wire ribbon cable 46mm long. Solder the wires to the **SCL**, **SDA**, **VIN** and **GND** pins.



## Feather Wiring

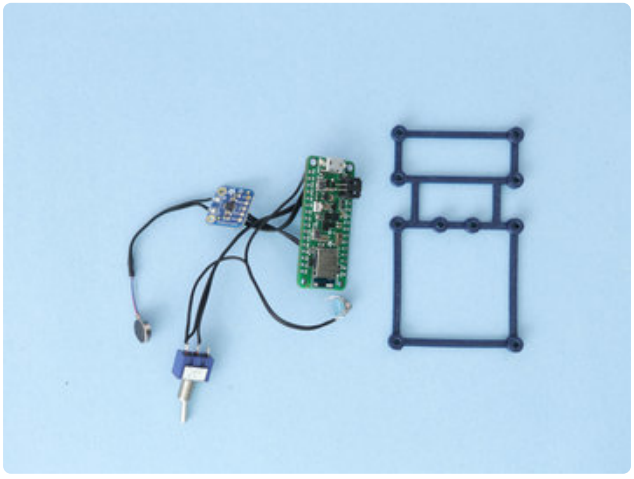
Solder the 4-wires from the DRV2605L breakout to the **SDA**, **SCL**, **3V** and **GND** pins on Feather. Solder the signal wire from the button to the **RESET** pin. Solder the ground wire from the toggle switch to the **GND** pin on Feather. Solder the signal wire from the toggle switch to the **EN** pin on Feather. The ground wires from the toggle switch and DRV2605L are shared across the single ground pin on Feather.



## Wired Circuit

Double check your wired connections to ensure the solder joints are solid. Use the circuit diagram and the wiring photo to reference the wired connections.

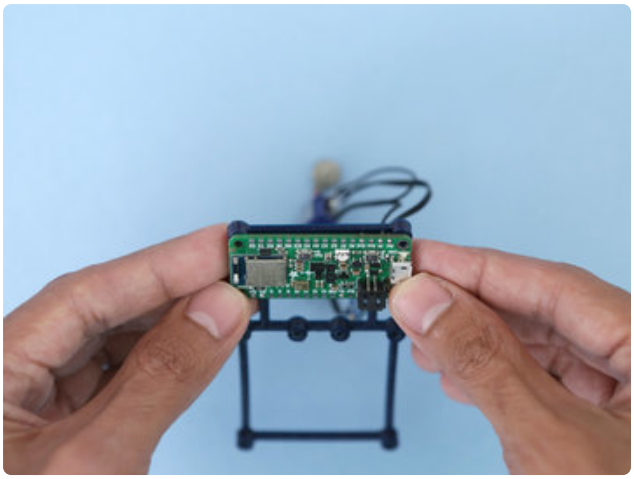
# Assembly



## PCB Mount

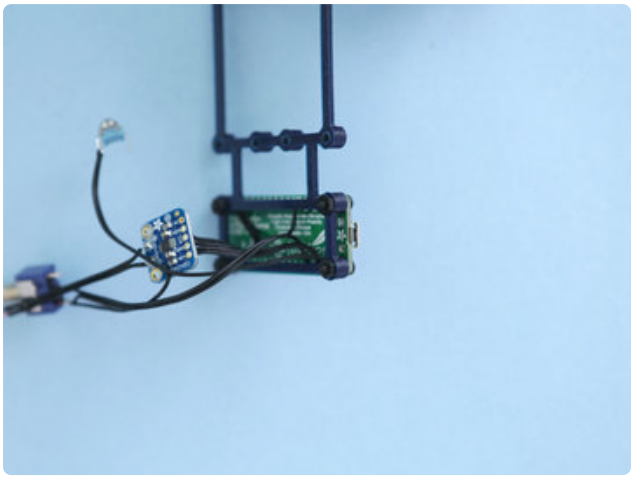
Use the following hardware to secure the Feather Sense and DRV2506L breakout.

4x M2.5 x 18mm screws
6x M2.5 x 10mm screws
10x M2.5 hex nuts



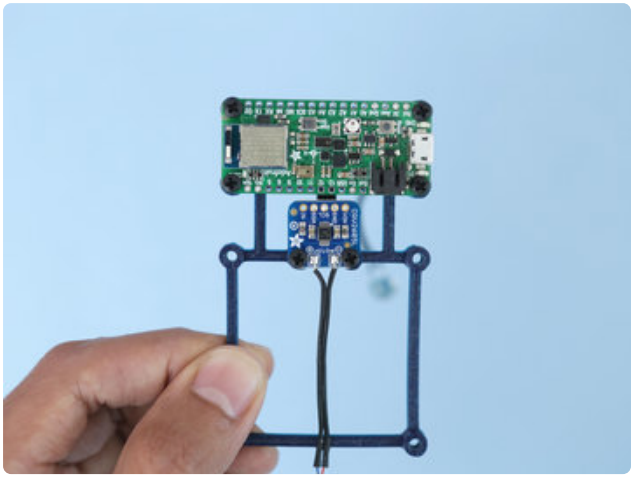
## Install Feather to PCB Mount

Place the Feather PCB over the mount and line up the mounting holes with the 4x standoffs. Reference the photo for the correct orientation.



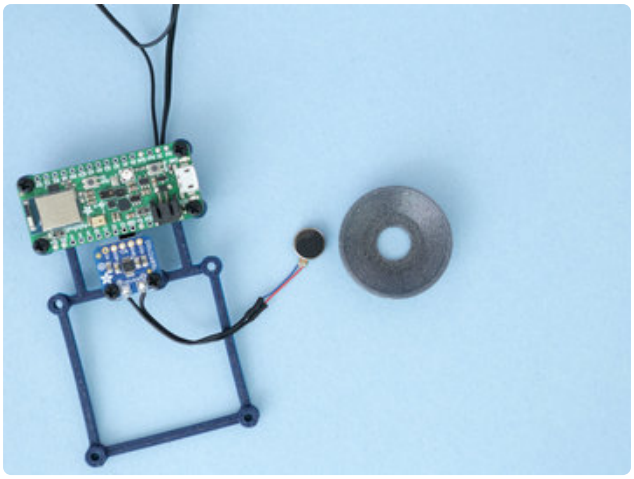
## Secure Feather

Insert and fasten 4x M2.5 x 10mm long screws through the top of the feather PCB and through the standoffs. Secure the screws using 4x M2.5 hex nuts. Note: The components and wiring are passed through the opening in the center of the Feather standoffs.



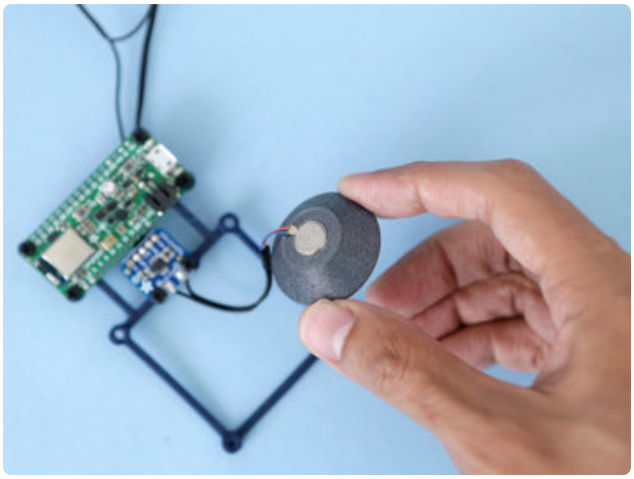
## Secure DRV2605L

Place the DRV2605L breakout over the two standoffs, right below the Feather PCB. Use 2x M2.5 x 10mm long screws and hex nuts to secure the PCB to the mount.



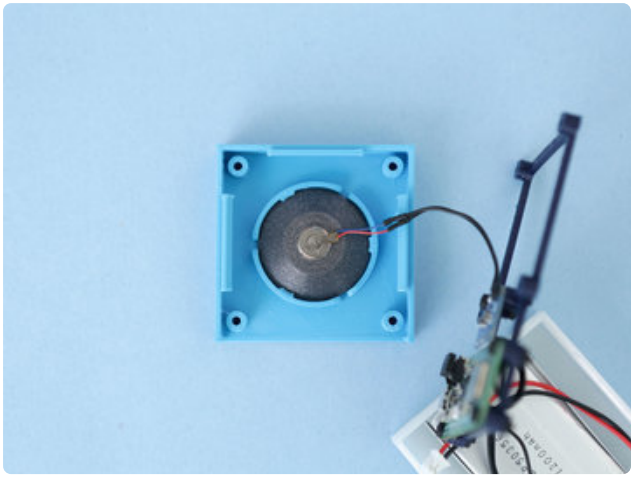
## Motor Disc

The vibrating motor is press fitted into a 3D printed cone. This helps amplify the sound of the buzz from the motor.



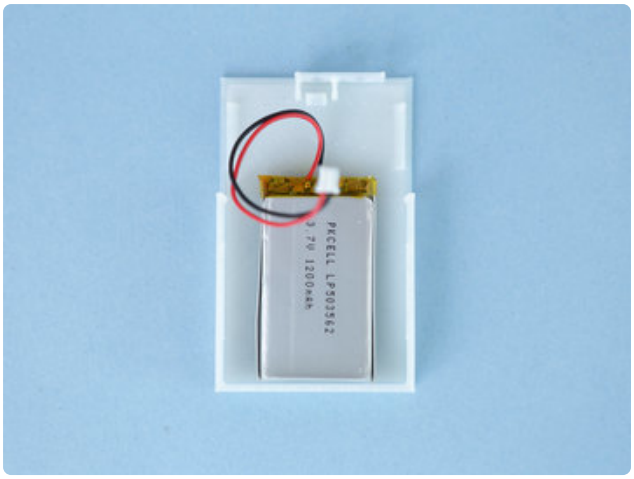
## Install Vibe Motor

The motor disc fits into hole in the center of the speaker cone.



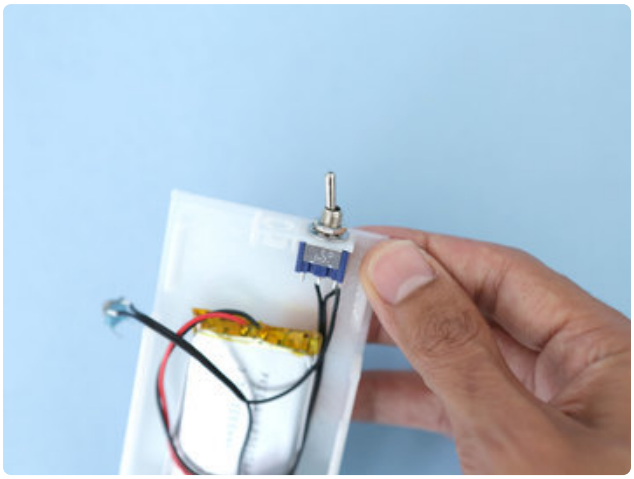
## Install Speaker Cone

The speaker cone is press fitted into the speaker cover. Insert the cone at an angle so it fits under two of the three nubs. Firmly press the cone to snap fit it into the third nub.



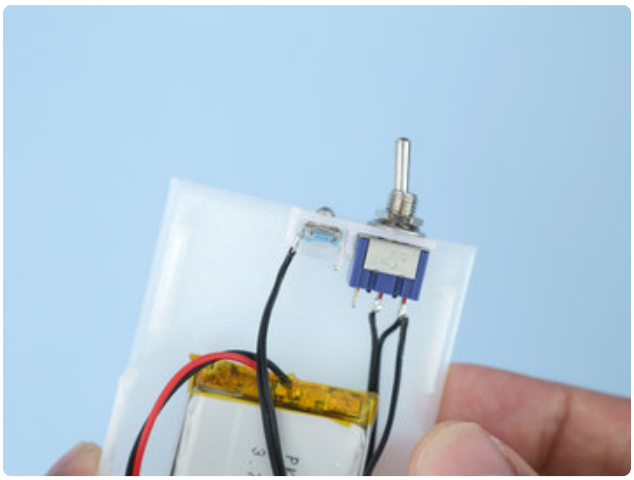
## Install Battery

Use double-sided tape or mounting tack to secure the lipo battery to the back cover.



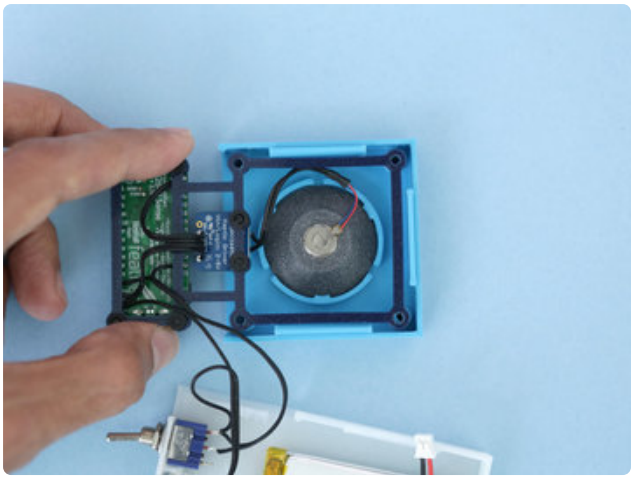
## Mount Toggle Switch

Panel mount the toggle switch to the back cover. Use the washer and hex nut to secure the toggle switch.



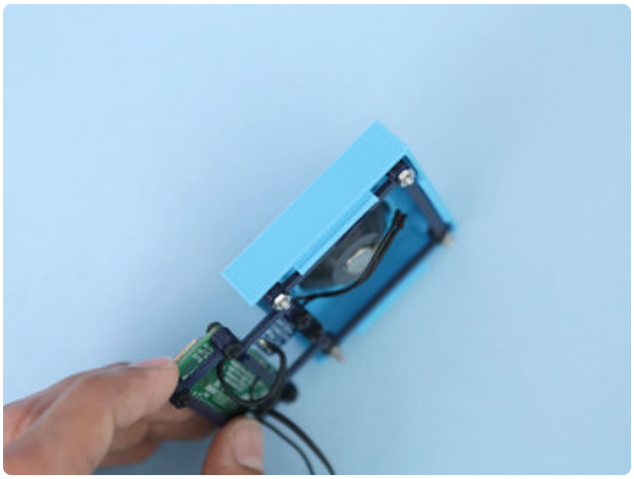
## Install Button

Install the metal ball tactile button to the back cover by inserting it at an angle with the metal ball going into the holder.



## Installing PCB Mount

Place the PCB mount over the four standoffs on the speaker cover. Reference the photo for the correct orientation.

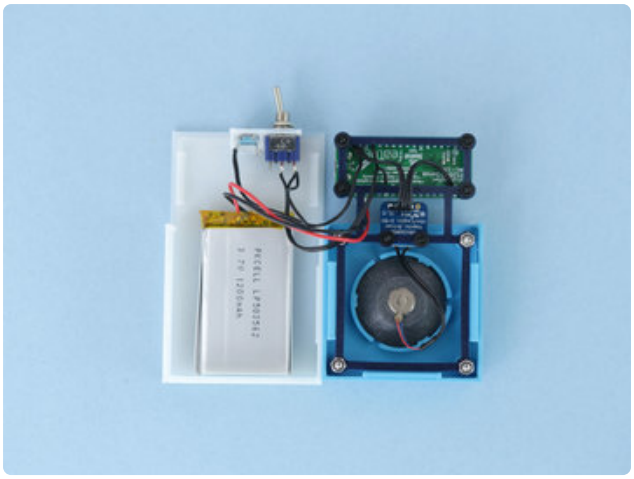


## Secure PCB Mount

Insert and fasten 4x M2.5 x 18mm long screws into the speaker cover and through the PCB mount. Install 4x M2.5 hex nuts onto the threads of the screws to secure it in place.

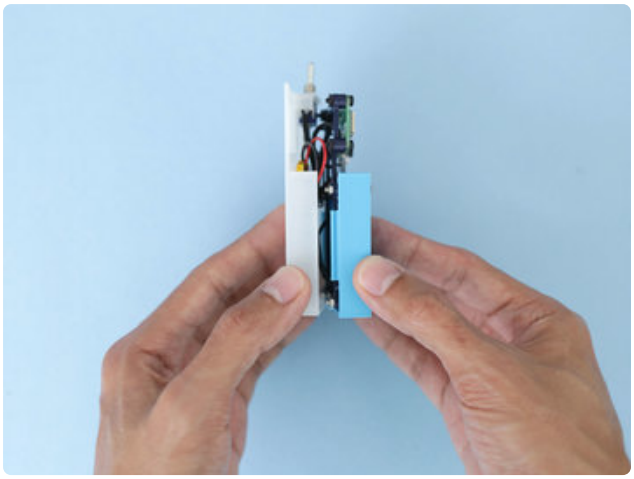
## Connect Battery

Plug in the JST connector from the battery to the Feather. The battery cable is routed through the PCB mount.



## Check Point

Double check the build and reference the photo for correct placement.

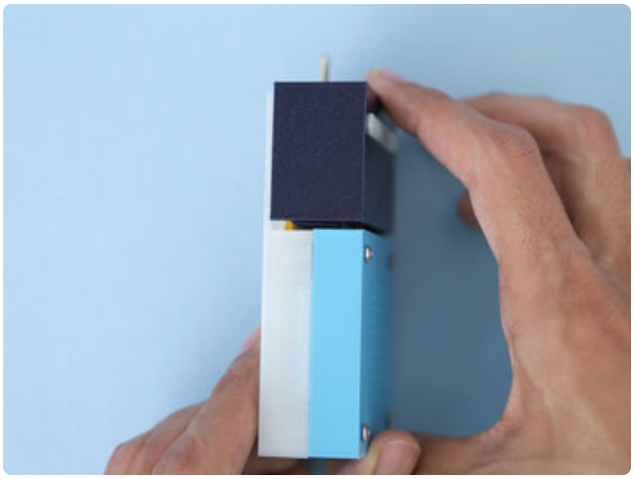


## Snap Fit Case

Bring the two halves of the case together and begin to snap fit them closed. Ensure all of the wiring is inside the enclosure and not being kinked.

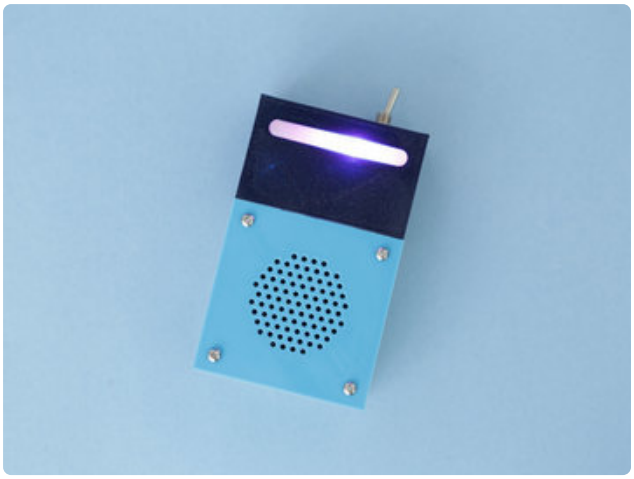
## Install Diffuser

Insert the diffuser into the top cover. Use hot glue, super glue or double-sided tape to secure the diffuser to the top cover.



### Install Top Cover

Insert and slide the top cover onto the speaker cover and back cover. Firmly press the top cover to snap fit into place.



### Final Build

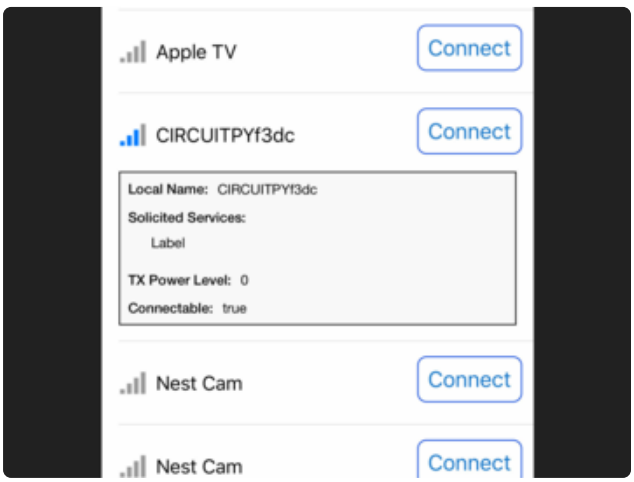
And there we have it! The case is assembled and ready to use.

---

# Usage

## Connect iOS devices to CircuitPython Bluetooth Devices

Use the iOS settings app and select Bluetooth from the list. Search for **CIRCUITPY** under My Devices. Tap to connect and proceed to pair and allow the device to display notifications.

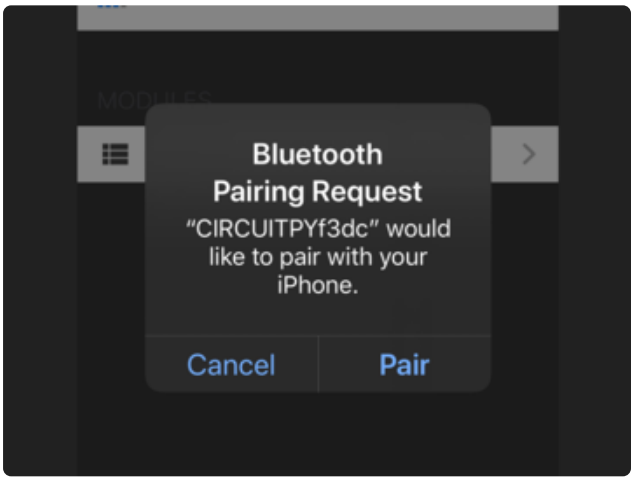



### Connect Device

You can optionally use the Adafruit Bluefruit Connect LE app to connect and pair with the **CIRCUITPY** device. Search and tap connect on the **CIRCUITPYxxxx** device.

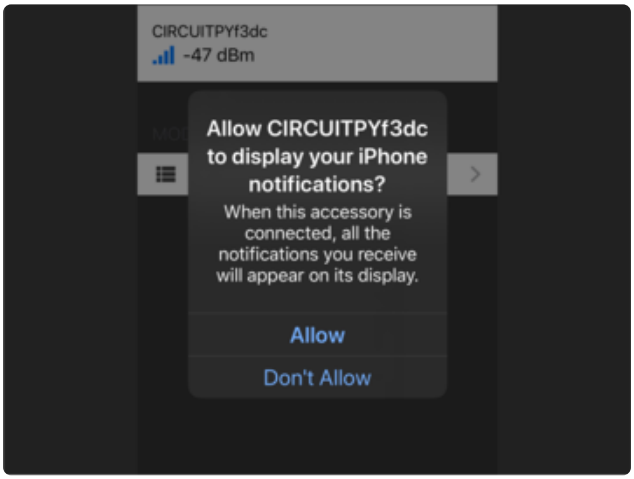
**Download Adafruit Bluefruit LE Connect App for iOS**

https://adafru.it/ddu




## Bluetooth Pairing

The iOS device will prompt a dialog box with option to pair or cancel. Tap on the Pair button.




## Allow Notifications

The next prompt will ask if you'd like to allow the **CIRCUITPY** device to display notifications from the iOS device.

## Connection Status!

The on-board NeoPixel will light up and stay RED until an iOS device is paired. Incoming notifications will trigger a buzz and blink the NeoPixel twice with a purple color. The NeoPixel will remain lit until the notification has been cleared on the iOS device. The **CIRCUITPY** device will automatically connect to the iOS device automatically.