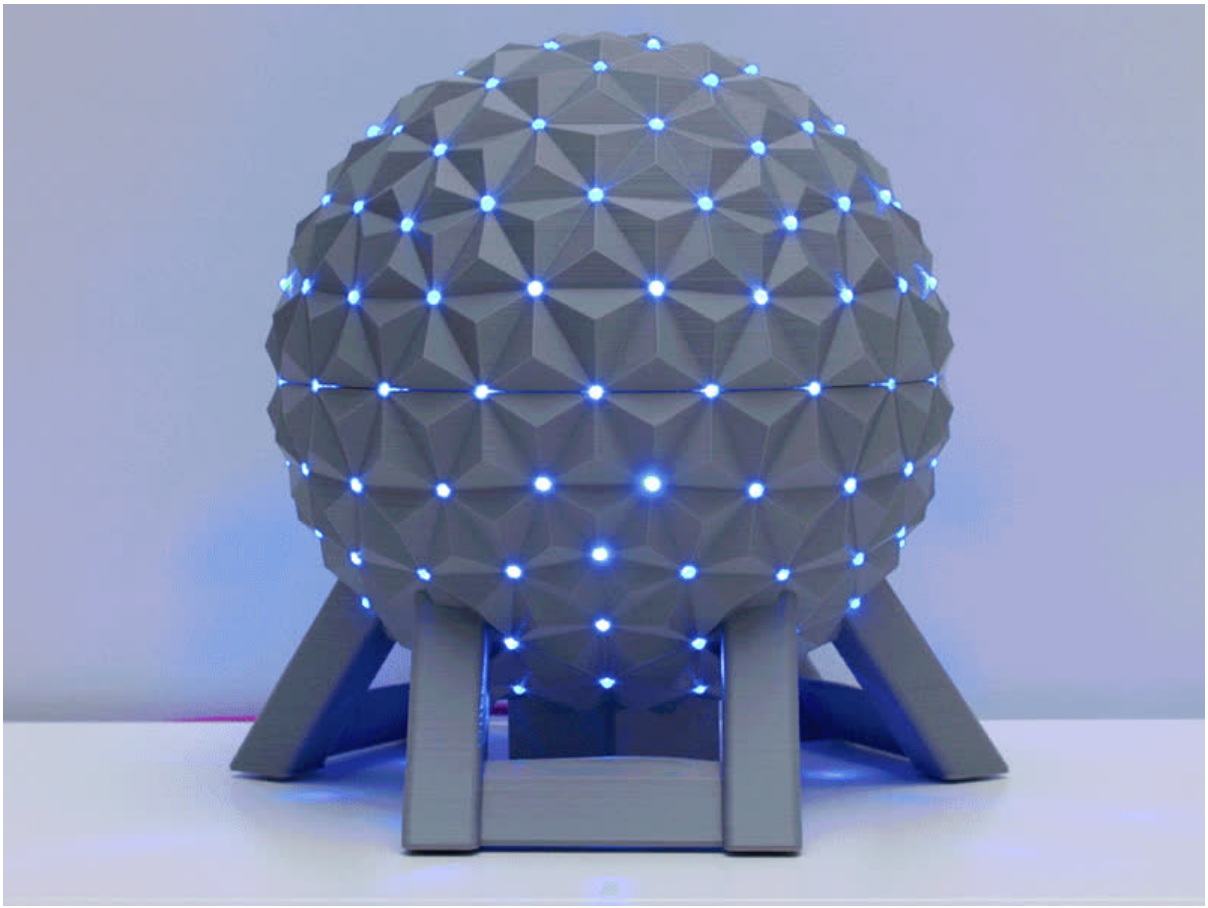
EPCOT Spaceship Earth with WLED

Created by Ruiz Brothers



https://learn.adafruit.com/epcot-spaceship-earth-with-wled

Last updated on 2024-03-08 04:13:29 PM EST

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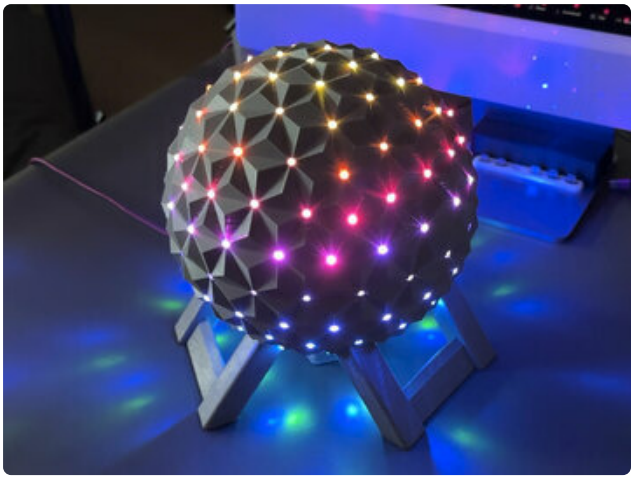
Overview

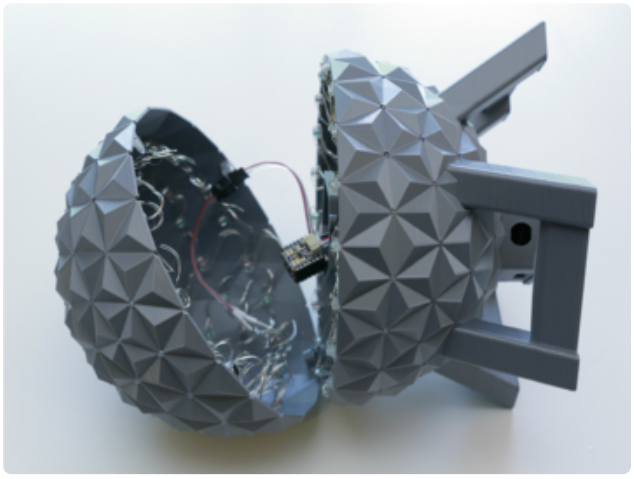


EPCOT NeoPixel Lamp

Build your own IoT NeoPixel lamp inspired by Disney's EPCOT Spaceship Earth! Use a QT Py ESP32 PICO, NeoPixel BFF Driver, and WLED (web-based LED control software) to make amazing lighting effects!

Mobile Device Control

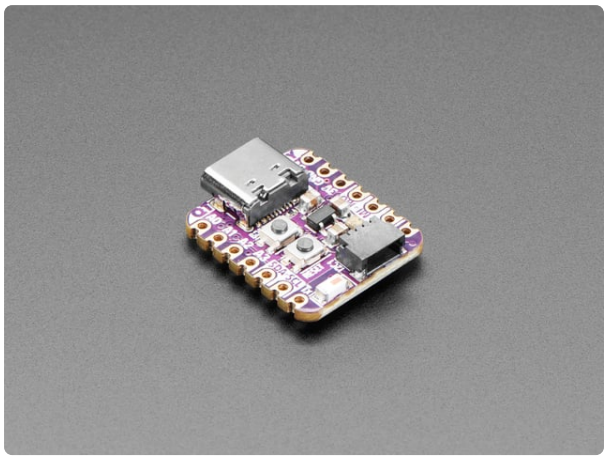
Using the WLED firmware (https://adafru.it/11dN), the project controls LED animations using a mobile phone! You can pick from dozens of beautiful animations and use the Presets feature to create your own playlists.



3D Printed Geodesic Sphere

The geodesic sphere is split into two halves that are joined with neodymium magnets. A total of 156 NeoPixel LEDs are hot glued to the various points and connected via JST plugs. The parts are 3D printed without any support material.

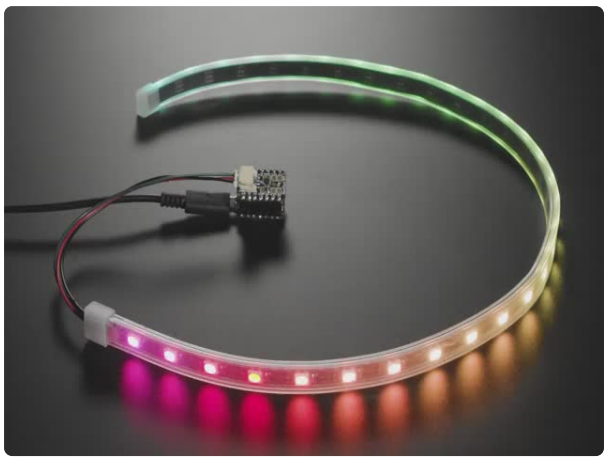
Parts



Adafruit QT Py ESP32 Pico - WiFi Dev Board with STEMMA QT

This dev board is like when you're watching a super-hero movie and the protagonist shows up in a totally amazing costume in the third act and you're like 'OMG! That's...

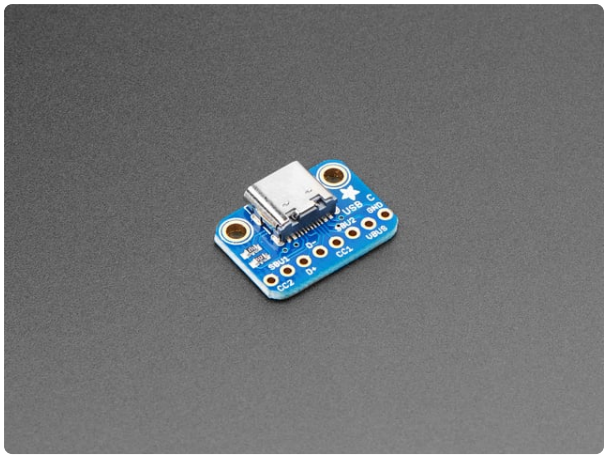
https://www.adafruit.com/product/5395



Adafruit NeoPixel Driver BFF Add-On for QT Py and Xiao

Our QT Py boards are a great way to make very small microcontroller projects that pack a ton of power - and now we have a way for you to quickly add a

https://www.adafruit.com/product/5645



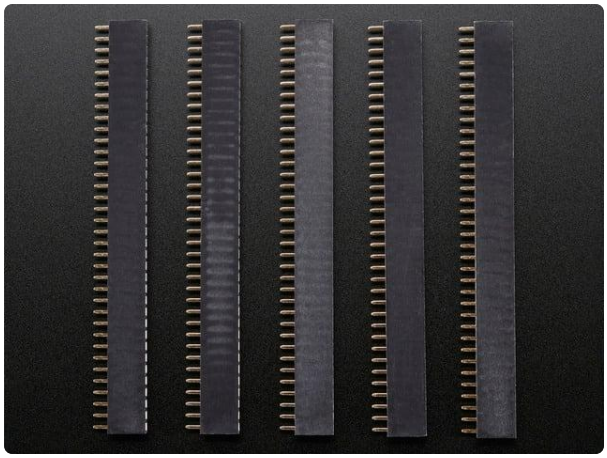
Adafruit USB Type C Breakout Board - Downstream Connection

Throw out all those Mini and Micro B USB cables you have in a plastic bin - the next generation of USB connectors is here with USB C! You will start to see these...

https://www.adafruit.com/product/4090

USB C to Micro B Cable - 1 ft 0.3 meter
As technology changes and adapts, so does Adafruit! Rather than the regular USB A, this cable has USB C to Micro B plugs!USB C is the latest...
https://www.adafruit.com/product/3879

Pink and Purple Woven USB A to USB C Cable - 2 meters long
This cable is not only super-fashionable, with a woven pink and purple Blinka-like pattern, it's also made for USB C for our modernized breakout boards, Feathers and more.
https://www.adafruit.com/product/5044



36-pin 0.1" Female header - pack of 5!
Female header is like the duct tape of electronics. Its great for connecting things together, soldering to perf-boards, sockets for wires or break-away header, etc. We go through these...
https://www.adafruit.com/product/598

1 x 3-Pin JST PH Cable — https://www.adafruit.com/product/3893
STEMMA JST PH 2mm 3-Pin to Male Header Cable - 200mm

4 x Soft Flexible Wire NeoPixel Strand — https://www.adafruit.com/product/4560
Strand of 50 NeoPixels (156 NeoPixels Required)

8 x Neodymium Magnets — https://www.kjmagnetics.com/proddetail.asp?prod=D42
D42 - 1/4" dia. x 1/8" thick

Tools & Supplies

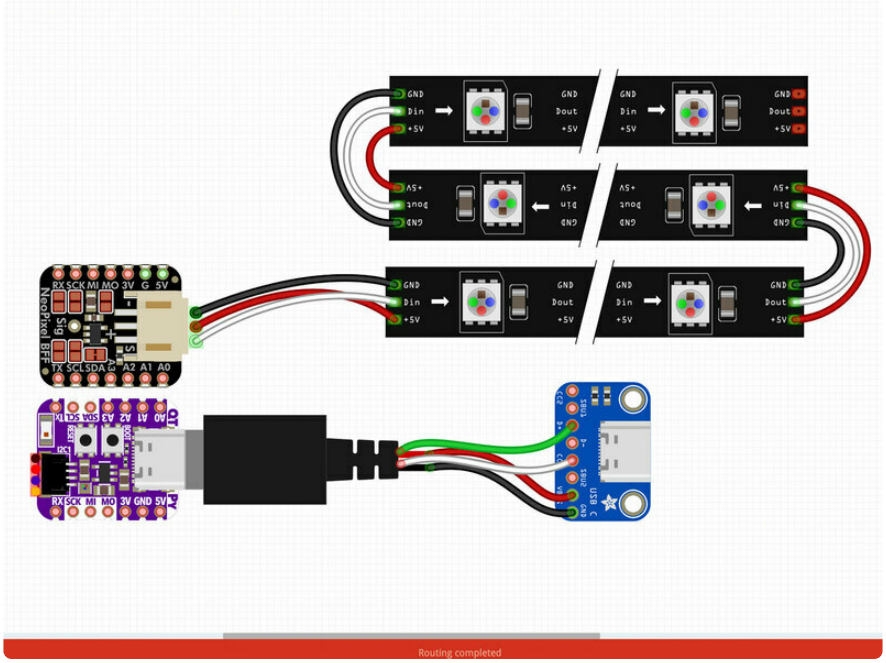
- Hot Glue & Hot Glue Gun
- Soldering Iron & Solder Wire
- 2x M2.5 x 10mm nylon screws
- 2x M2.5 hex nuts
- CA Glue (a.k.a. Superglue)

Circuit Diagram

The diagram below provides a general visual reference for wiring of the components once you get to the **Assembly** page. This diagram was created using the software package Fritzing (https://adafru.it/oEP).

Adafruit Library for Fritzing

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



Wired Connections

The QT Py is powered by a 5V 2A power supply wall adapter.

NeoPixel Strip to NeoPixel Strip

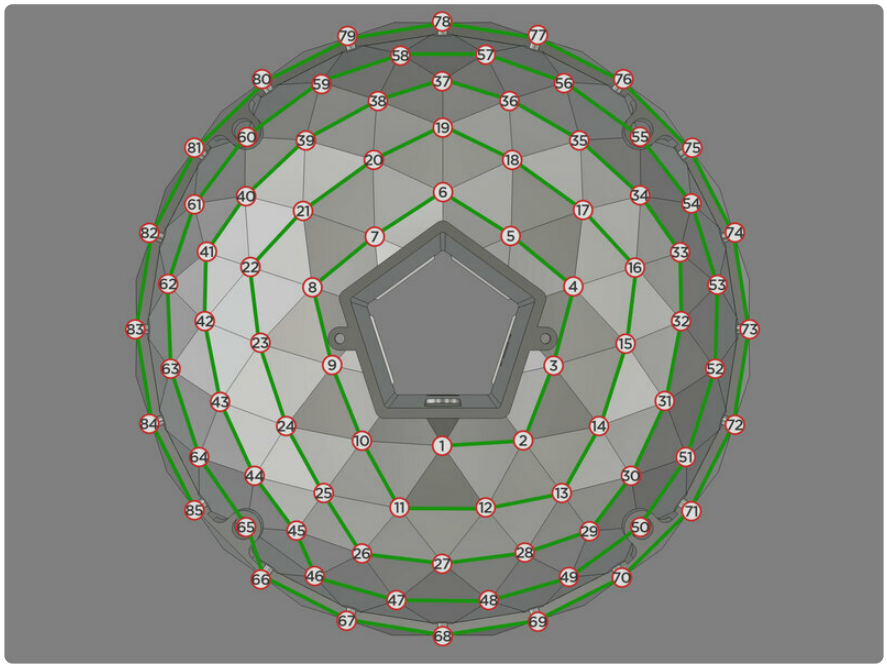
- **DATA OUT** to **DATA In**
- **GND** to **GND** pin
- **5V** to **5V** pin

NeoPixel Strip to BFF NeoPixel Drive

The power, data, and ground connections from the first NeoPixel strip connect directly to the 3-pin JST port on the NeoPixel BFF board.

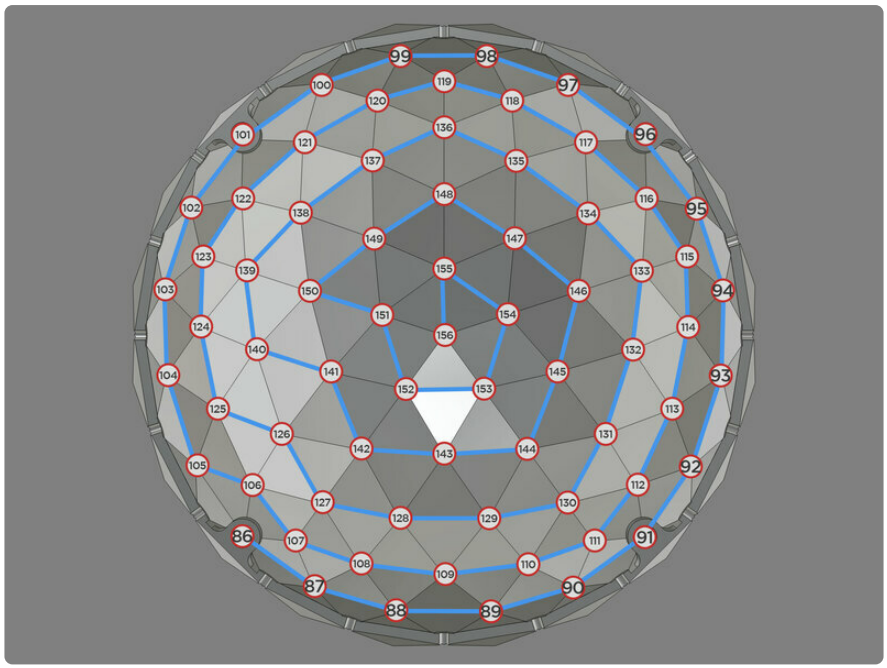
Bottom Sphere

The diagram below depicts the first LED strip going in a spiral direction. Reference the numbered labels to see how they are ordered.

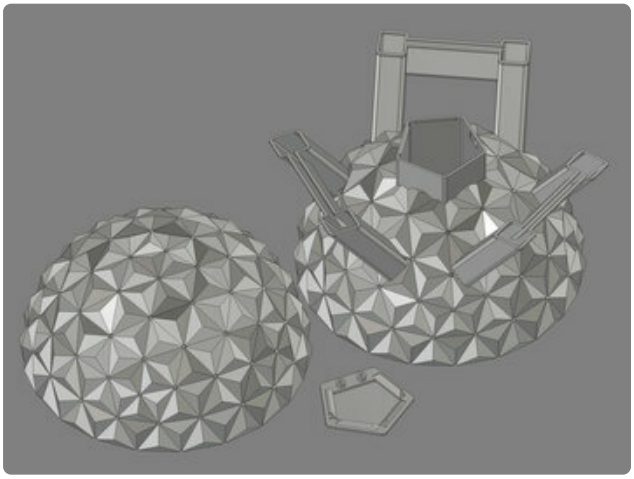


Top Sphere

The diagram below depicts the second LED strip, starting from NeoPixel LED #85 – #156.



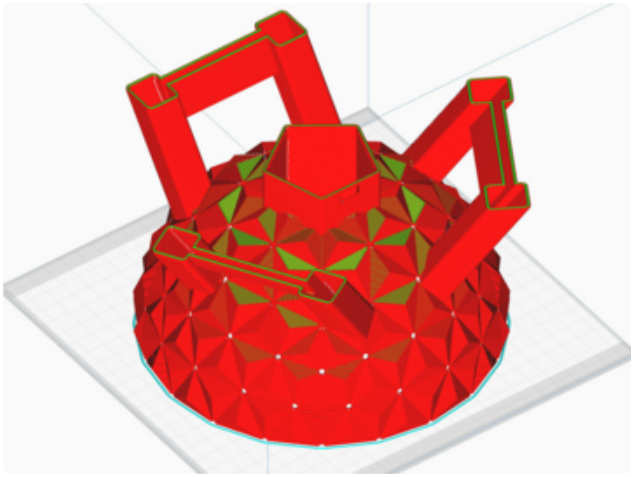
CAD Files



CAD 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 using PLA filament. Original design source may be downloaded using the links below.

sphere-top.STL
sphere-bottom.STL
sphere-cover.STL



Build Volume

The parts require a 3D printer with a minimum build volume.

228mm (X) x 202mm (Y) x 118mm (Z)

Download CAD source

https://adafru.it/18Db

Download STLs.zip

https://adafru.it/18Dc

Install WLED

Driver Update

The **QT Py ESP32 Pico** board will need a driver update before installing the WLED firmware. Head over to our How to Install Drivers for WCH USB to Serial Chips (https://adafru.it/-f8) tutorial, and download and install the new driver.

As of the writing of this guide, WLED is not supported on ESP32-S2 and ESP32-S3 so the ESP32 is used

Install WLED

These next steps require a **Web Serial-compatible browser**. As of this writing, that means **Google Chrome**, **Microsoft Edge** or **Opera** “desktop” browsers. Other browsers (Safari, Firefox, Explorer and anything mobile) won’t work.

Visit https://install.wled.me/ (https://adafru.it/11dL)

Plug your microcontroller into your computer with a known good power+data USB cable. Click "Install" and select the port for your board.

Depending on the USB-to-serial bridge chip on the board, you might see one or two serial ports. On Mac, for instance, there might be both “/dev/cu.usbmodem[number]” and “/dev/cu.wchusbserial[number]”. Use the “**wchusbserial**” one.

After successful installation, enter your WiFi network name and password when prompted.

WiFi Setup

In the WLED interface, locate and click on the **Config** icon in the top menu. Then, click on the **WiFi Setup** button. Under the **mDNS address** section, enter a desired name for your project. This will make connecting to your project from the web browser easier.

Click the **Save** button when finished.

LED Preferences

Use the **Back** button in the top menu and click on the **LED Preferences** button.

Under **Length**, enter **156** in the textbox.

Under **GPIO**, enter **15** into the textbox.

Click the **Save** button when finished.

Wiring

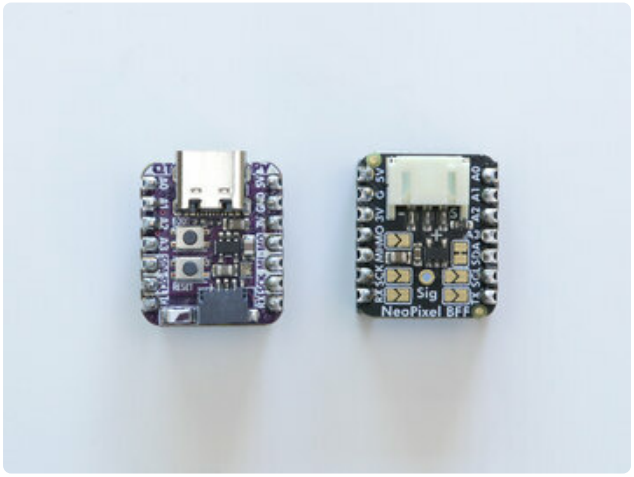
Wiring USB-C Breakout

Measure and cut the USB-C cable so it's 4 inches (10cm) in length.

Using a wire stripper, remove about an inch of insulation to expose the four colored wires. Strip some insulation from their tips.

Solder the four wires to the following pins on the USB-C Breakout:

Green wire to **D+** pin
White wire to **D–** pin
Black wire to **GND** pin
Red wire to **VBUS** pin

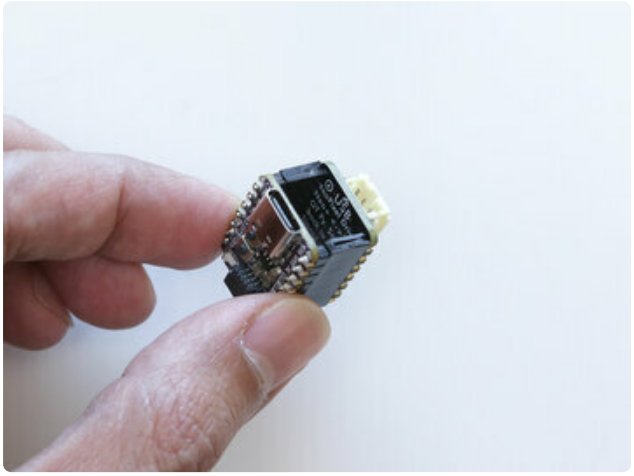


Solder Headers to QT Py & BFF

QT Py and BFF boards are connected "belly-to-belly".

Install and solder two 1x7 socket headers to the NeoPixel BFF Driver board's bottom side.

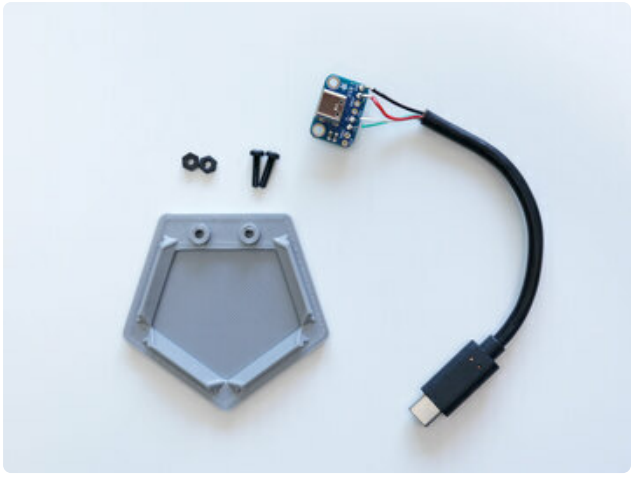
Install and solder two 1x7 header pins to the QT Py ESP32 Pico's bottom side.



Install QT Py to BFF

Orient the QT PY ESP32 Pico with the NeoPixel BFF Driver board so the USB port is lined up with the 2-pin JST PH connector.

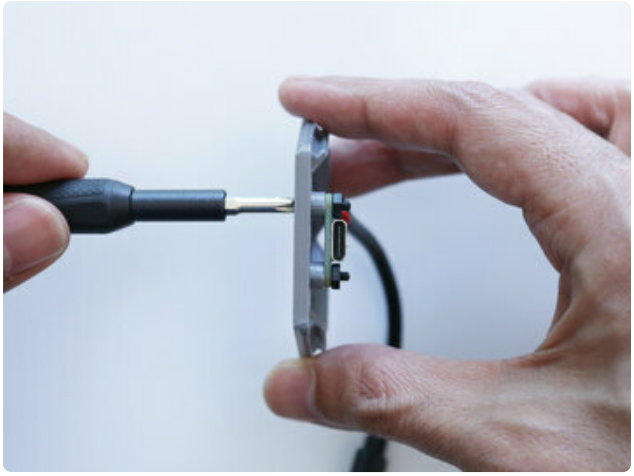
Plug in the QT PY ESP32 Pico to the NeoPixel BFF Driver board.



Hardware for Bottom Cover

Use the following hardware to secure the USB-C Breakout board to the bottom cover.

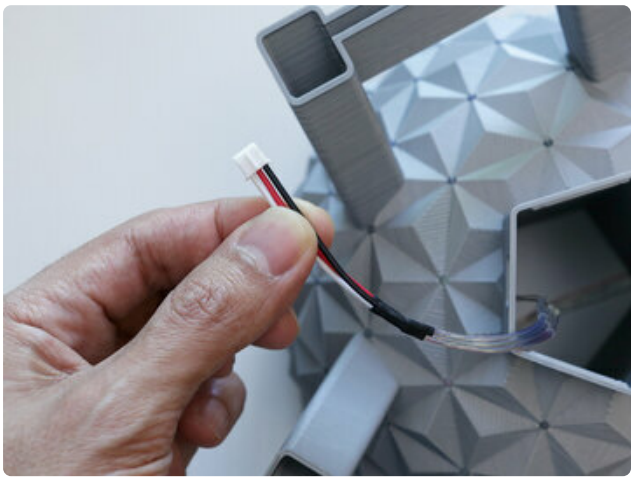
2x M2.5 x 10mm long screws
2x M2.5 hex nuts



Secure USB-C Breakout

Place the USB-C breakout PCB over the standoffs on the bottom cover.

Insert and fasten the screws through the mounting holes. Use the hex nuts to secure the USB-C breakout.

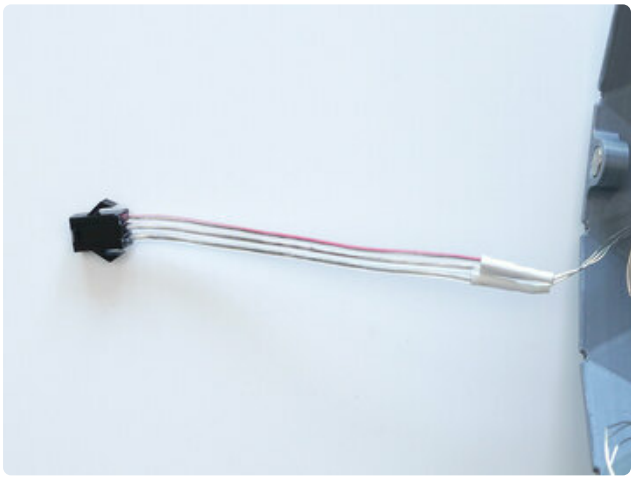


Solder LED Strips for Bottom Half

The bottom half of the sphere will need 85 NeoPixel LEDs. Connect two LED strips together by soldering their wires. Make sure the DATA OUT wire connects to the DATA IN wire. Cut the joined strips so it has a total of 85 LEDs. Replace the first LED's connector with the 3-pin JST PH connector. Use heat shrink tubing to insulated the exposed wire.

Soldering Connector for Bottom Half

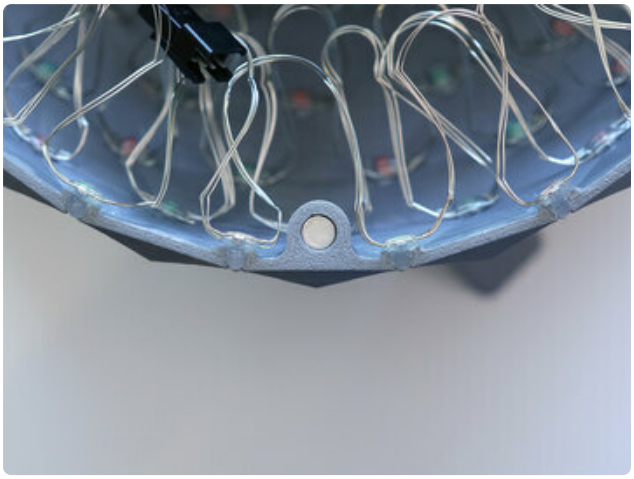
Solder the 3-pin socket connector to the end of the strip. Use heat shrink tubing to insulate the exposed wire.



Solder LED strips for Top Half

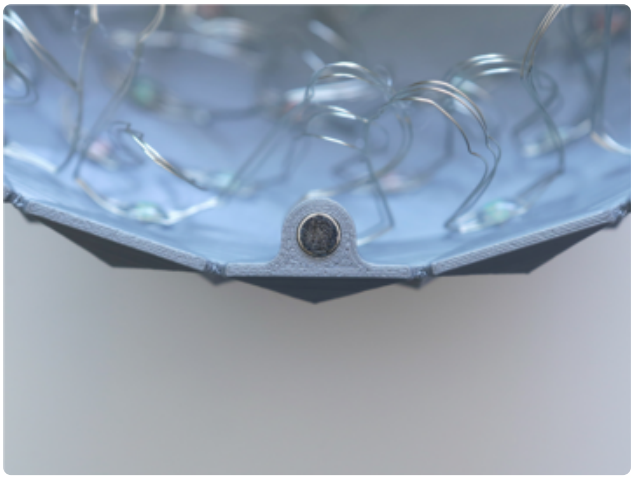
The top half of the sphere is need 71 NeoPixel LEDs. Solder two LED strips together and cut the joined strip so it only has 71 LEDs. Solder the 3-pin plug connector to the first LED in the strand. Use heat shrink tubing to insulate the exposed wire.

Assembly



Install Magnets into Bottom Half

Insert and glue a magnet into a magnet tab in the bottom half of the sphere. Allow the glue to dry before continuing to the next tabs.



Install Magnets in Top Half

Check polarity of the magnets for the top half of the sphere before installing.

Insert and glue a magnet into a magnet tab in the top half of the sphere. Allow the glue to dry before continuing to the next tabs.

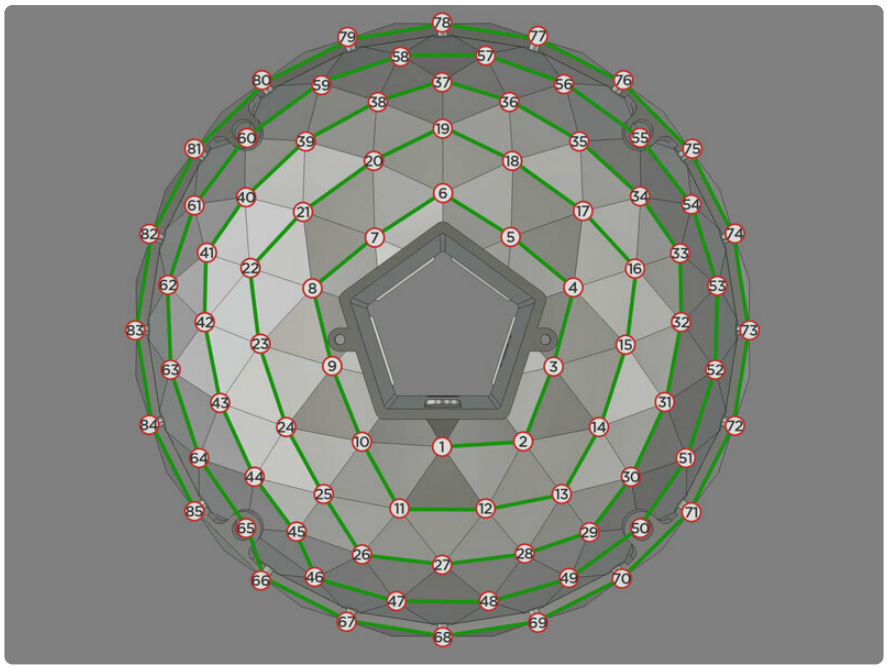
Install LED Strip to Bottom Half

Start hot glueing the 85x NeoPixel LED strip to the bottom half of the sphere.

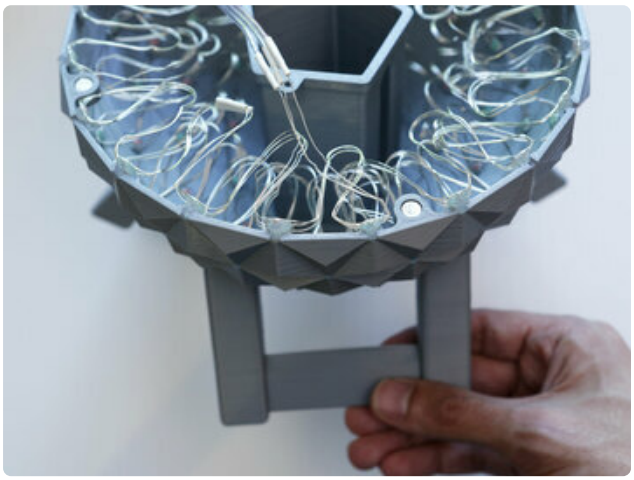
Install the first NeoPixel LED to the hole closest to the slot.

Add a small drop of hot glue to the hole. Then, carefully place the LED onto the hot glue and hold for a few seconds.

Repeat this process, going in a spiral direction until all LEDs are hot glued.



Glue Bottom Strip Edges

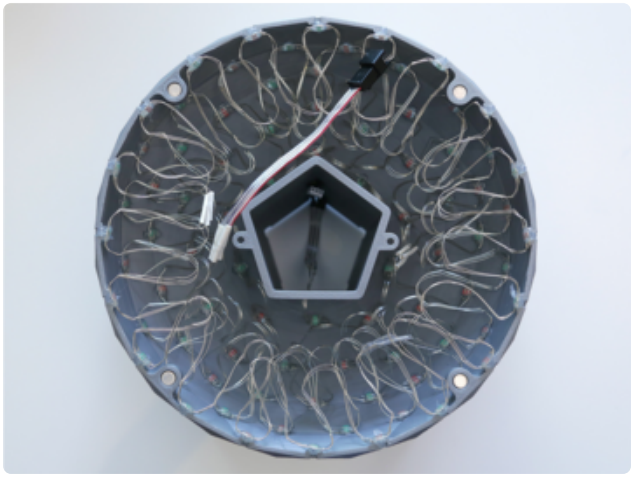


NeoPixel LED #66 – #85 will need to be glued to the edge of the sphere's bottom half.

Lean the dome on it's side to prevent the hot glue from drooping down. Add a small drop of hot glue to the hole halves and carefully place the LEDs onto the edge. Hold for a few seconds to allow the hot glue to dry.

Repeat this process until all LEDs are glued to the edges.

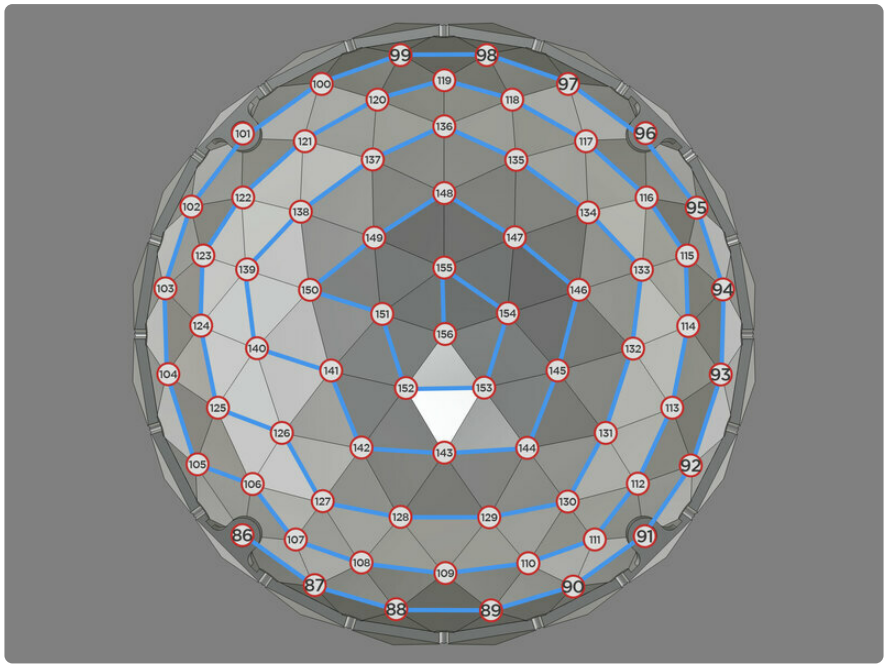
Glued Bottom Strip

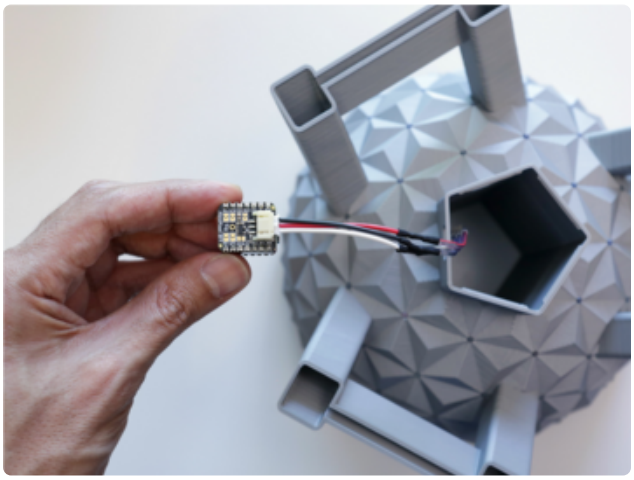


Take a moment to check all of the NeoPixel LEDs have been properly hot glued to the holes.

Install LED strip to Top Half

Start attaching the second LED strip to the top half of the sphere beginning with the first LED hot glued to the edges. Then, continue attaching in a spiral direction.



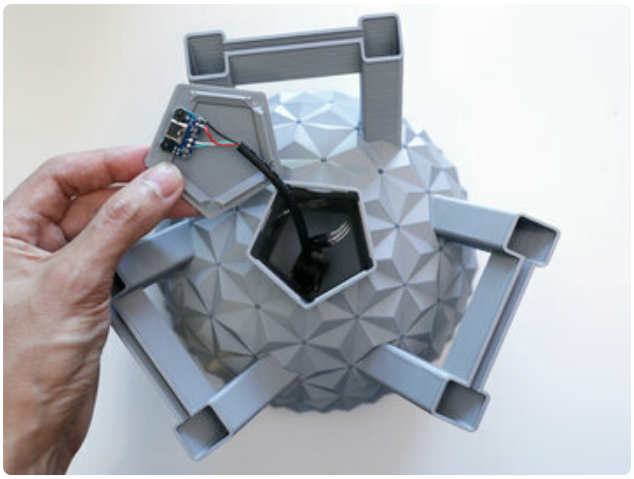


Connect Strip to BFF

Grab the 3-pin JST PH connector from the bottom LED strip and plug it into the NeoPixel BFF driver board.

Connect USB to QT Py

Grab the USB-C cable from USB-C breakout that's secured to the bottom cover and plug it into the QT Py's USB-C port.



Install QT Py & BFF

Insert the QT Py and NeoPixel BFF into the center of the bottom half.

Installed QT Py & BFF

Pull the QT Py & NeoPixel BFF driver board through the top of the center pillar. It should freely stay in place.

Install Bottom Cover

Orient the bottom cover with the center pillar of the bottom half so the USB port is aligned with the USB cut out.

Secured Bottom Cover

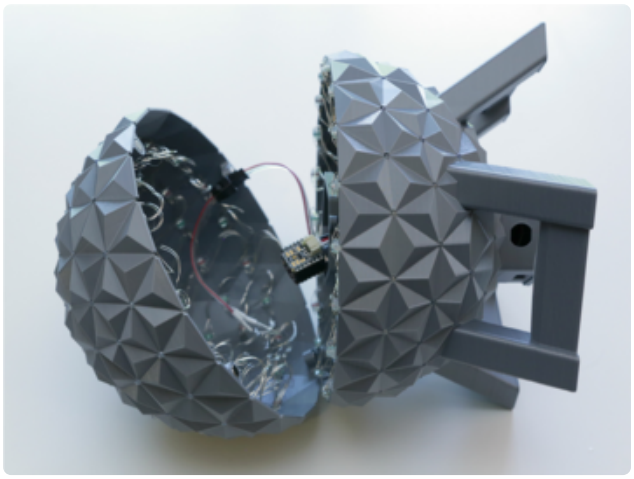
Firmly press the edges of the bottom cover so they snap fit into the center pillar of the bottom half of the sphere.

Connect Strips

Grab the 3-pin connectors from the top and bottom strips and then plug them together.

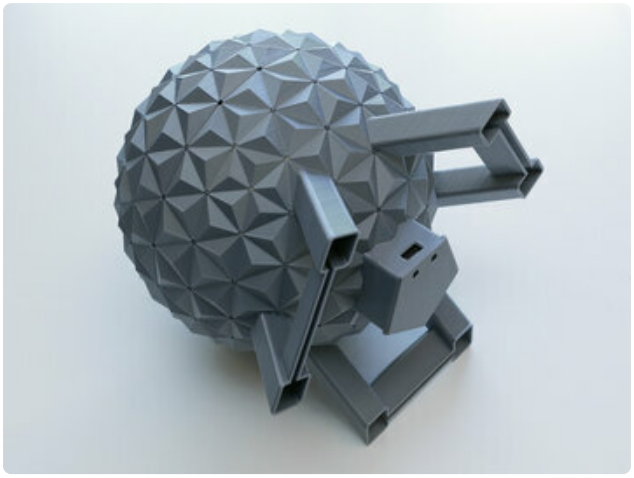
Connected Strips

Orient the two halves so the order of the strips allow the continuity of the spiral direction.



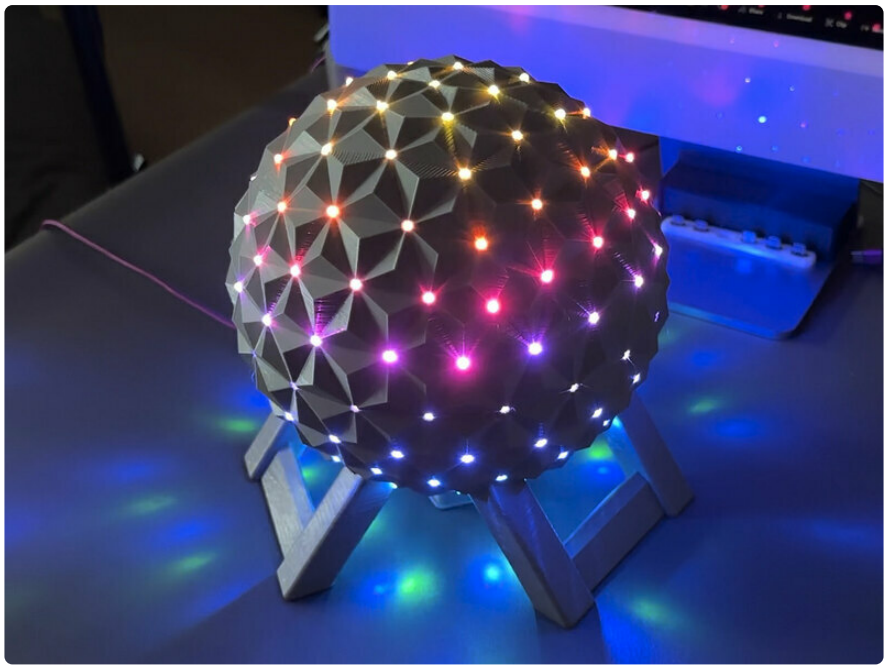
Closing Halves

Carefully join the two halves together, making sure all of the wires and connectors are fitted inside the sphere.



Closed Dome

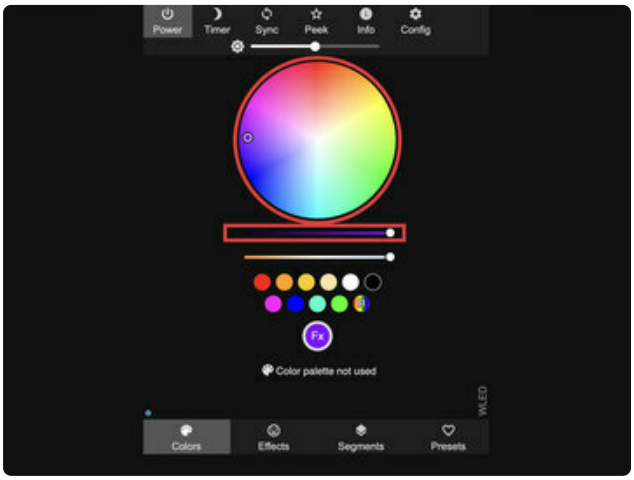
Congratulations on your build! Connect a USB-C cable to the USB-C breakout and provide power using a 5V 2A USB power supply.



Using WLED

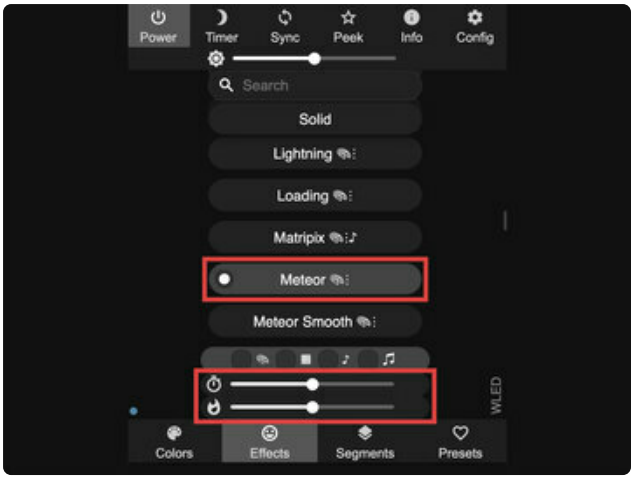
Now you can use any computer or handheld device to control your LEDs wirelessly.

Make sure your device is on the same WiFi network as your board. Navigate to your custom URL in a web browser. You'll see a color picker above a whole bunch of color palette choices.



Color Picker

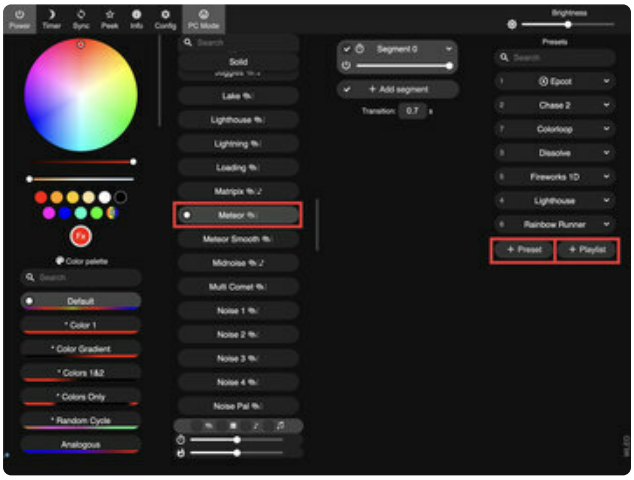
The **Color** tab allows you to pick solid colors with no effects. The gradient slider below the color wheel allows you to adjust the brightness.



Effects

The **Effects** tab allows you to click from a list of built-in animations. Scroll through the list to see more animations. Click on an effect to activate it immediately.

Each effect will have sliders to adjust parameters such as speed, size, and rate. Click and drag the slider to adjust the setting.



Presets

Presets allow you to save effects. This is a nice way to quickly trigger your favorite animations from the long list of effects.

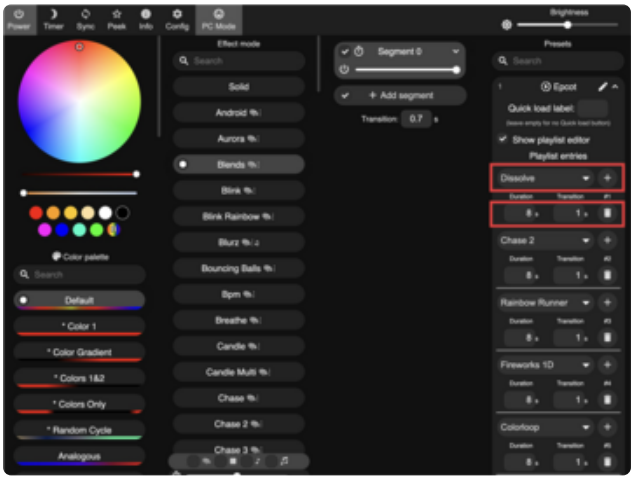
Click the **+Preset** button to add an active animation (the current effect that is running).

Your saved effects will show up in a list under the **Presets** section.

Playlists

Playlists allows you to group together animations from your saved preset.

Click the +**Playlist** button to create a playlist. Enter a title into the text box.



Click on the **dropdown** menu to select an effect from the list of presets.

Enter a desired value in the **Duration** text box to set how long to play the effect.

Enter a desired value in the **Transition** text box to set how long to blend from one effect to the next.

Click the + button next to the effect title to add another preset.

Click the **save** button when finished setting up your playlist.

Click on the Playlist Bubble to activate and playback the playlist.