Manual - OSP Hardware

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Disclaimer - Device Overheating Issue

While the device is plugged in with a USB cable(s) and operating at the same time for a prolonged period of time, the device will eventually overheat, which can reduce its audio quality and performance. The OSP team is working to resolve this.

For now, it is recommended to set up a SSH connection (explained in sections 5.4.3 for Hotspot mode and 5.4.7 for NetworkManager mode) in this manual so that you don't have to use a cable to connect and operate the Processing and Communication Device (PCD) to your computer for long periods of time.

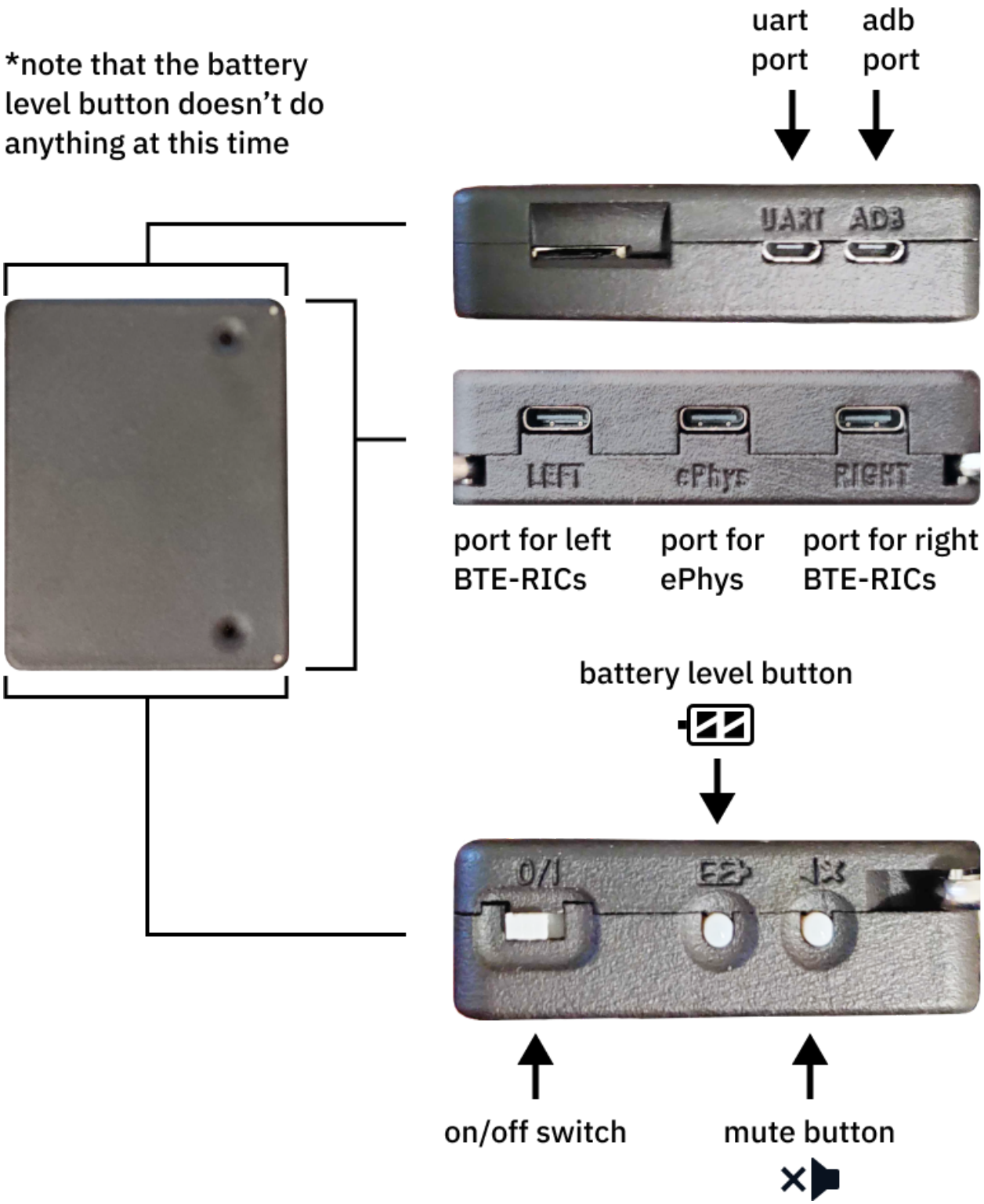
1 - Purpose of Document

This document will explain how to do the following with the Processing and Communication Device (PCD, also named “the device”):

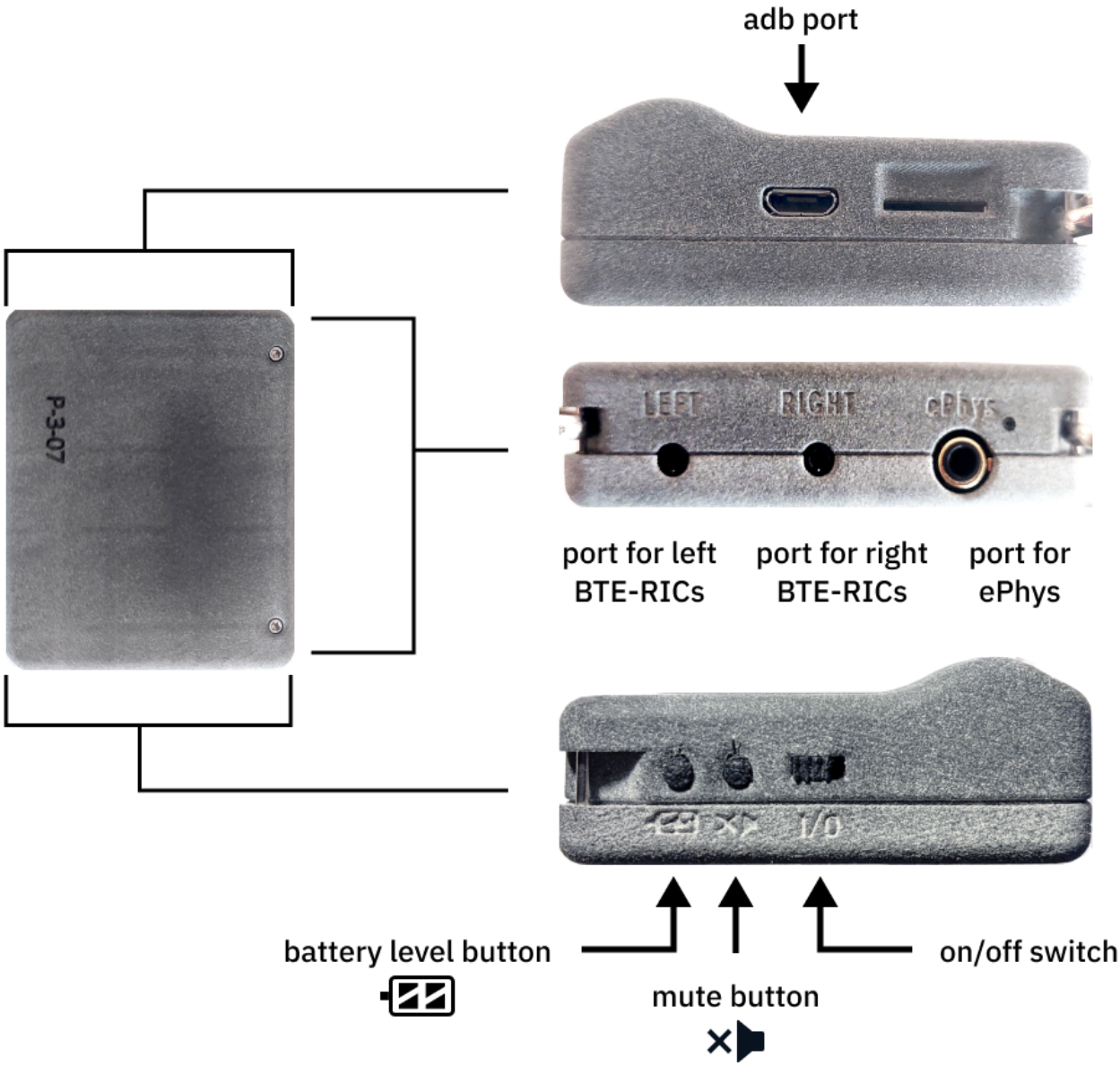
- how to better understand and troubleshoot the installation steps via a macOS, Linux, or Windows computer
- how to connect the device to your desired wifi hotspot with various methods, using a serial port and SSH connection
- how to update the software within the device
- how to customize the device operation

This document is a comprehensive version of the both the Hardware Quick Guides (macOS/Linux and Windows) and the Getting Started Guide. Refer to these guides first if you have not set up the hardware.

V8 Version of the Processing and Communication Device (PCD)

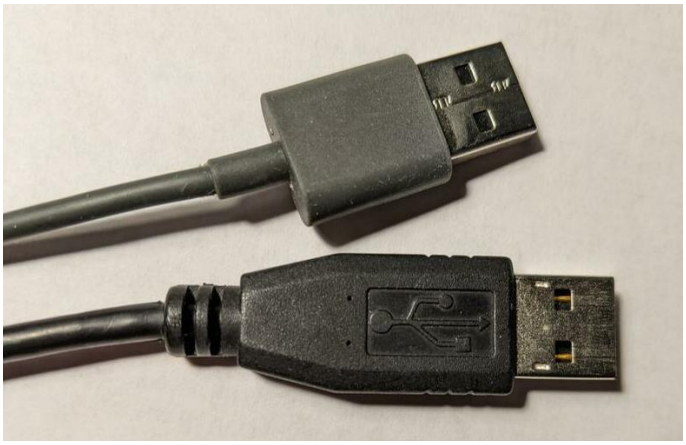


V9 Version of the Processing and Communication Device (PCD)



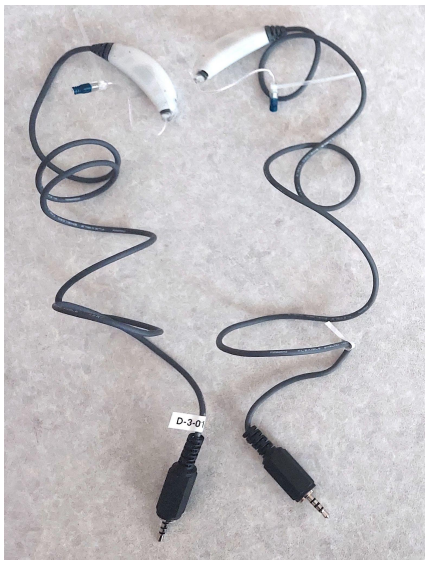
2 - Requirements

- The device (PCD), either the V8 or V9 version.
    - *V8 version* - Has two micro-usb ports labelled "UART" and "ADB".
    - *V9 version* - Has a single micro-usb port.
    - **The PCD should be sufficiently charged, otherwise it will not function properly during installation. For V8 versions, charge using the ADB port.**
- Micro-usb cable(s) that **can exchange data**.
    - 2 cables for the V8 version, 1 cable for the V9 version.
    - Use cables that can exchange data and verify that they can, even if they have the trident logo. Do not use any cables that only charge the device (aka "charge-only").



The top cable is a "charge-only" usb cable, do not use these. Bottom cable is a usb cable with the trident logo, which typically signifies that you can exchange data.

- Behind-the-Ear, Receivers-in-the-Canal (BTE-RICs)



- Knowledge of using a maxOS/Linux/Windows computer to update (flash) the device.
    - For macOS/Linux, you would need to navigate and use Finder or some other file manager application, a terminal, and a browser (like Chrome).
    - For Windows, you would need to navigate and use a terminal (such as Microsoft Powershell), Windows' Settings, File Explorer, Device Manager, and a browser (like Chrome).
- Reliable wifi access and connection to hotspots that have a 2.4 GHz bandwidth. 5 GHz hotspots are not supported at this time.

- At least 2 GB of storage space on your macOS/Linux/Windows computer to set up the OSP software.
- Software packages for your Mac or Linux computer. Steps for installing these packages will be covered in this guide.
    - *Linux Only* - "fastboot" package from android tools
    - *Linux and macOS* - Python3, and python packages "pyserial" and "colorama". Use Homebrew to install Python3.

3 - Installation Steps Part I (macOS, Linux)

3.1 - Download, Save, and Open the PCD .zip File

Go to this link to the "Binaries" folder on GitHub to find and download a .zip file named "pcd-2021A.zip".

It is recommended to save the .zip file somewhere convenient on your computer, such as your “Downloads” or “Desktop” directory.

3.2 - Extract the .zip File

Go to your file manager application (such as Finder for Mac), and extract the contents of the zip file, and open the extracted folder. For example, if you have extracted a .zip file named “pcd-2021A”, you will see a folder named “pcd-2021A”.

In step 5.1, you will need to use the terminal to navigate inside the "pcd-[NAME]” folder that gets produced from the extracted .zip file.

3.3 - Connect the Device to Your Computer Using Micro-USB Cables

Depending on which version of the device you have, do one of the following:

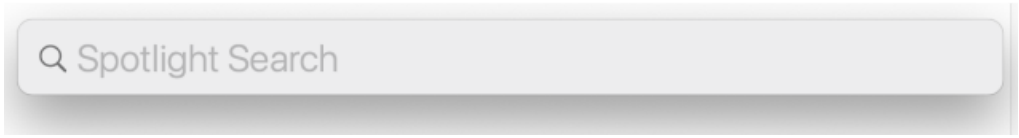
- **If you have the V8 version with two micro-usb ports**, attach one micro-usb cable to the “ADB” port. Attach the other cable to your computer or the USB hub.
- **If you have the V9 version with one micro-usb port**, attach one micro-usb cable and connect the cable to your computer via the USB hub.

Reminder to only use cables that can transfer data. The micro-usb ports are used for charging, flashing, and connecting as a serial port.

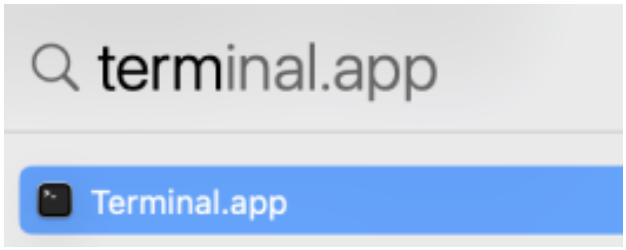
3.4 - Open a Terminal Window

For Mac

1. Open Spotlight Search (or simultaneously press the command and spacebar keys), which looks like a long horizontal area in your screen with a Search icon.

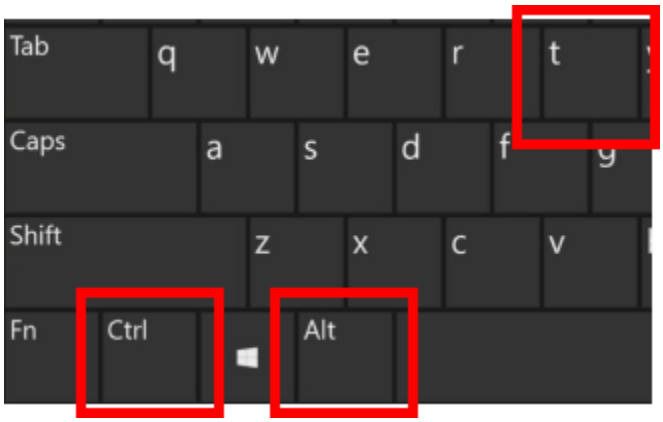


2. Type in “terminal”, and the application should show up automatically. Press enter.



For Linux

- Simultaneously press the "Ctrl", "Alt", and "t" keys on your keyboard to open a terminal.



- If this doesn’t work, select “Activities” on the upper left corner of your screen or click on the 3x3 icon on the side of your screen. Use the search feature to type in "terminal" and open the terminal app.

3.5 - Install Required Software Packages

For Linux, install the "fastboot" package by typing this command into the terminal (and pressing enter): `sudo apt install fastboot`

For macOS and Linux, Python3 must be installed using Homebrew.

- On macOS, enter the commands in order within the terminal (this may take several minutes depending on your computer's download speeds):
  - `ruby -e "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install)"`
  - `brew install python3`
- On Linux, use your package manager to install it within the terminal. Depending on the type of Linux you're using (e.g. Debian or Fedora), the command(s) used for Python3 may vary.

Then, enter the command: `pip3 install pyserial colorama` to install the two non-standard Python3 packages "pyserial" and "colorama". You may need to prefix this command with `sudo` depending on how Python3 is installed on your system.

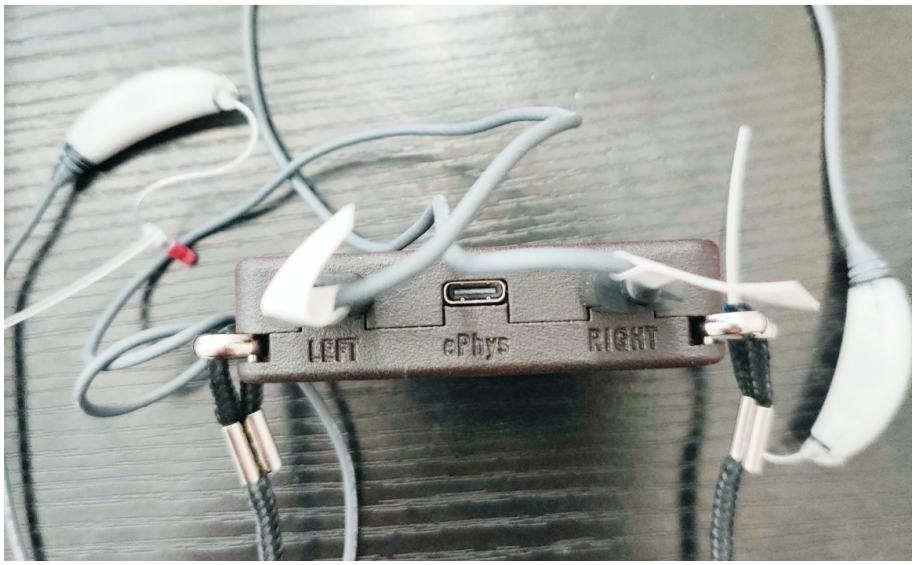
3.6 - Attach the BTE-RICs to the Device

Insert the BTE-RICs into the ports labeled “left” and “right”.

“Left” and “Right” ports for V8 versions of the PCD.

port for left BTE-RICs

port for right BTE-RICs



“Left” and “Right” ports for V9 versions of the PCD.

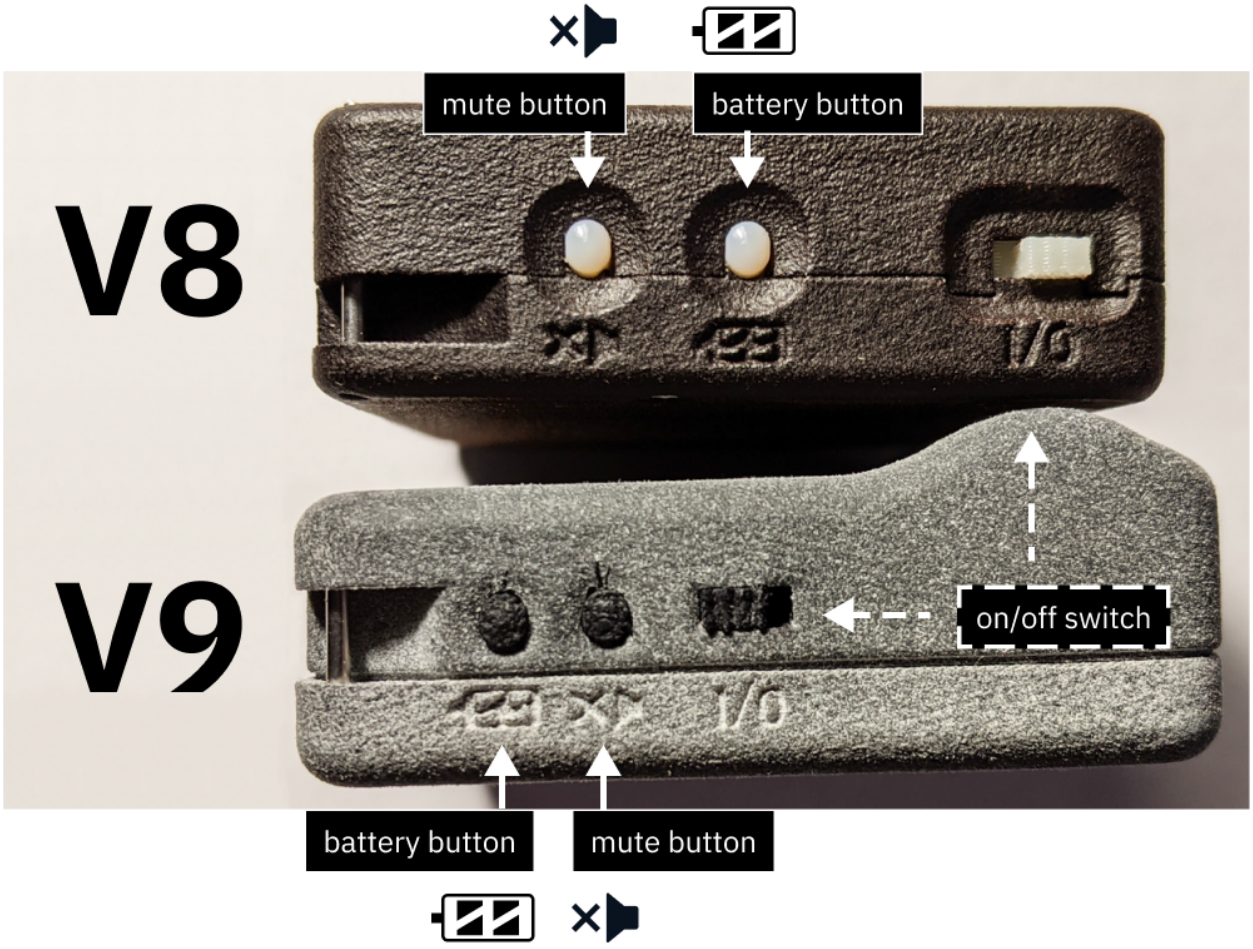
port for left BTE-RICs

port for right BTE-RICs

3.7 - Turn on the Device in Boot Mode

To flash the device, the device must first be turned on and set to Boot mode. Do one of the following for your device version (also see image below).

- *V8 Version* - While pressing and holding down the *battery button*, flick the on/off switch **towards the battery button**.
- *V9 Version* - While pressing and holding down the *mute button*, flick the on/off switch **towards the mute button**.



(top area) V8 device. The battery button is closer to the on/off switch.
(bottom area) V9 device. The mute button is closer to the on/off switch.

Proceed to “5 - Installation Steps Part II”.

4 - Installation Steps Part I (Windows)

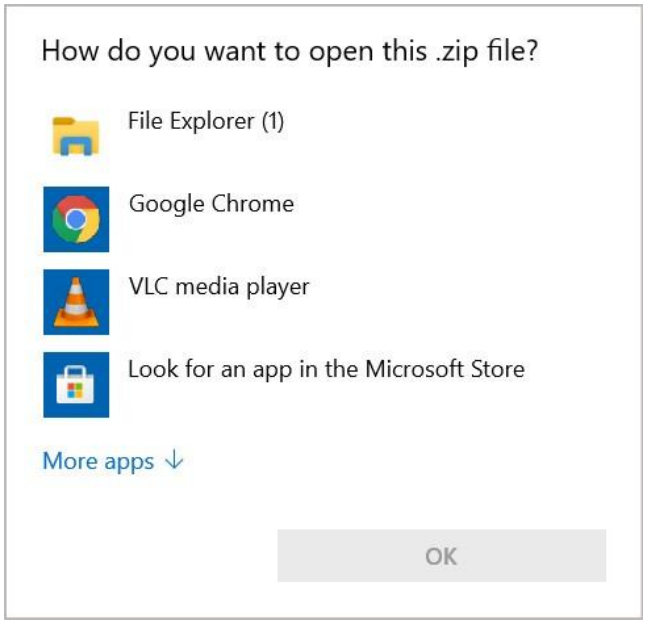
4.1 - Download, Save, and Open the PCD .zip File

Go to this link to the "Binaries" folder on GitHub to find and download and download a .zip file named "pcd-windows-2021A.zip".

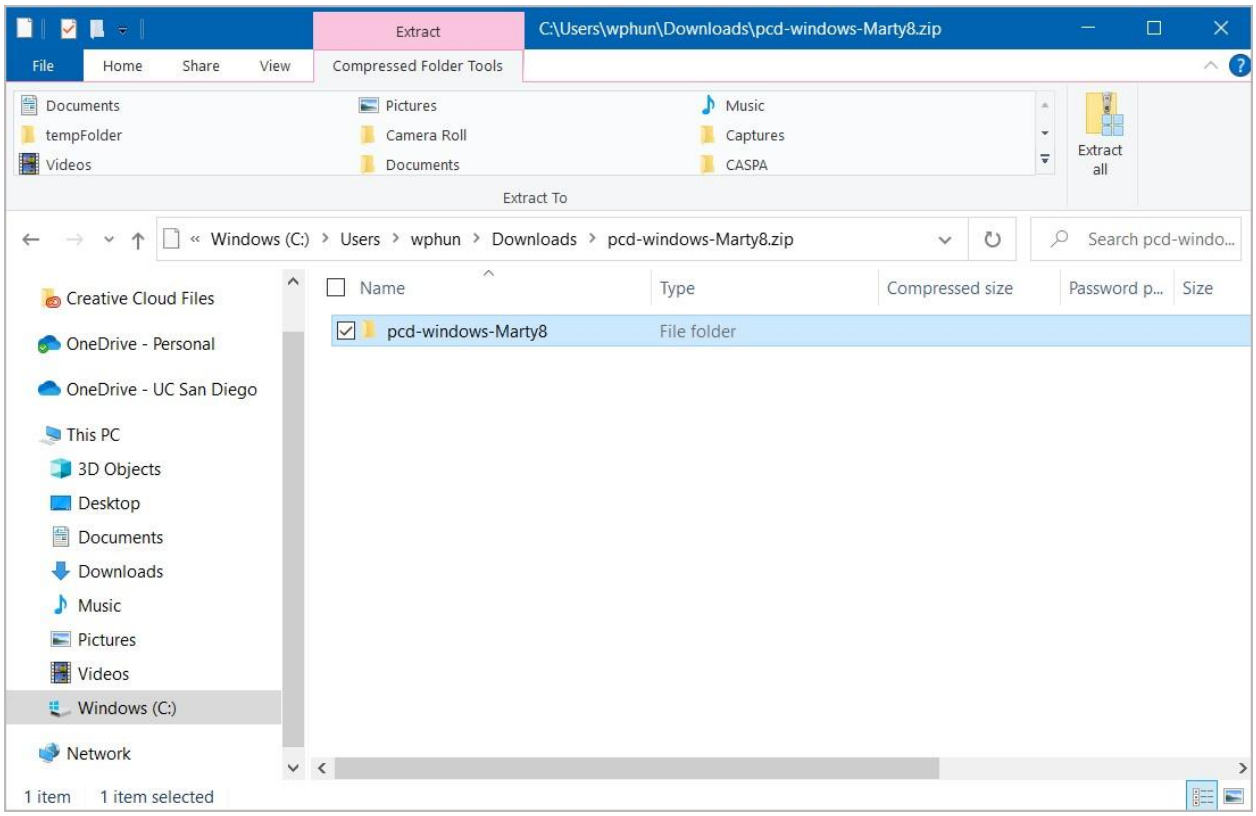
It is recommended to save the .zip file somewhere convenient on your computer, such as “Downloads” or “Desktop”.

4.2 - Extract the .zip File

Go to File Explorer, and double-click to extract the contents of the zip file. When asked which application to open this file, choose “File Explorer”.

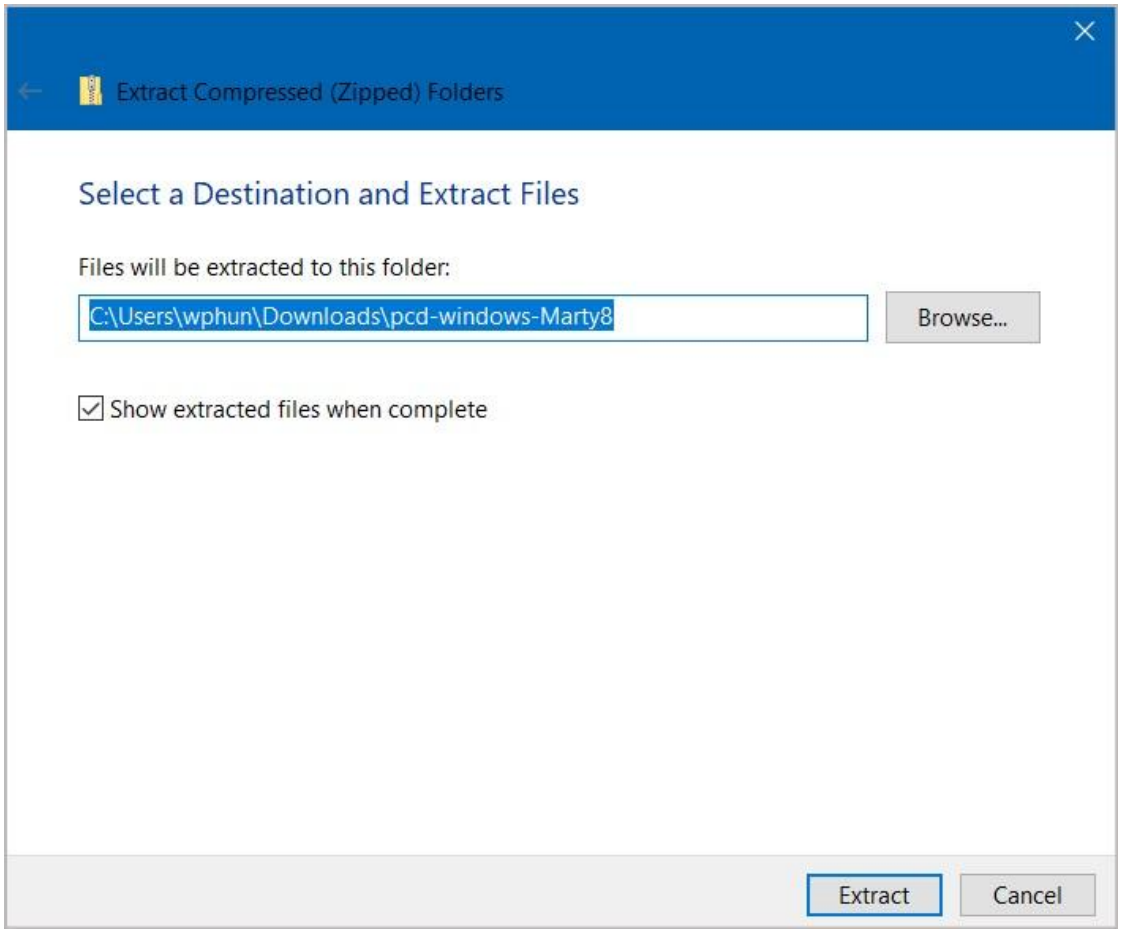


You will see the following after you opened the .zip file.

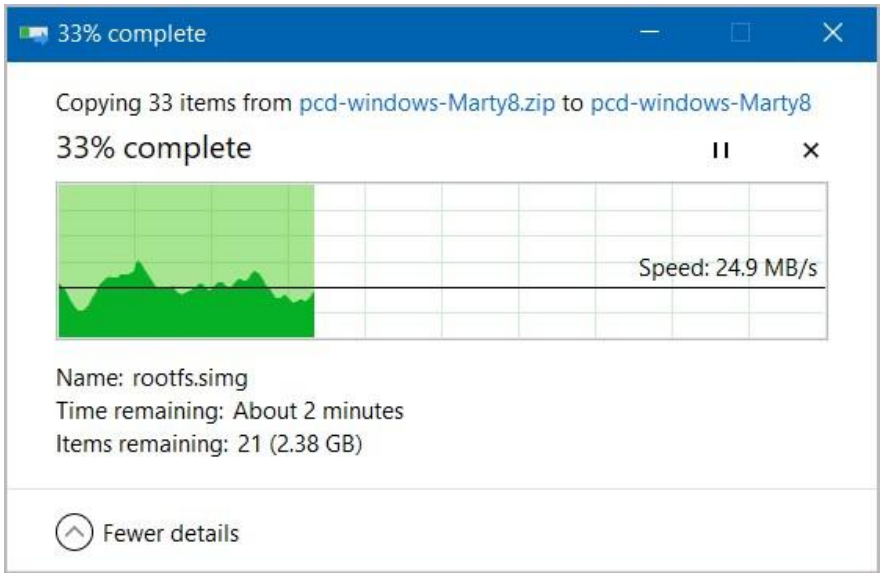


In the top portion of the File Explorer interface, select “Extract all”.

You will be asked where to save the extracted folder. We recommend saving the extracted folder in an easy-to-locate place, such as “Downloads” or “Desktop”.



Select “Extract”, and wait for the folder to be extracted.



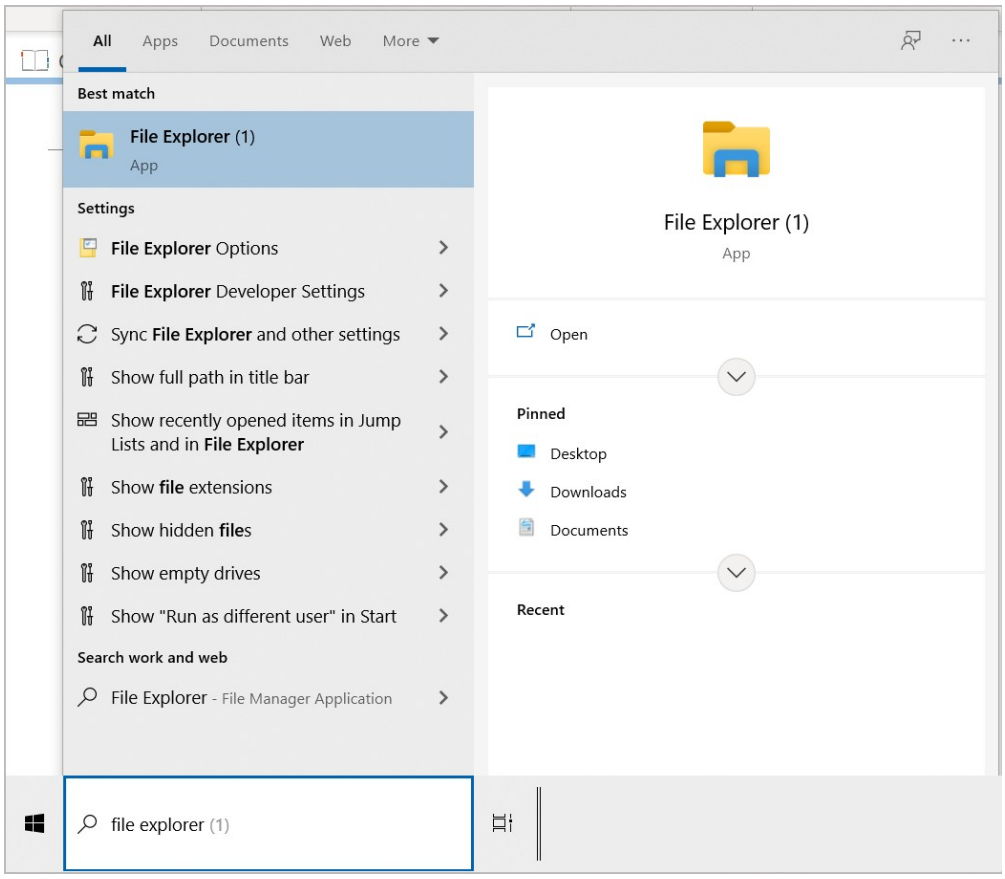
In step 4.9, you will need to use the terminal to navigate inside the "pcd-windows-[NAME]” folder that gets produced from the extracted .zip file. For example, if you have extracted a .zip file named “pcd-windows-2021A”, you will see a folder named “pcd-windows-2021A”.

If you’re not sure how to find File Explorer:

1. Go to the bottom left-hand corner of your Windows taskbar. Make sure that you have the Search box shown (appearing as a rectangle with a magnifying glass). You can also just press the Windows key on

your keyboard.

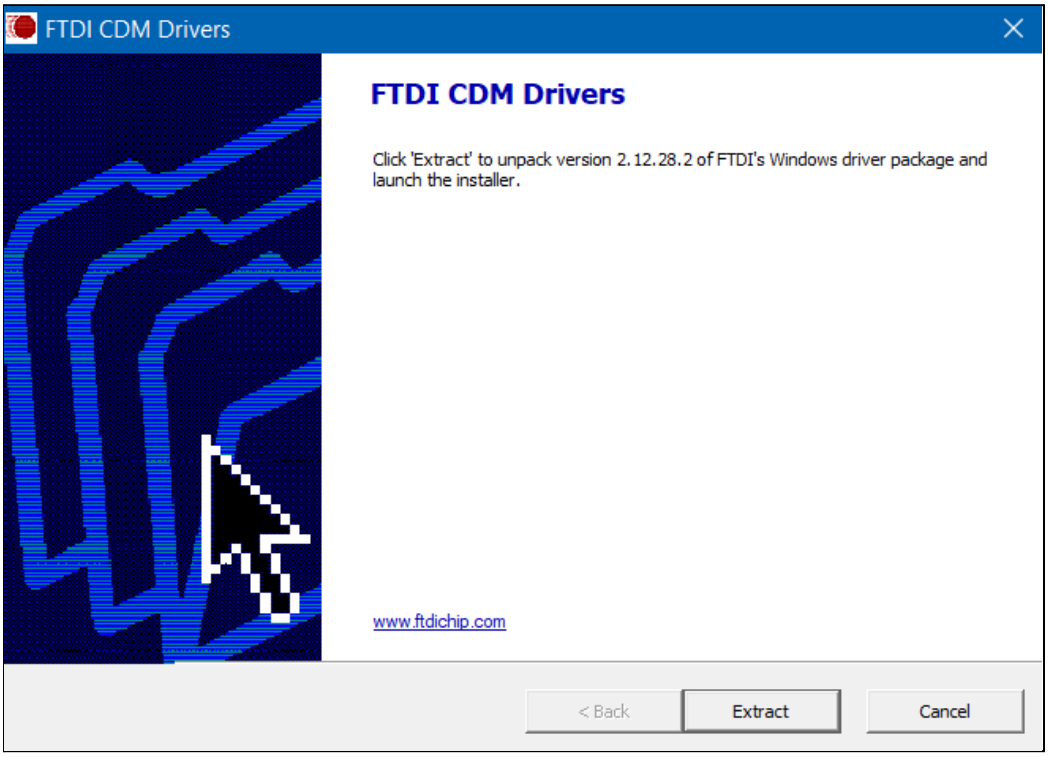
2. Type in “File Explorer” and you’ll see it.



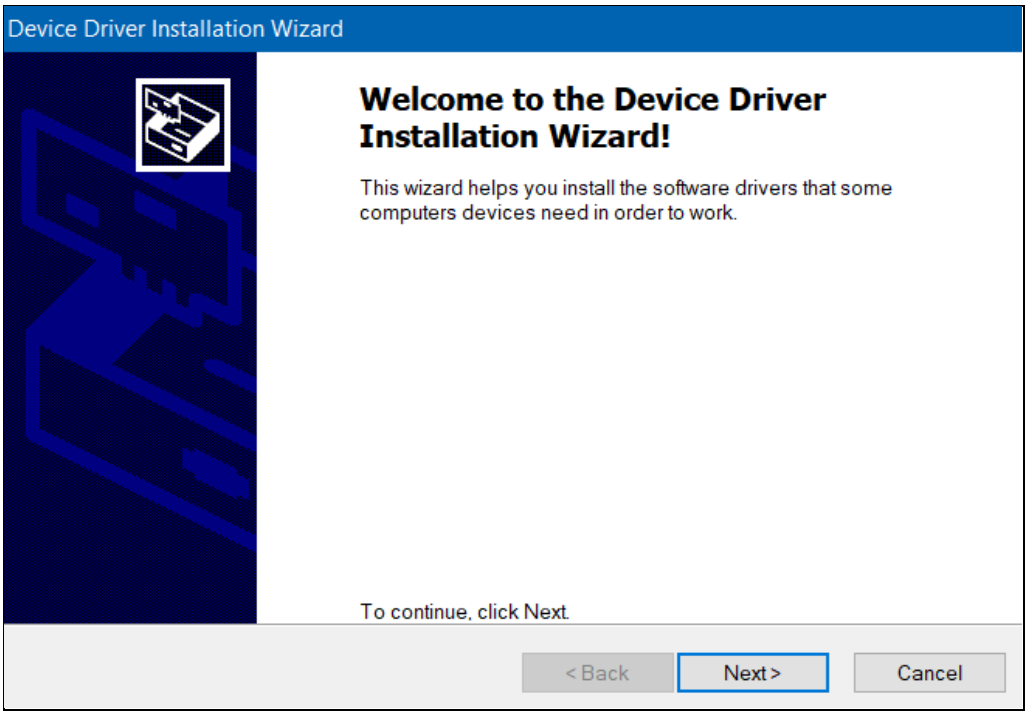
4.3 - Install the FTDI USB Drivers

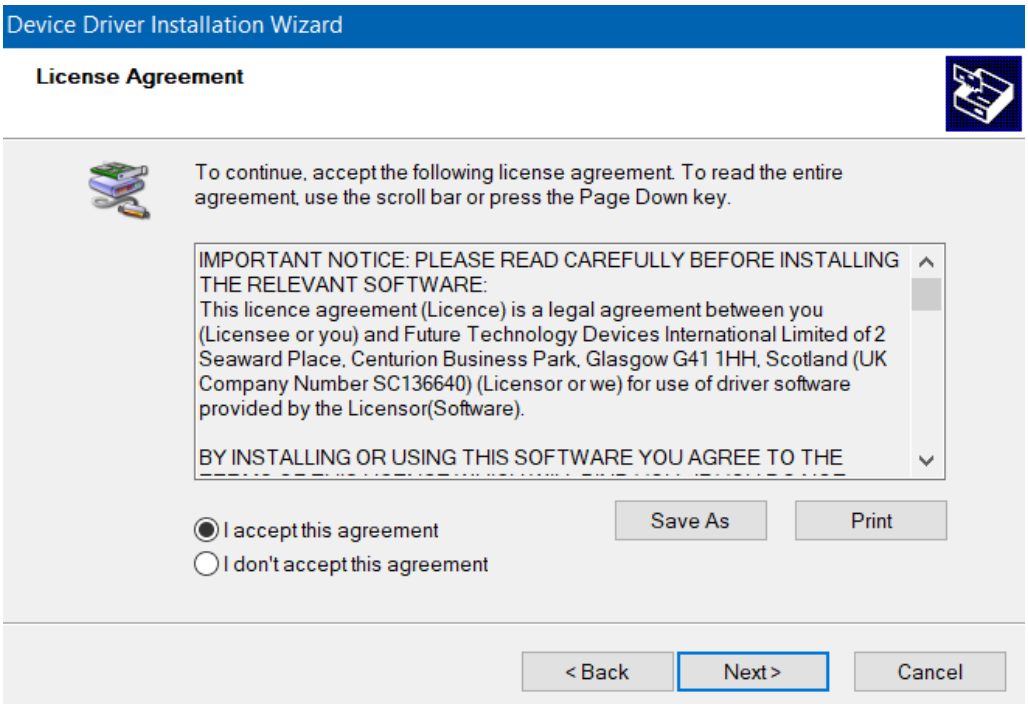
- In File Explorer, click on the extracted folder, go to a folder named “win”, and click on a file named “CDM21228_Setup.exe” to open it.

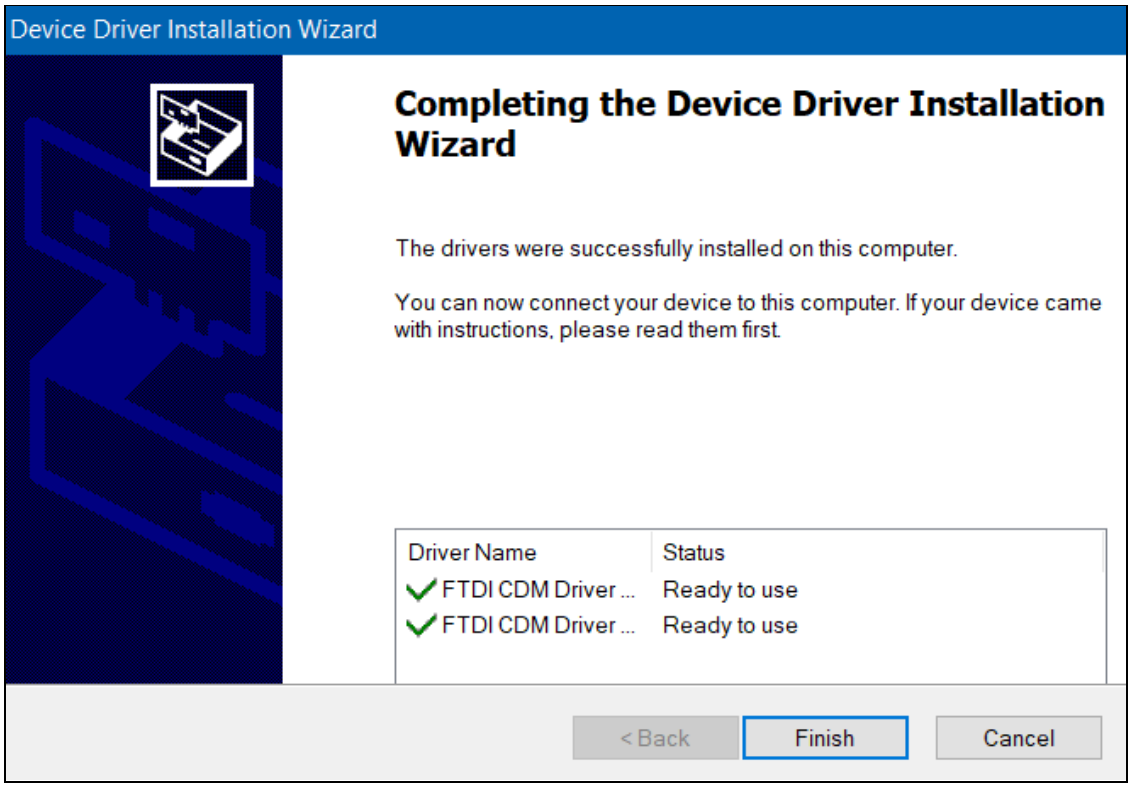
- You should see a window called “User Account Control” that asks you “Do you want to allow this app to make changes to your PC?”. Click “Yes” to continue and start the FTDI CDM installer instructions window.



- Follow the instructions from the Device Driver Installation Wizard. Accept their license agreement to complete the installation.


Device Driver Installation Wizard
Welcome to the Device Driver Installation Wizard!
This wizard helps you install the software drivers that some computers devices need in order to work.
To continue, click Next.
< Back
Next >
Cancel


Device Driver Installation Wizard
License Agreement
To continue, accept the following license agreement. To read the entire agreement, use the scroll bar or press the Page Down key.
IMPORTANT NOTICE: PLEASE READ CAREFULLY BEFORE INSTALLING THE RELEVANT SOFTWARE:
This licence agreement (Licence) is a legal agreement between you (Licensee or you) and Future Technology Devices International Limited of 2 Seaward Place, Centurion Business Park, Glasgow G41 1HH, Scotland (UK Company Number SC136640) (Licensor or we) for use of driver software provided by the Licensor(Software).
BY INSTALLING OR USING THIS SOFTWARE YOU AGREE TO THE
I accept this agreement
I don't accept this agreement
Save As
Print
< Back
Next >
Cancel



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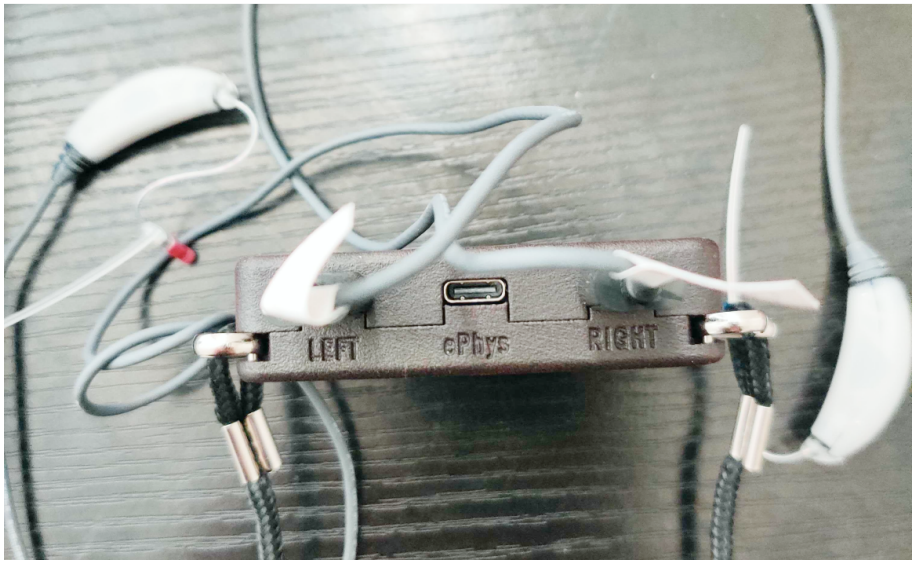
port for right BTE-RICs



“Left” and “Right” ports for V9 versions of the PCD.

port for left BTE-RICs

port for right BTE-RICs

4.5 - Connect the Device to Your Computer Using Micro-USB Cables

Depending on the device version, do one of the following:

- **If you have the V8 version with two micro-usb ports**, attach one micro-usb cable to the “ADB” port. Attach the other cable to your computer or the USB hub.

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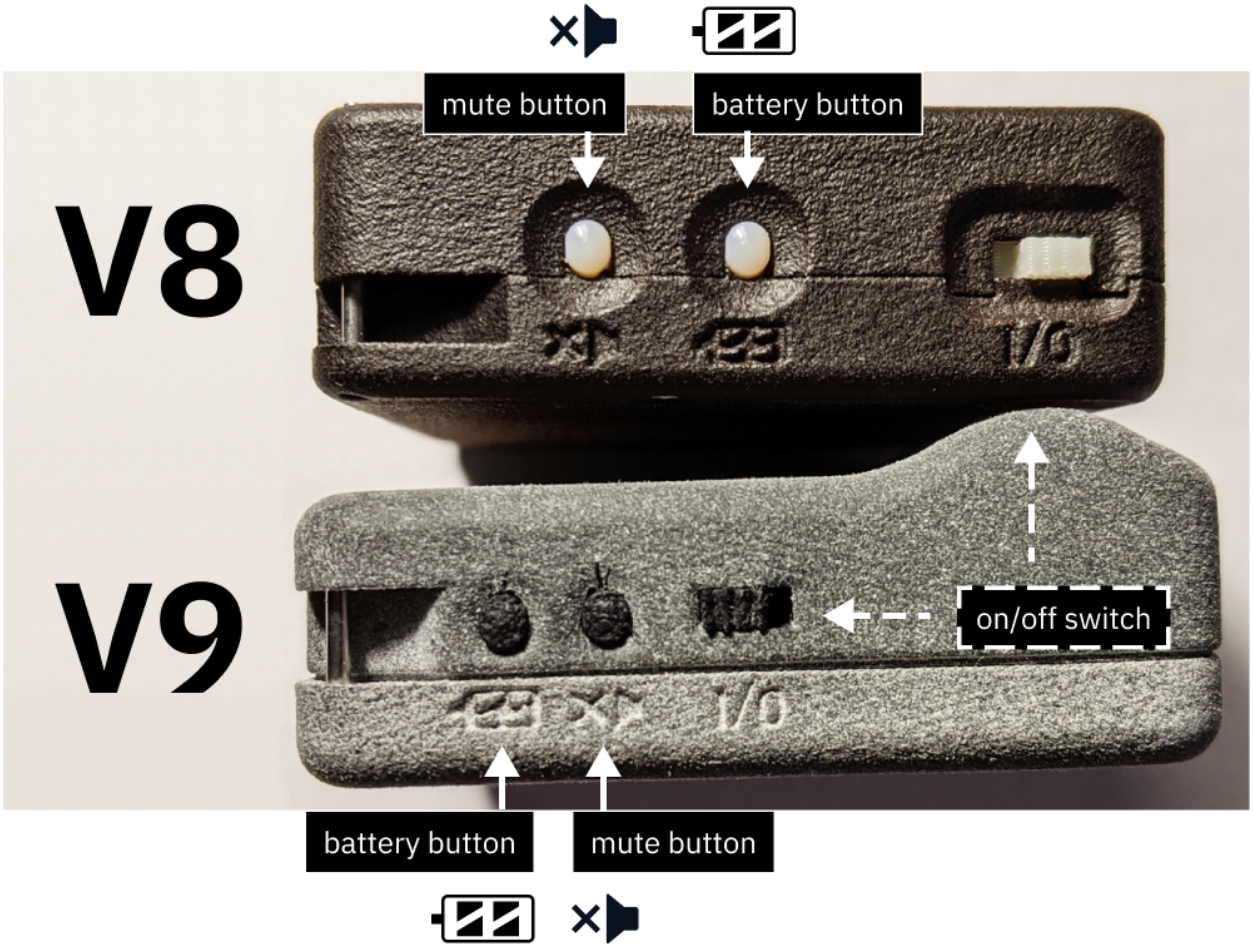
4.6 - Turn on the Device in Boot Mode

To flash the device, the device must first be turned on and set to Boot mode. Do one of the following for your device version (also see image below).

- *V8 Version* - While pressing and holding down the *battery button*, flick the on/off switch **towards the battery button**.
- *V9 Version* - While pressing and holding down the *mute button*, flick the on/off switch **towards the mute button**.

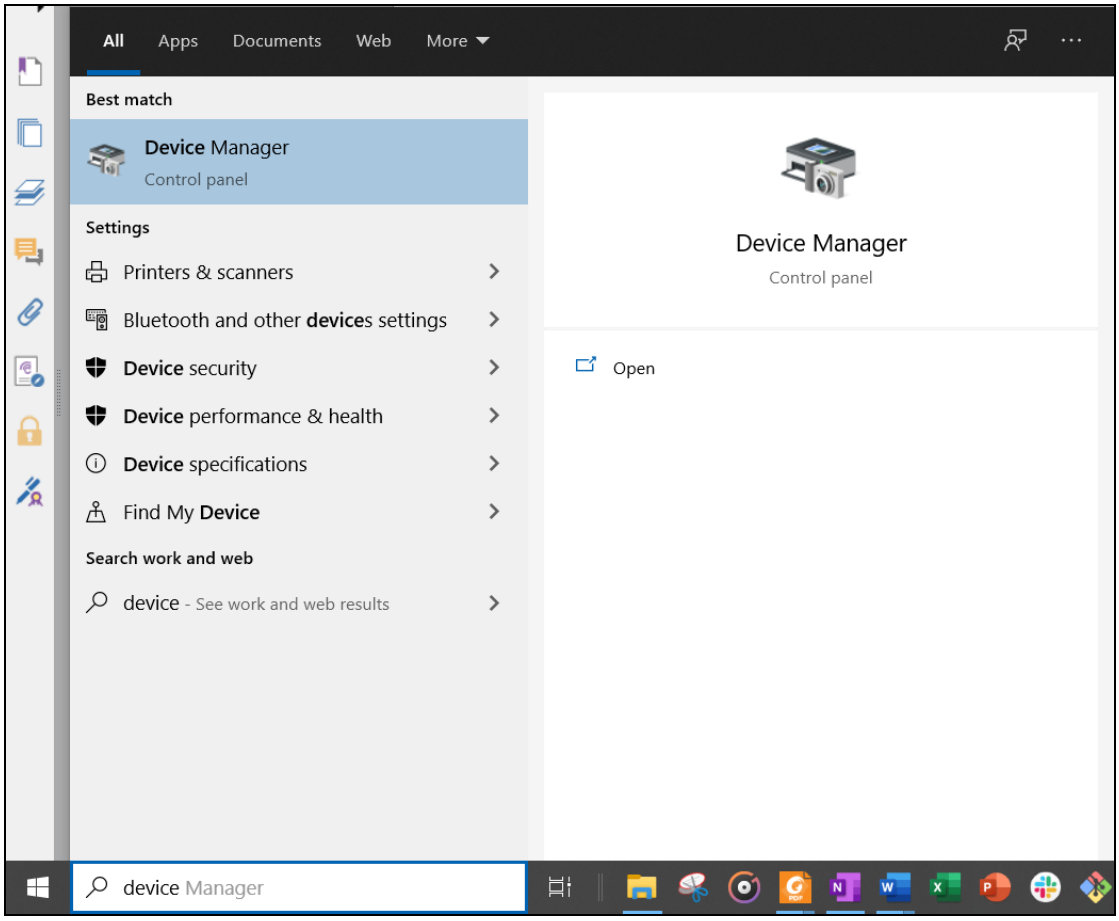


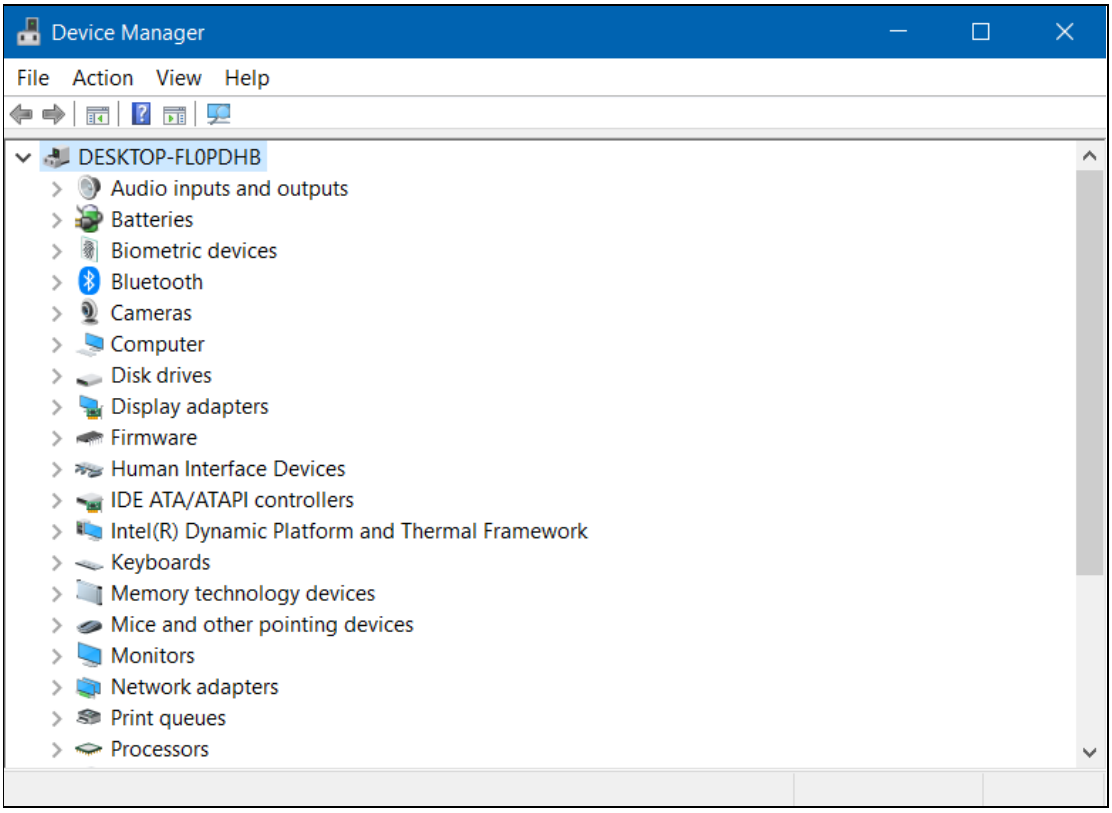
(top area) V8 device. The battery button is closer to the on/off switch.

(bottom area) V9 device. The mute button is closer to the on/off switch.

4.7 - Open Device Manager

In your Windows taskbar, use the Search box to find Device Manager and open it.

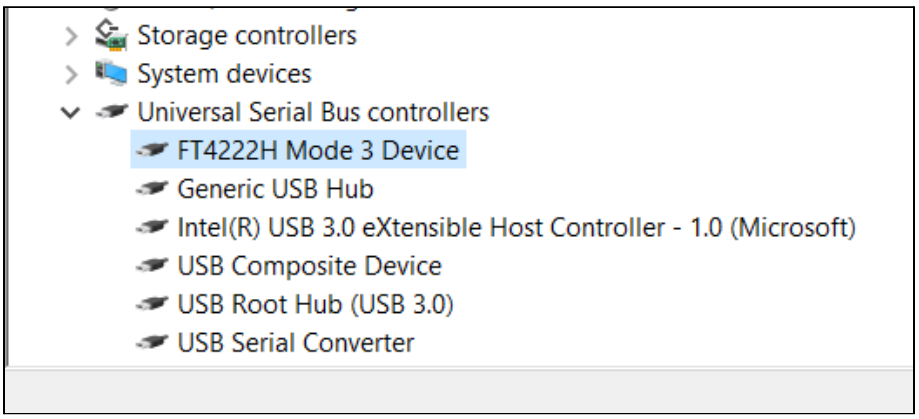

All
Apps
Documents
Web
More
Best match
Device Manager
Control panel
Settings
Printers & scanners
Bluetooth and other devices settings
Device security
Device performance & health
Device specifications
Find My Device
Search work and web
device - See work and web results
Device Manager
Control panel
Open
device Manager



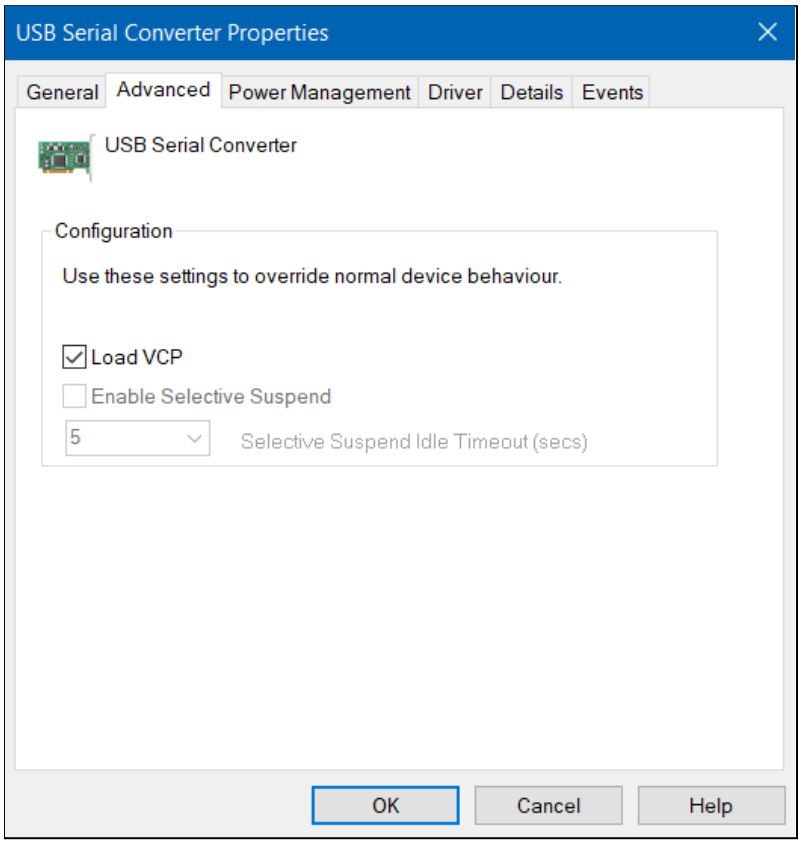
Device Manager Interface

4.8 - Update Drivers in Device Manager

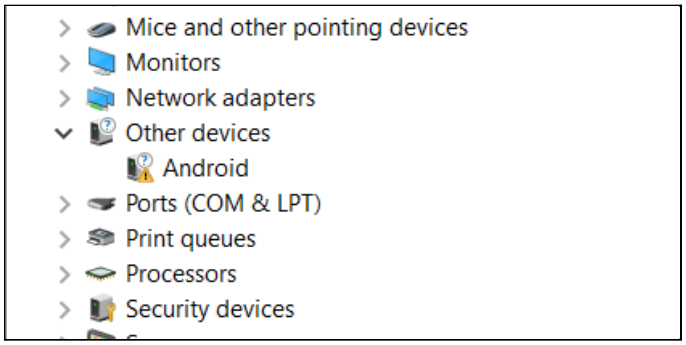
1. In device manager, find the following:
    - *“FT4222H Mode 3 Device”* and *“USB Serial Converter”*: both are under “Universal Serial Bus Controllers”.



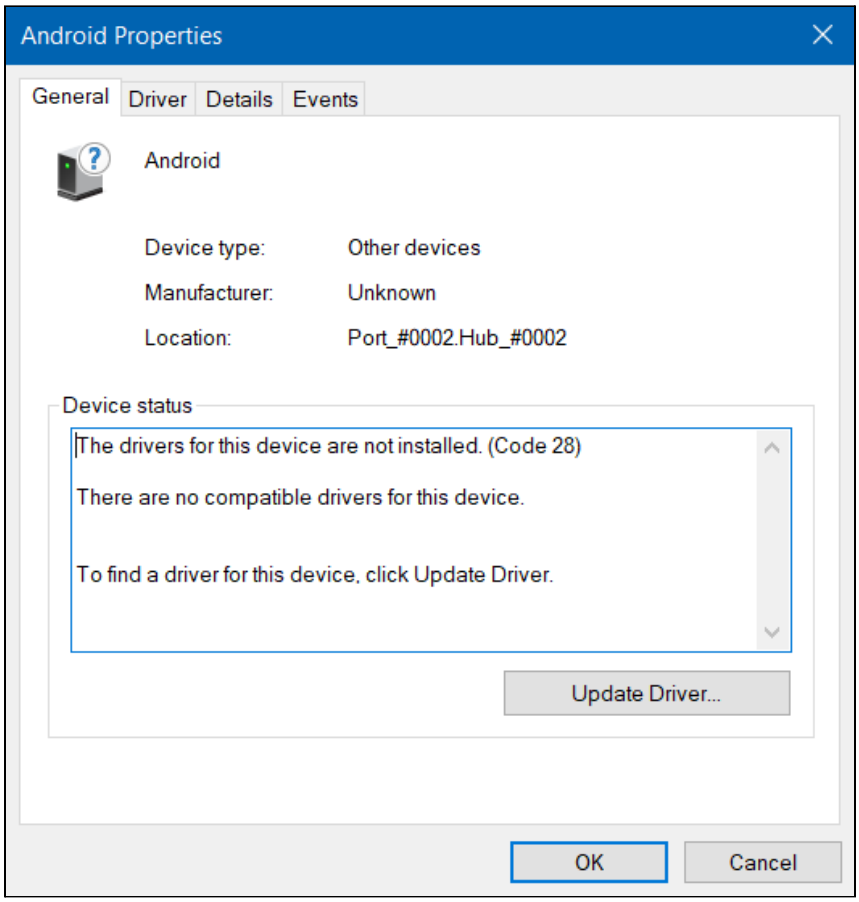
- Click on “USB Serial Converter” and a window should appear describing the Converter’s properties. Go to “Advanced” and verify that “Load VCP” is checkmarked (if not, click on the check box to do so).



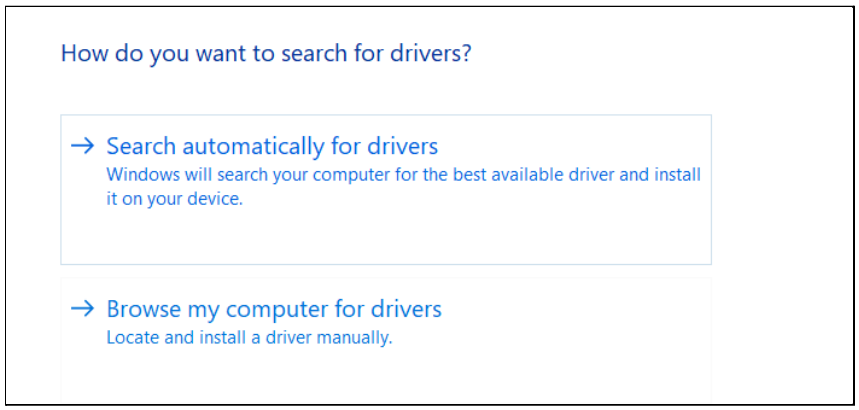
- *“Android”*: This should appear under “Other devices”. You may need to restart your PCD in boot mode a few times to see this.



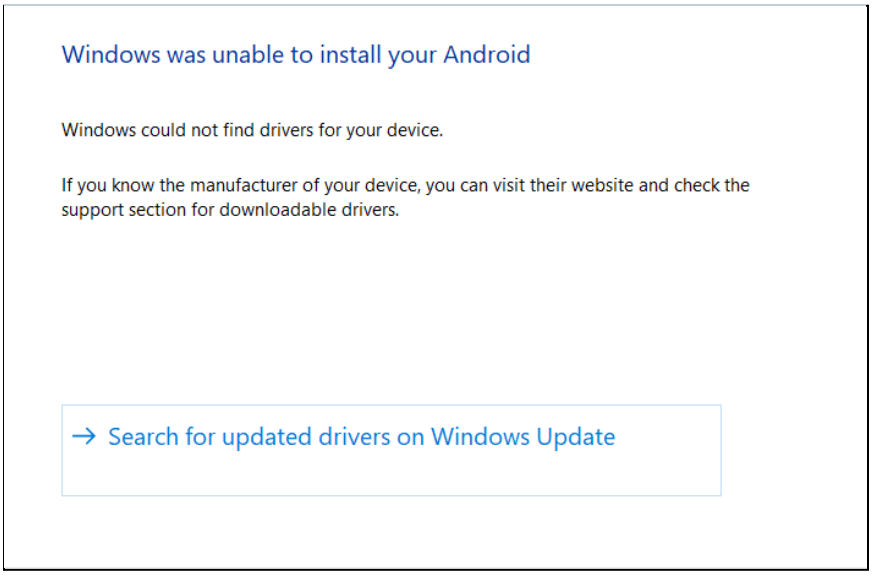
2. Click on “Android”. You'll see a window that describes its properties. Then, select “Update Driver...”.



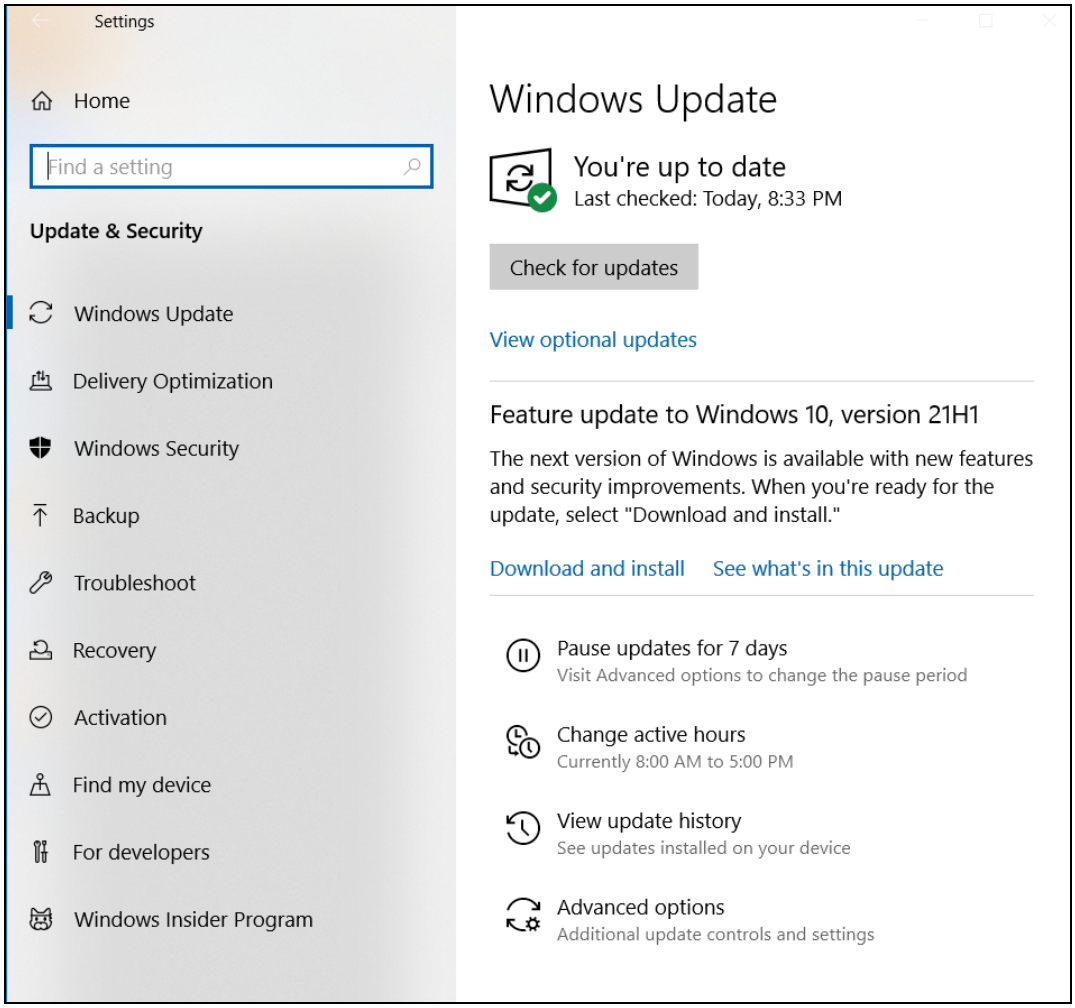
3. Select “Search automatically for drivers”.



4. Select “Search for updated drivers on Windows Update”.

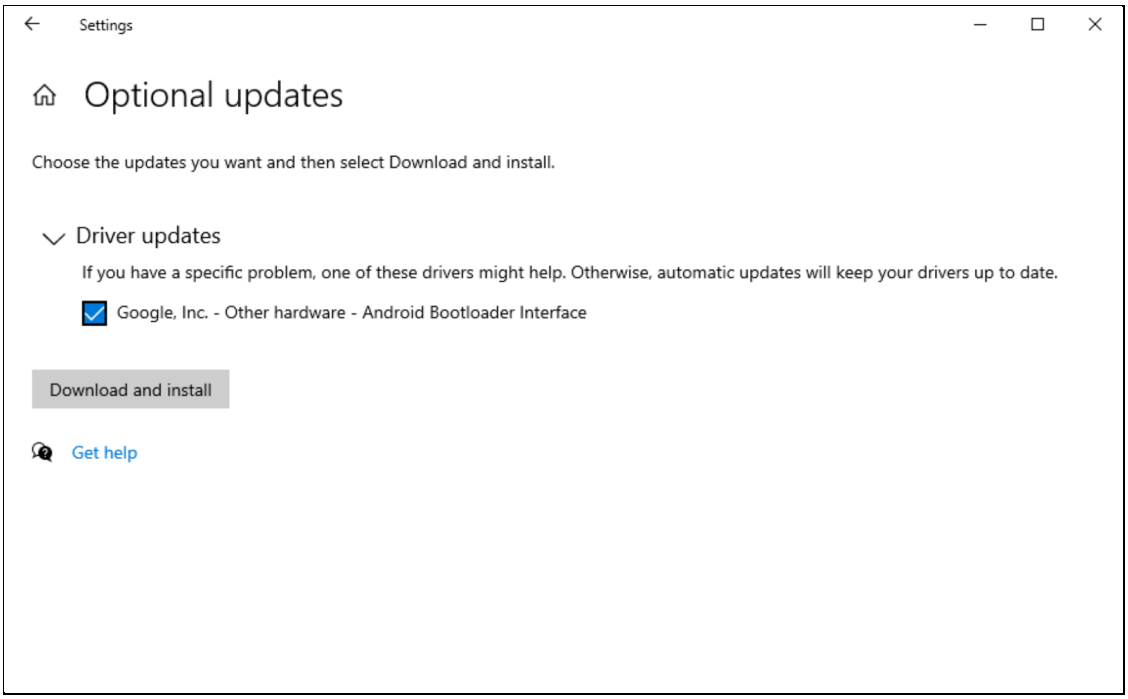


5. You’ll see the Windows Settings window appear, showing “Windows Update”. Select “View optional updates”.

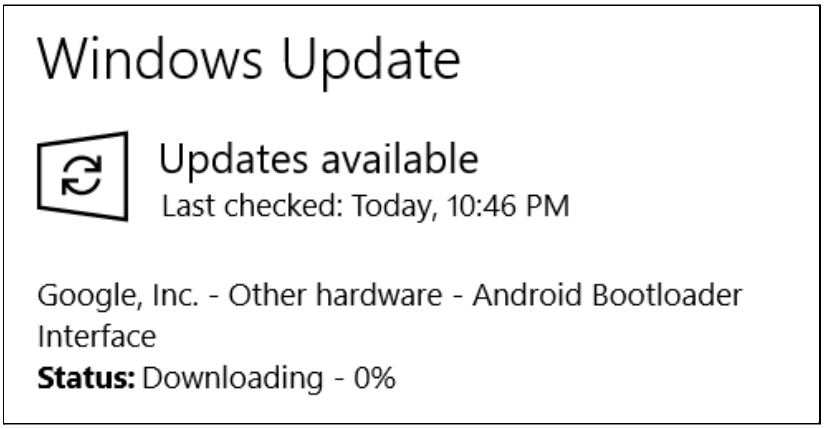


6. Go to “Driver Updates” and find “Google Inc - Other hardware - Android Bootloader Interface”.

   Click on the box next to “Google Inc...Bootloader Interface” to select it, then select the “Download and install” button.



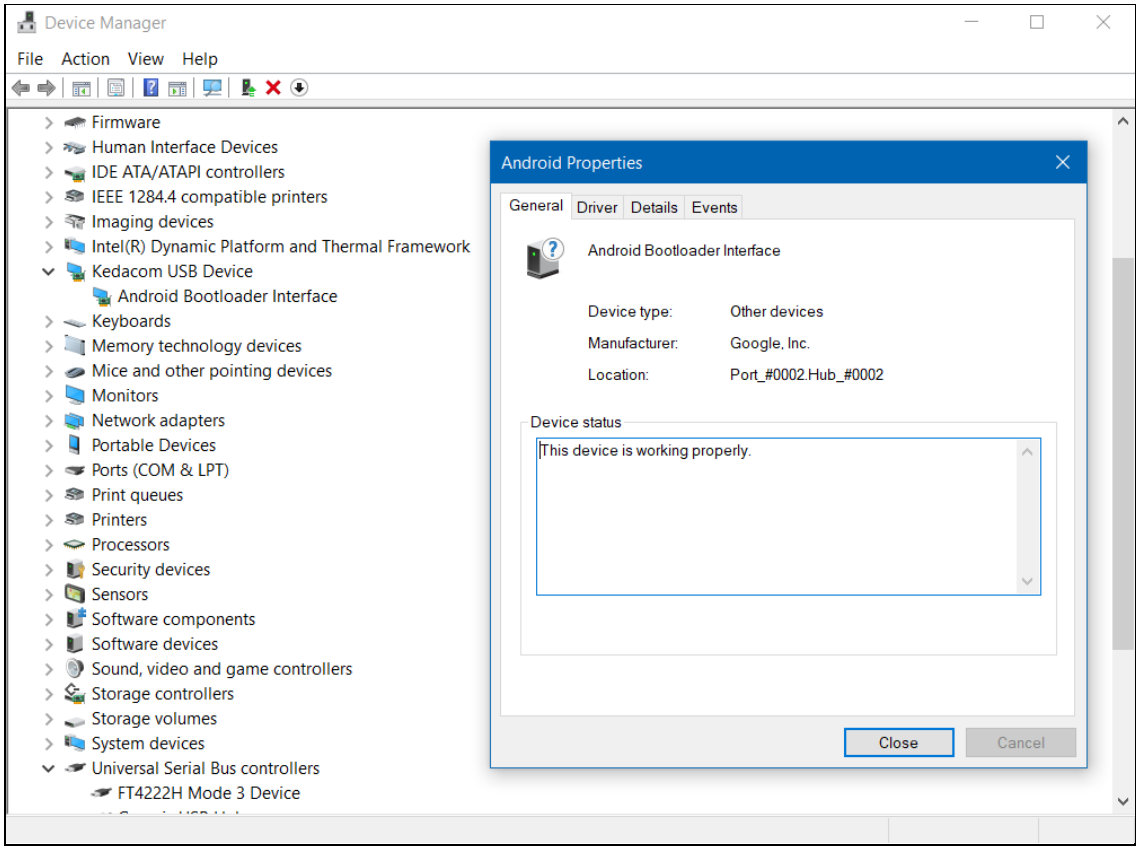
In the previous screen, you'll see it start downloading. You don't need to wait for the percentage to reach to 100%.



Troubleshooting: If "Google Inc...Bootloader Interface" doesn't immediately show up, go back to "Windows Updates", click on the "Check for updates" button, wait a few seconds, then repeat the

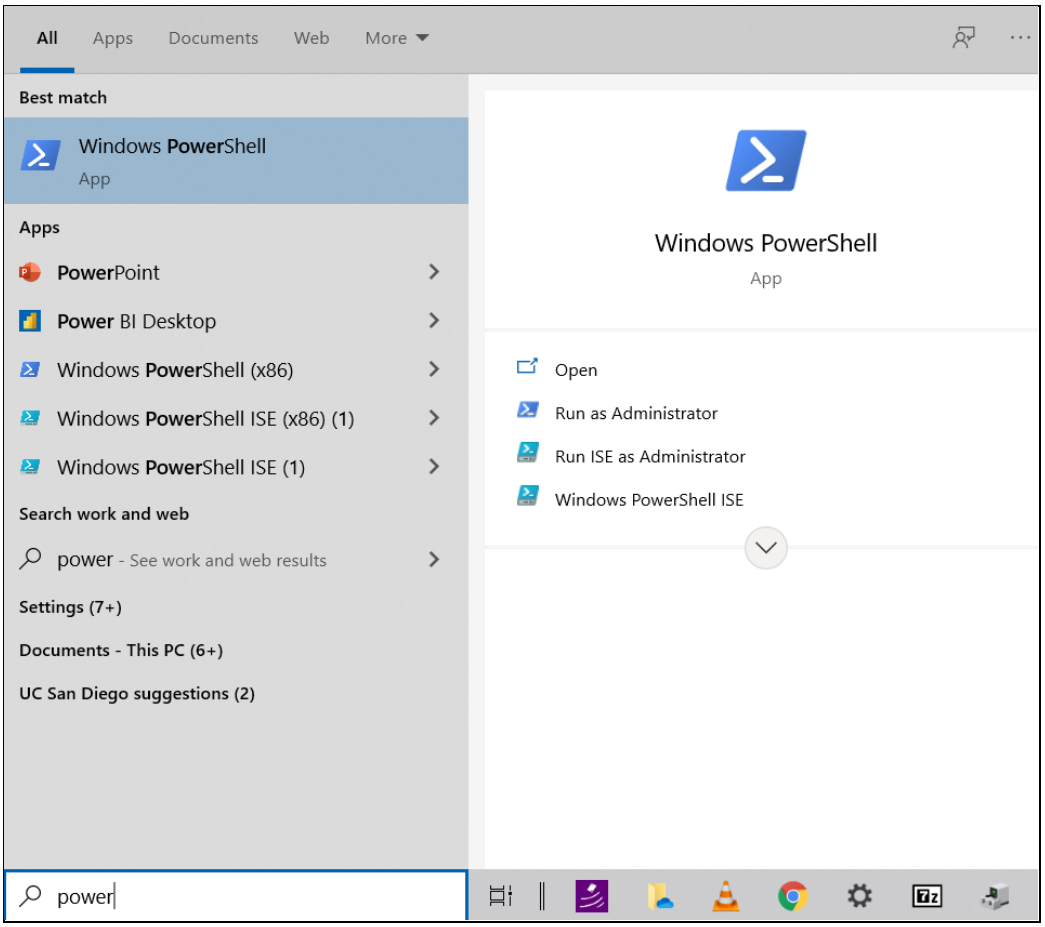
following: “View optional updates” > “Driver Updates”.

7. Go back to Device Manager and find the “Android Bootloader Interface” under “Kedacom USB Device”. If it is there, you are now ready to connect to the PCD.



4.9 - Connect to the PCD Using Windows Powershell

Go back to the Search box in the Windows taskbar, and start typing “Microsoft Powershell” to open the program.



You will see a blue terminal window with a message similar to below.

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights
reserved.

PS C:\Users\[USERNAME]>
```

Proceed to “5 - Installation Steps Part II”.

5 - Installation Steps Part II

5.1 - Navigate to the “pcd-[NAME]” Folder

In your terminal or Windows Powershell, navigate to the “pcd-[NAME]” folder that was produced from either step 3.2 or step 4.2 for extracting the .zip file. You can do this by entering the command: **cd [PATH_TO_“pcd-[NAME]”_FOLDER]**

For example in macOS/Linux, if you have extracted a .zip file named “pcd-2021A”, you will see a folder named “pcd-2021A”. If that .zip file and folder were both saved within “Downloads”, you would enter: **cd Downloads/pcd-2021A**

```
MacBook-Pro:~ USER$ cd Downloads/pcd-2021A
MacBook-Pro:pcd-2021A USER$
```

For example in Windows, the folder name would be similar to “pcd-windows-[NAME]”, with the [NAME] being “2021A” so you would instead enter: **cd .\Downloads\pcd-windows-2021A\pcd-windows-2021A**

```
PS C:\Users\[USERNAME]> cd
.\Downloads\pcd-windows-2021A\pcd-windows-2021A
```

```
PS
C:\Users\[USERNAME]\Downloads\pcd-windows-2021A\pcd-wi
ndows-2021A>
```

If you receive error messages that do not enable you to navigate to those directories, you may need to locate the correct file path and modify the example commands.

5.2 - Check For “pcdtool” File

Enter the command: `ls`

- For macOS/Linux, check that the file name “pcdtool” appears.
- For windows, check that the file name “pcdtool.exe” appears.

```
PS
C:\Users\[USERNAME]\pcd-windows-2021A\pcd-windows-2021
A > ls
Directory: C:\Users\[USERNAME]\pcd-windows-2021A
Mode LastWriteTime Length Name
---- ------------- ------ ----
d----- 5/18/2021 3:50 PM opt
d----- 5/18/2021 3:01 PM win
------ 5/18/2021 3:19 PM 1823 ospboard_id
-a---- 5/18/2021 4:08 PM 6922874 pcdtool.exe
-a---- 5/18/2021 4:08 PM 7007 pcdtool.py
------ 2/24/2021 3:19 PM 2107578 README.pdf
```

```
------ 5/18/2021 3:19 PM 2107578 WINDOWS.pdf
```

5.2 - Flash the Image to the Device

The "pcdtool" utility can flash the file system, boot the device, connect to it, and transfer files to and from it.

Enter one of the following terminal commands to flash the device:

- macOS/Linux: **`./pcdtool flash`**
- Windows: **`.\pcdtool.exe flash`**

You may be prompted to enter your computer password before the terminal proceeds executing the command.

```
FLASHING DEVICE.  Hold mute button and power on
device

Flashing rootfs and rebooting

Password:
Sending 'boot' (16426 KB)
OKAY [  0.519s]
Writing 'boot'
OKAY [  0.354s]
Finished. Total time: 0.891s
```

```
Sending sparse 'rootfs' 1/12 (262140 KB)
OKAY [  9.005s]
Writing 'rootfs'
OKAY [  5.903s]
```

If something goes wrong, the bootloader in the device may have been corrupted. If so, try entering one the terminal commands:

- macOS/Linux: **`./pcdtool flash -b`**
- Windows: **`.\pcdtool.exe flash -b`**

To view all the available commands for the device, enter one of the following commands:

- macOS/Linux: **`./pcdtool`**
- Windows: **`.\pcdtool.exe`**

You'll see the following commands below.

```
usage: pcdtool [-h] {connect,conn,flash,recv,send}
...

Serial port utility for PCD Devices

pcdtool conn[ect]
    Connects to attached pcd device and displays
output. Hit ^Z to exit.

pcdtool flash [-b]
```

```
    Connects to attached pcd device, flashes the
the rootfs
    and restarts the device.  If -b flag is there,
it first flashes the bootloader.

pcdtool send {filename}
    Sends the file to the current directory on the
device.

pcdtool recv {filename}
    Receives a file from the device.

A device must first be connected via USB on
/dev/ttyUSB0 (or /dev/cu.usbserial* for Mac)

positional arguments:
  {connect,conn,flash,recv,send}

optional arguments:
  -h, --help            show this help message and
exit
```

5.3 - Connect to the Device Using the Serial Port

You can use a terminal program, such as **pcdtool**, to connect the PCD to a usb port (/dev/ttyUSB0 on Linux or /dev/cu.usbserial* for Mac). You may

need to specify the device name and speed (baud rate) to use so that the terminal program can start the connection. If you have multiple devices, you may see ttyUSB1, cu.usbserial1, etc. and they only appear when the PCD is attached and powered on.

If you're continuing to use **pcdtool** after flashing the device, you need to connect to the device by entering one of the terminal commands:

- macOS/Linux: **./pcdtool conn**
- Windows: **.\pcdtool.exe conn**

You will see the following, indicating that the terminal has successfully connected to the PCD.

```
Hit Ctrl-Z to exit


OSP VERSION: 2021A


Hotspot Mode
Connect to the device at SSID "ospboard" password
"hearingaid" then
open a browser and connect to
http://192.168.8.1:5000 and/or http://192.168.8.1
If you wish to put the board back into
NetworkManager mode then use following command:
```

```
set_mode nm
root@ospboard:~>
root@ospboard:~>
```

SSID is the wifi name when you typically view available wifi networks. If you don't see any terminal output, you may need to press the "Enter" key once or twice for terminal feedback. To confirm feedback, you'll see **`root@ospboard:~>`** and you are able to type freely.

If you are considering an alternative to **`pcdtool`**, PuTTY works well (link to PuTTY download) for any installation step that requires the serial port. In PuTTY, set the baud rate (speed) of 115200, which is required to communicate with the PCD.

Troubleshooting Error - "can't open device "/dev/ttyUSB0": Permission denied"

If you receive this error from the terminal, you need to add yourself to the 'dialout' group.

To do so, enter the command: **`sudo usermod -a -G dialout $USER`**

You will then need to restart the device. If this doesn't work, you may need to log out and log back into your computer.

Check that you are in the groups by entering the command: **groups**

```
> groups
mmh adm dialout cdrom sudo dip plugdev lpadmin
sambashare docker
```

After flashing the device, you should expect the following:

- You should see "ospboard" show up in the wifi SSID list on a laptop or cell phone.

- You should be able to connect to the device with a serial connection over the USB cable.
- You should be able to see lights flashing inside the case.

5.4 - Connect to a Wifi Hotspot

The device has two different modes for wifi connectivity, "Hotspot mode" and "NetworkManager mode".

You can check the device's current mode by entering the command:

print_mode

Terminal messages shown will differ depending on the current mode.

The following sections explain the different ways you can connect the device to the Wifi hotspot for both modes.

- Via SSH connection - ospboard.local, ospboard.lan, or with an IP address. This is generally recommended to address the overheating issue with the devices due to prolonged USB cable connectivity.
- Via creating a custom Wifi hotspot.

5.4.1 - Hotspot Mode: Introduction

When the device is first flashed, the device is in hotspot mode by default.

- *Benefits* - This mode allows you to connect to the PCD using a browser-enabled phone or computer via wifi SSID. The PCD has a consistent IP address and is not dependent on any external wifi router.
- *Drawbacks* - The device has no internet connectivity and when you connect your phone or laptop to the PCD, it will lose internet too.
- *Application* - This mode would be best used if you don't have reliable Wifi hotspots nearby or out in the field.

To set the PCD to hotspot mode, enter the command `set_mode hs` and let the device reboot itself.

Entering the **print_mode** command shows the following terminal output for hotspot mode.

```
root@ospboard:~> print_mode
Hotspot Mode
Connect to the device at SSID "ospboard" password
"hearingaid" then
open a browser and connect to
http://192.168.8.1:5000 and/or http://192.168.8.1
If you wish to put the board back into
NetworkManager mode then use following command:

set_mode nm
```

5.4.2 - Hotspot Mode: Connect to Your Wifi

You can connect to the PCD using the PCD's native wifi hotspot by connecting to the wifi “ospboard” under your computer’s available wifi networks and entering the password “hearingaid”.

5.4.3 - Hotspot Mode: Using SSH to Connect to the Device

To use ssh to connect to the device, enter the command: **`ssh -i ospboard_id root@192.168.8.1`**

“ospboard_id” is a file containing an ssh key that is included in the zip file. To simplify ssh connections to the PCD, you should copy ospboard_id to "~/.ssh" and add an entry to your ".ssh/config" file such as:

```
Host osp_hs
HostName 192.168.8.1
User root
IdentityFile ~/.ssh/ospboard_id
```

Then, you can enter the command **`ssh osp_hs`** instead to connect to the device in Hotspot mode.

5.4.4 - Hotspot Mode: Setting the HotSpot SSID

For 01Mar2021 and later PCD file releases, you can set the Hotspot SSID and passphrase.

Simply enter the command: **set_hs_name -n ospboard2 -p my_password**

Then, restart the PCD by entering the command: **reboot**

Enter the command **print_mode** to check that the “ssid=” and “wpa_passphrase=” are the same as the wifi name and password that you entered.

```
root@ospboard:~> set_hs_name -n ospboard2 -p
my_password
Done. Reboot for changes to take effect
root@ospboard:~> print_mode
Hotspot Mode
Connect to the device at ssid=ospboard2 with
wpa_passphrase=my_password
open a browser and connect to
http://192.168.8.1:5000 and/or http://192.168.8.1
If you wish to put the board back into
NetworkManager mode then use following
command:
set_mode nm
```

5.4.5 - NetworkManager Mode: Introduction

NetworkManager mode allows you to connect to a local wifi SSID. Its address will be allocated by the wifi router.

- *Benefit* - Easy connectivity from your phone, laptop, or desktop computer.
- *Drawback* - Device must connect to a specific wifi network. If you want to talk to the device via SSH, you need a specific IP address reserved. The device cannot perform wifi connections to 5G networks yet.
- *Application* - This mode would be best used if you are using the device in an environment with plenty of other Wifi hotspots and you want to maintain reliable internet access.

To set the device in NetworkManager mode, enter the command **`set_mode nm`** and let the device reboot itself.

Once the device has finished rebooting, entering the **`print_mode`** command shows the terminal output below with a list of SSIDs the device can see. (The list may not be complete, so you can always try other SSIDs.)

```
root@ospboard:~> print_mode
NetworkManager Mode
Connect to your wifi with one of the following:
```

```
> nmcli dev wifi con MYSSID password "MY PASSWORD"
or
> nmtui
IN-USE  SSID  MODE   CHAN  RATE        SIGNAL  BARS  SECURITY
        DNRC  Infra  1     130 Mbit/s  49      __    WPA2
        DNRC  Infra  6     130 Mbit/s  42      __    WPA2
        DNRC  Infra  6     130 Mbit/s  40      __    WPA2
If you wish to put the board back into hotspot mode
then use following command:

set_mode hs
```

5.4.6 - NetworkManager Mode: Connect to Your Wifi

Connect to your wifi by entering the command: **nmcli dev wifi con MYSSID password "MY PASSWORD"**

```
root@ospboard:~> nmcli dev wifi con MYSSID password
"MY PASSWORD"
[  203.944162] wlan0: authenticate with
70:3a:cb:2a:06:d8
[  203.989349] wlan0: send auth to
70:3a:cb:2a:06:d8 (try 1/3)
```

```
[  204.000409] wlan0: send auth to
70:3a:cb:2a:06:d8 (try 2/3)
[  204.002978] wlan0: authenticated
[  204.006728] wlan0: associate with
70:3a:cb:2a:06:d8 (try 1/3)
[  204.023939] wlan0: RX AssocResp from
70:3a:cb:2a:06:d8 (capab=0x1431 status=0 aid=4)
[  204.057159] wlan0: associated
[  204.164330] IPv6: ADDRCONF(NETDEV_CHANGE):
wlan0: link becomes ready
Device 'wlan0' successfully activated with
'2ce4abfd-9c36-446c-9a25-6511d85c9dea'.
```

When entering the **print_mode** command, note the assigned IP address number to the right of "inet", as you will need this to launch the OSP software on your browser. This number will be different for your network.

```
root@ospboard:~> print_mode
NetworkManager Mode
        inet 192.168.86.33  netmask 255.255.255.0
broadcast 192.168.86.255
Connected
```

```
If you wish to put the board back into hotspot mode
then use following command:
set_mode hs
```

At this point, the device should be running on your local wifi and will continue to use this mode after it reboots.

You can now:

- simultaneously hit the "ctrl" and "z" keys to exit from the terminal
- disconnect the USB cable, if you want to

You will periodically need to reconnect the device to a charger to recharge its battery.

5.4.7 - NetworkManager Mode: SSH Connection to Device

Connect to the device via SSH connection by entering one of the commands:

- **`ssh -i ospboard_id root@ospboard.lan`** (try this first)
- **`ssh -i ospboard_id root@ospboard.local`**

In the terminal, this command would execute successfully if a message similar to this appears: *“Device 'wlan0' successfully activated...”*.

If neither of the above commands work, you can connect the device by entering the command: **`ssh -i ospboard_id root@192.168.86.33`**
Replace "192.168.86.33" with your IP address number.
To find the IP address number, enter the command **`ifconfig`**
For the IP address method, it is highly recommended that your wifi router reserves that IP address for your device so it doesn't change in the future.

Otherwise, try the following steps:

1. First show hidden files for the following keyboard shortcuts: command + shift + . (for macOS), or ctrl + H (for Linux).
2. Go to the default home directory: **`cd ~`**
3. Navigate to the hidden ".ssh" directory: **`cd Users/[USERNAME]`**
4. Create a new file named "config".
5. Copy the "ospboard_id" file to the unhidden "~/.ssh" directory and add the following entry to your ".ssh/config" file:

```
Host osp
     HostName  192.168.86.33
     User root
     IdentityFile ~/.ssh/ospboard_id
```

This way, you can simply enter the command `ssh osp` for future use instead of `ssh -i ospboard_id root@192.168.86.33`.

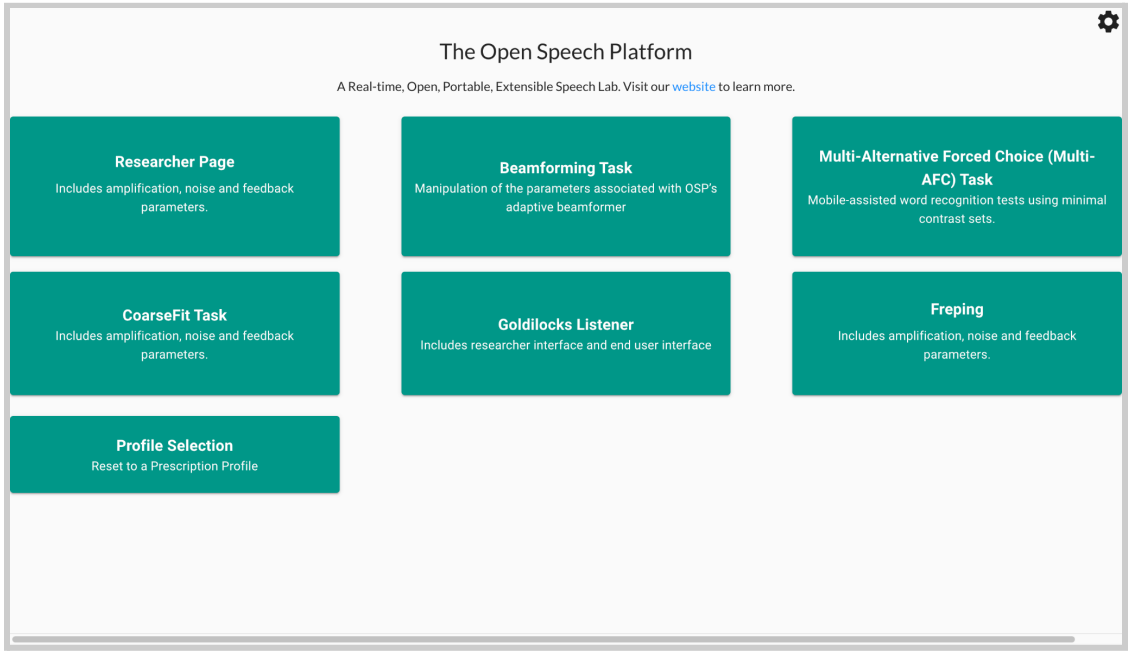
5.5 - Launch OSP Software

After you have connected your device and computer to the desired Wifi hotspot:

1. Open any browser (Google Chrome, Firefox, etc.).
2. Enter one of the following into the search bar:
   `http://ospboard.lan:5000` (try this first) or
   `http://ospboard.local:5000`

   If neither of them work, you can try using the IP address found from the `ifconfig` command. For example, if your IP address is "192.168.8.1", you would enter "`http://192.168.8.1:5000`".

You'll see the landing page like the image below.

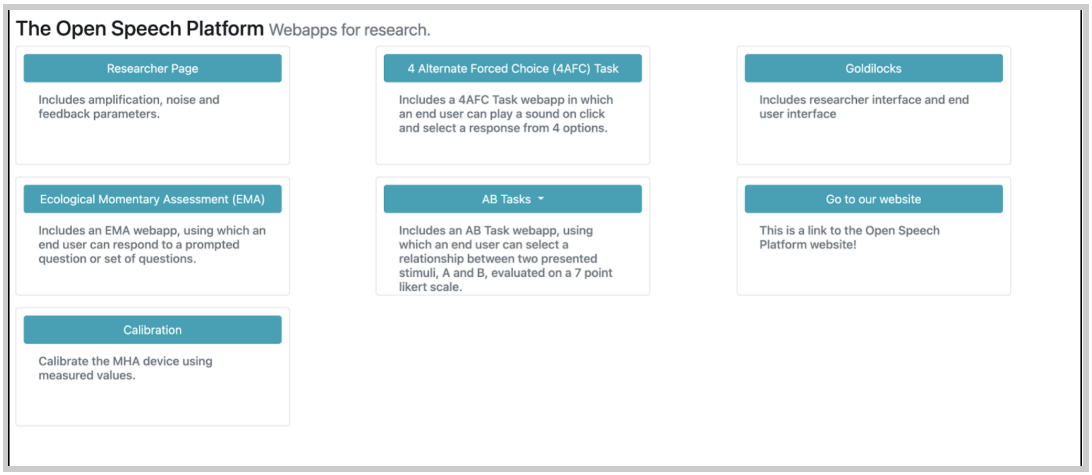


Optionally, you can access the legacy version of OSP software by simply entering one of the following into the search bar:

- `http://ospboard.lan` (try this first)
- `http://ospboard.local`
- `http://[YOUR_IP_ADDRESS]`

  Your IP address can be found from the `ifconfig` command. For example, if your IP address is "192.168.8.1", you would enter "`http://192.168.8.1`".

You'll see the landing page like the image below.



6 - Sanity Checks

This section covers aspects to test that the following work as expected on OSP hardware:

- BTE-RICs can provide audio input and output.
- Node.js version of EWS
- PHP/Laravel version of EWS
- RT-MHA functionality

The steps below assume that you have already:

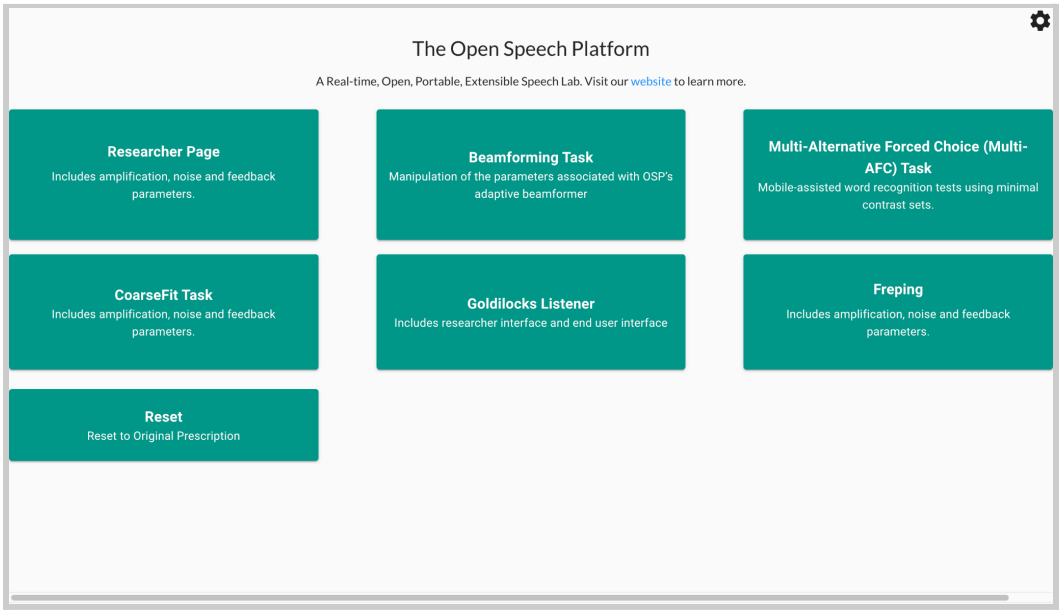
- sufficiently charged the Processing and Communication Device (PCD).
- connected the Behind-the-Ear, Receivers-in-the-Canal (BTE-RICs) to the correct ports of the PCD.

- connected your mobile/tablet/desktop device to either the PCD's hotspot via the PCD's Hotspot Mode or to an available wifi network via the PCD's NetworkManager Mode.
- launched the Node.js version of EWS successfully via one of the following URLs:
    - `http://ospboard.lan:5000`
    - `http://ospboard.local:5000`
    - `http://[YOUR_IP_ADDRESS]:5000`
- launched the PHP/Laravel version of EWS successfully via one of the following URLs:
    - `http://ospboard.lan`
    - `http://ospboard.local`
    - `http://[YOUR_IP_ADDRESS]`

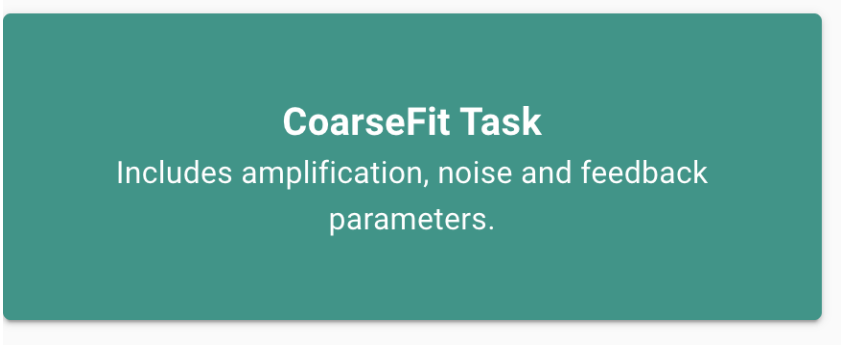
6.1 - Checking Node.js version of EWS

1. First, check your browser that you're on the right landing page. If not, type in one of the following in the browser search bar.
    a. `http://ospboard.lan:5000` (try this first)
    b. `http://ospboard.local:5000`
    c. `http://[IP_ADDRESS]:5000`
    The IP address found from the `ifconfig` command, For example, if your IP address is "192.168.8.1", you would enter

“`http://192.168.8.1:5000`”

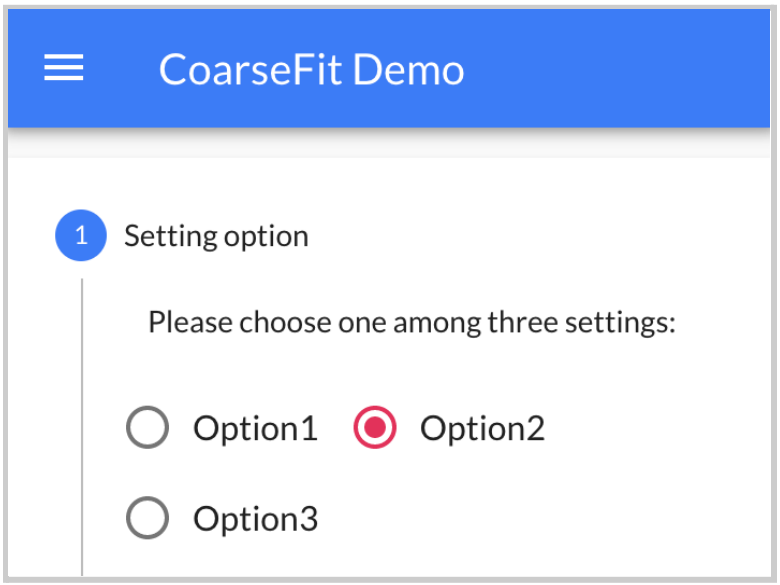


2. You will test out EWS and RT-MHA by accessing and using a series of demos. First, try to access the CoarseFit demo. To do so, select a button labeled “CoarseFit Task”. On mobile, you may need to scroll down to find this button before selecting.



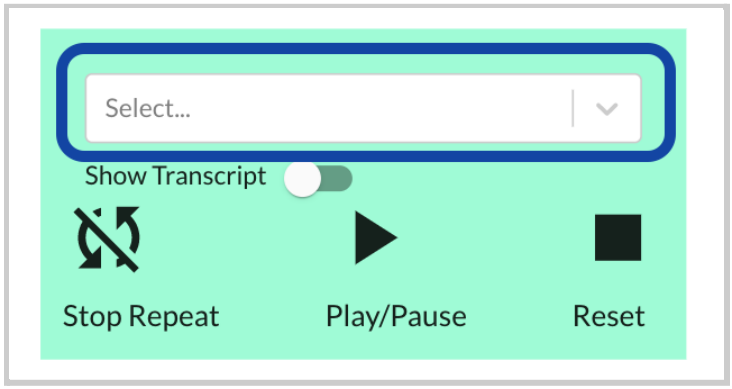
3. You can select one of three coarse adjustment options.

a. **Option 1**: Worst band hearing loss, based on the range of worst hearing loss level.
b. **Option 2**: All band average hearing loss, based on the range of average hearing loss level.
c. **Option 3**: Four band average hearing loss, for four frequencies: 500, 1000, 2000, 4000 Hz.

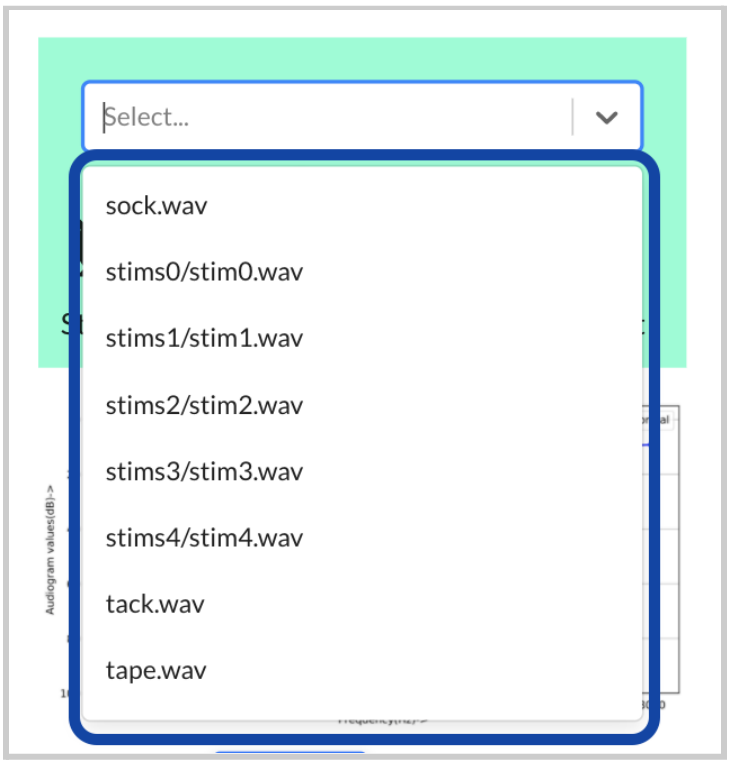


4. Select the “Next” button to proceed to the next part of CoarseFit.

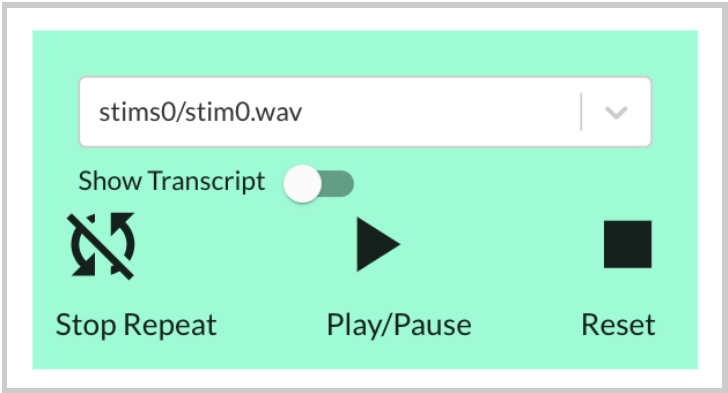
5. Select the dropdown menu.



You should be able to view and select one of the available audio files.

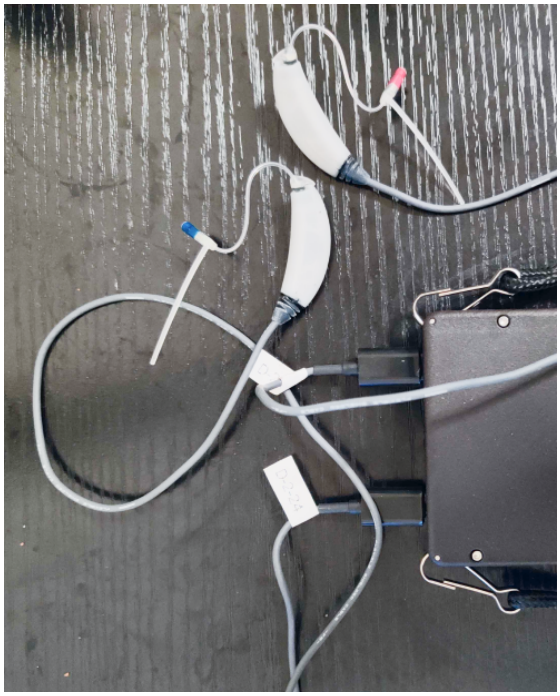


Scroll down to find and select a file named “stims0/stim0.wav”.

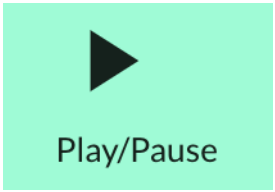


6. Get one of the BTE-RICs and hold it close to its intended ear. **DO NOT put it too close or inside your ear yet.**

   Disclaimer: For people in general, BTE-RICs can become quite loud. You can risk damaging your ears. You must test the BTE-RICs to determine how loud they are before inserting them close or inside into your ears.

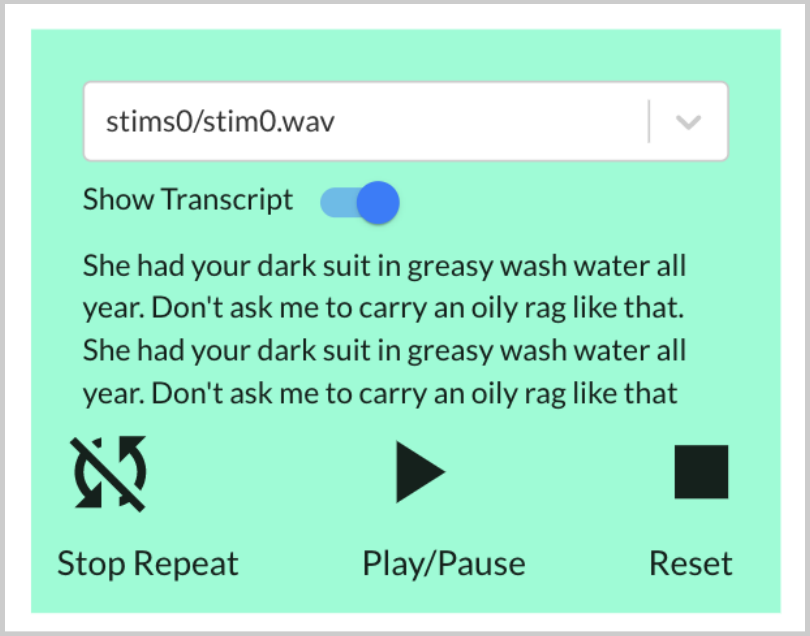


7. Select the “Play/Pause Button” to play the audio file. You should be able to hear sound. Adjust the volume on your computer accordingly until you can comfortably listen to the audio file.

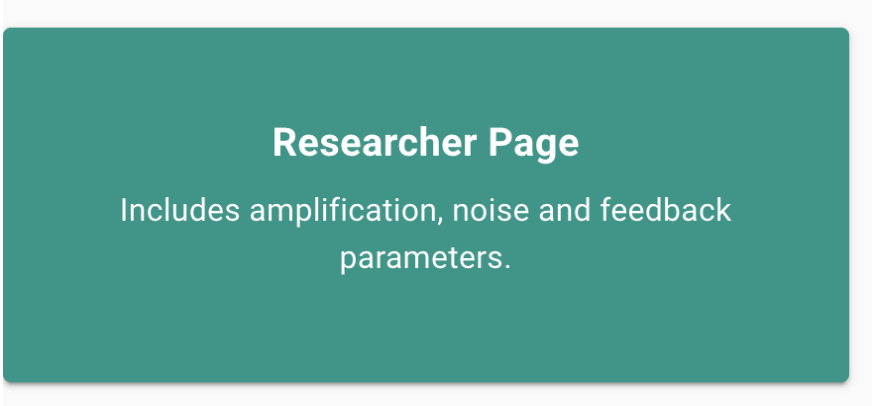


You can then select a different hearing loss profile (normal, mild, medium, severe, profound). You should perceive changes to the overall volume level.

8. Only files named “stims#/stims#” have transcripts. You can select the toggle next to the label “Show Transcript” to show a transcription of the audio file.

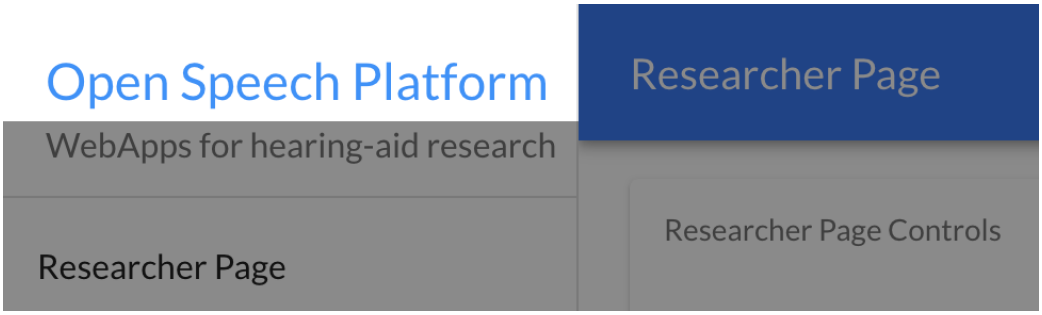


9. When you are finished with the CoarseFit demo, you will then learn how to access the global RT-MHA settings, how to switch the available frequency bands, and verify that the frequency bands show up correctly for the other apps and demos. First, navigate to the Researcher Page demo by selecting the button labeled “Researcher Page”.

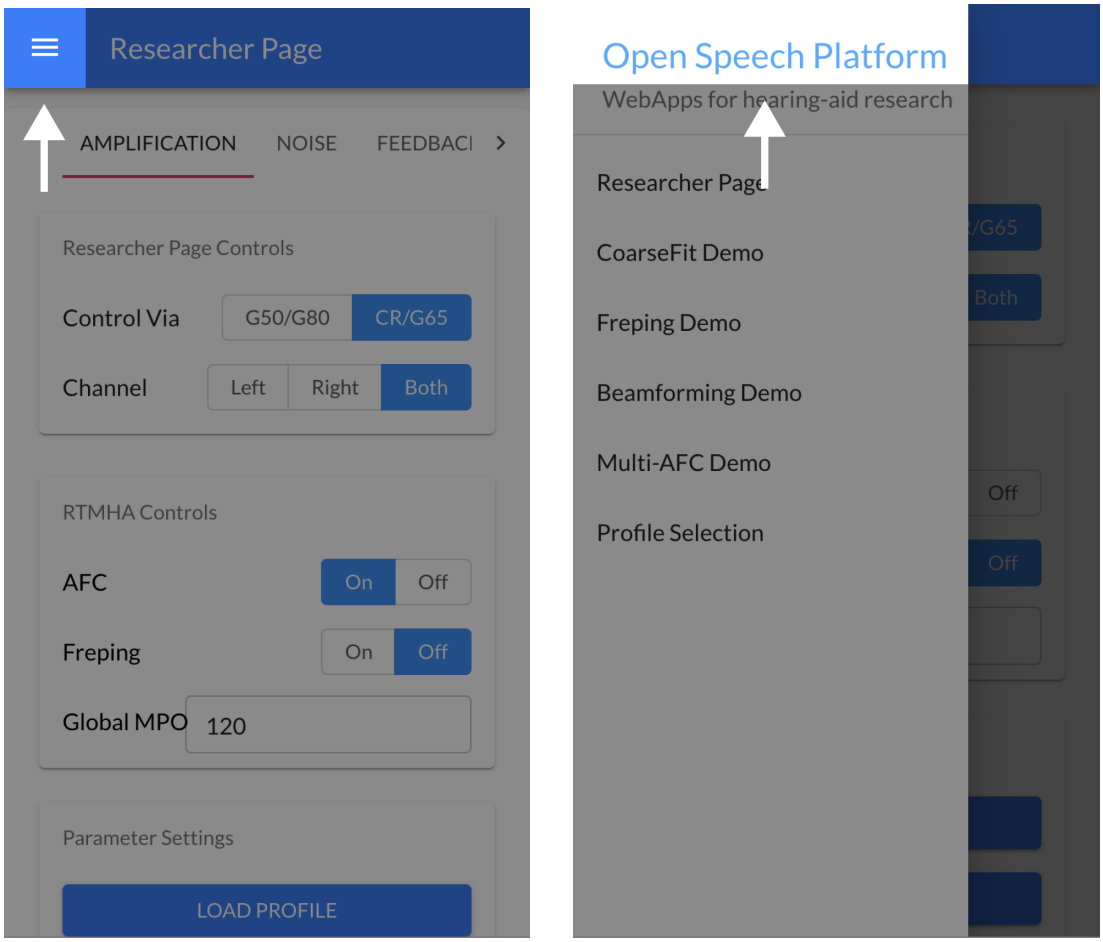


10. Notice that under “Parameter Settings”, there are six column headers showing the values of the center frequency bands (in Hertz): 250, 500, 1000, 200, 4000, and 8000

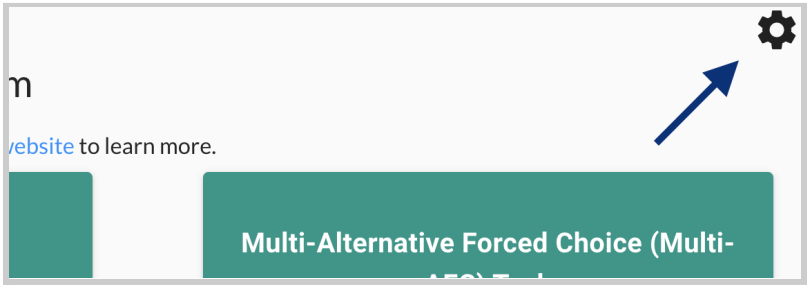
11. Select “Open Speech Platform” on the upper left corner to navigate back to the landing page.



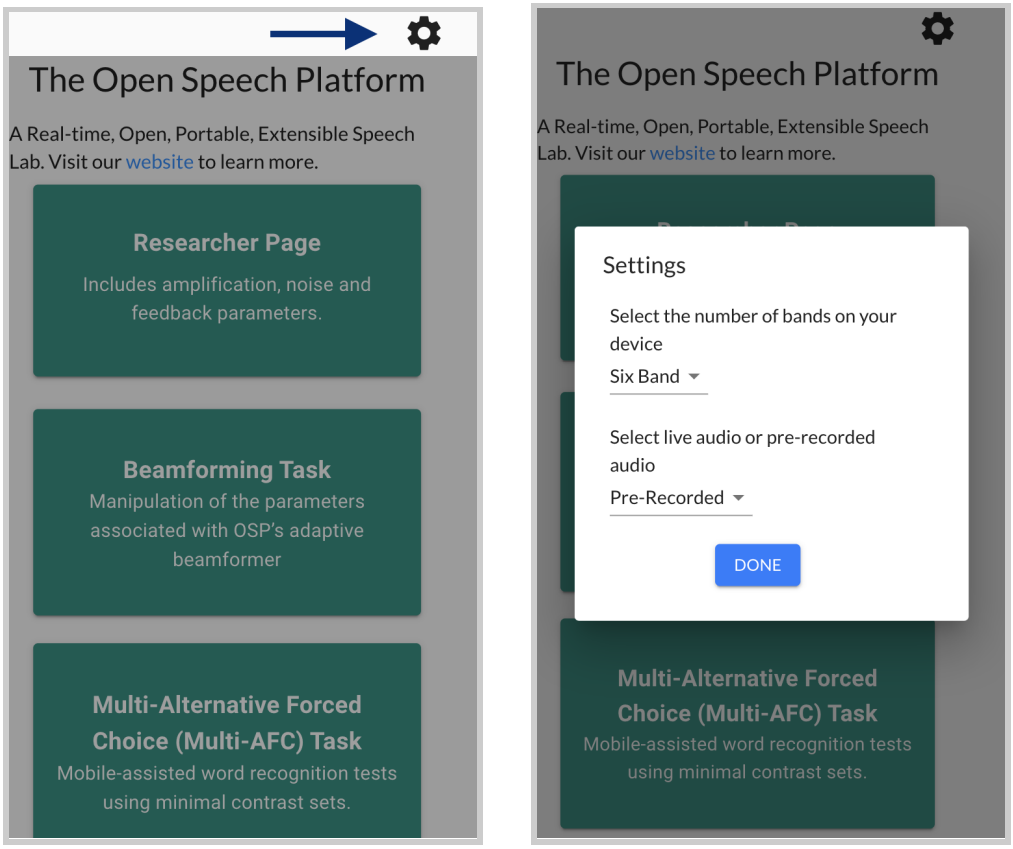
On mobile, you would instead select the hamburger menu icon on the upper left corner, then select “Open Speech Platform” to navigate back to the landing page.



12. From the landing page, select the gear icon in the upper-right corner of the screen.

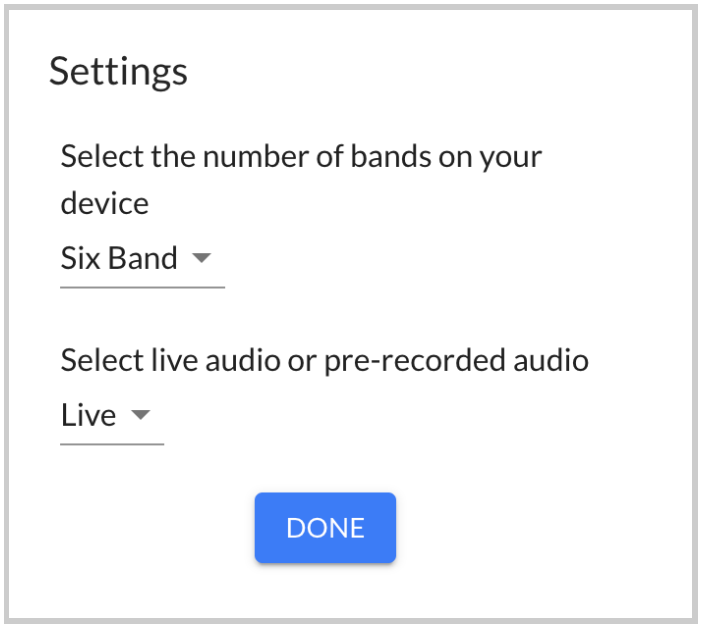


Landing page button (with gear icon) via desktop view.

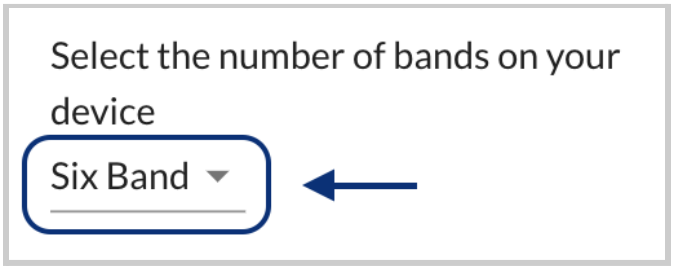


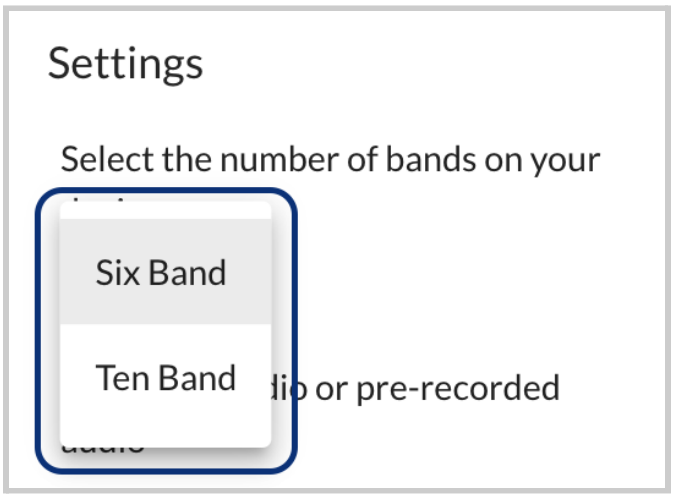
Landing page button (with gear icon) via mobile view.

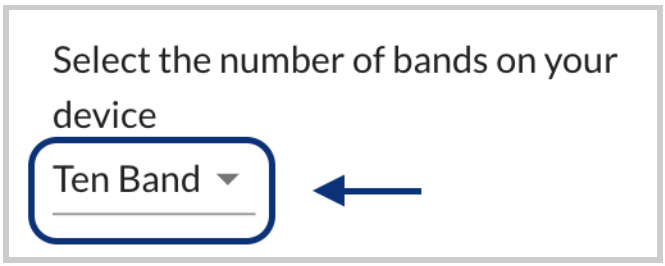
You will see a popup with two different settings, one for selecting the number of bands and one for selecting the type of audio. These are treated as global settings from RT-MHA.



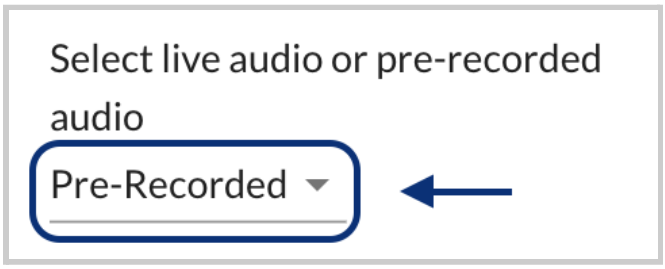
13. Select the top-most dropdown menu (labeled “Six Band” by default) to change from “Six Band” to “Ten Band”.

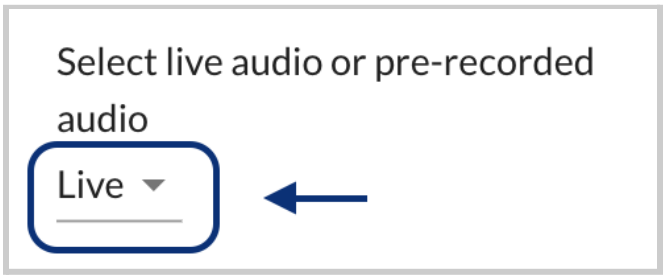






14. Under “Select live or pre-recorded audio”, make sure that you see “Live”. If the label shows “Pre-Recorded”, select the dropdown menu to change to “Live”.



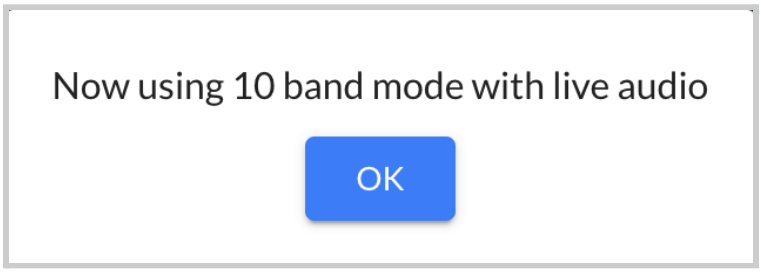


You should try speaking to see if you can hear feedback from the

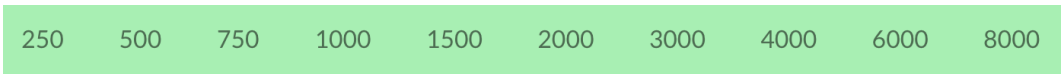
source audio input (e.g. microphone).

15. Exit the settings interface by selecting the “Done” button or selecting the gray area outside of the settings interface.

You will see a message that confirms your saved settings.

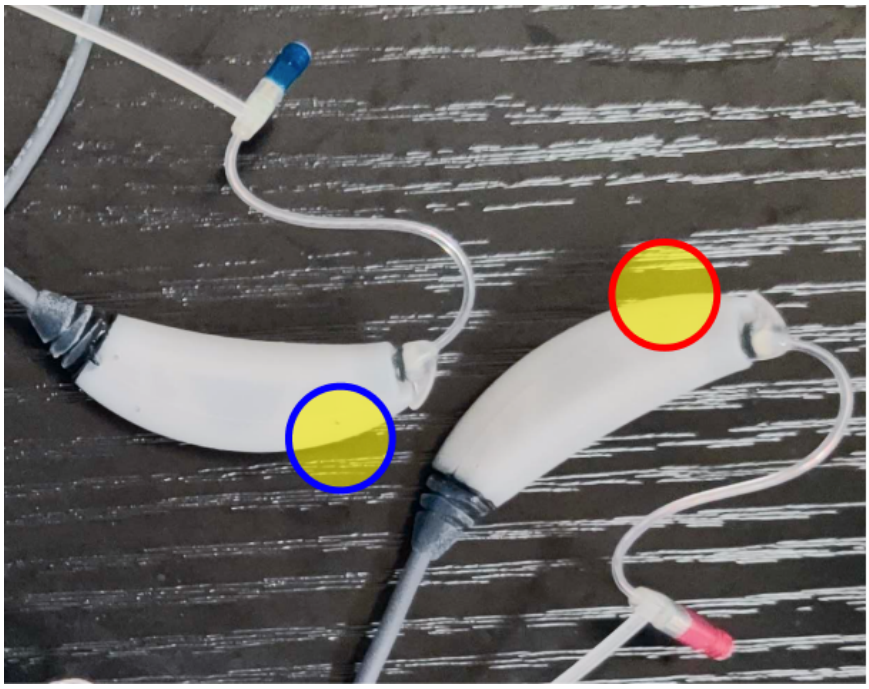


16. Return to the Researcher Page by selecting the button with the same label. In the “Parameter Settings” table, you should now see ten column headers instead of six for the center frequencies: 250, 500, 750, 100, 2000, 3000, 4000, 6000, 8000

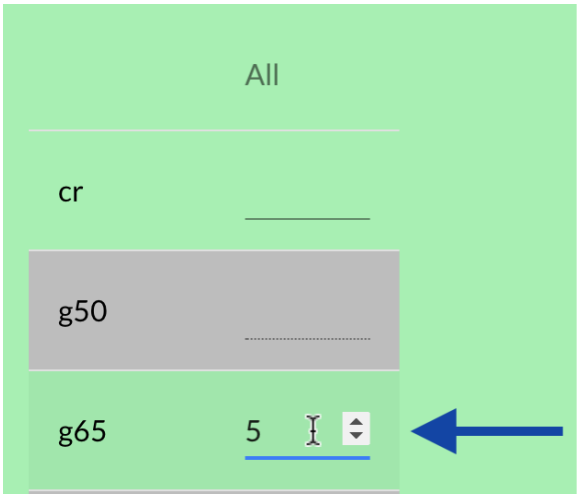


17. Scroll to the bottom of the page and click on the “Transmit” button.

Then, scratch the BTE-RICs on the circled areas and listen for immediate audio feedback. You may also try to talk aloud to hear the feedback.



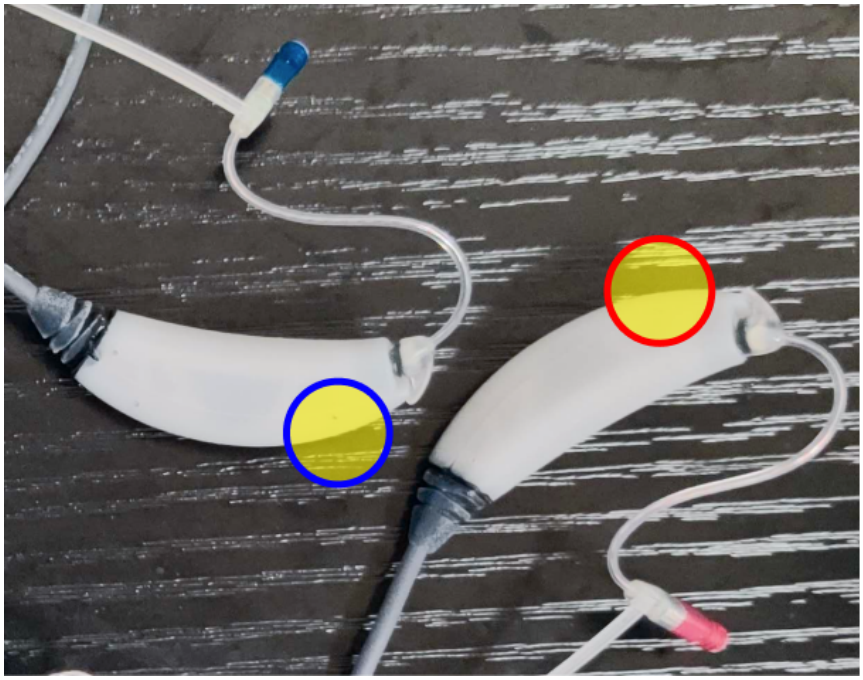
18. Select the horizontal line that aligns with “All” and “g65” and enter a value of 5.



You will notice that all values within the “g65” row for all of the center frequencies (200 to 8000) will all change to 5.

19. Below the table, you will see two buttons labeled “Pull” and “Transmit”. Select the “Transmit” button. You should now hear changes to the live audio input.

Scratch the BTE-RICs on the circled areas again or talk aloud to listen again for immediate audio feedback. Notice the differences in volume.



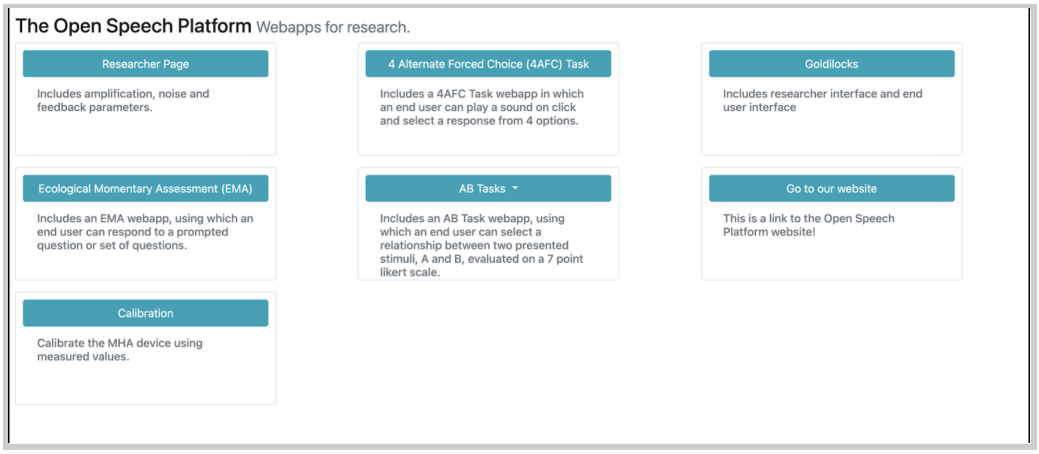
20. At this point, you can explore the other apps and demos in the OSP software. Other sections of this document will explain in greater detail on how each app and demo should work.

6.2 - Checking PHP/Laravel Version of EWS

1. First, check your browser that you're on the right landing page. If not, type in one of the following in the browser search bar.
    a. `http://ospboard.lan` (try this first)
    b. `http://ospboard.local`
    c. `http://[IP_ADDRESS]`

       The IP address found from the `ifconfig` command, For

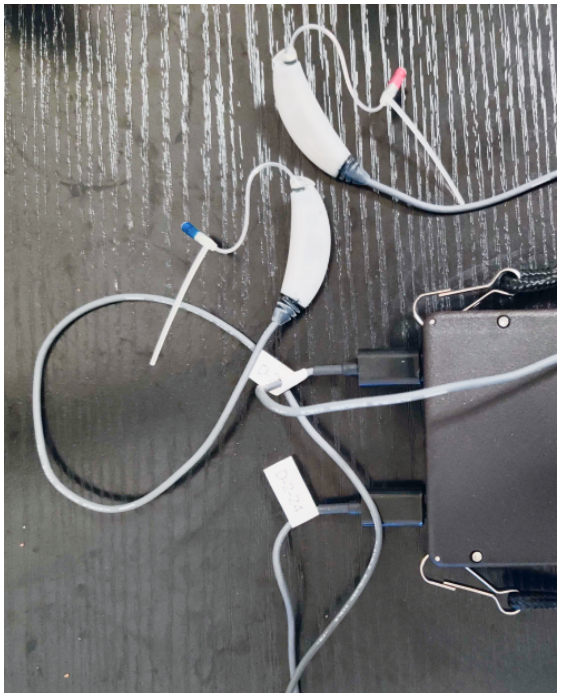
example, if your IP address is “192.168.8.1”, you would enter “**http://192.168.8.1**”



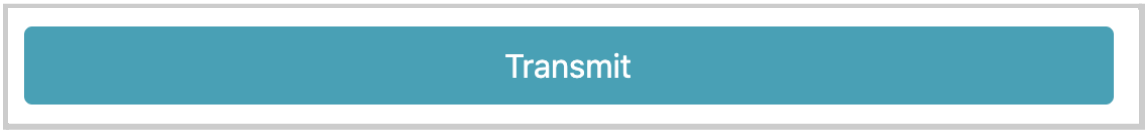
2. You should see this screen for the Researcher Page, within “Amplification”.

3. Get one of the BTE-RICs and hold it close to its intended ear. **DO NOT put it too close or inside your ear yet.**

   Disclaimer: For people in general, BTE-RICs can become quite loud. You can risk damaging your ears. You must test the BTE-RICs to determine how loud they are before inserting them close or inside into your ears.

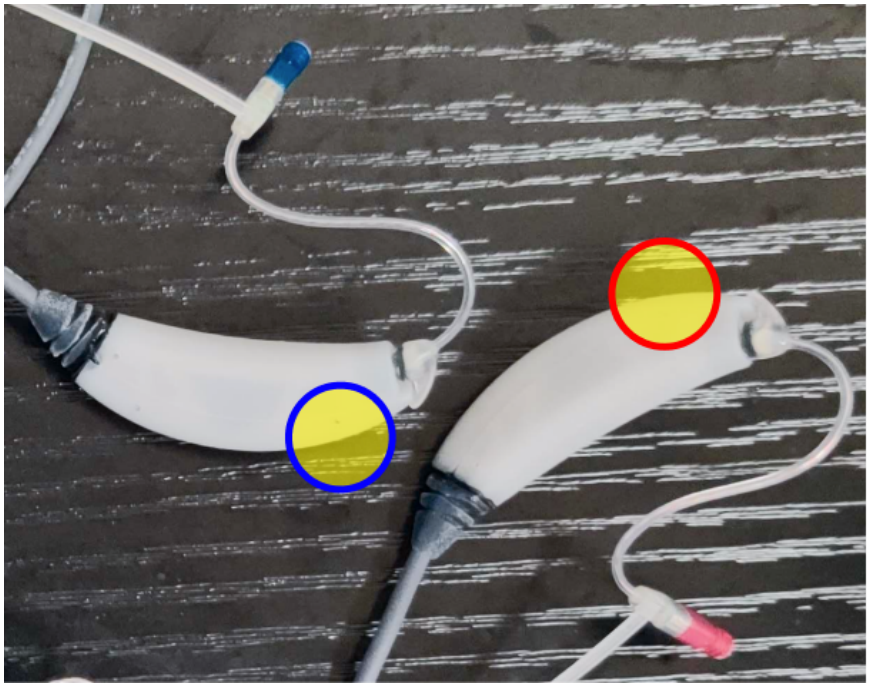


4. Scroll to the bottom of the page and click on the “Transmit” button.



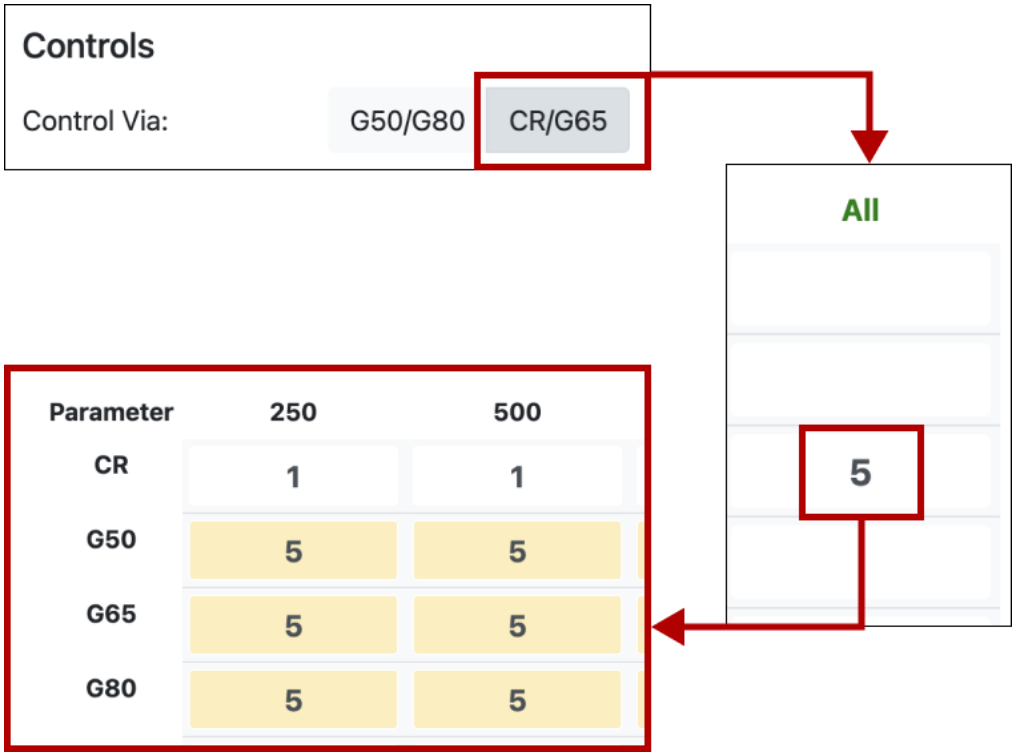
   Then, scratch the BTE-RICs on the circled areas and listen for

immediate audio feedback. You may also try to talk aloud to hear the feedback.

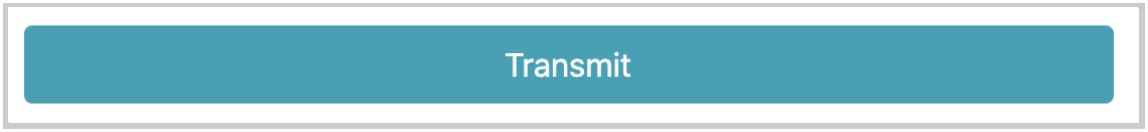


5. Scroll back up and view the “Controls” settings. Next to “Control Via:”, click on CR/G65. Then, in the boxed cell within the “All” column and “G65” row, type in “5”. Notice the change in values.

   Changing the value in the boxed cell to “5” should change the gain for “g65” to be 5 decibels (dB SPL) across all frequency bands (250 to 8000 Hertz).

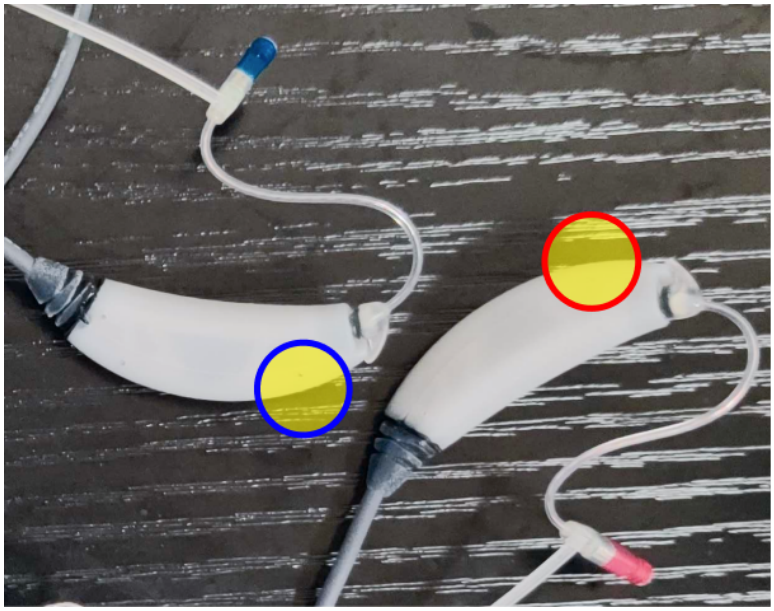


6. Scroll to the bottom of the page and click on the “Transmit” button again.



Then, scratch the BTE-RICs on the circled areas again or talk aloud to listen again for immediate audio feedback. Notice the differences

in volume.



7 - Using Visual Studio Code

Visual Studio Code is an integrated development environment that, when used with the Remote SSH Extension, is a great way to do development on the device.

You will need to set up your “~/.ssh/config” file as described above.

8 - Charging the Device

Currently, the devices do not have a way to measure the battery level. They also have some charging quirks, which would be fixed in later hardware revisions.

If a device in Hotspot mode is not creating an "ospboard" SSID, the battery may be too low. If the device is in NetworkManager mode and you cannot ping or do an SSH connection to it, the battery is likely discharged.

8.1 - V9 Device Charging

V9 PCDs will charge at up to 600mA when powered on and when powered off, but only if the PCD is turned off while the USB port is connected.

If a device is not responding, attach a USB cable and plug the PCD into a computer or charger. Switch the power on. Normally the PCD will charge briefly then start working. If it does not start after 15 minutes, turn the PCD off then on again. It may take 6-8 hours to fully charge.

If you disconnect the USB cable or unplug the charger/laptop, keep the device power on. Once it is moved, wait 5 seconds then you can turn the

power off and it will keep charging. If the device was off, you should turn it on, wait 30-40 seconds then turn it off.

A way to tell that the PCD is low in battery power and needs charging is

- if it automatically shuts off during use
- it would keep turning on and off
- it would keep turning the LED lights on and off

Disclaimer - Device Overheating Issue

While the device is plugged in with a USB cable(s) and operating at the same time for a prolonged period of time, the device will eventually overheat, which can reduce its audio quality and performance. The OSP team is working to resolve this.

For the time being, it is recommended to set up a SSH connection so that you don’t have to use a cable to connect the Processing and Communication Device (PCD) to your computer.

8.2 - V8 Device Charging

V8 devices charge whenever the USB port labelled "ADB" is connected.

9 - Customizing Device Operation

9.1 - Understanding the Device's Current State of Operation

To see a summary of the PCD's system status, enter the command:

system_check

```
root@ospboard:~> system_check

10:22:13  CPU0-1: 73.0         CPU2-3: 72.0

CPU busy (%)   (1-4) : 11.799999999999997 30.0 30.0
17.0

CPU freq (kHz) (1-4) : 998.4  998.4  998.4  998.4

TIME IN STATE
-------------
kHz  Percent
-------------
200   0
400   0
800   90
998   8
```

```
OSP Status
CPUID CLS PRI %CPU   LWP COMMAND
    0  TS  19  0.0   544 OSP
    1  FF 130 29.8   555 OSP: Chan 0
    2  FF 130 29.1   556 OSP: Chan 1
    3  FF  41 16.0   591 OSP: AudioCB

Diskfree: 58.7%

Charge Log
----------
Setting initial current limit to 600 mA
Charging Enabled
Battery  SDP  Off
Thu Feb 14 10:12:12 2019: Temp: 68. Setting current
limit to 100 mA

root@ospboard:~>
```

9.2 - Device Temperature

To check the CPU temperature, enter the command **temp**.

To monitor the temperature every 5 seconds, enter the command

temp -t 5

Temperature is in Celsius (°C).

```
root@ospboard:~> temp -t 5
10:12:28 42.0
```

```
10:12:33 41.0
10:12:38 40.0
10:12:43 40.0
10:12:48 41.0
```

9.3 - Setting the Time Zone

If you need correct times from the device, you must set the time zone. You can get a list of time zones with the command **`timedatectl list-timezones`**.

Then you set the timezone with **`timedatectl set-timezone <your zone>`**, putting in your desized time zone. For example, **`timedatectl set-timezone America/Los_Angeles`**

9.4 - Monitoring and Controlling the OSP Processes

OSP has three processes that are started automatically in “/etc/rc.local”. You can cat or tail the log files. You can also kill any of the processes you don't need.

```
ionice -c 1 /opt/release/bin/osp -m >
/var/log/osp.log &

/opt/release/bin/start -ews > /var/log/ews.log &

/opt/release/bin/start -ews-php >
/var/log/ews-php.log &
```

For osp, you can monitor CPU usage by entering the command: **ps_osp**

osp runs real-time threads in CPUs 1-3.

```
root@ospboard:~> ps_osp
CPUID CLS PRI %CPU   LWP COMMAND
    0  TS  19  0.0   558 OSP
    1  FF 130 22.3   566 OSP: Chan 0
    2  FF 130 21.8   567 OSP: Chan 1
    3  FF  41 13.0   607 OSP: AudioCB
```

In the above example, the command **kill 558** will kill all the OSP threads. You can restart it later with the command **nohup ionice -c 1 /opt/release/bin/osp -m > /var/log/osp.log &**

If you wish to disable all the OSP processes, simply create a file named **/root/.no_osp_startup** and reboot. As long as that file exists, OSP will not be run on startup.

Use the command **touch /root/.no_osp_startup** to create the file.

9.5 - Using openMHA

From the openMHA website, it "is an open-source software platform for real-time audio signal processing". Below describes how to set up openMHA in the PCD, examples, and other notes.

To use openMHA with the PCD, your config files must set the following to get live input from the mics:

```
srate = 48000
iolib=MHAIOPortAudio
io.device_index_in=1
io.device_index_out=0
```

Once you successfully connect to the PCD via the command **./pcdtool conn**, you should disable OSP processing by either creating a file named /root/.no_osp_startup and rebooting OR killing the osp process like this:

```
root@ospboard:/opt/openMHA/examples/00-gain >
ps_osp
CPUID CLS PRI %CPU LWP COMMAND
```

```
0 TS 19 0.0 534 OSP
1 FF 130 20.2 544 OSP: Chan 0
2 FF 130 19.5 545 OSP: Chan 1
3 FF 41 14.1 579 OSP: AudioCB
root@ospboard:/opt/openMHA/examples/00-gain > kill
534
```

The following examples in /opt/openMHA/examples have been tested and should work:

- 00-gain/gain_live_getting_started.cfg
- 00-gain/gain_live.cfg
- 00-gain/gain_live_double.cfg
- 01-dynamic-compression/dynamiccompression_live.cfg
- 17-PHL-generic-hearing-aid/generic-hearing-aid/index.cfg

10 - Command Line Interface (CLI) via Terminal

This section only describes how to access OSP's command line interface. The OSP Software Manual covers more of the CLI's key capabilities, and the different terminal commands available.

How to Access

1. Connect the USB cable(s) from the Processing and Communication Device (PCD) to your computer's USB port.
2. Open a new Terminal or Windows Powershell window.
3. Navigate to the folder that hosts the pcdtool(.exe) file. For example, if the name of the folder is named "pcd-2021A" or "pcd-windows-2021A" and is stored within "Downloads".
    a. macOS/Linux: `cd Downloads/pcd-2021A`
    b. Windows: `cd .\Downloads\pcd-windows-2021A\pcd-windows-2021A`
4. Use pcdtool to connect to the PCD.
    a. macOS/Linux: `./pcdtool conn`
    b. Windows: `.\pcdtool.exe conn`
5. Press enter to see "`root@ospboard:~>`".
6. Enter the command `osp_cli` to launch the OSP CLI.
7. To exit the OSP CLI, press the control + D keys on your keyboard to close the CLI. This will navigate back to the pcdtool interface (shown as the prompt "`root@ospboard:~>`").

11 - Next Steps and Resources

At this point, you should be very familiar with the hardware capabilities.

To better understand the PCD's software and capabilities over the browser, refer to the OSP Software Manual.

Below are hyperlinks to other OSP-related resources:

- OSP Website - General information of OSP.
- OpenSpeechPlatform on GitHub - This is a public repository where you will find installer files and other documentation files for setting up both OSP software and hardware. Check back for future OSP release notes, updated installer files, and other updates.
    - "Binaries" folder on GitHub - This is the specific folder where you can download the software builds for either macOS or for the OSP hardware provided.
- Google Form "OSP Feedback Form" - You can complete this form if you would like to follow up regarding any topics or issues using OSP to a project staff member.

12 - Acknowledgments and Bibliography

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- NIH R33-DC015046: Self-fitting of Amplification: Methodology andCandidacy
- NIH R01-DC015436: A Real-time, Open, Portable, Extensible SpeechLab to University of California, San Diego.
- NSF IIS-1838830: Division of Information & Intelligent Systems, ”AFramework for Optimizing Hearing Aids In Situ Based on PatientFeedback, Auditory Context, and Audiologist Input”
- The Qualcomm Institute

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