



ENERGY PEAK SHAYER

Seamless backup power. With or without solar.

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Complete Plans, Instructions, Parts List & 3D Drawings

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Introduction:

Energy Peak Shaver is a home battery that stores energy so you can use it on demand and self-power your home to reduce your reliance on grid electricity. In the event of a grid outage, Energy Peak Shaver automatically provides backup power or easily integrates with solar to ensure your home is powered 24/7. With Energy Peak Shaver, you are assured of energy and clean energy lifestyle.

The benefits of The Energy Peak Shaver:

Energy Peak Shaver allows you to store 0.88 kWz of energy but you can scale it so you can store much power and use that energy to run your home during the night and back up your home in the event of a power outage. Energy Peak Shaver is compact, safe and includes a battery inverter, which provides easier integration.

Self-Powered Home

Use the Energy Peak Shaver to reduce reliance on the grid and run your home day and night.

Backup Power

Protect your home from a power outage with seamless and reliable backup power.

Energy Savings

Reduce your electric bill, if your utility offers a time-of-use rate plan.

Self-Power Your Home With The Energy Peak Shaver:

A self-powered home is one that runs off Energy Peak Shaver, which gives you the ability to own your energy and reduce your reliance on the grid. With Energy Peak Shaver you can use more of your excess energy and using it at night, which roughly doubles the amount of energy that directly powers your home.

Tools:

Angle Nose Plier



Screwdriver



Bent Nose Plier



Plier



Soldering Station/Soldering Gun



Digital Multimeter



Rosin Core Solder



Electric Screwdriver



Screwdriver Bit and Ratchet Set



Caliper



Tweezer





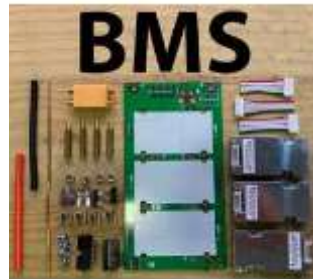
Drill










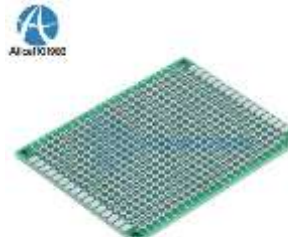
Drill Bits



Master List Of Materials:

Nr. Crt.	Description	Qty/Unit	Vendor	Images
1	Box Enclosure 800mm x 600mm x 260mm	1	eBay LINK	
2	Basic PCB Kit	20	Kit LINK	
3	BMS Module Complete Kit	1	Kit LINK	

4	Battery Capacity Voltage Checker Tester	1	eBay LINK	
5	AC 110V-220V TO DC 5V 12V 24V Switch Power Supply Driver Adapter LED Strip Light	1	eBay LINK	
6	1200W 20A DC Converter Boost Car Step-up Power Supply Module 8-60V to 12-83V	1	EBay LINK	
7	4 Four Channel Relay Module DC 5V + Optocoupler For Arduino PIC ARM AVR DSP	1	eBay LINK	

8	40PCS Dupont Wire Jumper Cable 2.54mm 1P-1P Male to Female 10CM/20CM/30CM (chose 10CM Female to Female)	1	eBay LINK	
9	WEMOS D1 ESP8266 WIFI Mini Pro 16M Connector IoT Board 2.4G SMA External Antenna	1	eBay LINK	
10	DC-DC / 3A adjustable buck module LM2596 regulated 24V to 12V 5V 3V	1	eBay LINK	
11	Double Side Prototype PCB Tinned Universal Breadboard 5x7 cm 50mmx70mm FR4	1	eBay LINK	

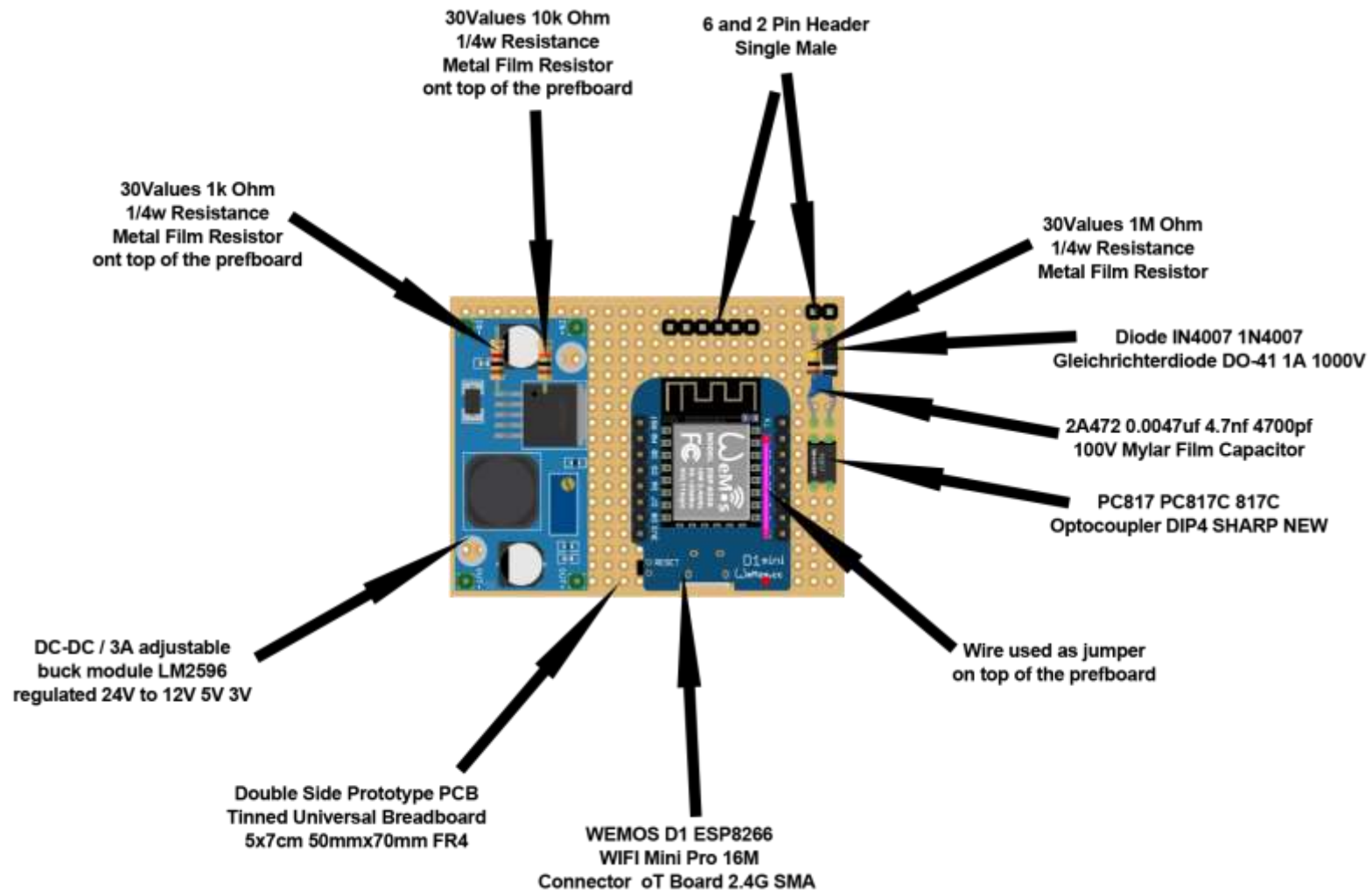
12	30Values 10-1M Ohm 1/4w Resistance 1% Metal Film Resistor Assortment Kit	1	eBay LINK	
13	Diode IN4007 1N4007 Gleichrichterdioden DO-41 1A 1000V	1	eBay LINK	
14	2A472 0.0047uf 4.7nf 4700pf 100V Mylar Film Capacitor	1	eBay LINK	
15	PC817 PC817C 817C Optocoupler DIP4 SHARP NEW	1	eBay LINK	

16	APC SC1500 TOWER POWER SUPPLY TOWER 1500VA 120V 865W	1	eBay LINK	
17	Lot of Battery Laptop	-	Search eBay Alibaba or Aliexpress	
18	16 Pin Flat IDC Cable Extension DuPont Wire&1.27mm Line Pitch Wires Connect	5	eBay LINK	
19	XT60 Male+ Female Bullet Connectors Plugs for RC Lipo Battery	10	eBay LINK	

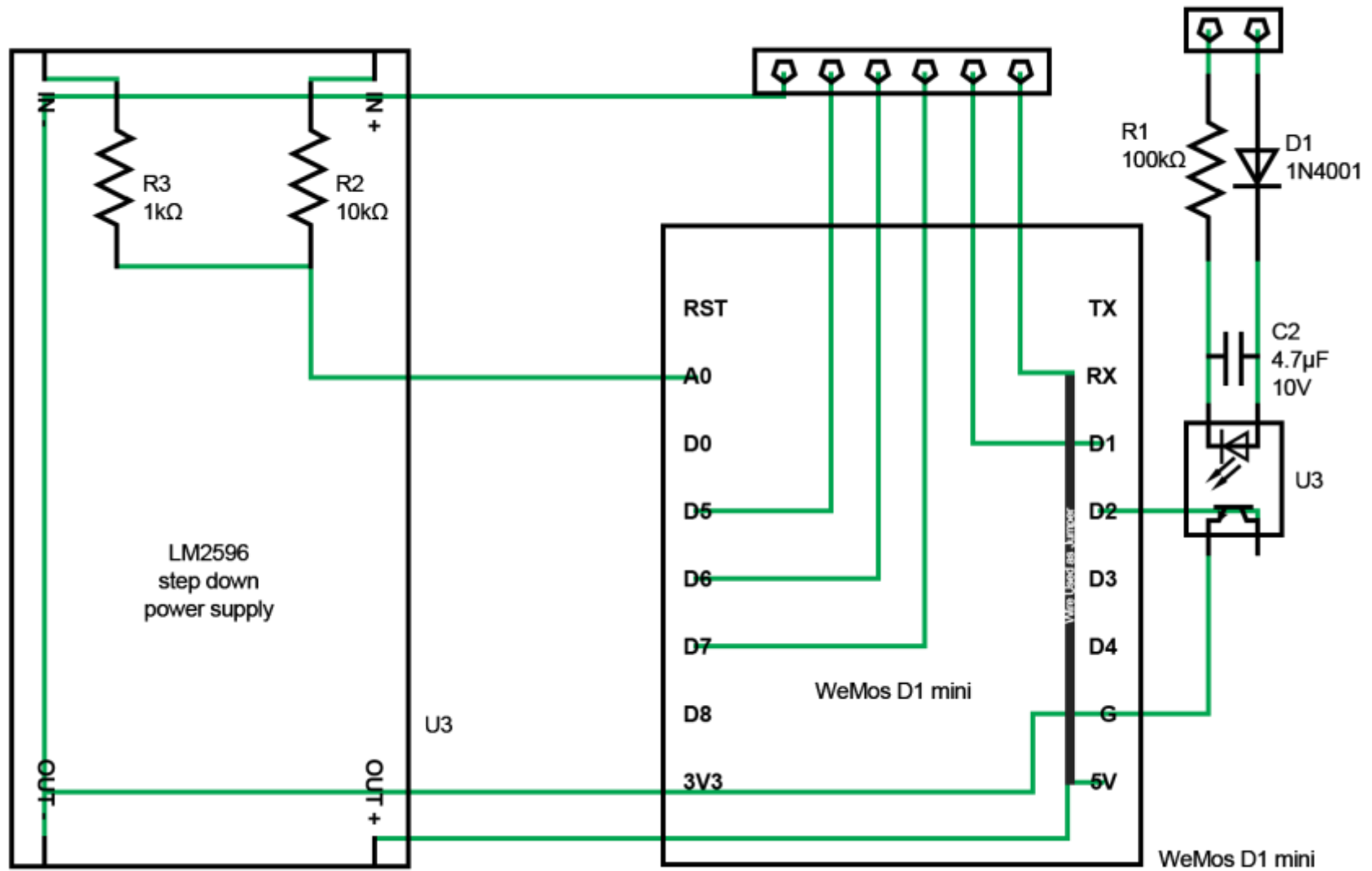
20	XT90 Female Male Banana Bullet Connector Plug For RC LiPo Battery Plug	1	eBay LINK	
21	Power Extension Cable Kettle Male to Female UPS Monitor, PC Lead C13 - C14	1	eBay LINK	
22	JST 2Pin Connector Male/Female Plug Cable 10cm Wire For Battery LED Lights	1	eBay LINK	

ESP Module Drawing and Diagram:

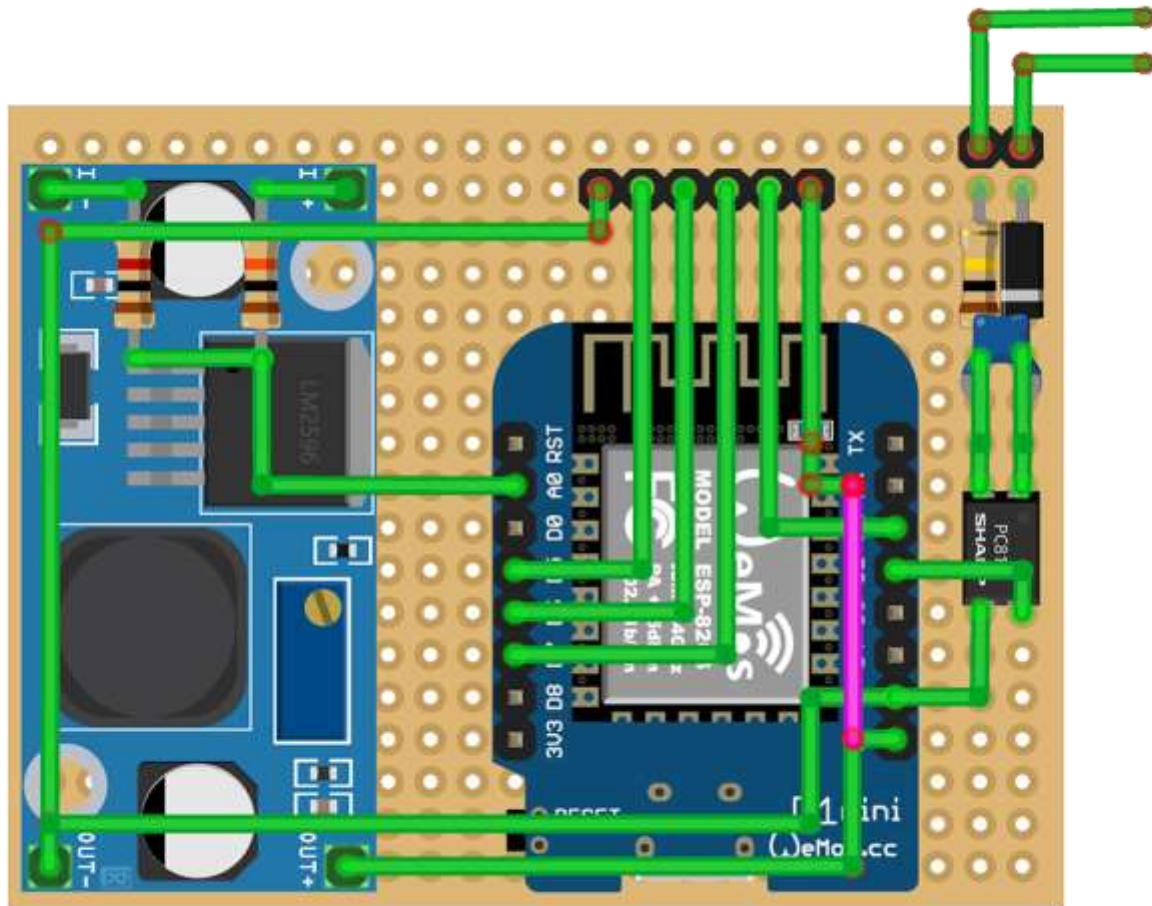
The position of the parts related to the Prefboard:



ESP module diagram:

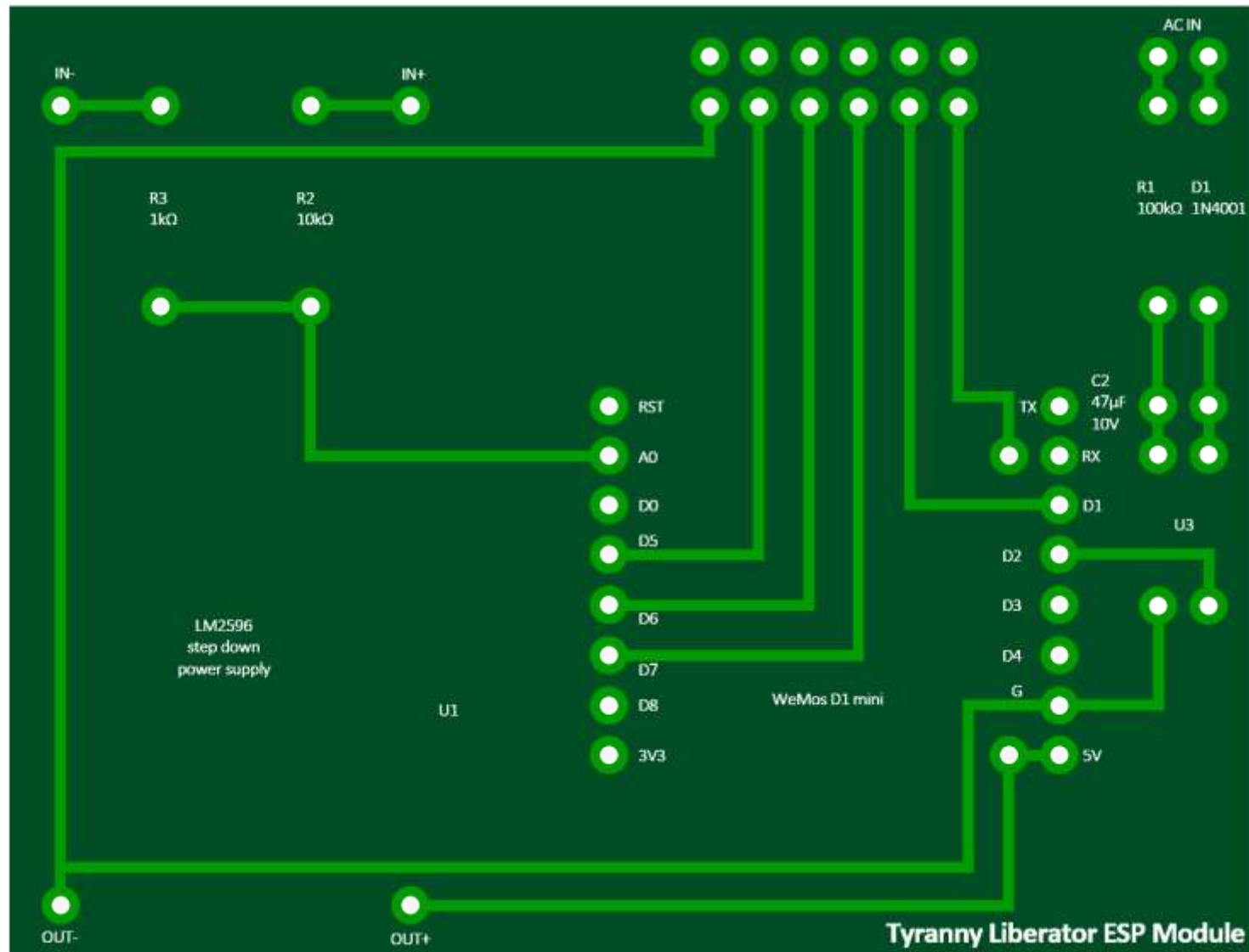


ESP module diagram with the pieces on perfboard:

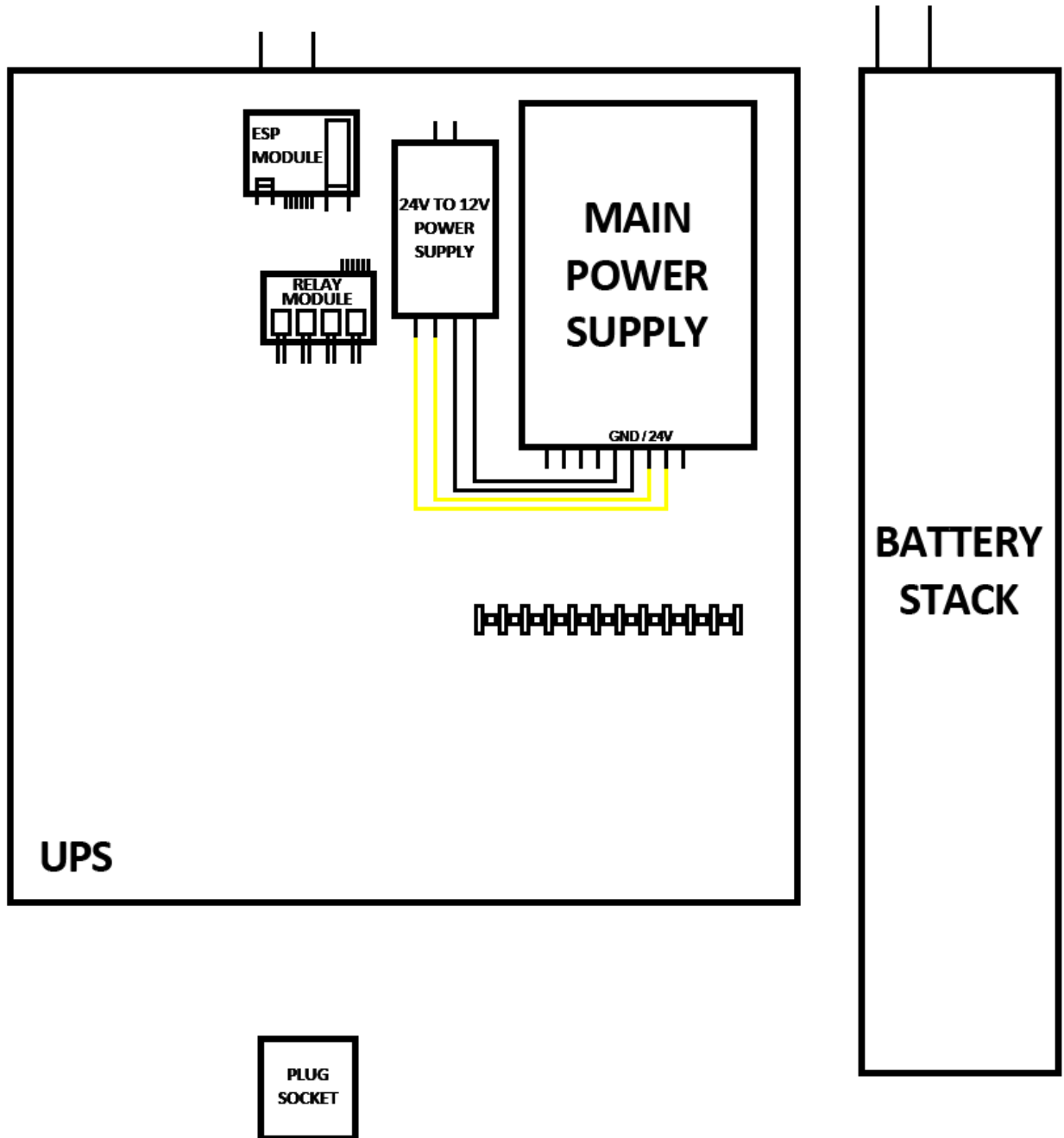


The R2 10k Ω and the R3 1k Ω are on the bottom of the perfboard. Also the wire jumper is under the WeMos D1 mini.

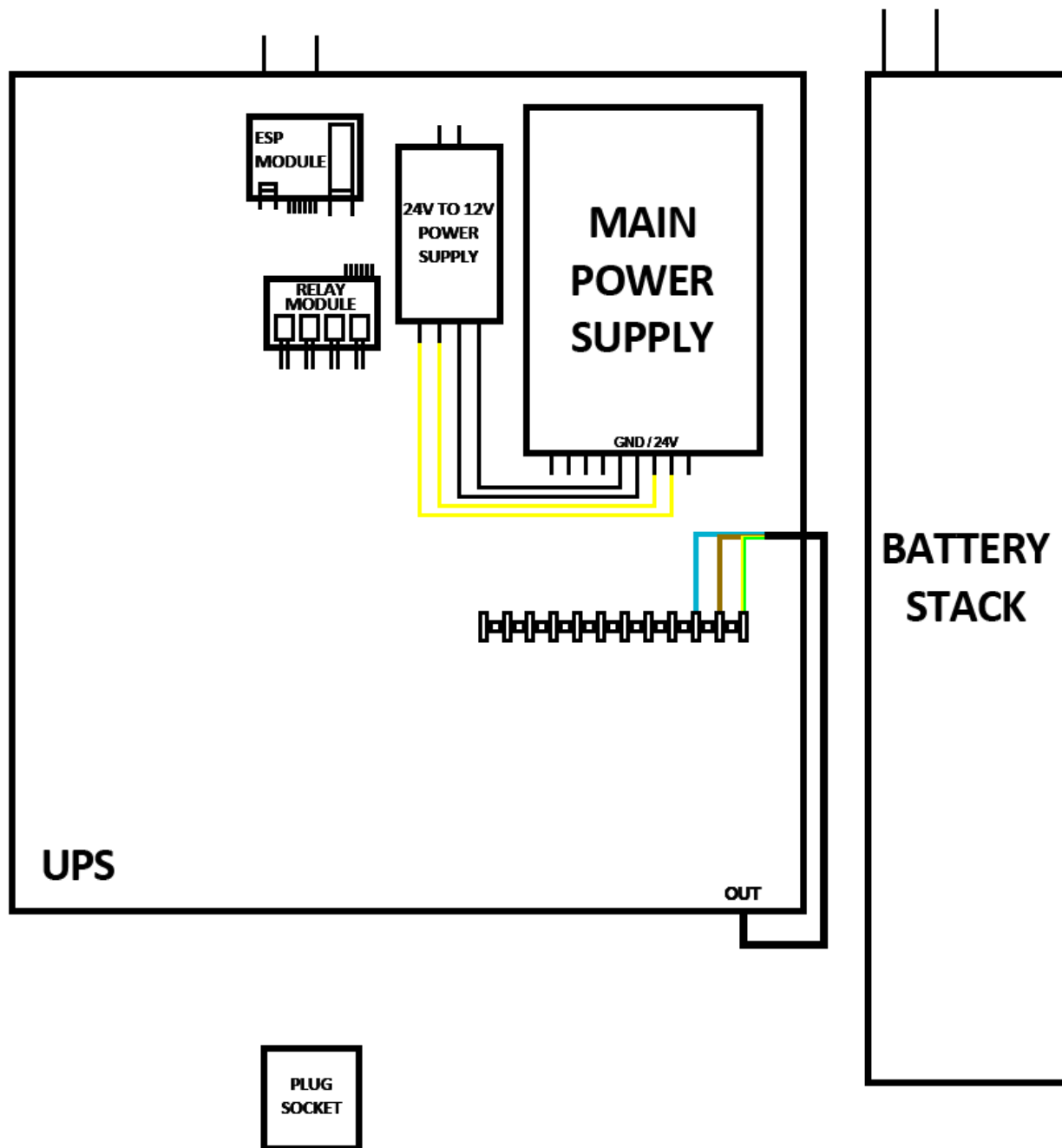
ESP Module PCB design:



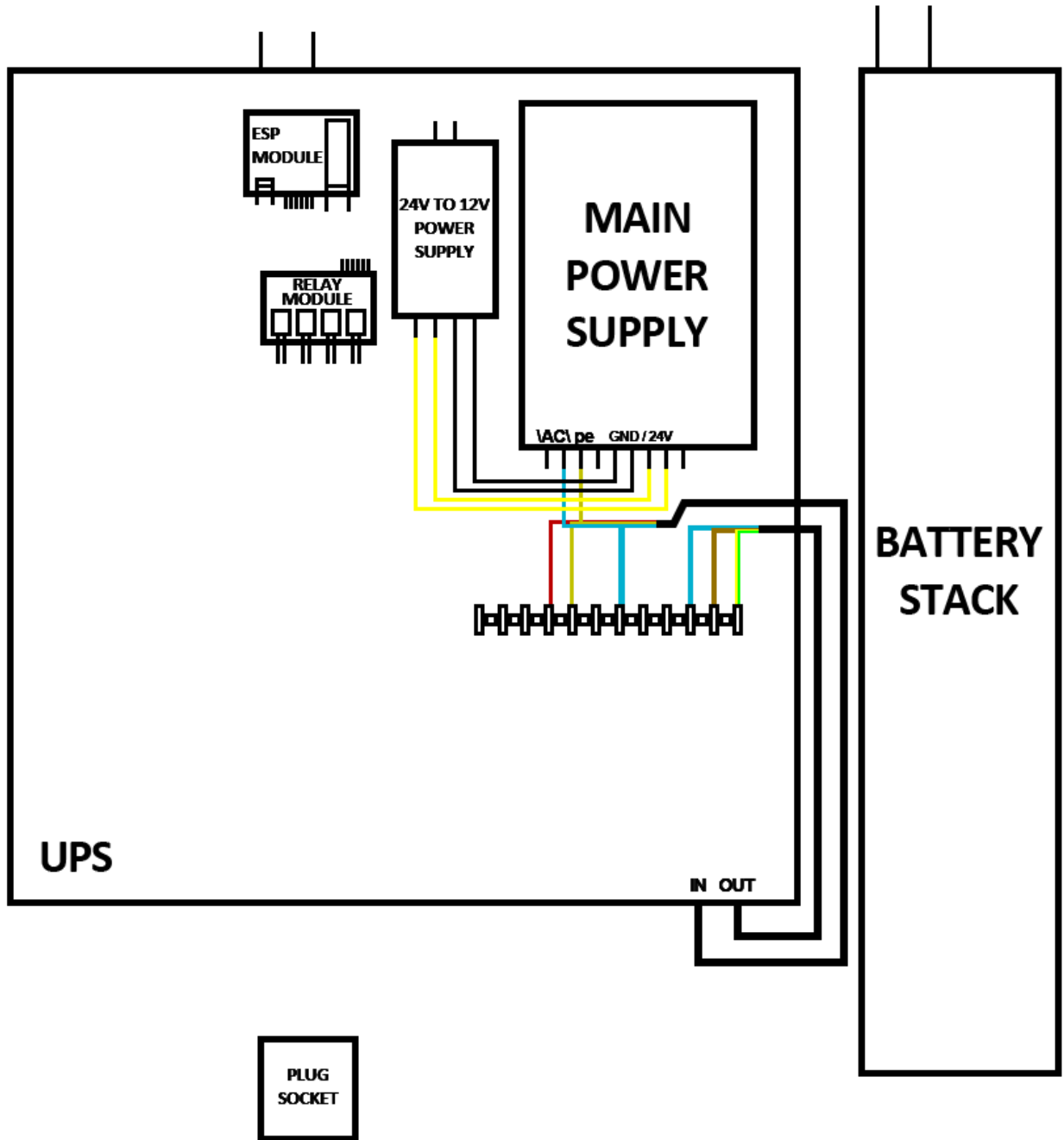
Power Wall Cable Connections:



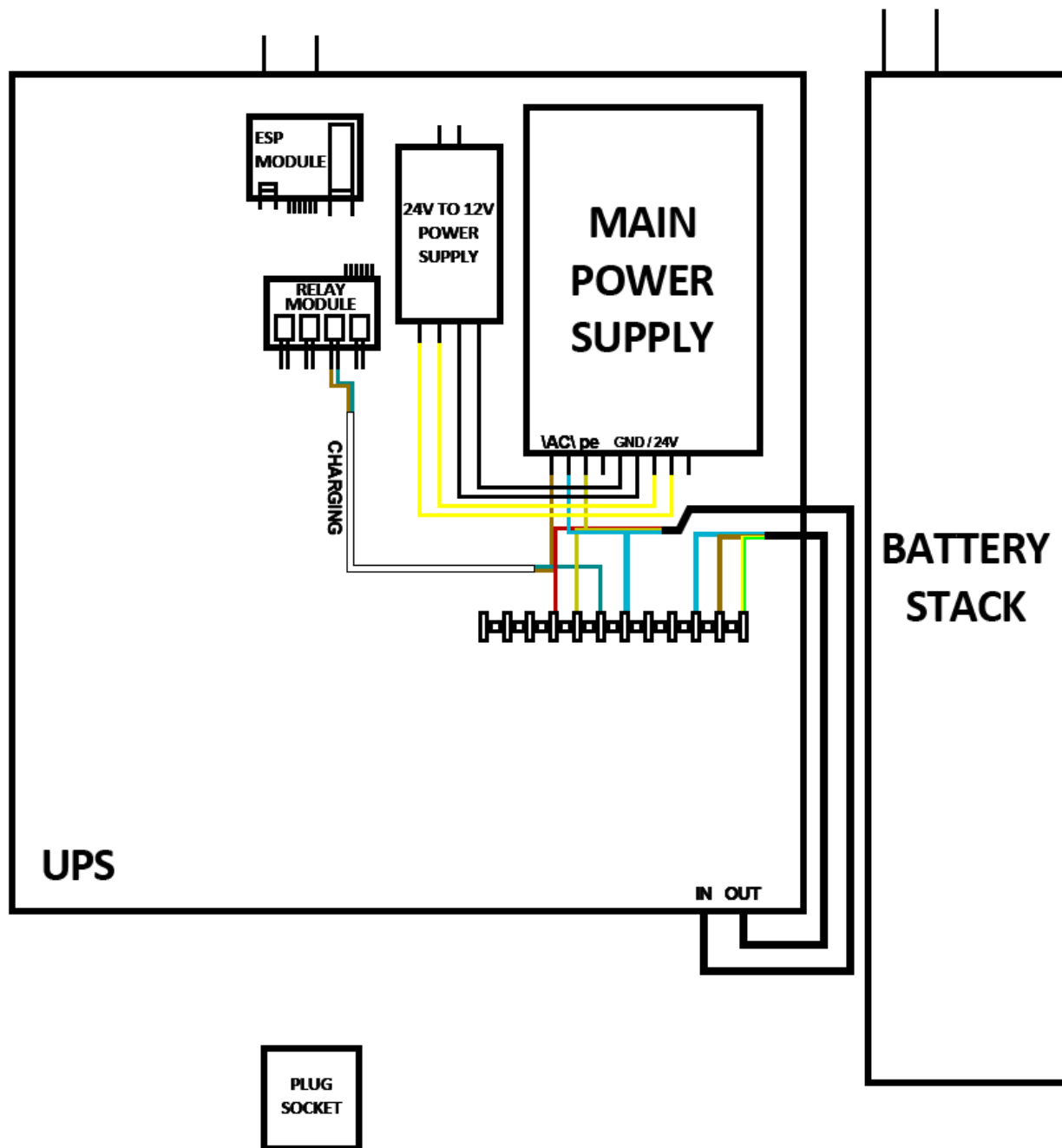
Step 1



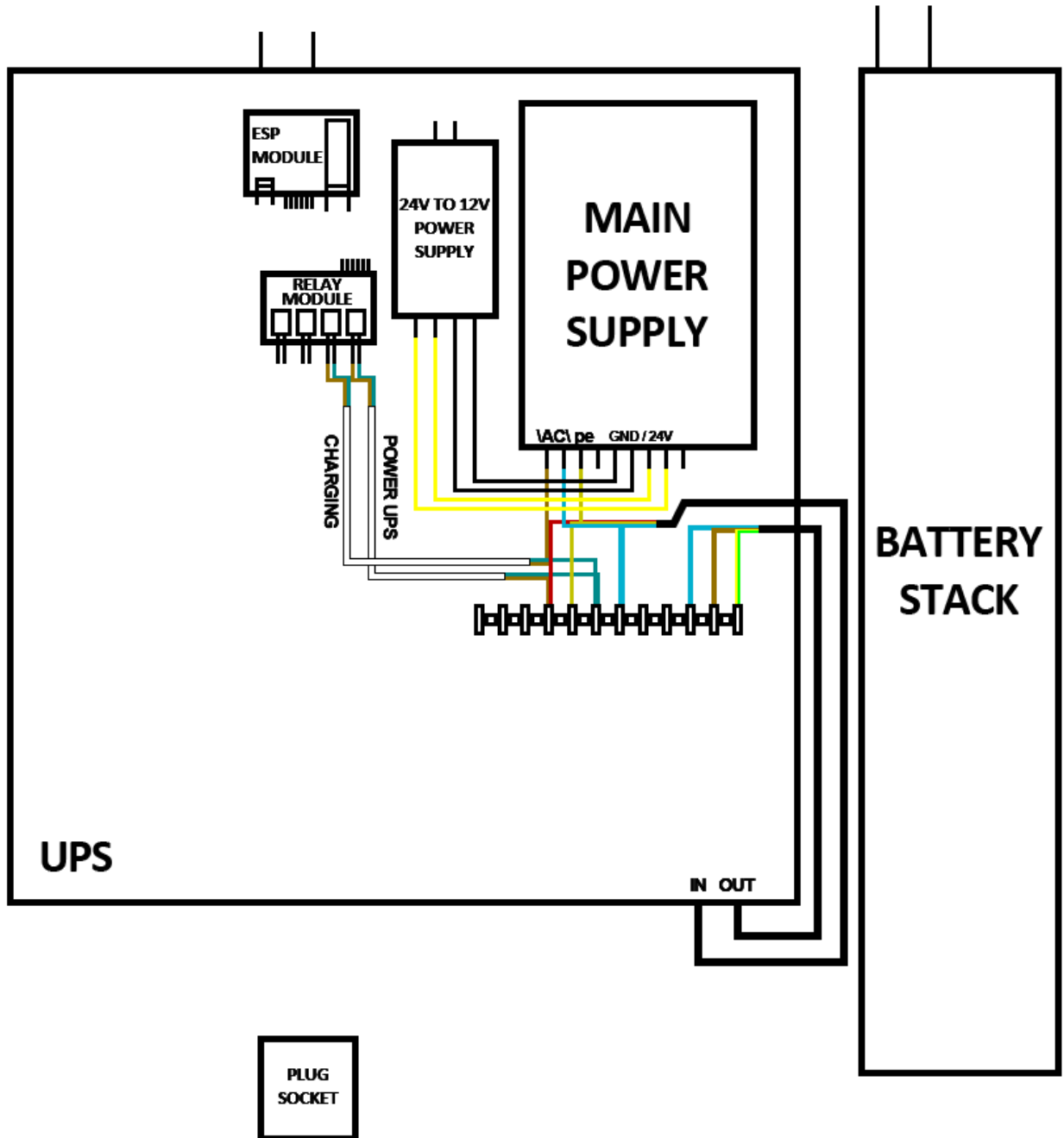
Step 2



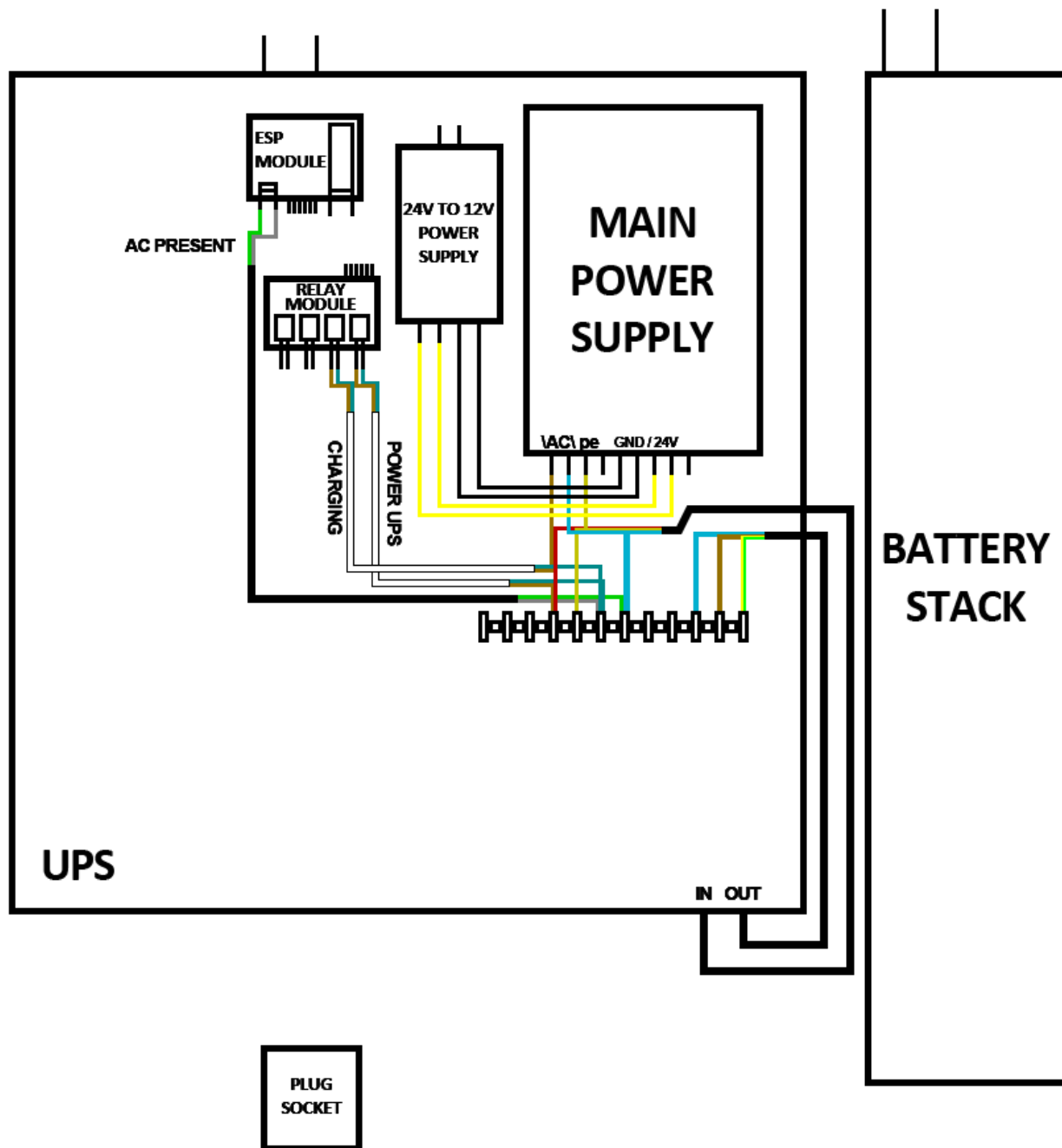
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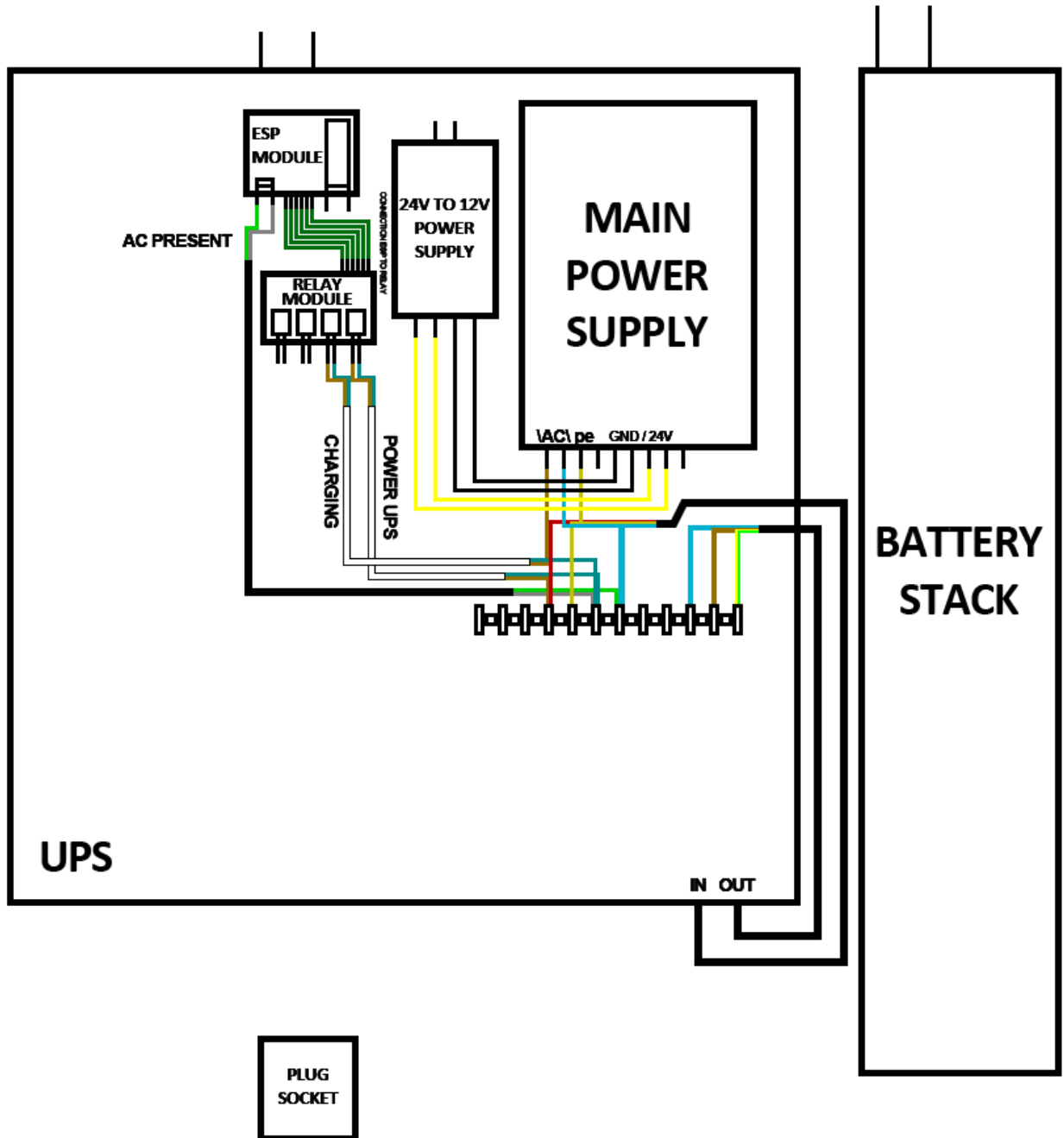
Step 4



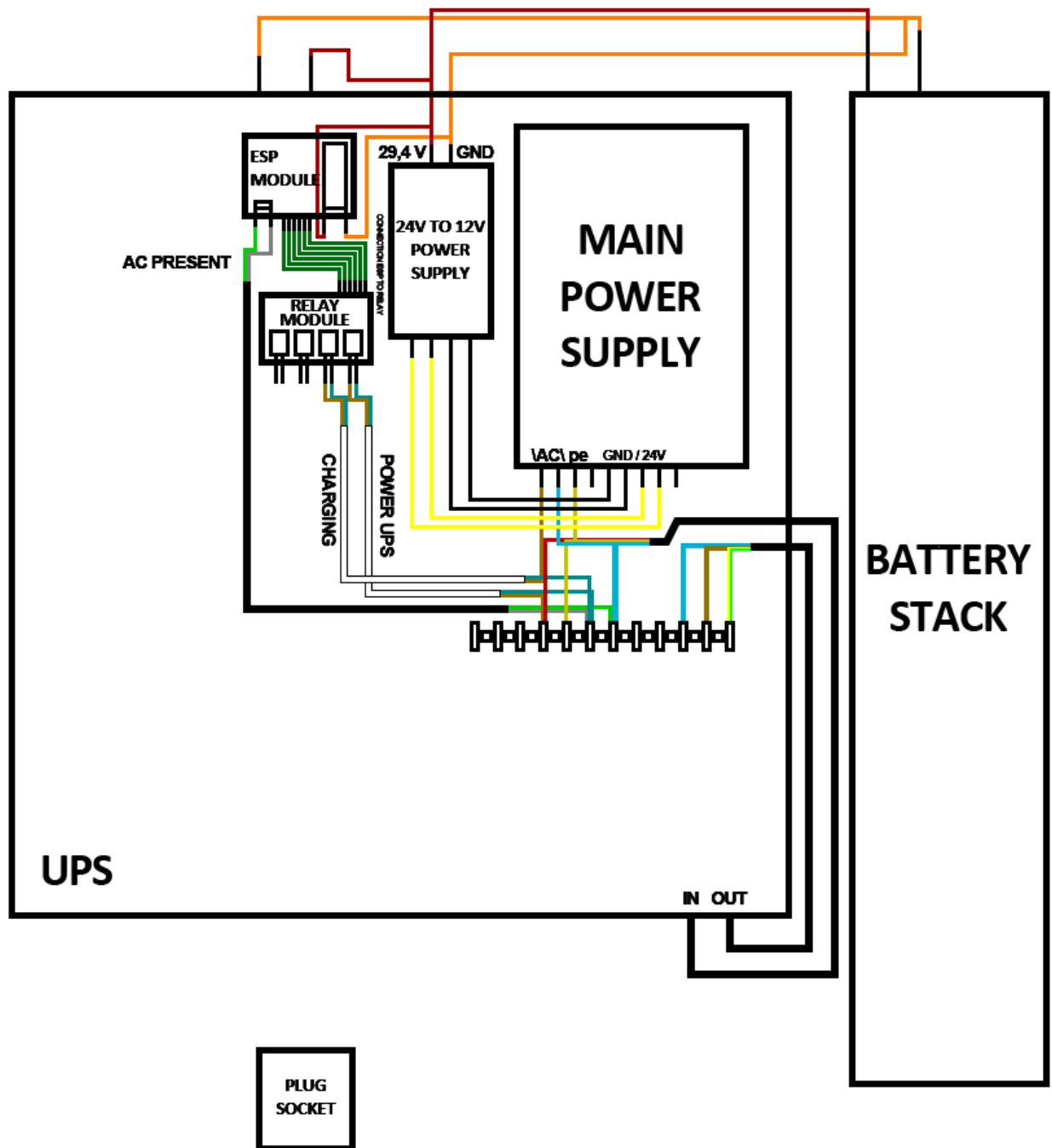
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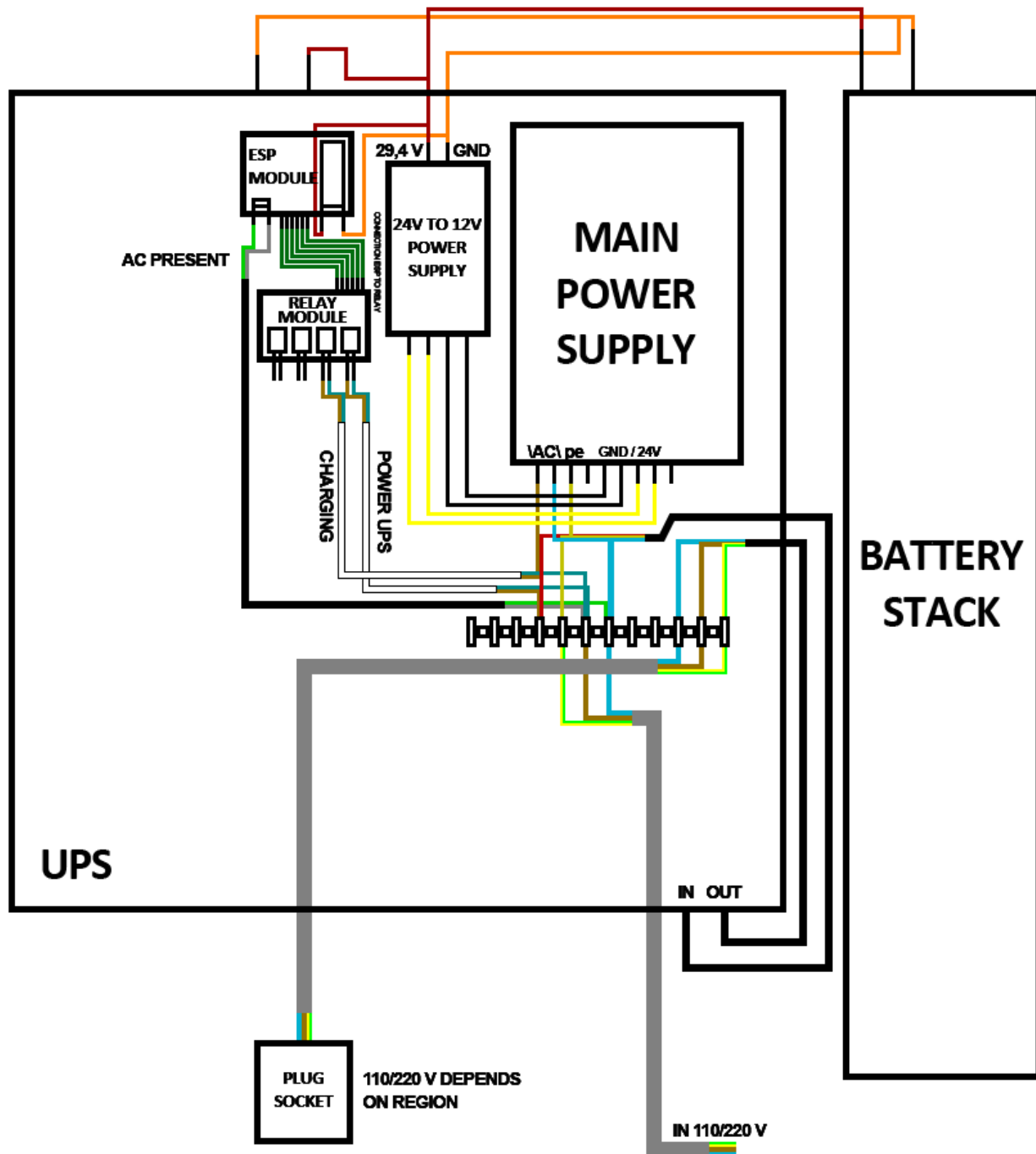
Step 6



Step 7

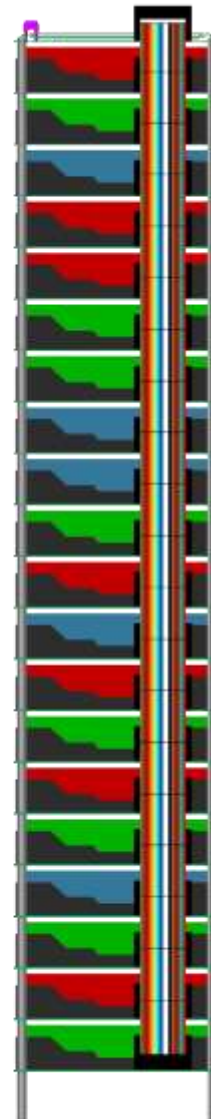
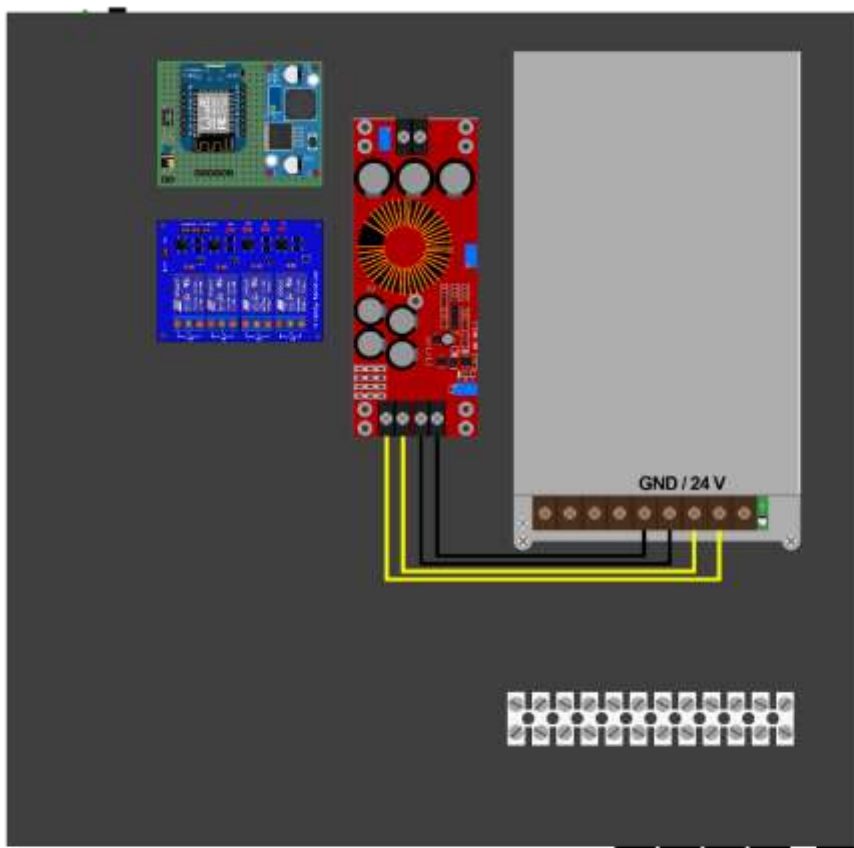


Step 8

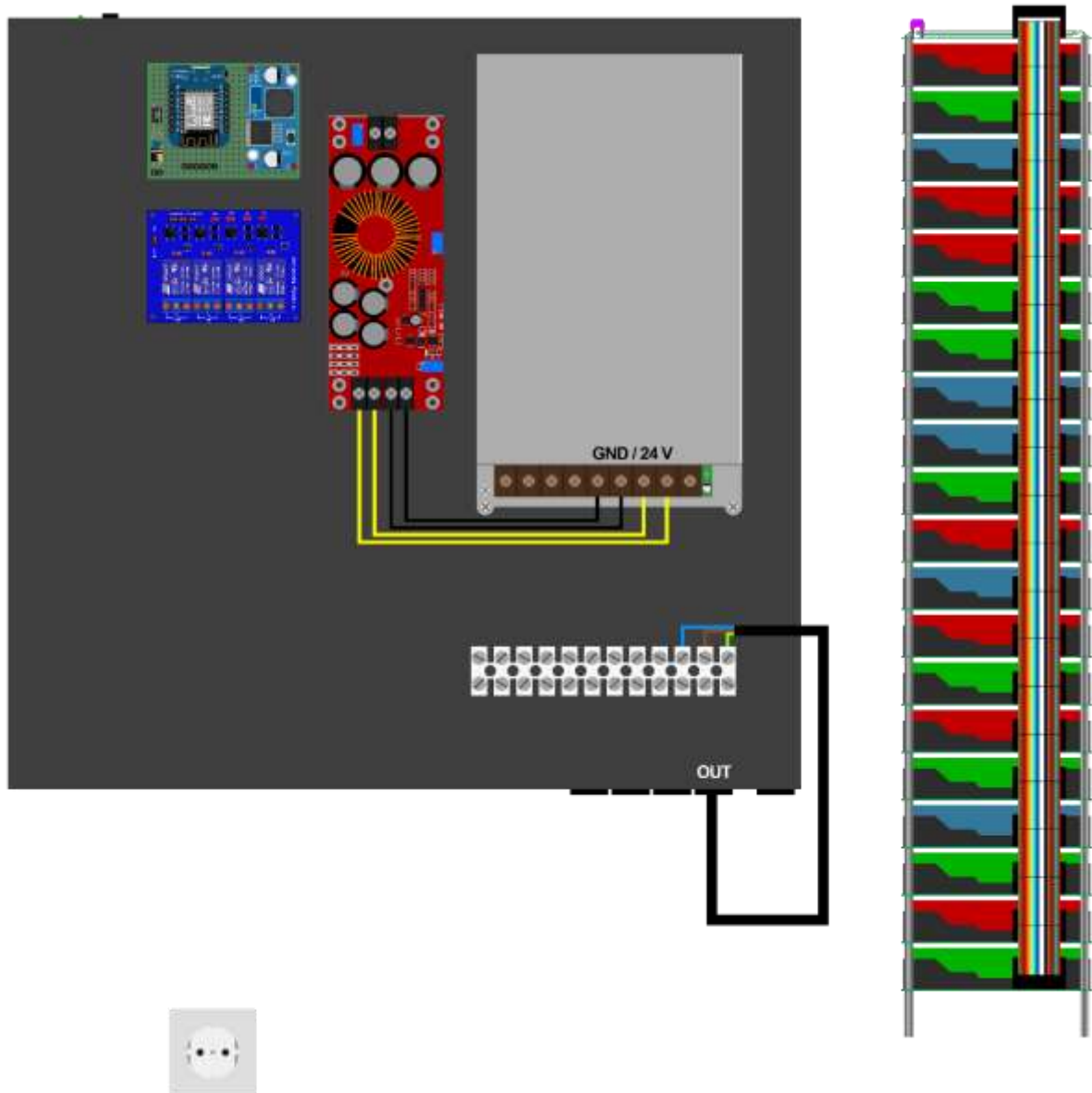


Step 10

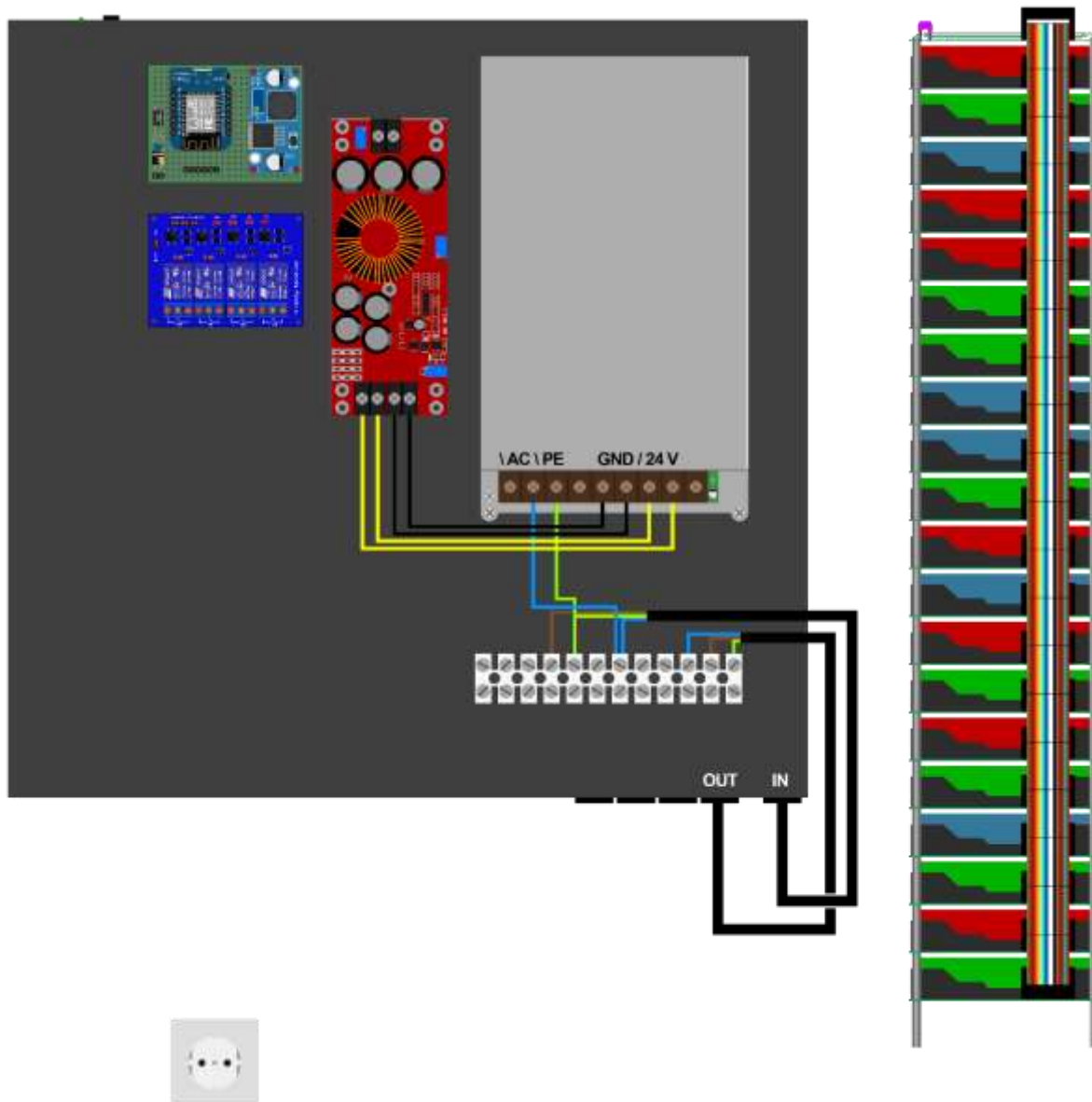
Cable Connections in Drawings



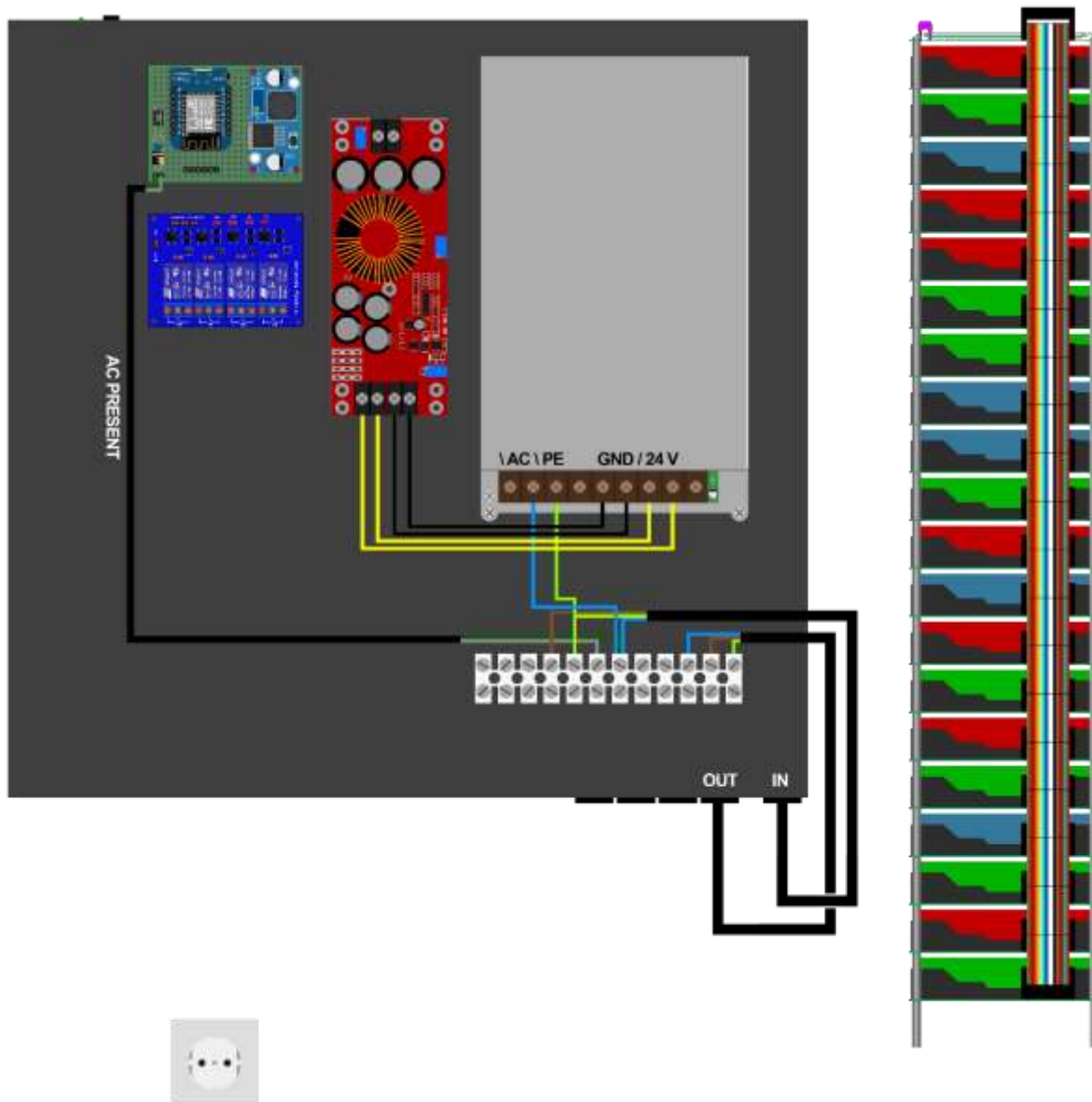
Step 1



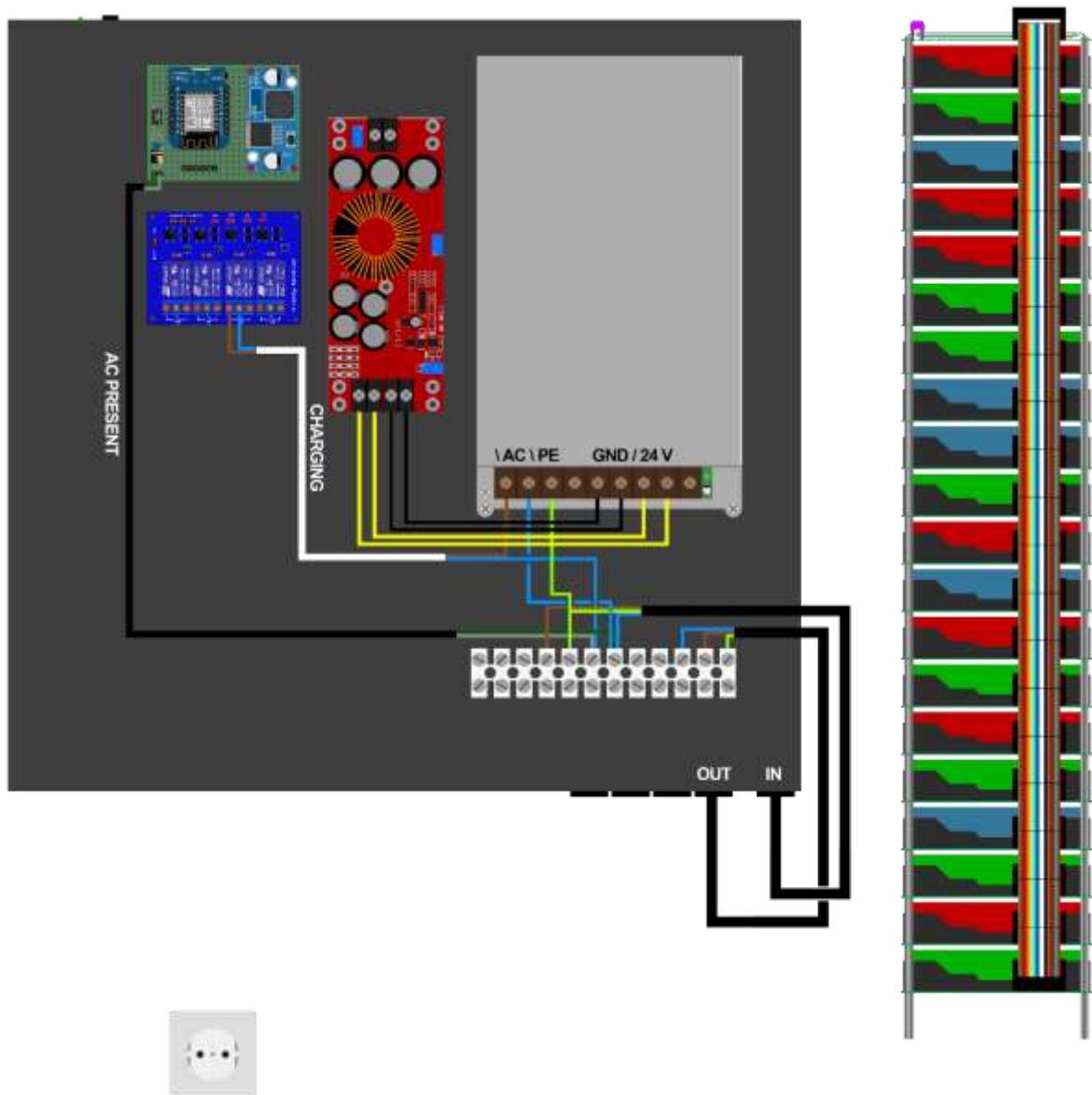
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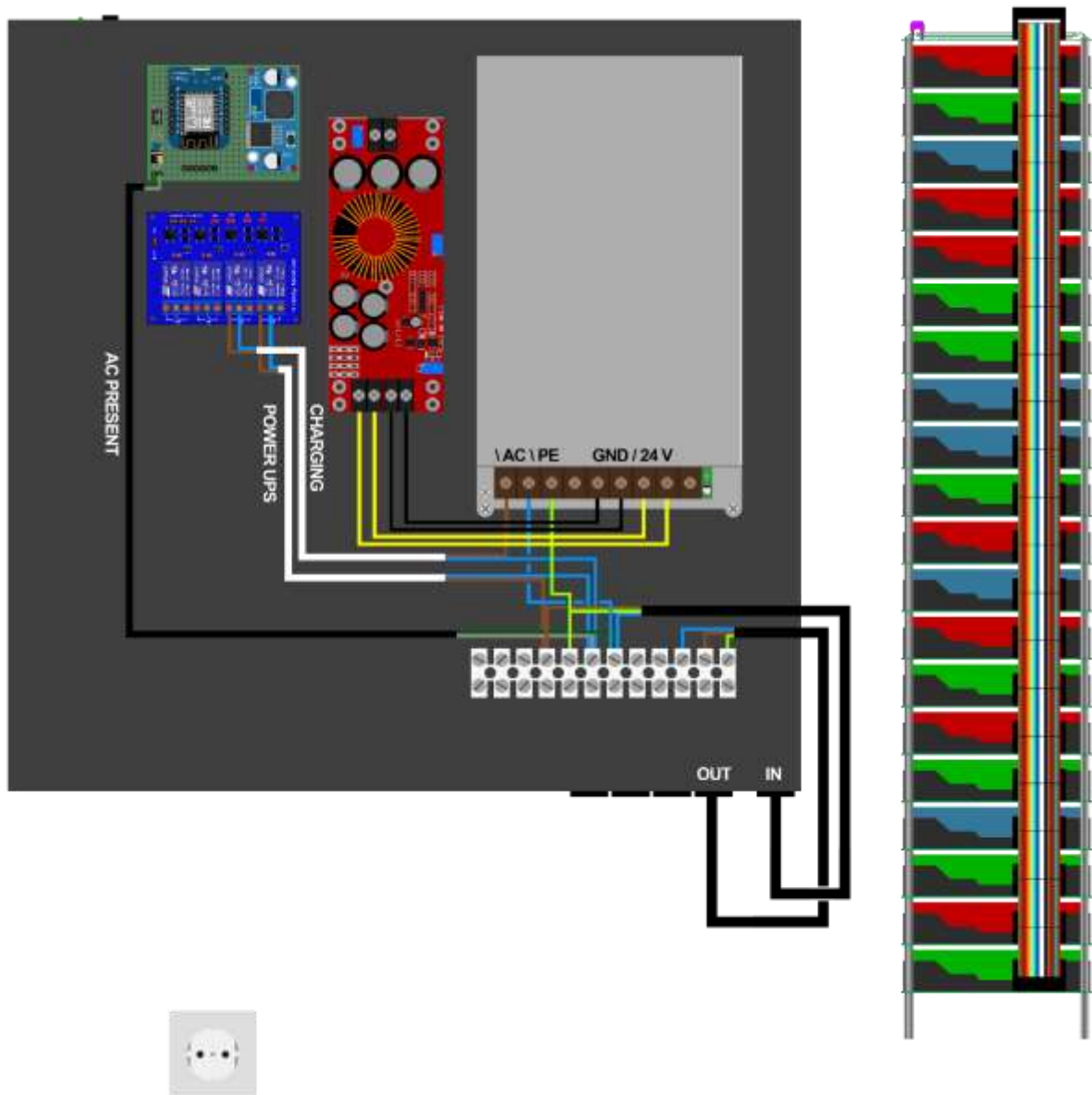
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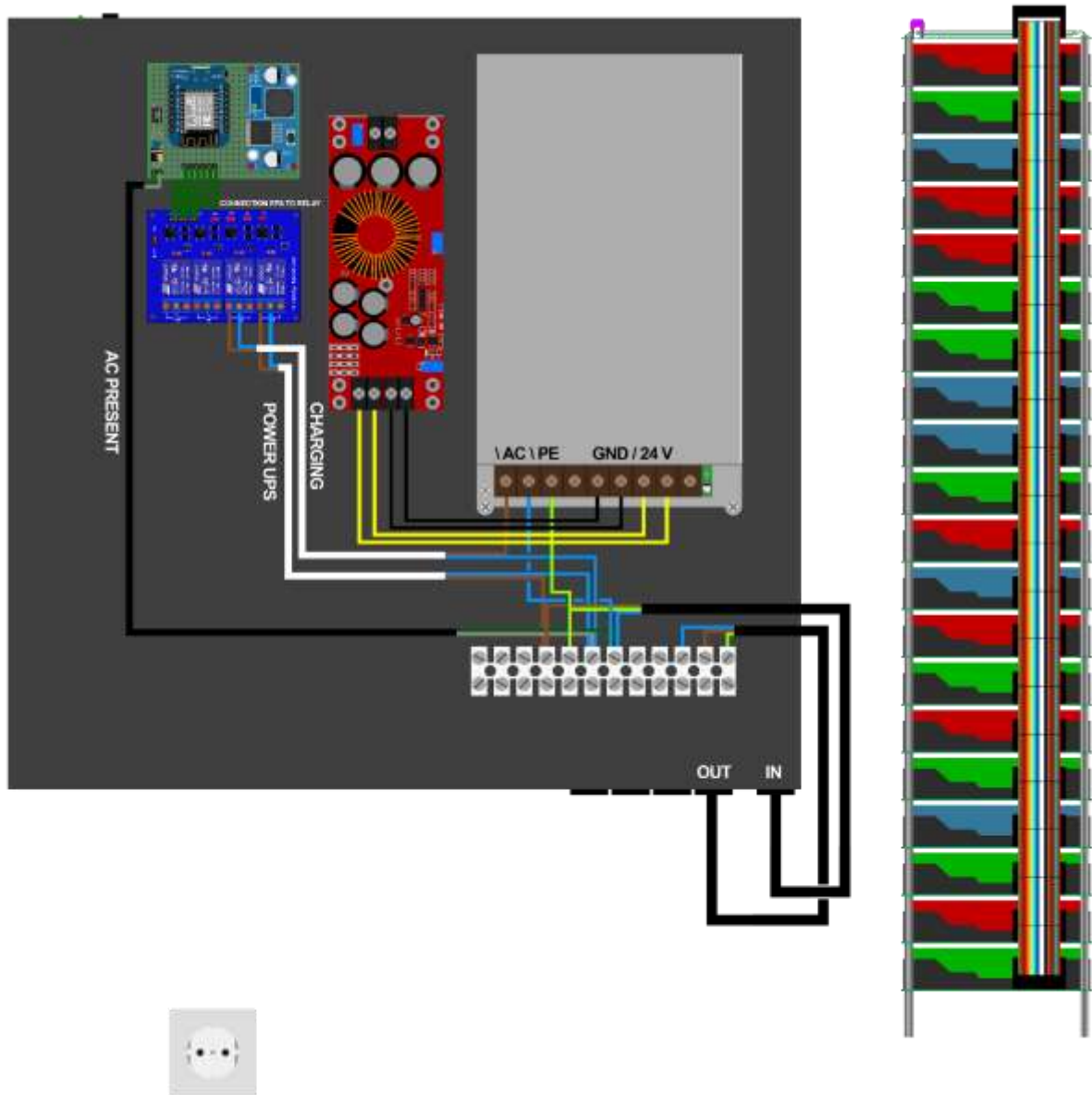
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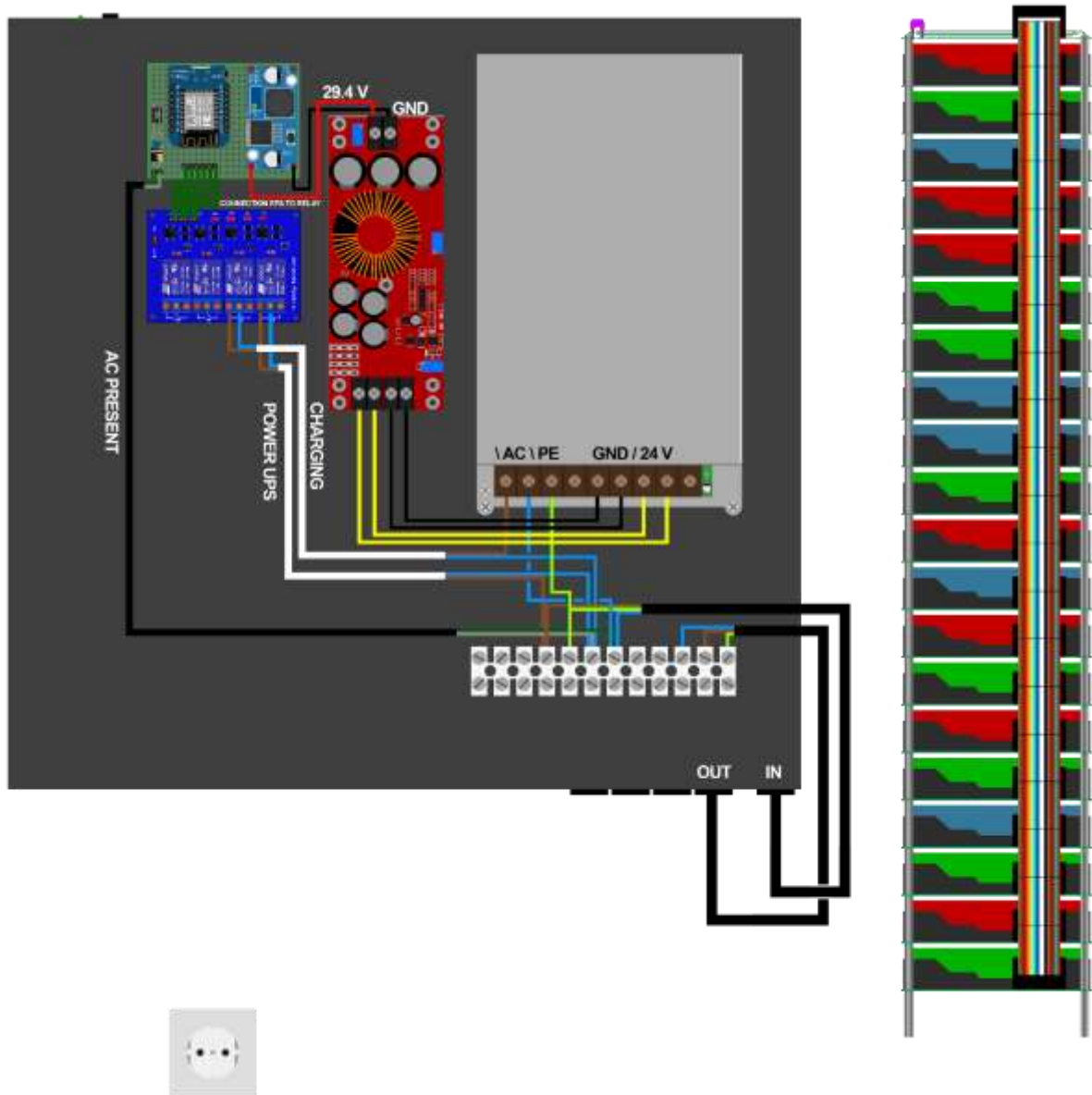
Step 5



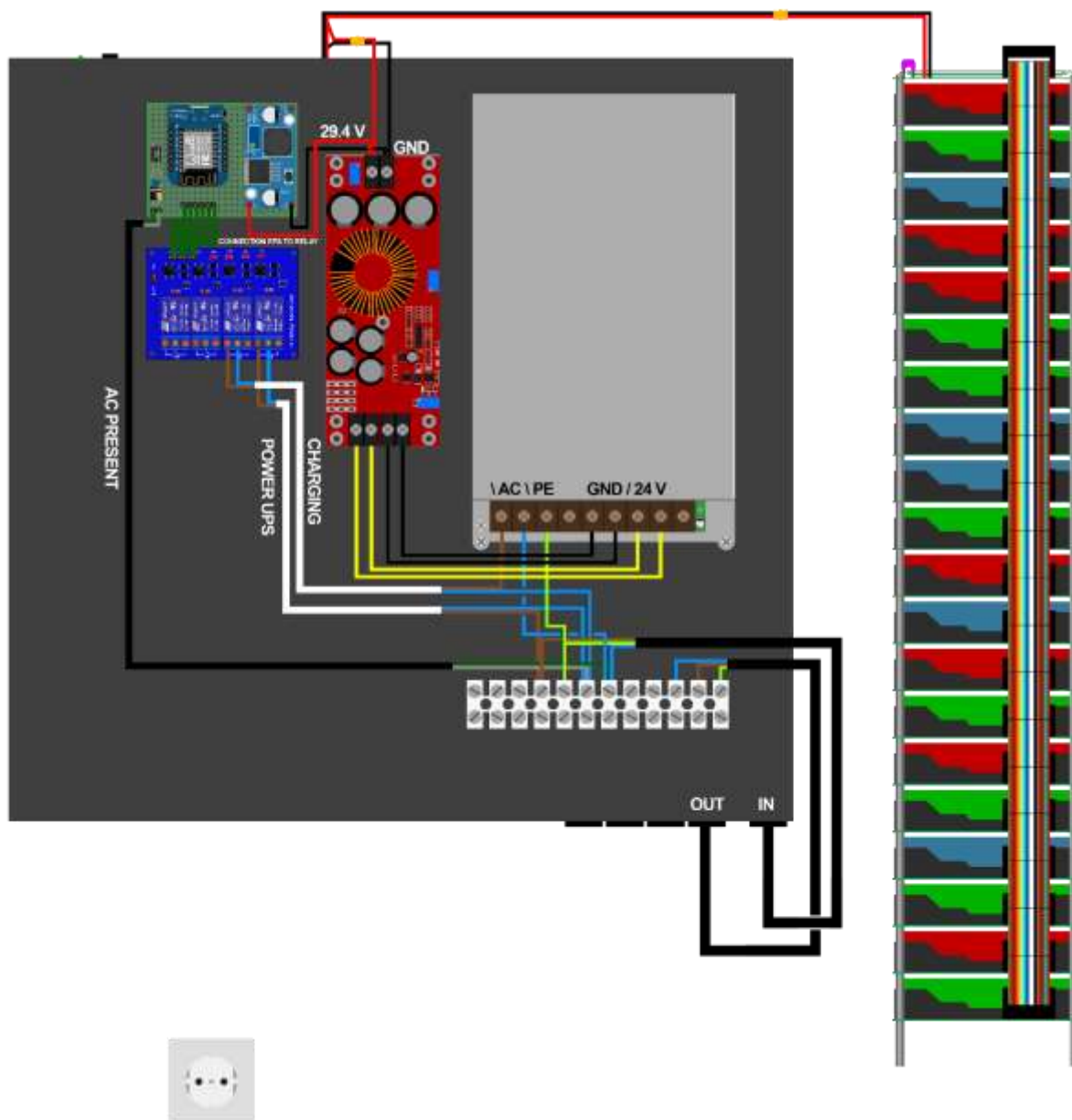
Step 6



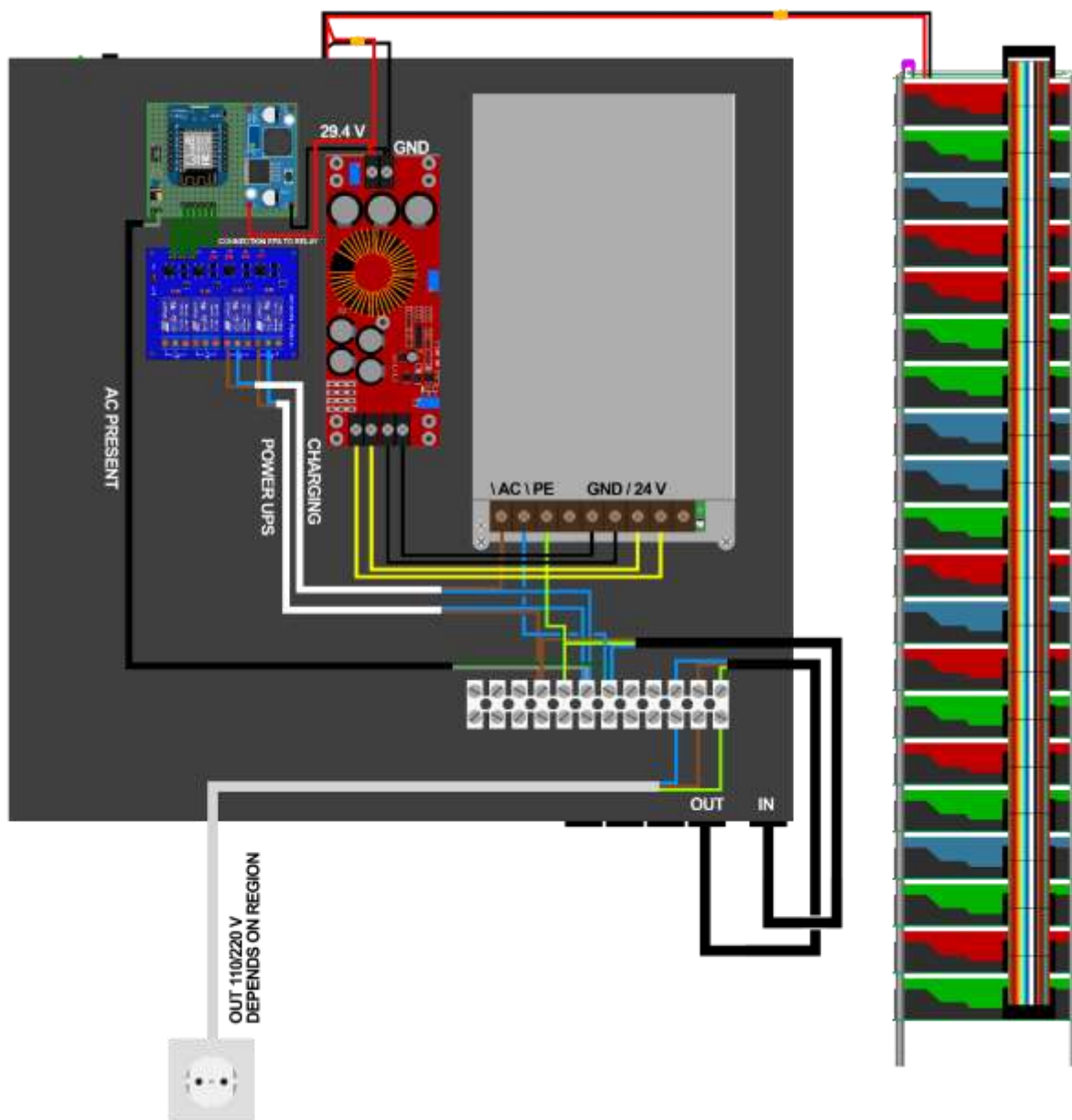
Step 7



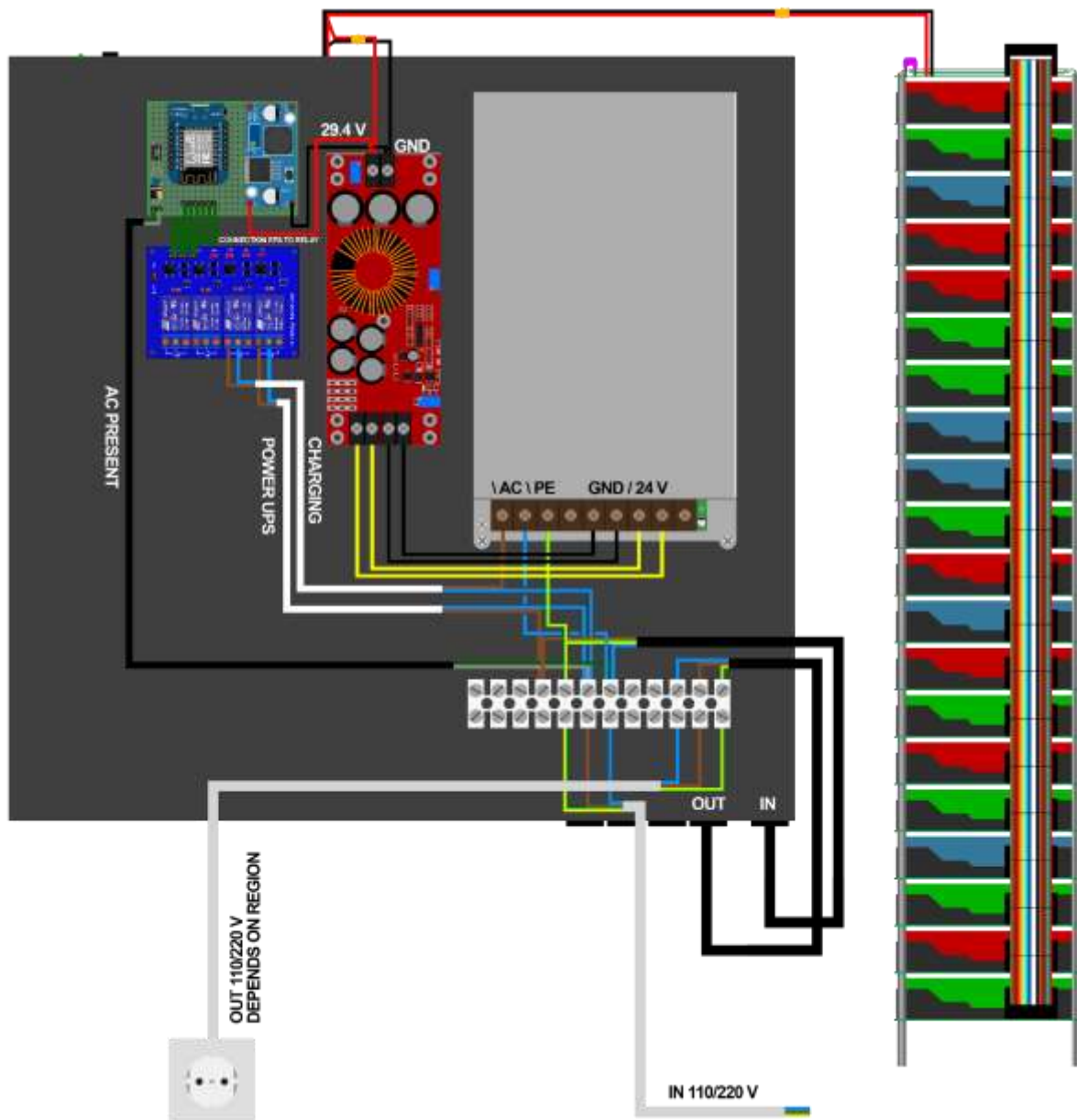
Step 8



Step 10



Step 11



Step 12

Sorting The Cells:

We have used 2 methods to sort the cells. Use the method you think suits for you.

Using the Opus Charger:



Easy-to-read LCD with backlight display makes it show more clearly in the dark.

Refresh mode can show you batteries capacity, letting you know real magnitude.



Quick test mode to test to test the battery impedance

There are also charge/discharge modes



When the display is flashing it is possible to select mode and current.



Using the SLOT button it is possible to reselect a slot and change parameters for it, also when the charger is working.

When putting multiple batteries in the charger at the same time, it is possible to select mode and current simultaneous for all of them.

When charging or discharging it is possible to use the DISPLAY button to select between V, mA, and mAh.

The DISPLAY button can also be used when the charge/discharge is finished, but the charger will change back to FULL display rather quickly.



I use an excel spreadsheet to write the values of each cell to use later with an online calculator called repackr.com.

Type in the address bar of your browser repackr.com

After this insert the excel spreadsheet in the cells section on the page.

rePack

Thank you for all your feedback! Development has now started on rePack v2.0 and I need Alpha users to help shape the functionality. Sign up
Chris Bird @chrishbird

Pack your recycled 18650 Li-ion cells into optimal packs for your bike, power wall or other 18650 projects.

You'll need to specify how many cells in series before you can generate a pack.

You'll need to specify how many cells in parallel before you can generate a pack.

Cells

Comma seperated list of cell capacities in mAh to be added to the packs

1833.57, 1980.12, 2107.16, 1977.98, 1626.36, 1984.12, 2074.02, 2043.63, 1987.82, 1986.23, 1976.54, 2116.78, 1944.88, 2026.04, 1907.36, 1879.76, 1867.34, 1766.39, 1886.37, 2033.09, 2007.36, 1908.65, 1864.74, 2034.94, 1912.09, 2086.91, 2187.81, 2709.62, 2018.67, 2027.73, 1980.54, 1960.97, 2132.52, 2016.76, 1651.64, 2166.76, 2225.2, 2137.3, 2067.38, 2162.55, 2236.95, 1647.03, 1570.1, 1832.36, 2152.82, 2054.67, 2001.66, 2039.96, 1969.3, 1948.8, 2125.43, 2119.78, 2026.82, 2115.45, 2129.16, 2056.75, 1581.88, 1518.48, 1746.59, 2145.21, 2196.34, 2056.97, 1663.06, 1742.3, 1964.59, 2024.36, 1867.65, 1682.46, 2254.6, 2194.07, 1730.48, 1808.32, 2423.81, 2219.76, 1782.26, 1660.1, 2147.26, 1743.18, 2454.54, 1644.87, 1791.55

Pack Options

Number of cell in series

Number of cells in parallel

☒ Arrange cells in to packs so each have similar capacity and same number of cells in parallel

☐ Arrange cells in to packs so each have similar capacity but vary the number of cells in parallel and keep cells in a pack roughly the same capacity

Generate Pack(s)

TYRANNY LIBERATOR

I am building a pack with 7 cells in series and 20 in parallel.

rePack - 18650 pack builder

← → ↻ ⚠️ [Print screen](#) | [repacks.com](#)

rePack

Thank you for all your feedback! Development has now started on rePack v2.0 and I need alpha users to help shape the functionality. [Sign up](#)
Chris Reid @chrreid

Pack your recycled 18650 Li-ion cells into optimal packs for your bike, power wall or other 18650 projects.

Cells

Comma separated list of cell capacities in mAh to be added to the packs

1803.57, 1989.17, 2032.19, 1977.48, 1928.36, 1984.12, 2074.02, 2043.93, 1987.82, 1980.23, 1976.54, 2116.78, 1944.85, 2038.04, 1987.36, 1879.16, 1967.18, 1782.09, 1896.77, 2033.09, 2007.46, 1908.85, 1964.74, 2034.94, 1818.09, 2086.91, 2187.61, 2705.62, 2078.67, 2021.73, 1960.54, 1988.97, 2132.52, 2018.76, 1631.64, 2166.76, 2225.2, 2157.3, 2067.26, 2162.53, 2239.51, 1647.03, 1579.1, 1532.26, 2152.82, 2054.87, 2001.56, 2039.96, 1969.2, 1948.8, 2155.43, 2119.76, 2028.82, 2115.46, 2109.16, 2055.75, 1581.86, 1818.68, 1746.09, 2145.21, 2196.94, 2026.97, 1885.06, 1742.3, 1964.59, 2024.36, 1867.45, 1882.48, 2254.0, 2194.07, 1730.48, 1888.32, 2425.81, 2219.78, 1782.26, 1660.1, 2148.26, 1743.18, 2454.54, 1644.87, 1791.33

Pack Options

Number of cell in series

7

Number of cells in parallel

20

☒ Arrange cells in to packs so each have similar capacity and same number of cells in parallel
☐ Arrange cells to packs so each have similar capacity but vary the number of cells in parallel and keep cells in a pack roughly the same capacity

[Generate packs](#)

TYRANNY LIBERATOR

Before clicking on generate packs make sure you check the arrange cell in to packs so each have similar capacity and same number of cells in parallel.

The screenshot shows the rePack website interface. At the top, there's a navigation bar with the rePack logo and a link to 'rePack v2.0'. Below this, a green banner reads: 'Thank you for all your feedback! Development has now started on rePack v2.0 and I need Alpha users to help shape the functionality. Sign up Chris Best @chrubert'. The main heading says 'Pack your recycled 18650 Li-ion cells into optimal packs for your bike, power wall or other 18650 projects.' Below this is a blue bar with the text 'Dividing your packs...'. The 'Cells' section contains a text area with a comma-separated list of cell capacities in mAh. The 'Pack Options' section has two input fields: 'Number of cell in series' (set to 7) and 'Number of cells in parallel' (set to 20). Below these are two radio button options: 'Arrange cells in to packs so each have similar capacity and same number of cells in parallel' (selected) and 'Arrange cells in to packs so each have similar capacity but vary the number of cells in parallel and keep cells in a pack roughly the same capacity'. A red box highlights the 'Generate packs' button at the bottom.

rePack

Thank you for all your feedback! Development has now started on rePack v2.0 and I need Alpha users to help shape the functionality. Sign up
Chris Best @chrubert

Pack your recycled 18650 Li-ion cells into optimal packs for your bike, power wall or other 18650 projects.

Dividing your packs...

Cells

Comma separated list of cell capacities in mAh to be added to the packs

1821.57, 1889.17, 2027.86, 1977.44, 1926.96, 1964.12, 2014.02, 2043.69, 1983.92, 1996.22, 1976.04, 2116.78, 1944.86, 2036.04, 1907.36, 1879.16, 1867.91, 1795.09, 1986.07, 2033.09, 2007.46, 1906.66, 1964.74, 2034.94, 1912.09, 2086.97, 2187.87, 2700.62, 2018.67, 2027.73, 1983.04, 1960.37, 2132.52, 2018.76, 1631.64, 2168.76, 2225.2, 2157.3, 2087.26, 2162.53, 2208.01, 1647.03, 1570.1, 1832.26, 2152.82, 2054.67, 2001.06, 2039.96, 1969.2, 1948.6, 2100.43, 2119.79, 2006.62, 2115.46, 2109.16, 2000.70, 1581.88, 1918.68, 1746.59, 2145.21, 2186.94, 2006.97, 1603.06, 1742.3, 1984.69, 2024.36, 1667.45, 1882.48, 2204.6, 2194.07, 1730.48, 1808.32, 2423.81, 2219.76, 1782.26, 1660.1, 2148.26, 1743.18, 2484.54, 1644.87, 1791.35

Pack Options

Number of cell in series

7

Number of cells in parallel

20

⚙️ Arrange cells in to packs so each have similar capacity and same number of cells in parallel
⚙️ Arrange cells in to packs so each have similar capacity but vary the number of cells in parallel and keep cells in a pack roughly the same capacity

Generate packs

TYRANNY LIBERATOR

After hitting “Generate Packs” it will calculate the modules which must be created.

I Copy and print the bottom values and arrange the cells as specified for each pack.

The screenshot shows the rePackr website interface. At the top, there's a navigation bar with the rePackr logo. Below it, there are five generated packs, each with its own set of modules. The packs are arranged in a grid-like fashion. At the bottom, there's a 'Pack Data' section with a table of data and a 'TYRANNY LIBERATOR' logo.

Pack 1: Capacity: 41324, Divergence: 0, Deviation: 81. Modules: 1973, 1980, 1960, 1948, 1944, 1937, 2204, 2204, 2162, 2154, 2102, 2121, 2115, 2118, 2067, 2055, 2035, 2027, 2018, 2014, 2001, 1960, 1966, 1964, 1969, 1948.

Pack 2: Capacity: 41324, Divergence: 0, Deviation: 122. Modules: 1958, 1964, 1951, 1951, 1937, 1908, 2454, 2168, 2159, 2159, 2154, 2148, 2105, 2096, 2085, 2096, 2024, 2001, 2001, 1983, 1953, 1964, 1960, 1960, 1944, 1928.

Pack 3: Capacity: 41324, Divergence: 0, Deviation: 91. Modules: 2239, 2239, 2225, 2156, 2137, 2132, 2097, 2056, 2043, 2039, 2035, 2026, 2021, 1989, 1988, 1967, 1966, 1964, 1976, 1969.

Pack 4: Capacity: 41324, Divergence: 0, Deviation: 111. Modules: 2423, 2196, 2168, 2156, 2121, 2119, 2056, 2054, 2054, 2039, 2035, 2034, 2025, 2024, 2018, 1984, 1977, 1968, 1946, 1928.

Pack 5: Capacity: 41324, Divergence: 0, Deviation: 115. Modules: 2423, 2194, 2152, 2145, 2137, 2132, 2116, 2115, 2035, 2028, 2021, 2018, 2018, 2014, 1987, 1984, 1976, 1973, 1948, 1908.

Pack Data Table:

Pack Data							
Tab separated data (Use this to paste into a google sheet)							
2454	2219	2204	2454	2239	2423	2423	
2225	2196	2204	2168	2239	2196	2194	

TYRANNY LIBERATOR

Using the Cell Doctor Charger

After I've done the first pack using the 4-cell tester from Opus, I realized that a better solution must be found to speed up the process considerably in order to make this project worthwhile.

Together with my friend Alex, we developed a 16-cell tester that's charging and discharging 2 times faster, giving you the ability to process 8 times more cells compared with a regular tester. We call it The Cell Doctor.

The best part is that's connected to a computer and has its own database to store the cell values and allows you to print labels automatically for each cell, this removes the tedious work you had to do with the regular testing device.

Once the database has all the values from the tested cells, you can generate the packs from the calculator page inside the cell doctor software.

The testing process can be started by holding the button until "Start MCap" is displayed on the LCD, this stands for "Measure Capacity".

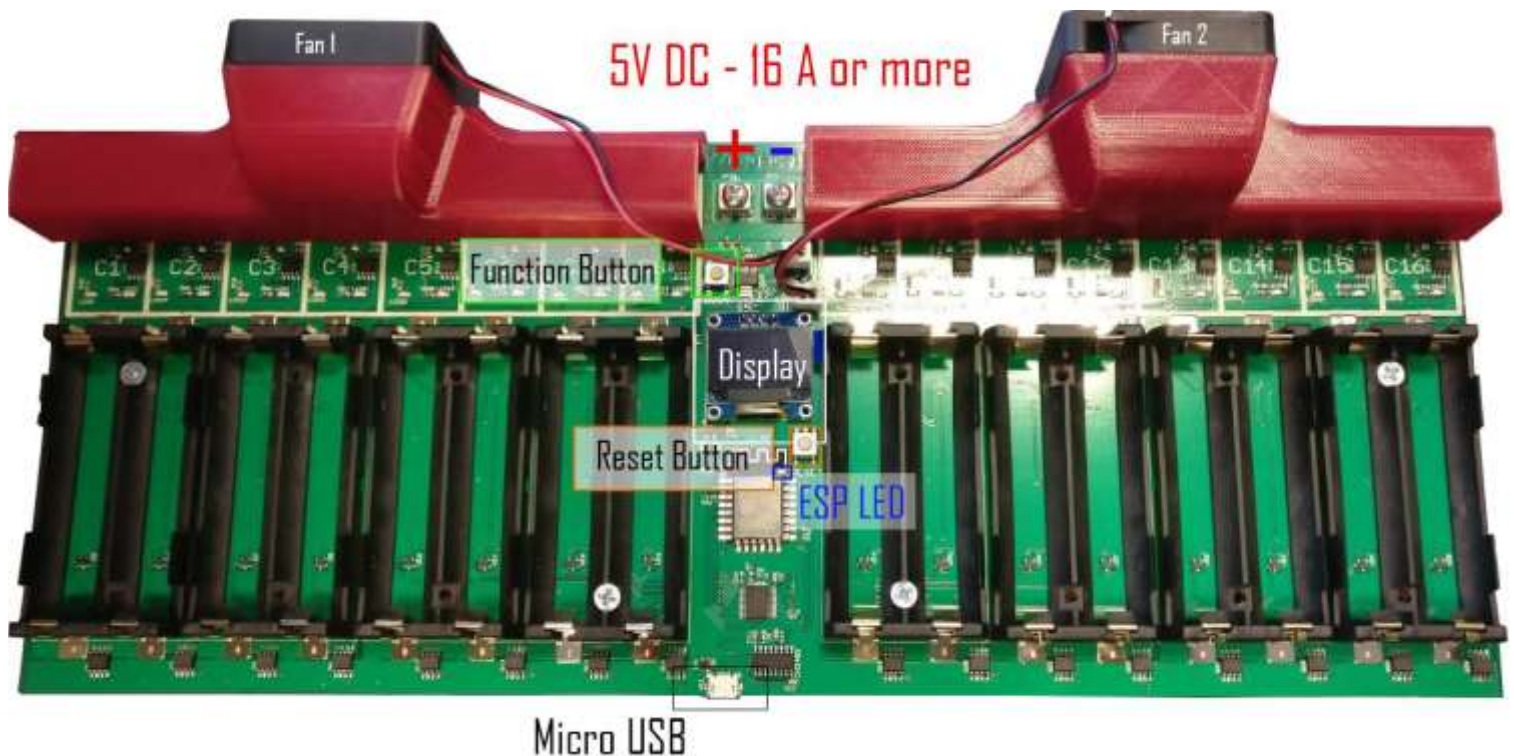
The cells will charge then automatically begin discharging, measuring the capacity in the process.

Setting up the Hardware:

I will give you a detailed overview on how to connect and how to use this board. I have also made some video guides and I will link them at the end of this file.

1. Connecting the board to Power. To power up the board, you must use 5V DC capable of 16 amps or more. Each cell is charging with max 1 amp/h.

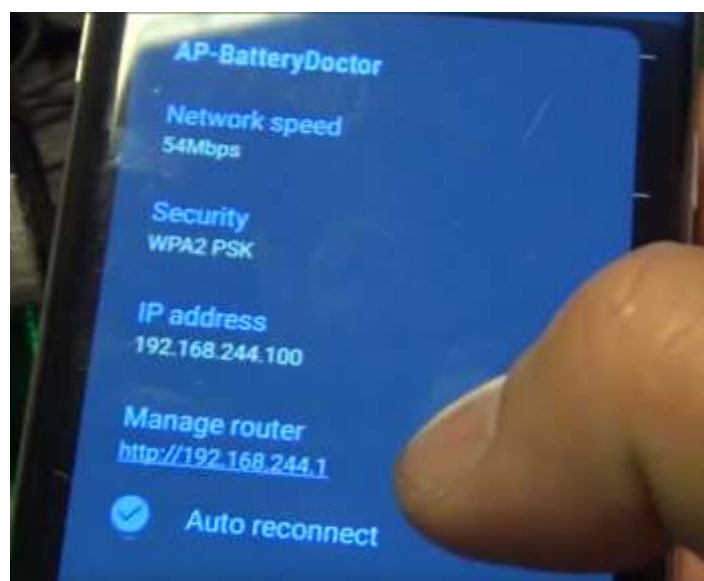
Caution: Do not reverse polarity or add a higher voltage than 6V to the input. The circuit is not protected for reversed polarity because of the high amperage required, we will try to find a solution in the future to avoid failure at polarity reversing.



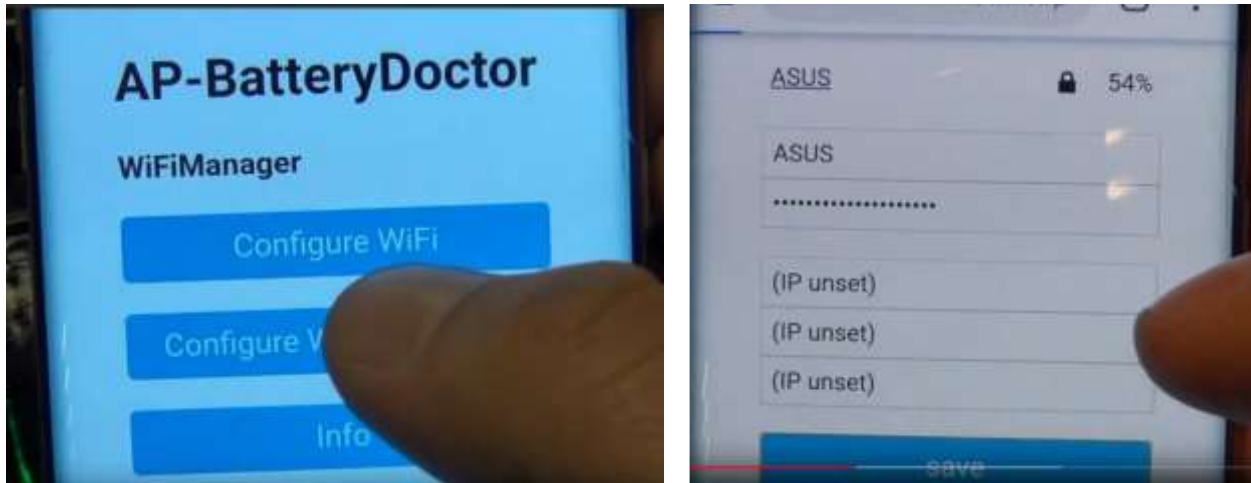
2. After board is being powered up, the ESP LED will light up. The display will stay black for 1 minute, during this time the ESP awaits for Wireless configuration.



3. After connecting to the wireless Access Point, you click on the IP address to manage router.



- Click on "Configure WiFi" and add the username and password of your router and click the save button:



TIP: You can connect to your main router or you could use a separate router which is not connected to internet and make an internal network to be used just with The Cell Doctor.
TIP: If you leave it unconfigured after 1 minute of powering it up, the cell doctor board remains set as an access point and you can connect with your laptop and send commands through software, default password is: 1234567890

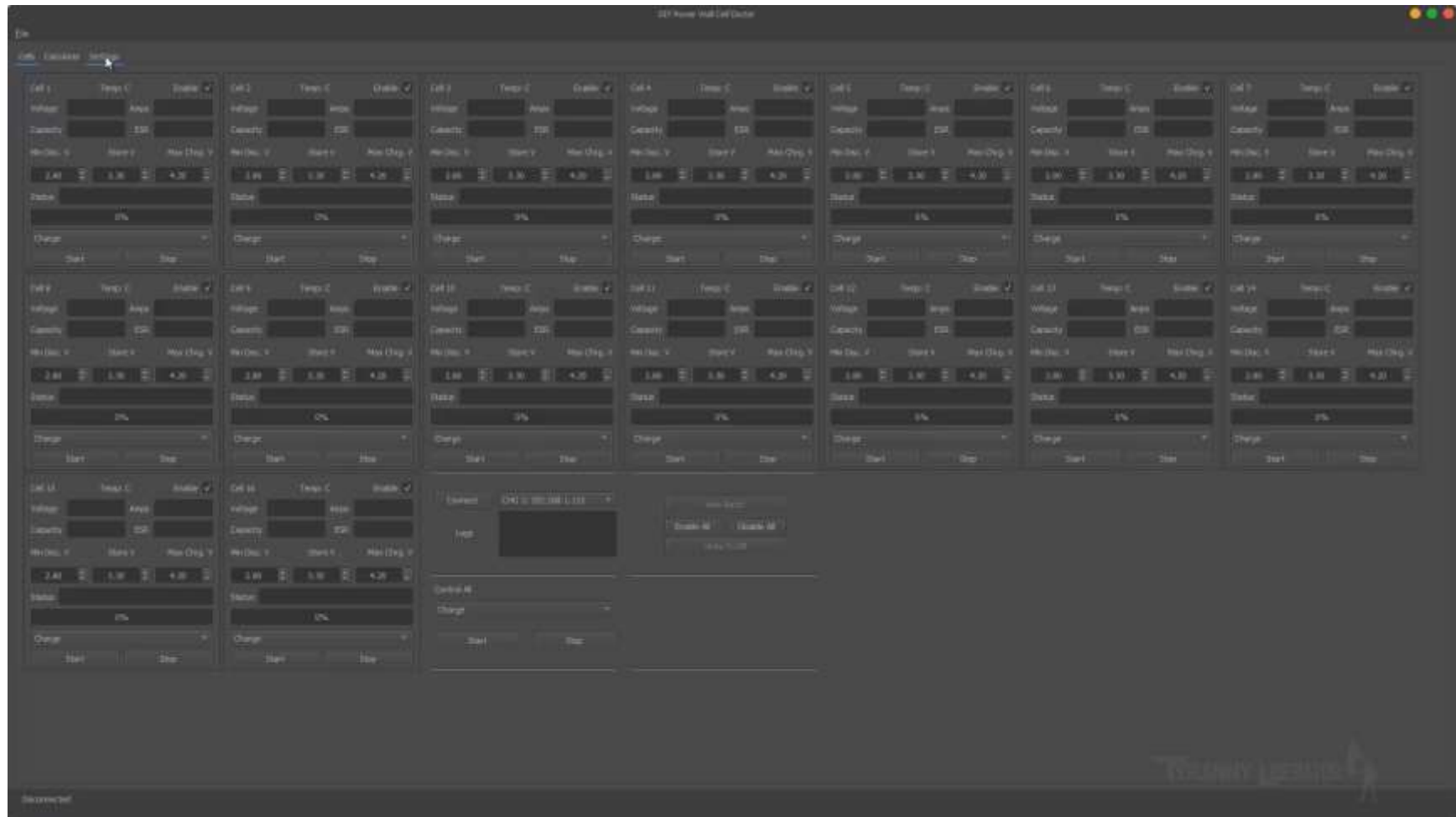
- After the configuration has been saved, the board will reset and display should look like:



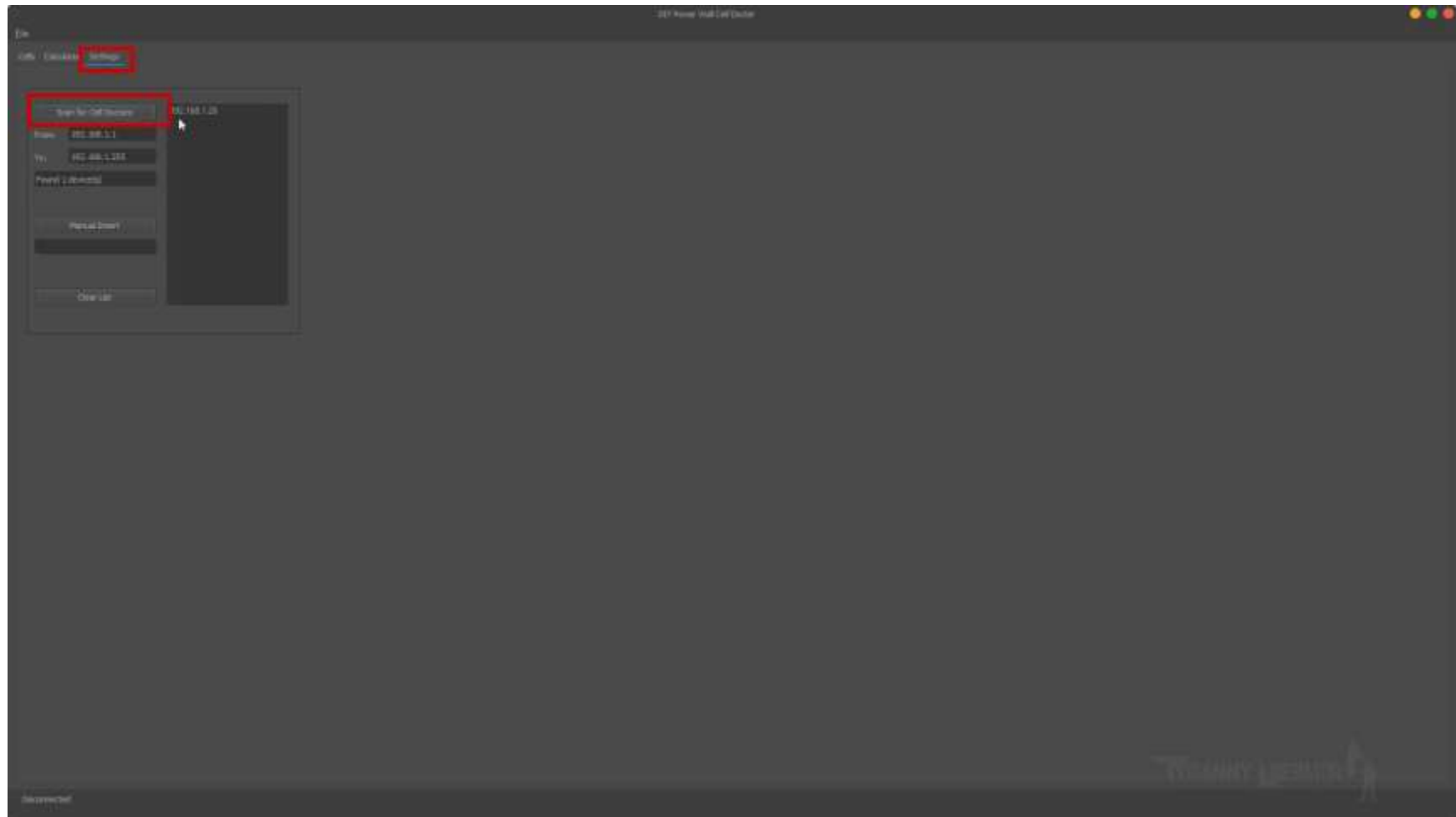
6. The function button can have the following options:

- Short press, less than 100 milli seconds (Click and release) will cycle through cells, displaying information for each cell at a time
- Press and hold will cycle through the following options:
 - Start MCap – This will start the process of measuring capacity with the following characteristics: - If cell voltage is lower than 4.1 V it will charge it until reaching 4.2 V **(that is default voltage on the board, but it can be configured if charger is controlled from the provided software)** - If cell voltage is above 4.1 V it will enter the discharge cycle **(each cell is independently controlled, one could be charging and another one could be discharging, depending on their state at insertion)** - After discharge cycle, the MCap option will charge the cells back to 3.3 V for default **(can be adjusted when using the PC software)**
 - Stop MCap – This will stop the capacity measurement **(charge or discharge will be stopped)**
 - Show IP - This is helpful to get the device IP if you want to connect to it with the PC software. The PC software has a scanning feature which will discover all the cell doctors on the same network with your computer, but depending on how your network is set, that feature might not work so you can add the IP manually
 - Self Testing – This option will run a test on the charger to see if all the cells are detected and if the charge / discharge works. There's data output if you connect to the USB and open a serial terminal such as termite. There's data displayed on the LCD as well if test passed or not.
Note: The cells should be removed and 5V DC present at the main terminals for the test to run properly.
 - Factory Reset – This option will put the device to run self-test first time the charger is powered up. **(it might do other functionality in the future)**

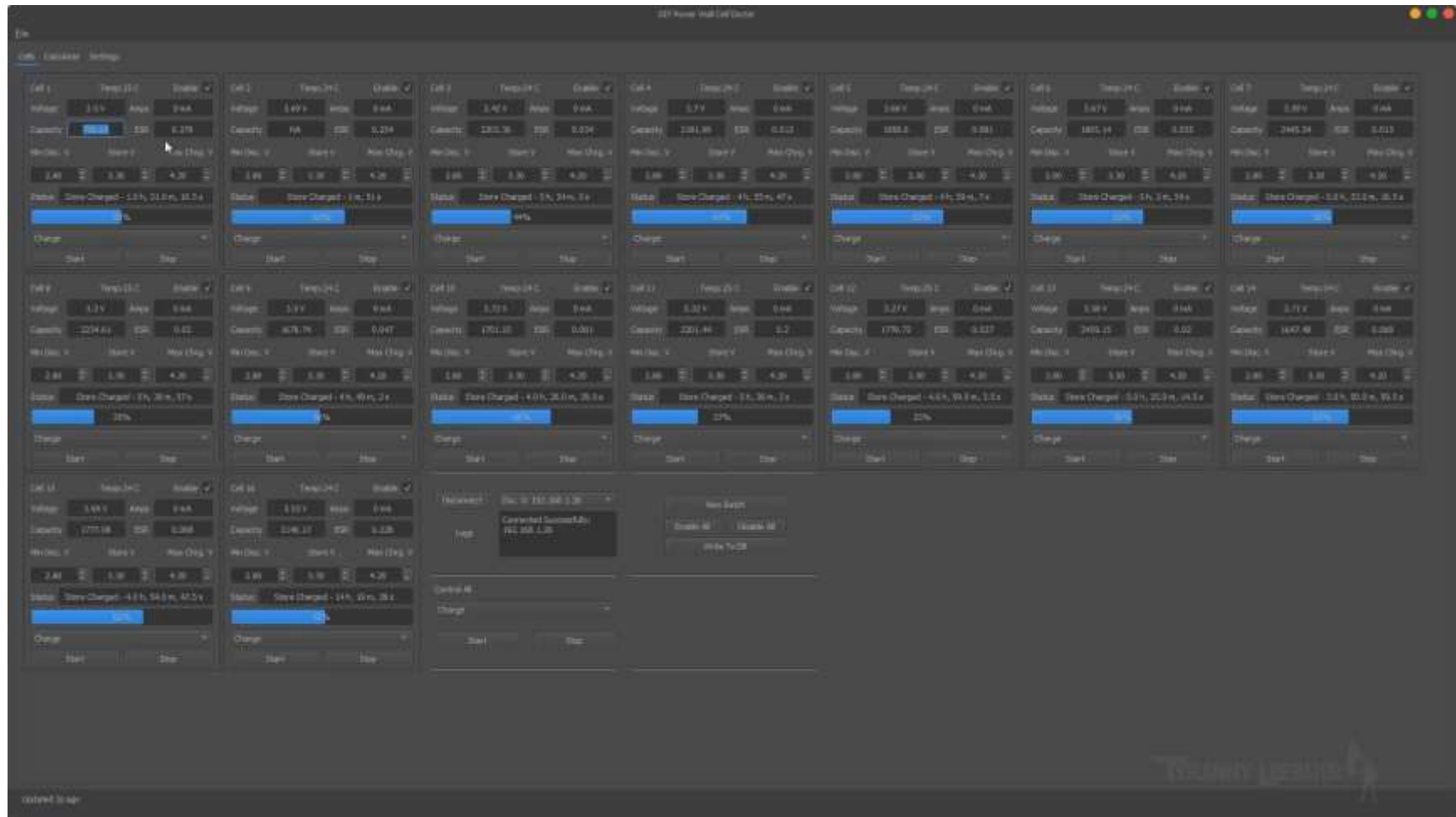
This is the desktop software which connects to The Cell Doctor.



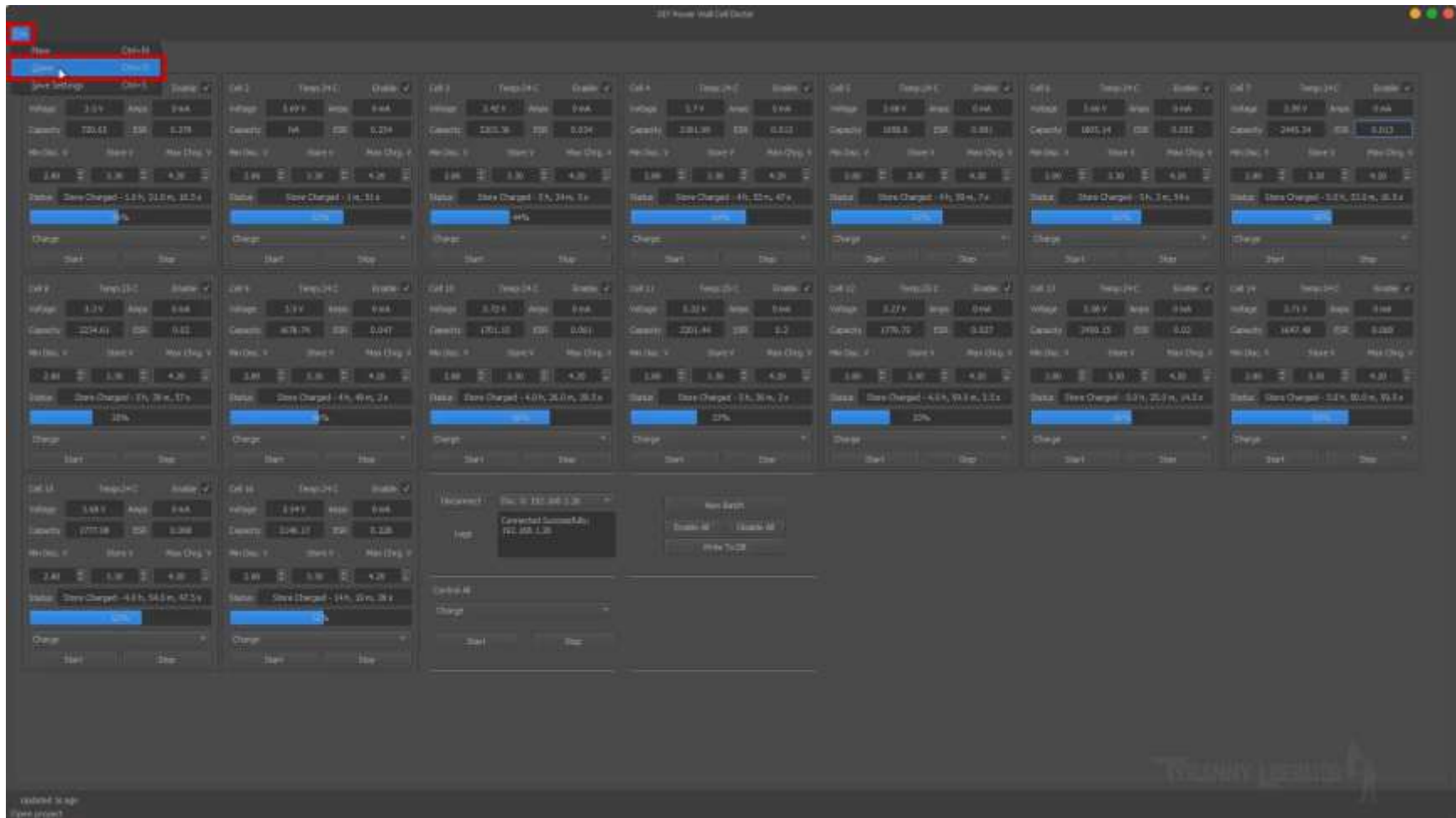
First select the settings tab and after that click on scan for cell doctors.

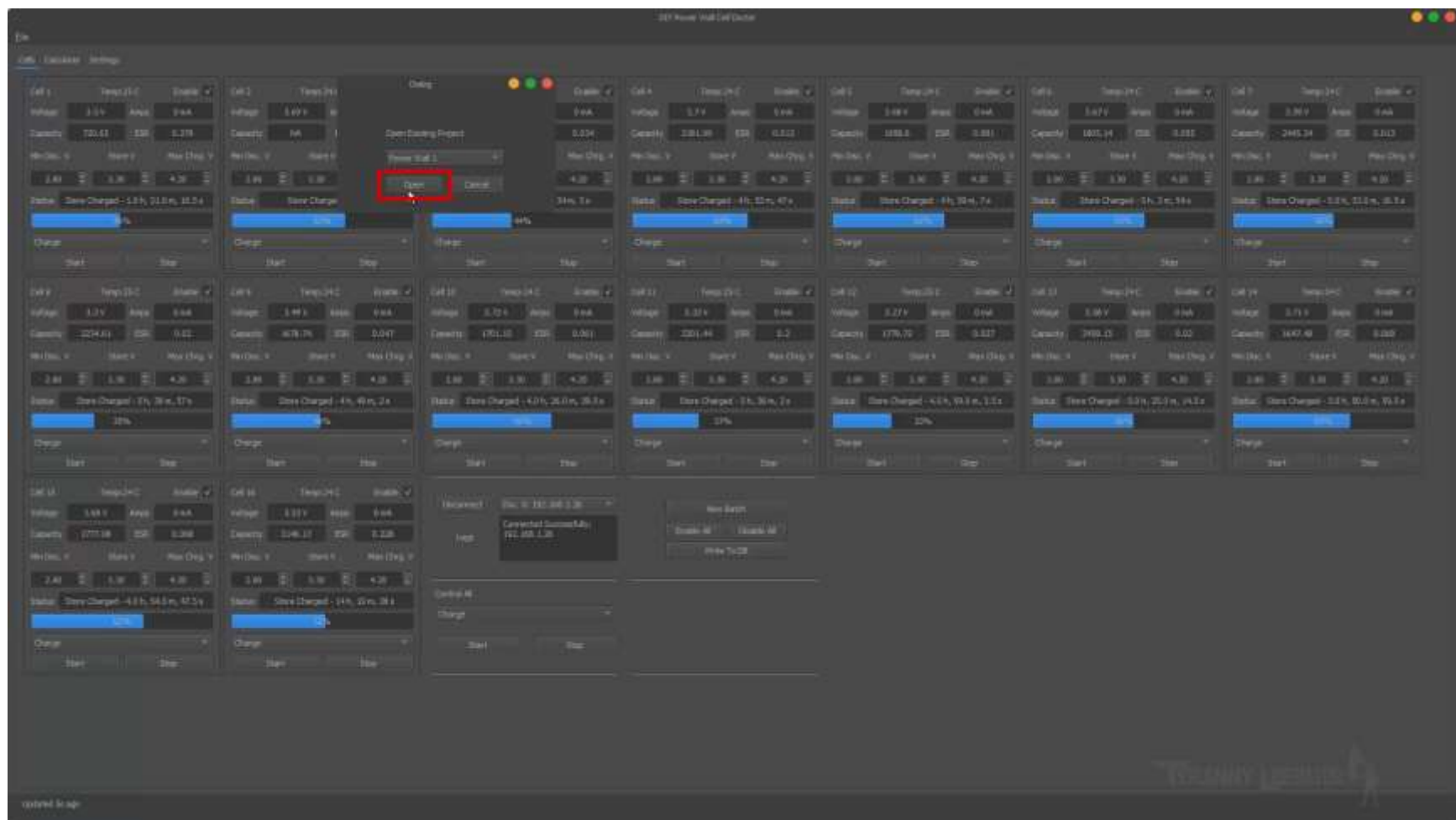


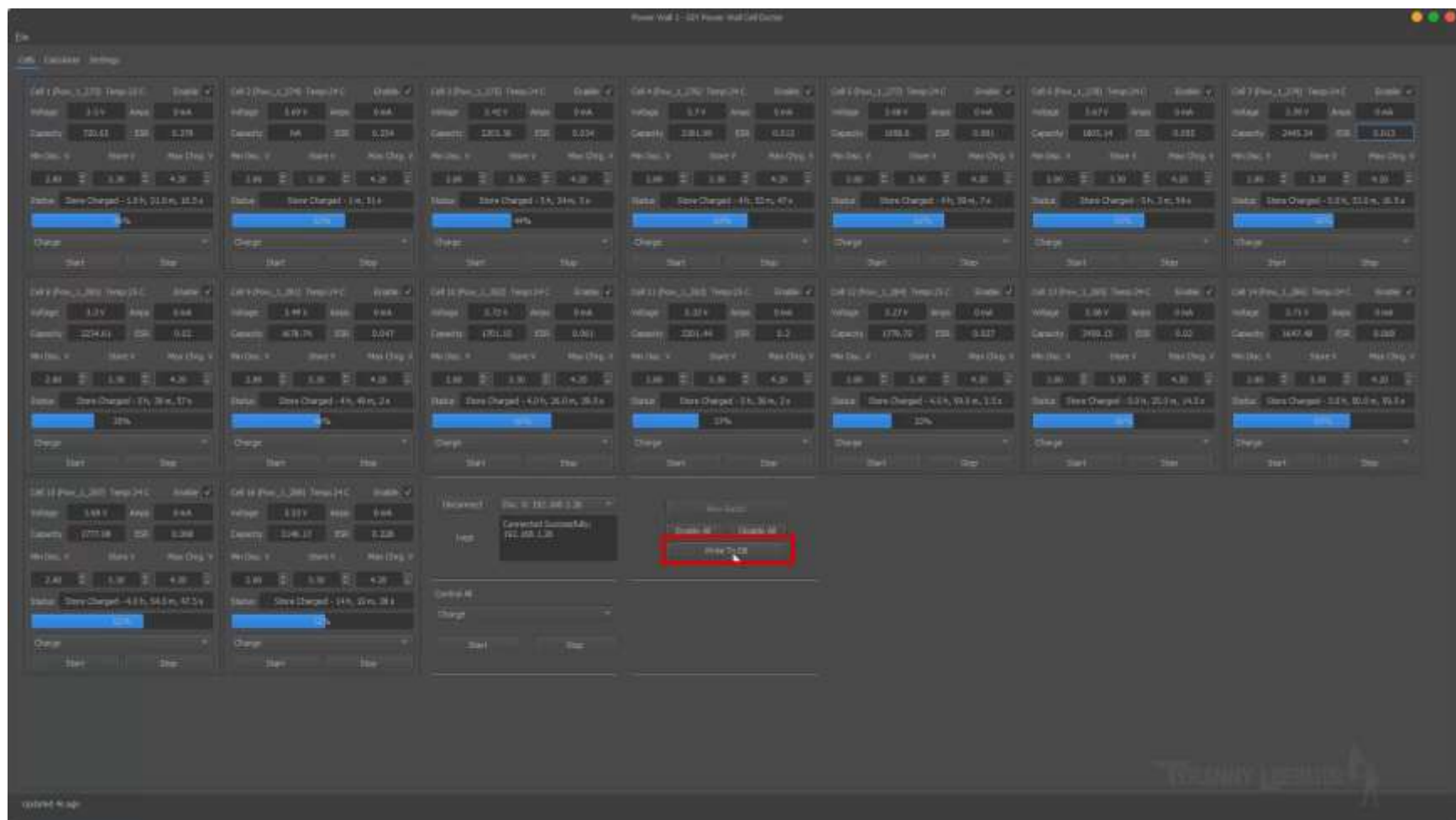
I scan the network to find my device and now I can read values and send commands to the charger.

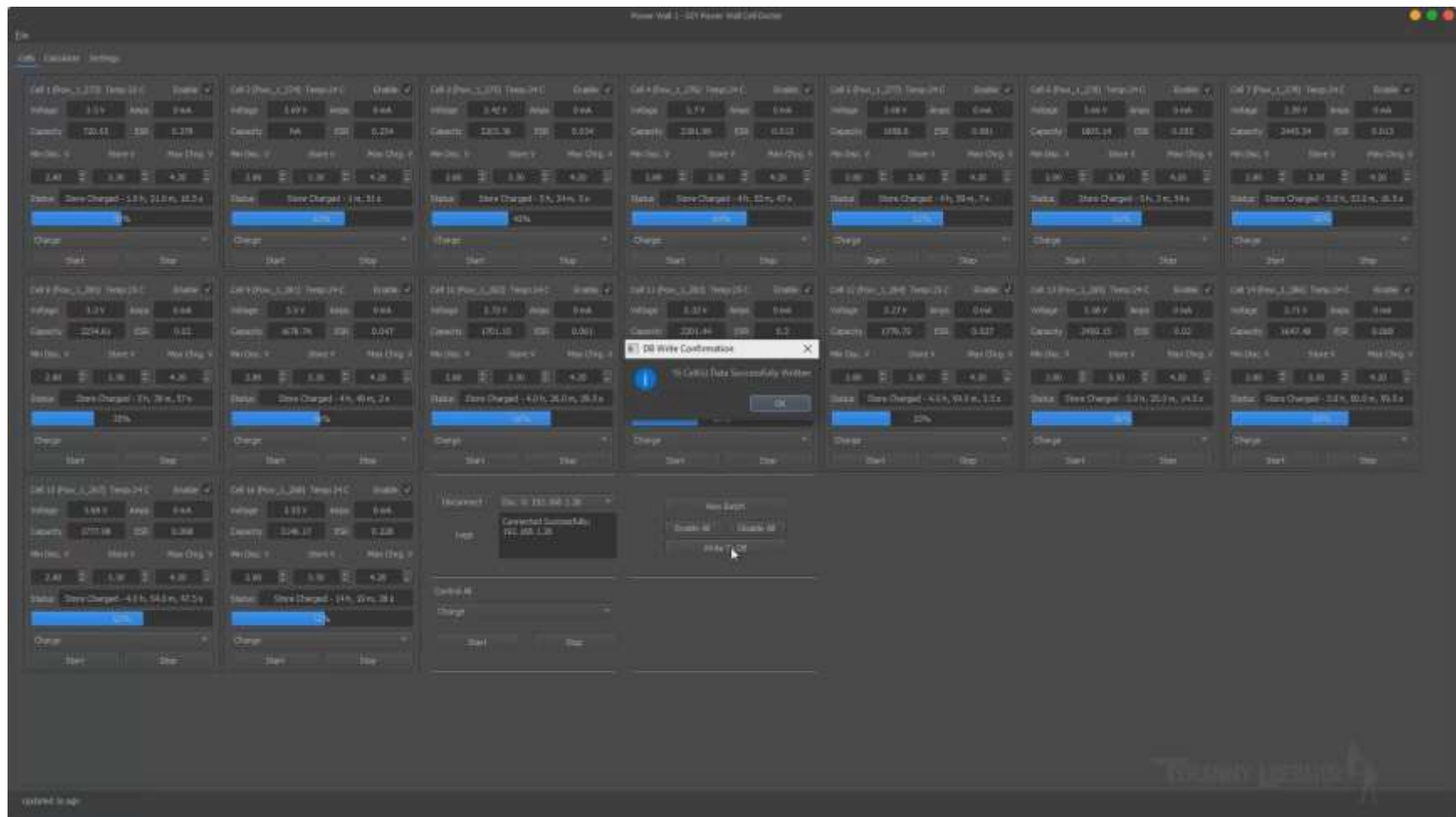


I open an existing project then I write the data inside the database.









I went through all the cells to find which ones are good and what capacity they have, then I moved to the next step, which is arranging the cells in modules.

Now I open the calculator and load all the cells above 1500 milliamps hour and choose the pack I want to create, 7 cells in series and 20 in parallel.

The screenshot shows the 'Power Wall 2 - 32V Power Wall Cell Doctor' application. The interface is divided into two main sections: 'Query Section' and 'Calculation Section'.

Query Section: This section contains a table of battery cells. The table has the following columns: ID, Power, Capacity, Voltage, ESR, Added, and Availability. The table lists 20 cells, each with a unique ID and various performance metrics. The 'Added' column shows dates, and the 'Availability' column indicates the status of each cell.

Calculation Section: This section allows users to configure the battery pack. It includes a 'Presets' dropdown, a 'Cells in Series' input field set to 7, and a 'Cells in Parallel' input field set to 20. There is also a 'Search Depth' dropdown set to 2 and a 'Find' button.

Bottom Panel: This panel displays a large list of cell IDs, which are the results of the search or calculation process. The list is scrollable and contains many IDs, such as 1001, 1002, 1003, etc.

I used 1 paper sheet for 20 cells and found the corresponding cells.

This allows making 20 modules of 7 cells each connected in parallel.

The screenshot displays a software interface for a power wall system, titled "Power Wall 1 - 32V Power Wall Cell Data". The interface is divided into two main sections: "Query Section" and "Calculation Section".

Query Section: This section contains a table with the following columns: ID, Power, Capacity, Voltage, ESR, Added, and Available. The table lists 20 rows of data, each representing a cell in the power wall. The "Added" column shows dates, and the "Available" column shows "YES".

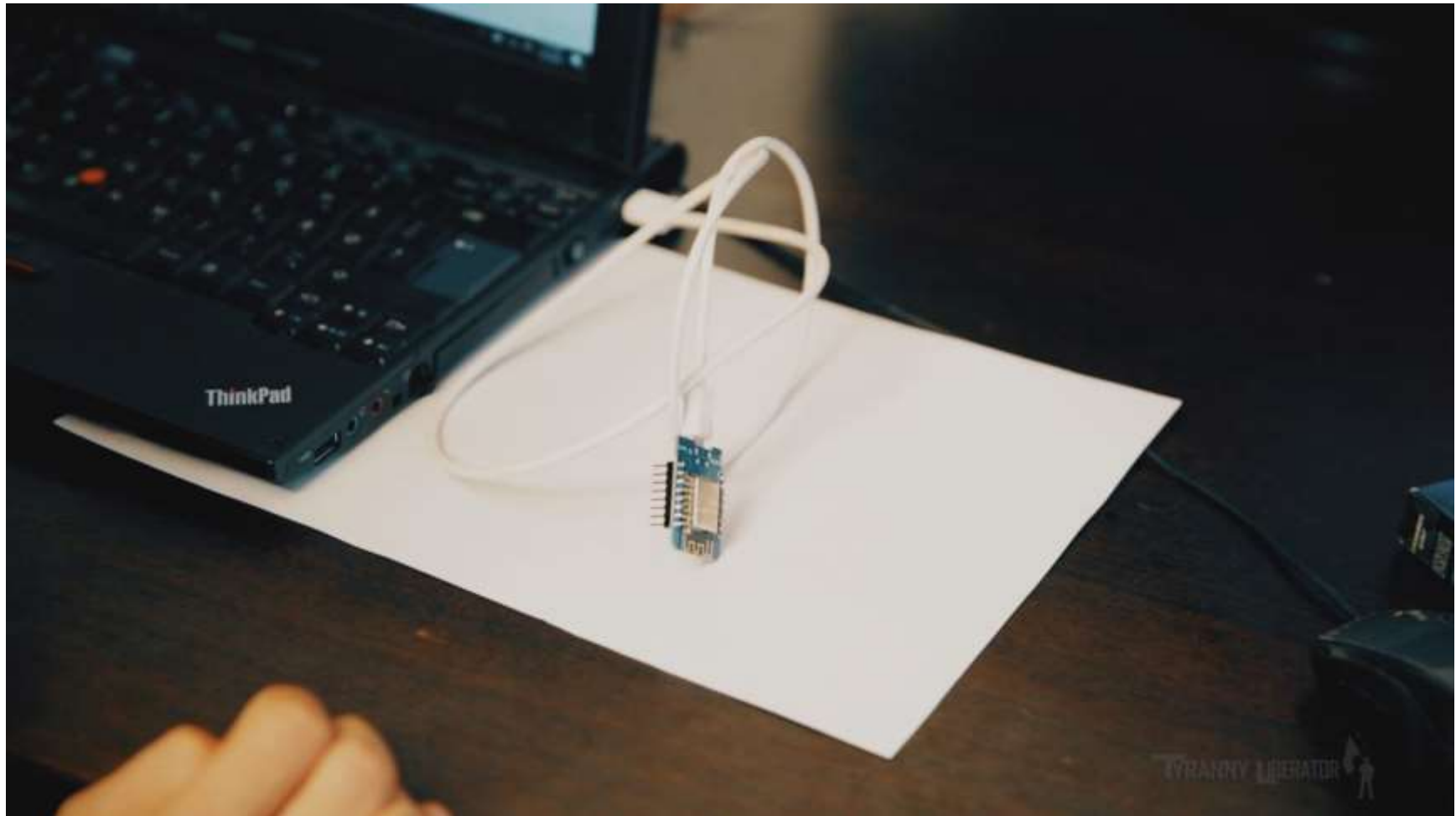
Calculation Section: This section contains a "Process" button and a "Calculation" button. Below these buttons is a list of calculations, including "Row 1: 1, Capacity: 3440.00, Divergence: 0.00" and "Row 2: 2, Capacity: 3440.00, Divergence: 0.00". The calculations are listed in a scrollable area.

The interface also includes a "Query Section" with a "New Cell" button and a "Load Cell" button. The "New Cell" button is currently disabled, and the "Load Cell" button is enabled. The "Query Section" also includes a "Calculation" button and a "Search" button.

The bottom of the interface shows a "Copyright © 2019" notice and a "TITANIX" logo.

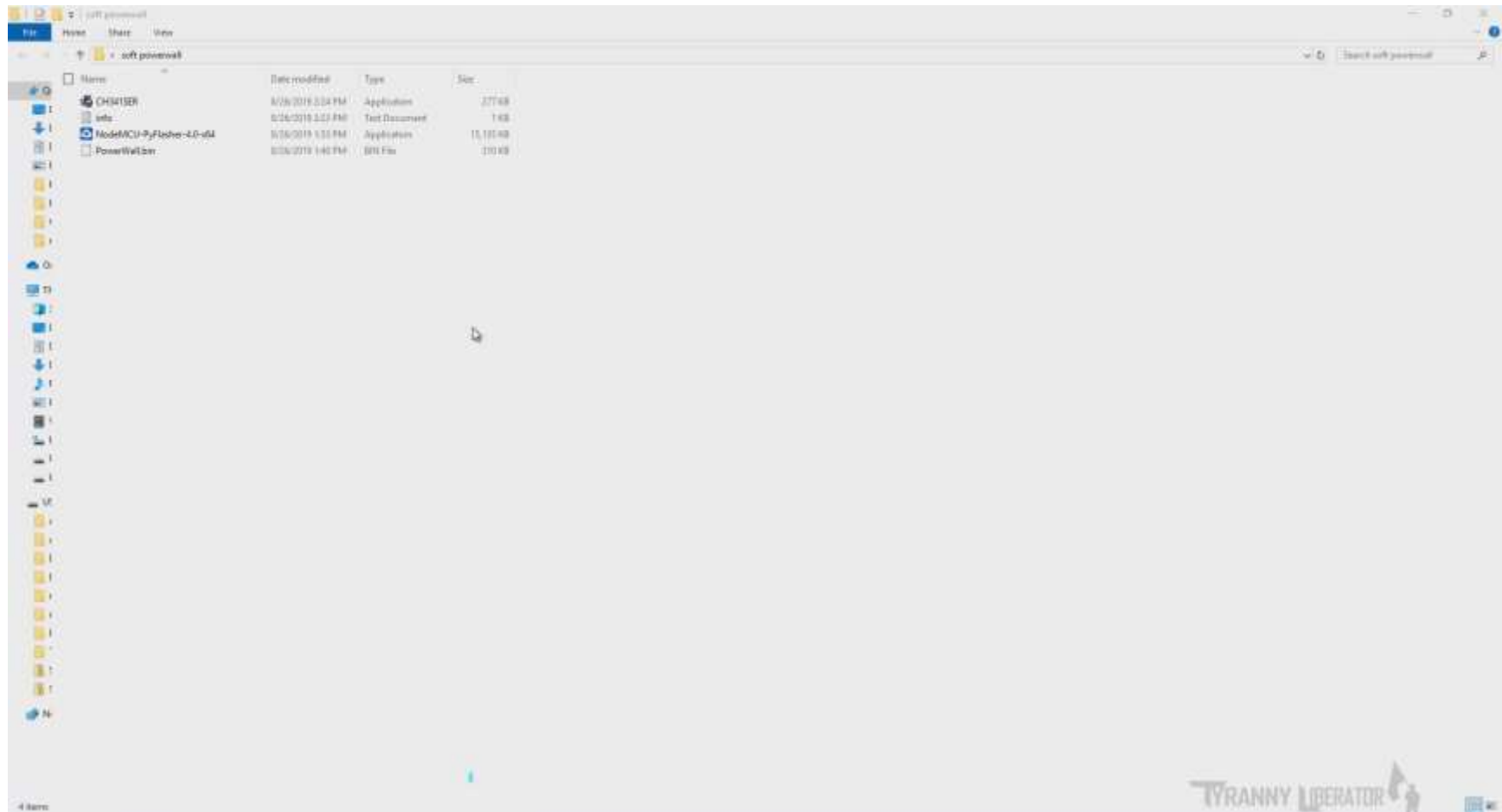
Setting-up the ESP:

To do that, connect the device to your computer with a micro USB cable, download the file called “ESP_Firmware.zip” on the download page and unzip it.

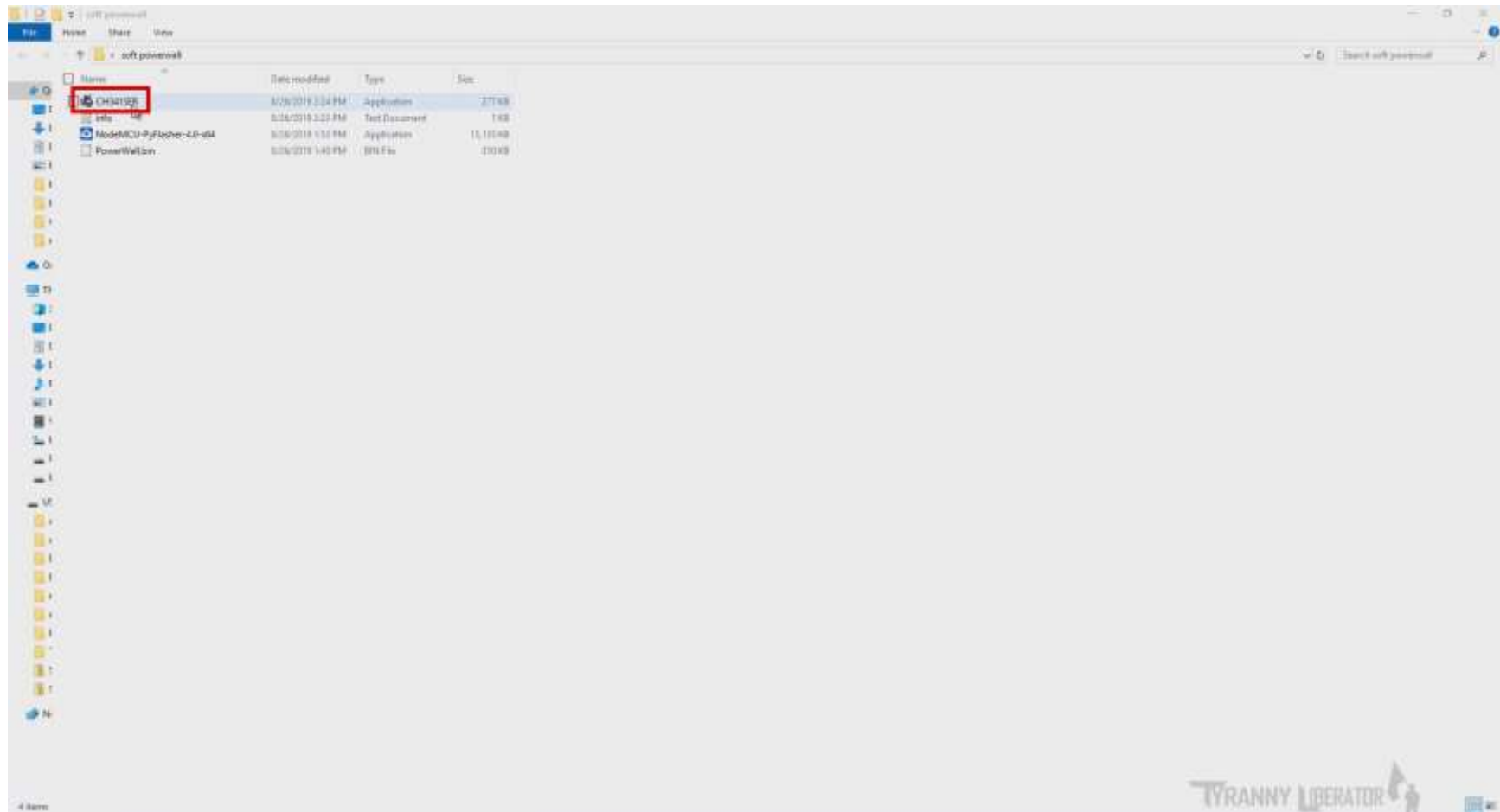


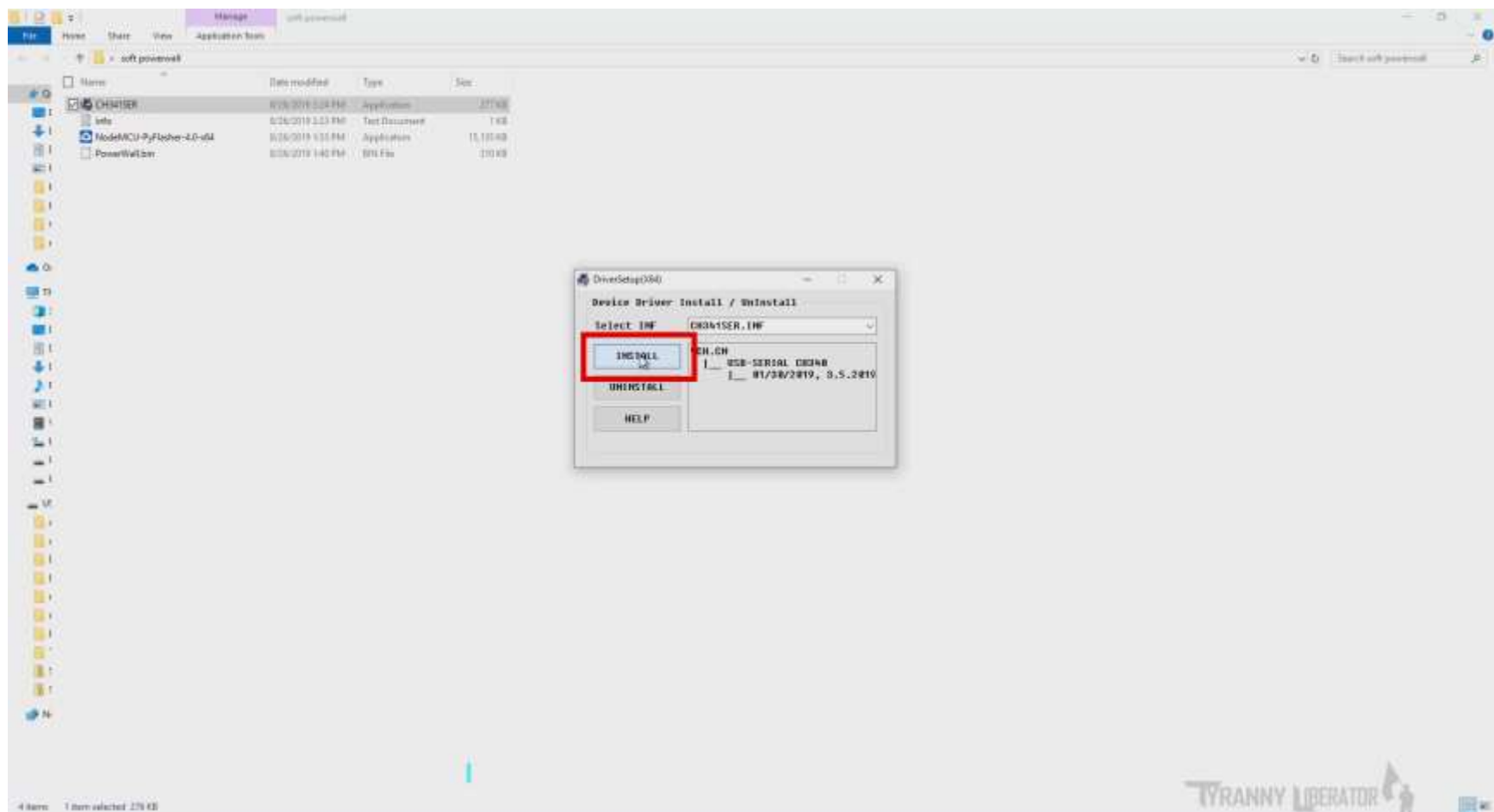
Flashing the firmware:

Inside you will see the files displayed in this video.

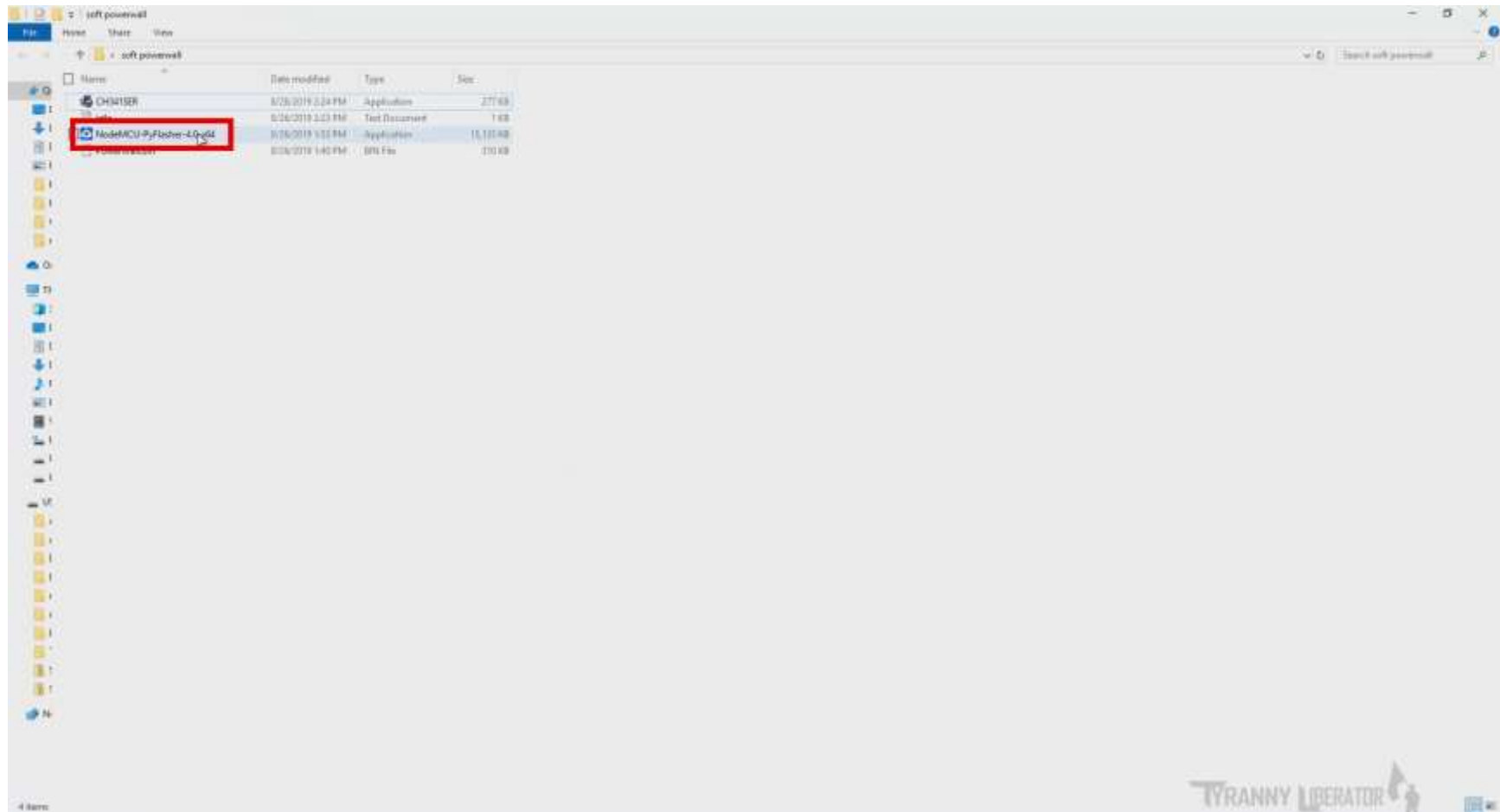


This process can be done on a windows machine. In order to connect to the ESP, you must have this driver installed, double click on CH341SER file and follow the installation steps.

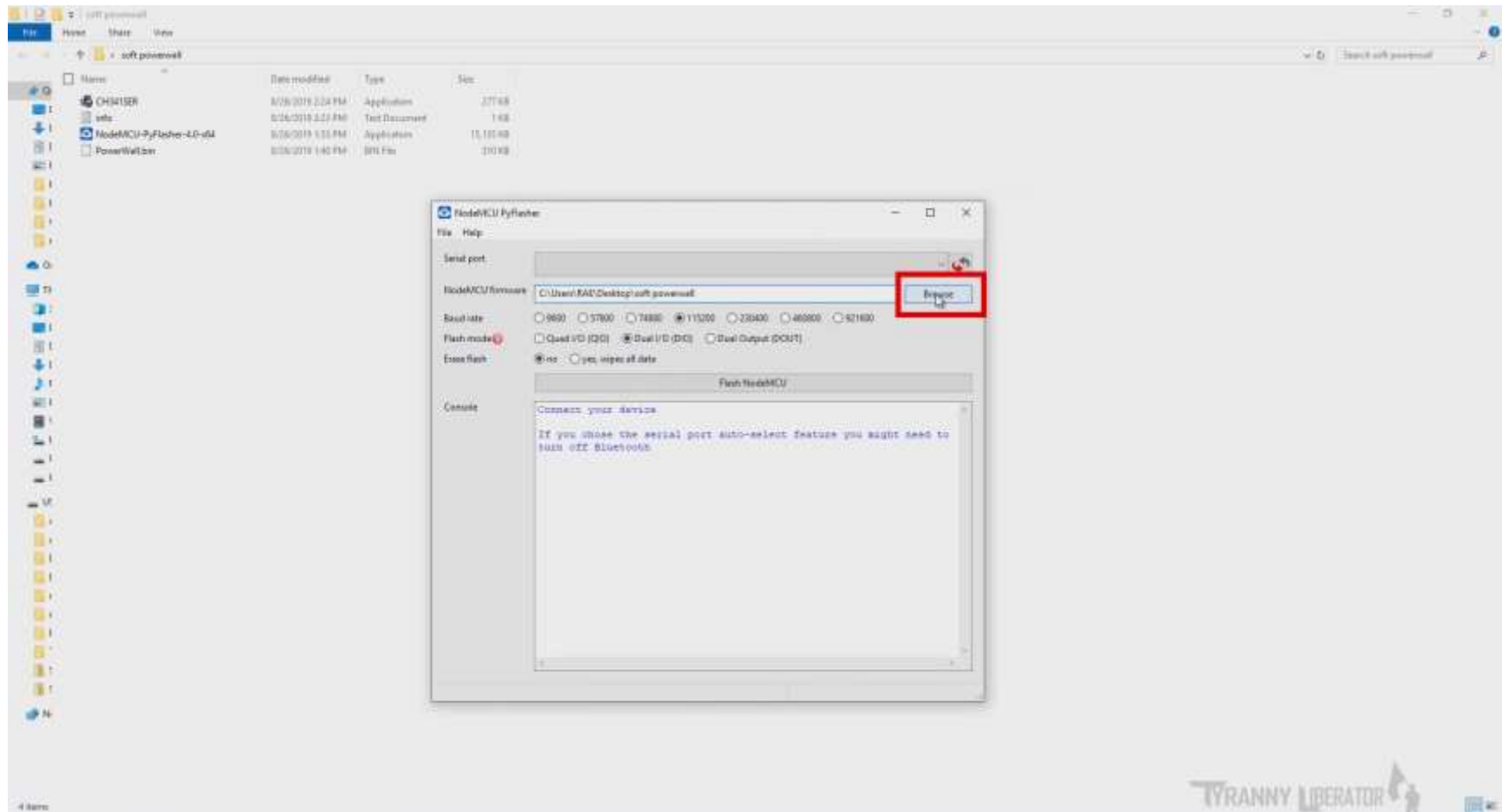


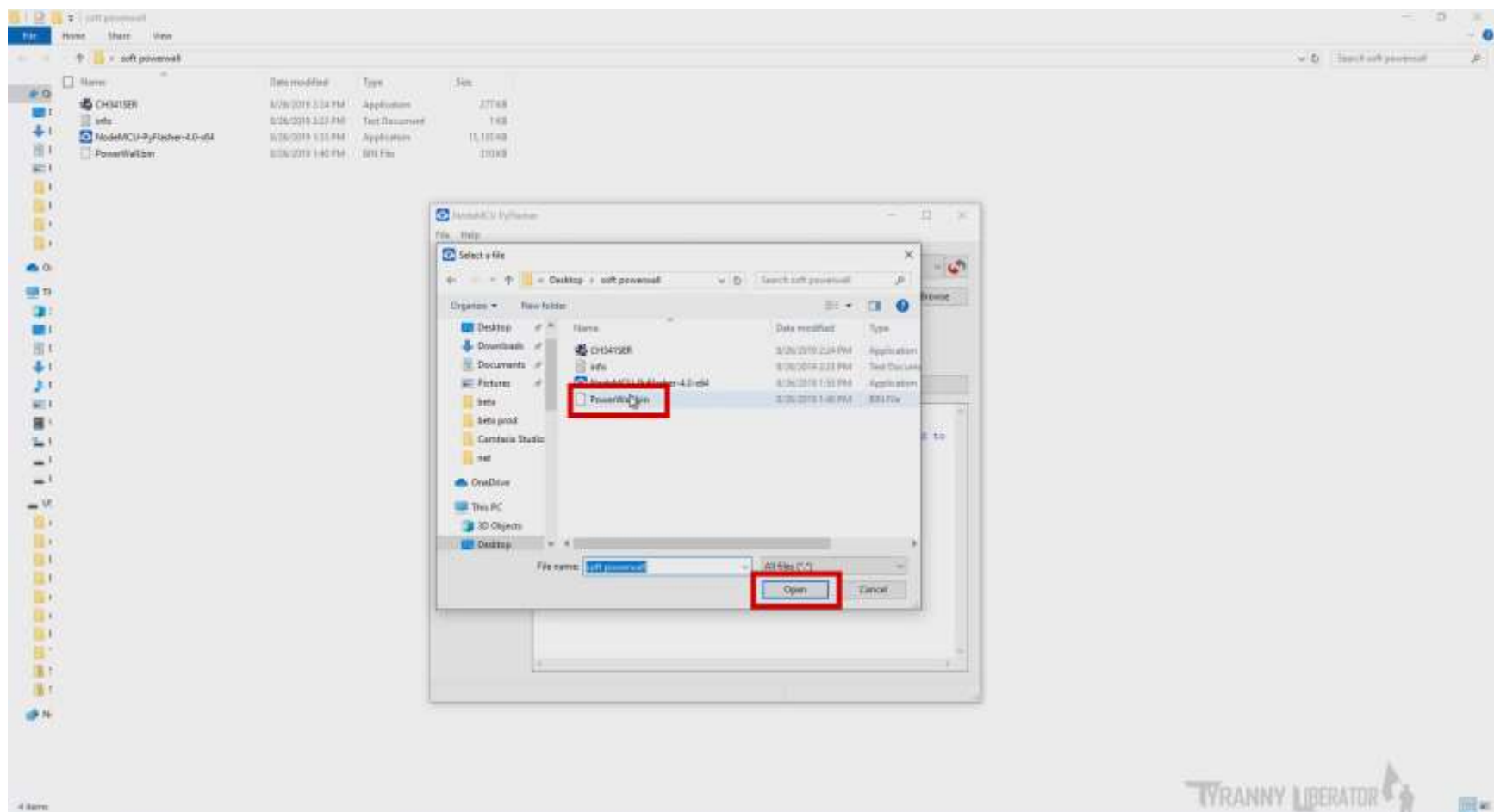


After the driver is installed, double click on “NodeMCU-PyFlasher-4.0-x64” to launch the application that’s going to write the code to the ESP.

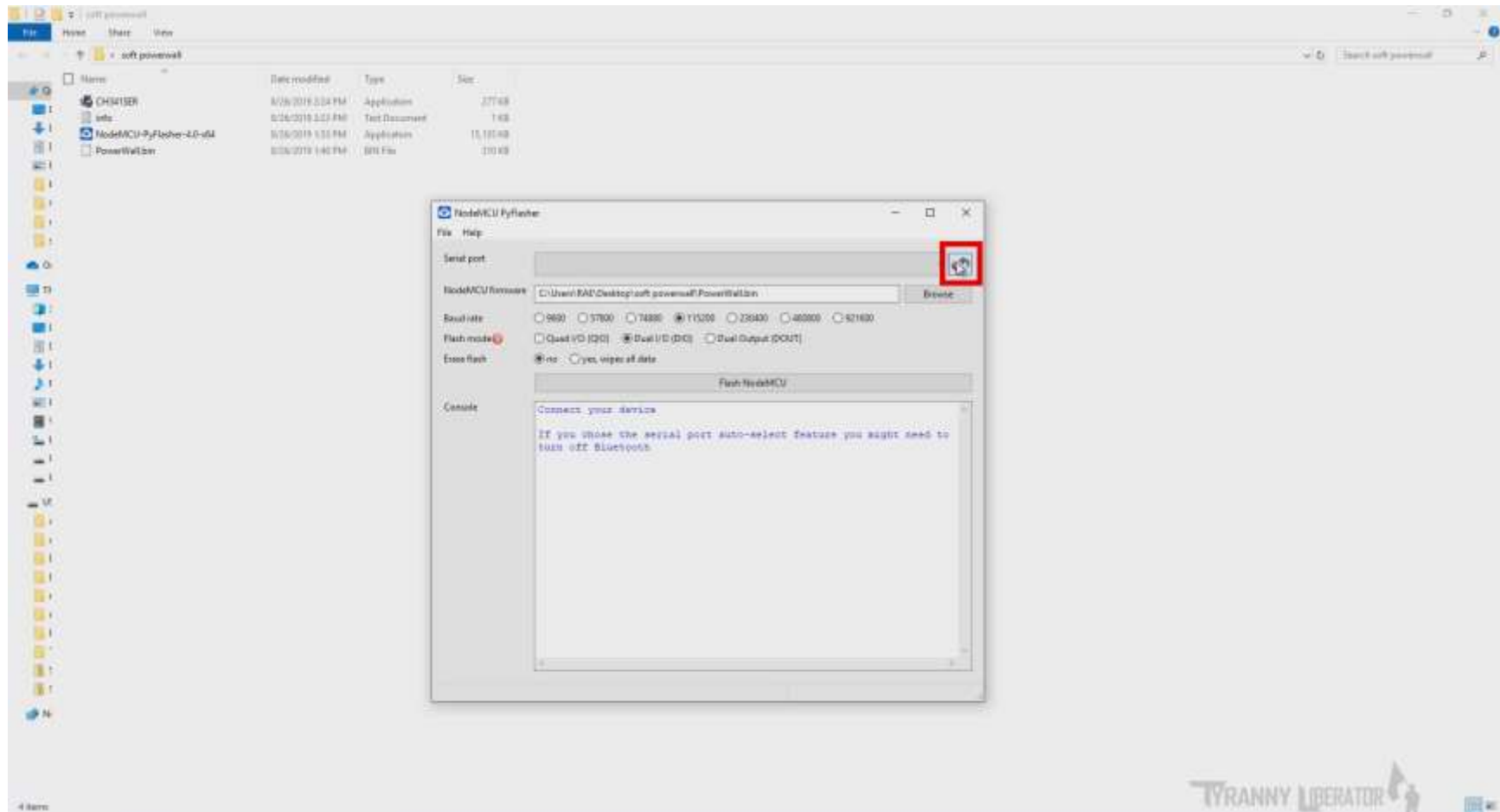


After the window opens, click on browse and navigate to the folder location where you have the file called Powerwall.bin .





If no device is connected, click on the refresh button then select the COM port that's available for communication with the ESP device.

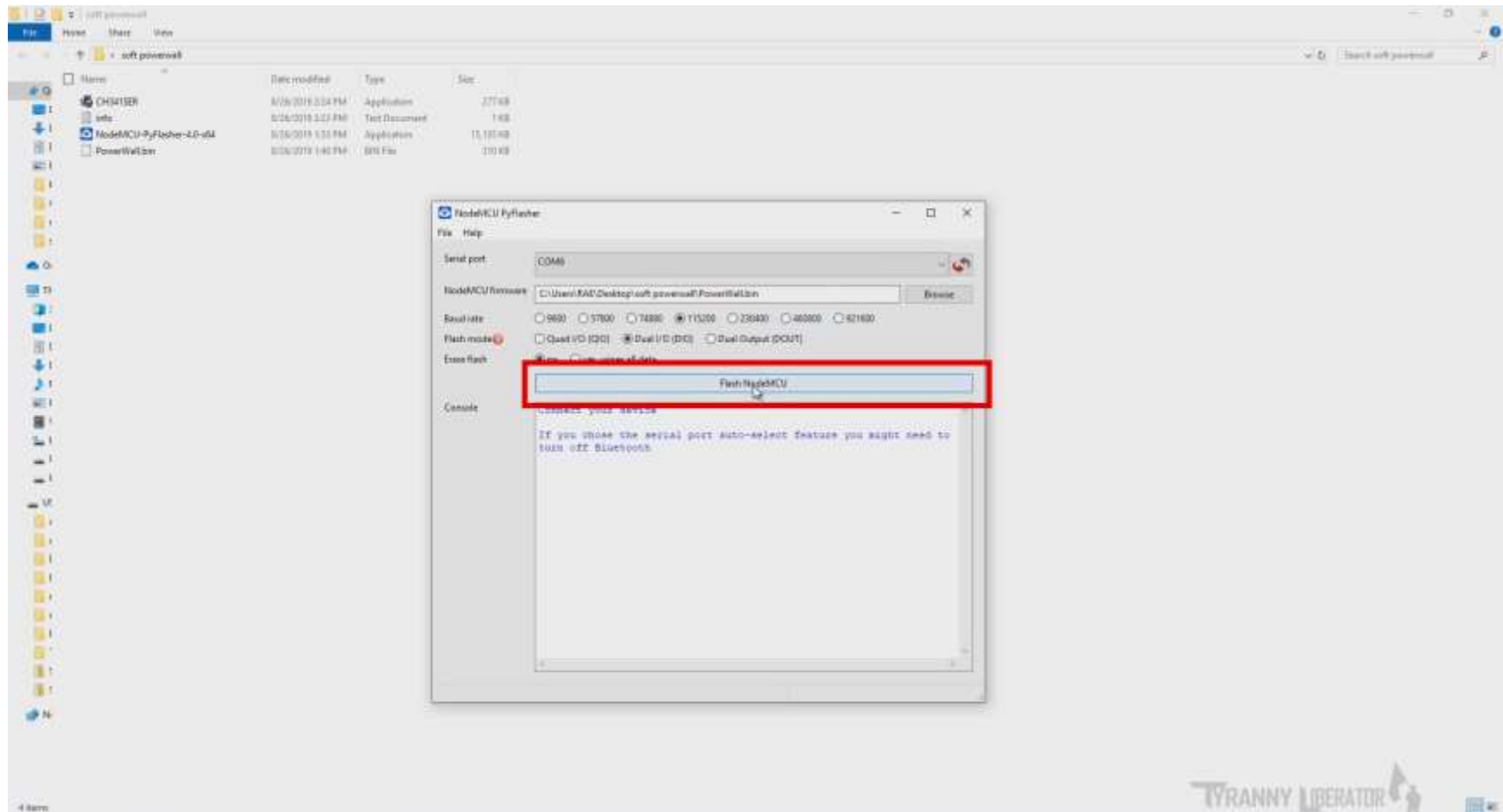


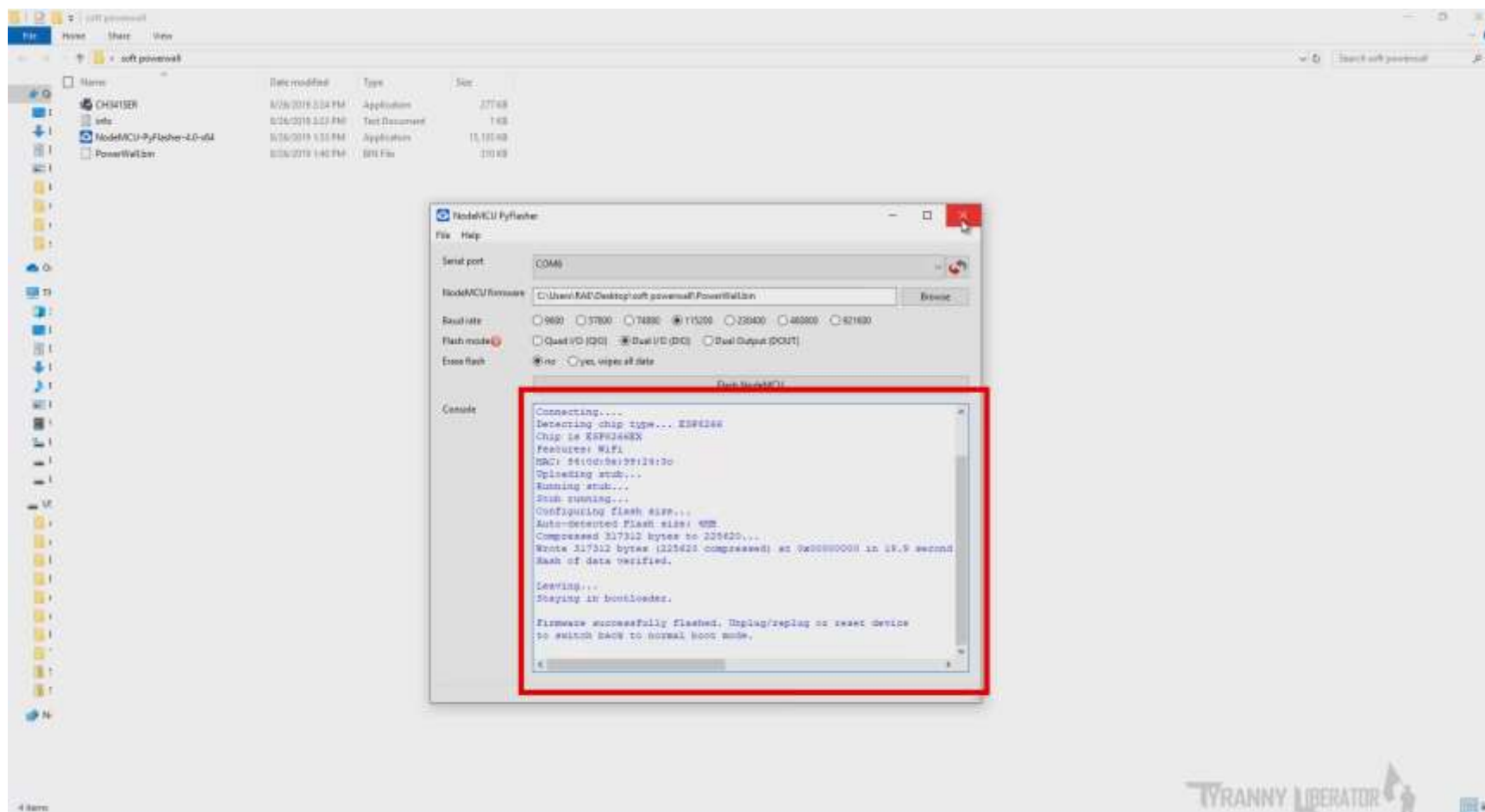


Once everything is set, click on the button called “Flash NodeMCU”.

The code is now written on the device.

You can unplug and plug the usb cable so the device is reset. After a few seconds, you should be able to login to the device.



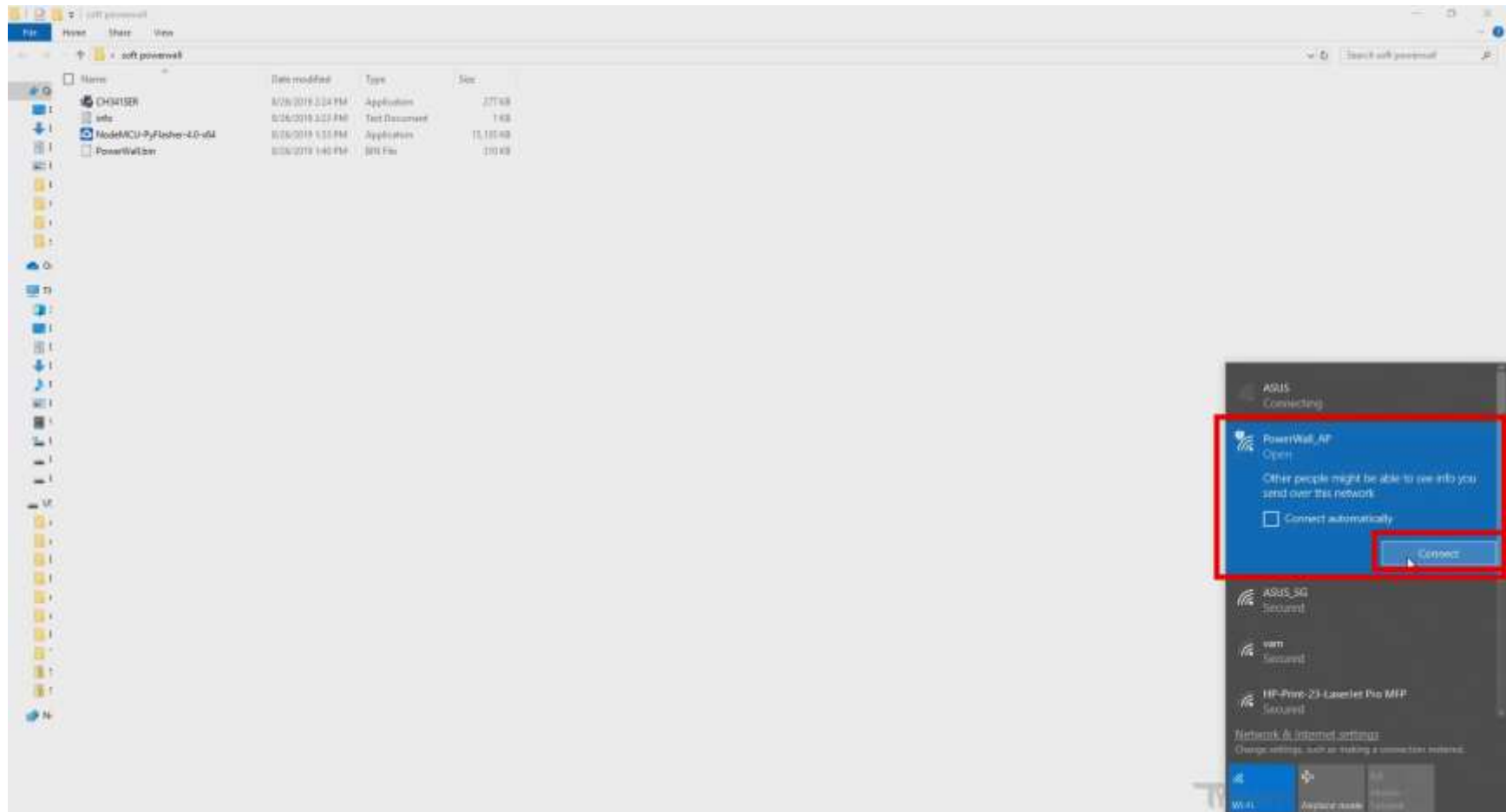


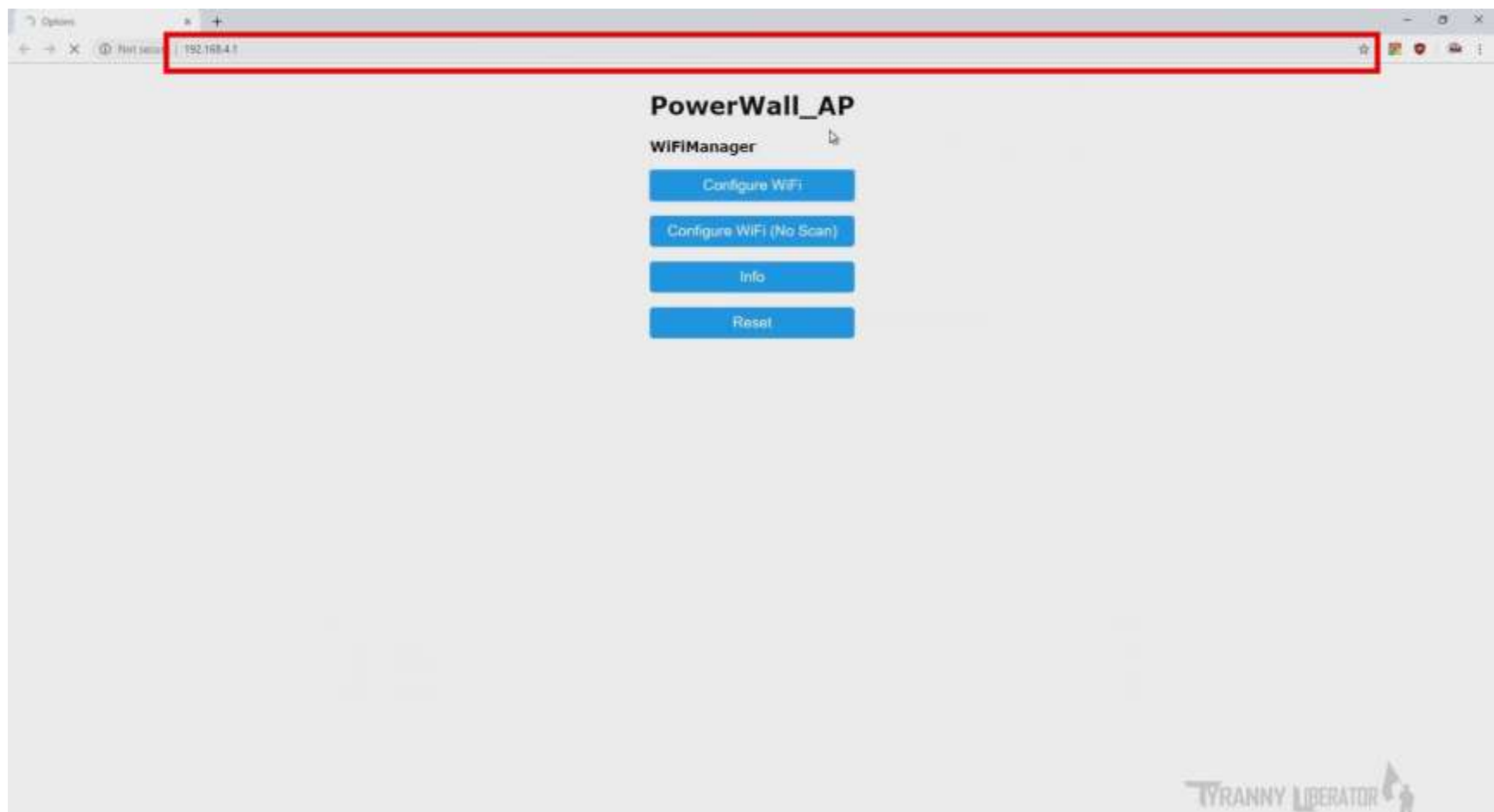
WiFi set-up:

In order to access the device in your network, you must connect to it and set the WiFi credentials from your router.

You can perform this step on a phone or laptop with wireless access.

Go to WiFi Connections and look for PowerWall_AP and choose to connect to it. Usually you will get redirected to a configuration page after it's connected. If that's not happening, open an internet browser and type this address: <http://192.168.4.1>.

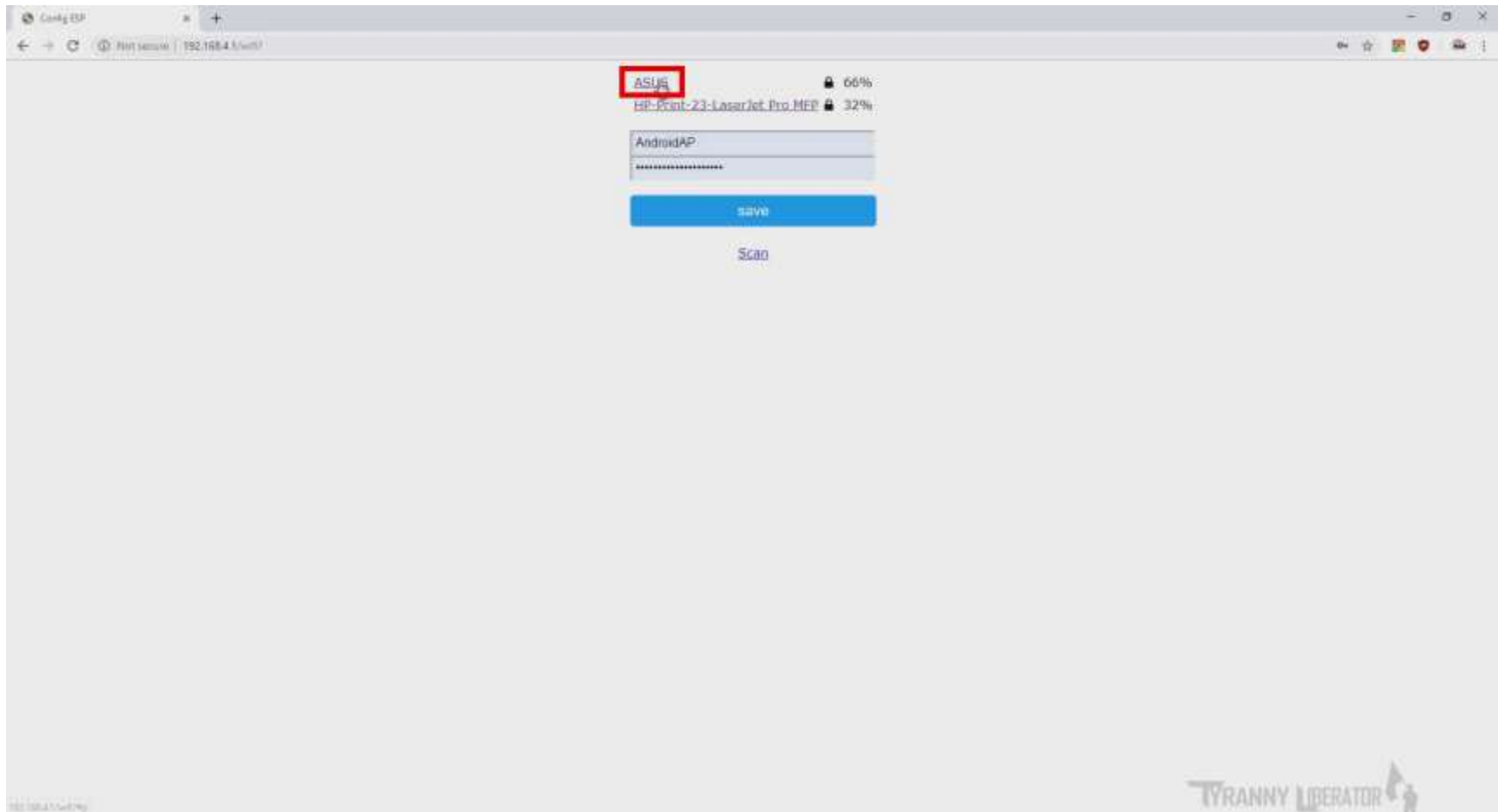




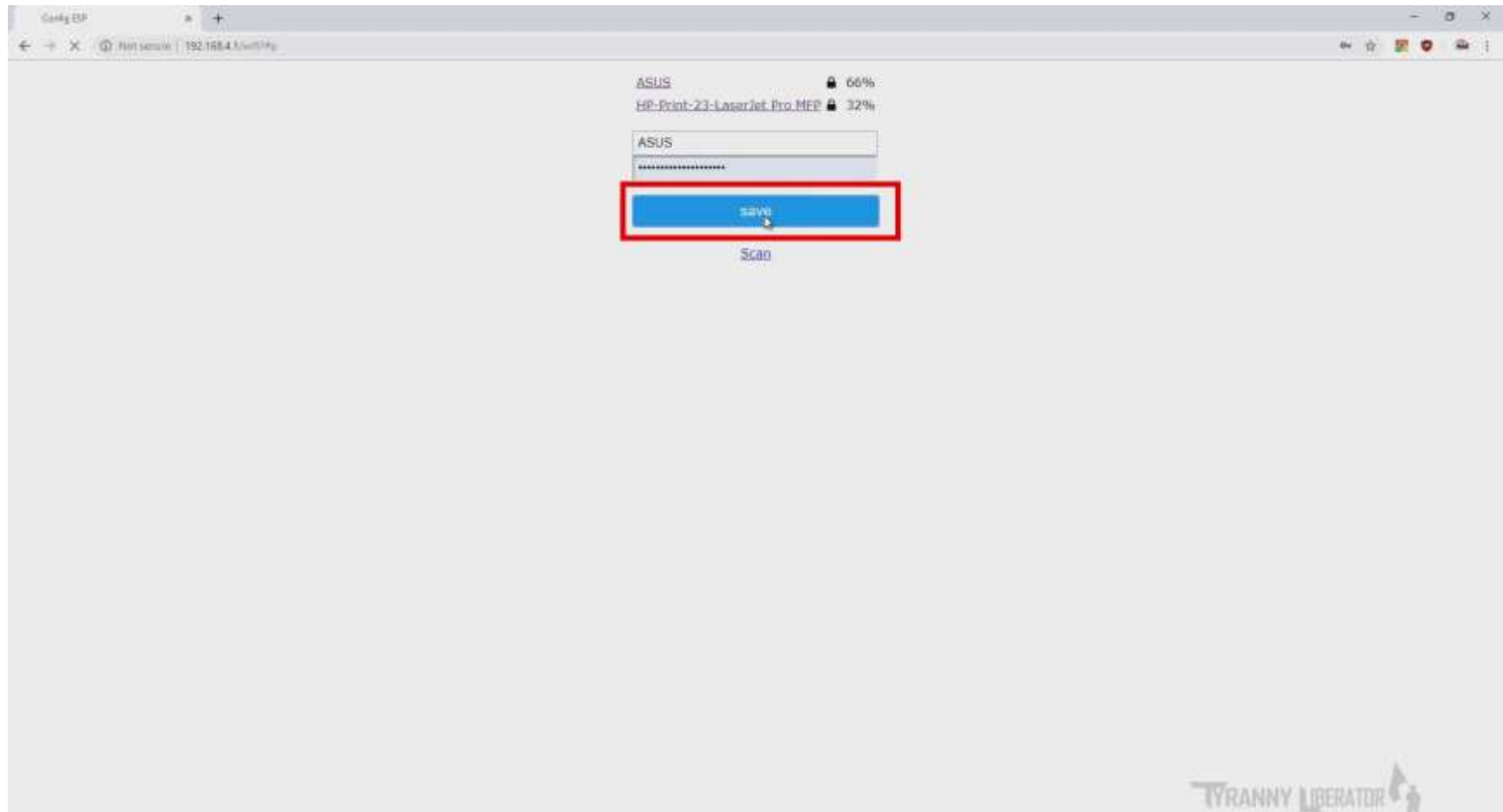
On the configuration page choose the “Configure WiFi” option.



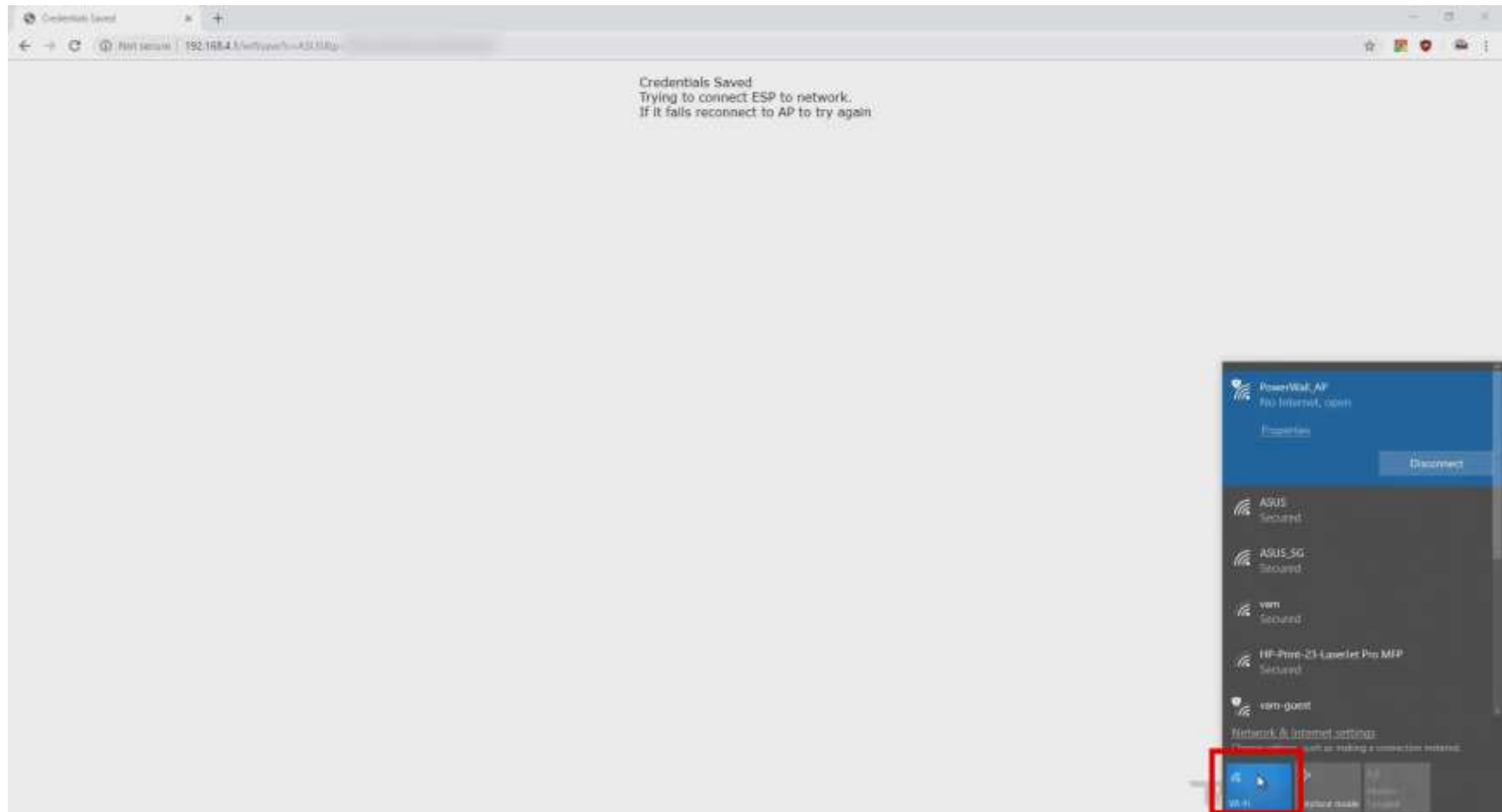
On that page, you will see the available routers to connect to. Choose the System ID of your router by clicking on it, then input your wireless password. Mine is named ASUS.

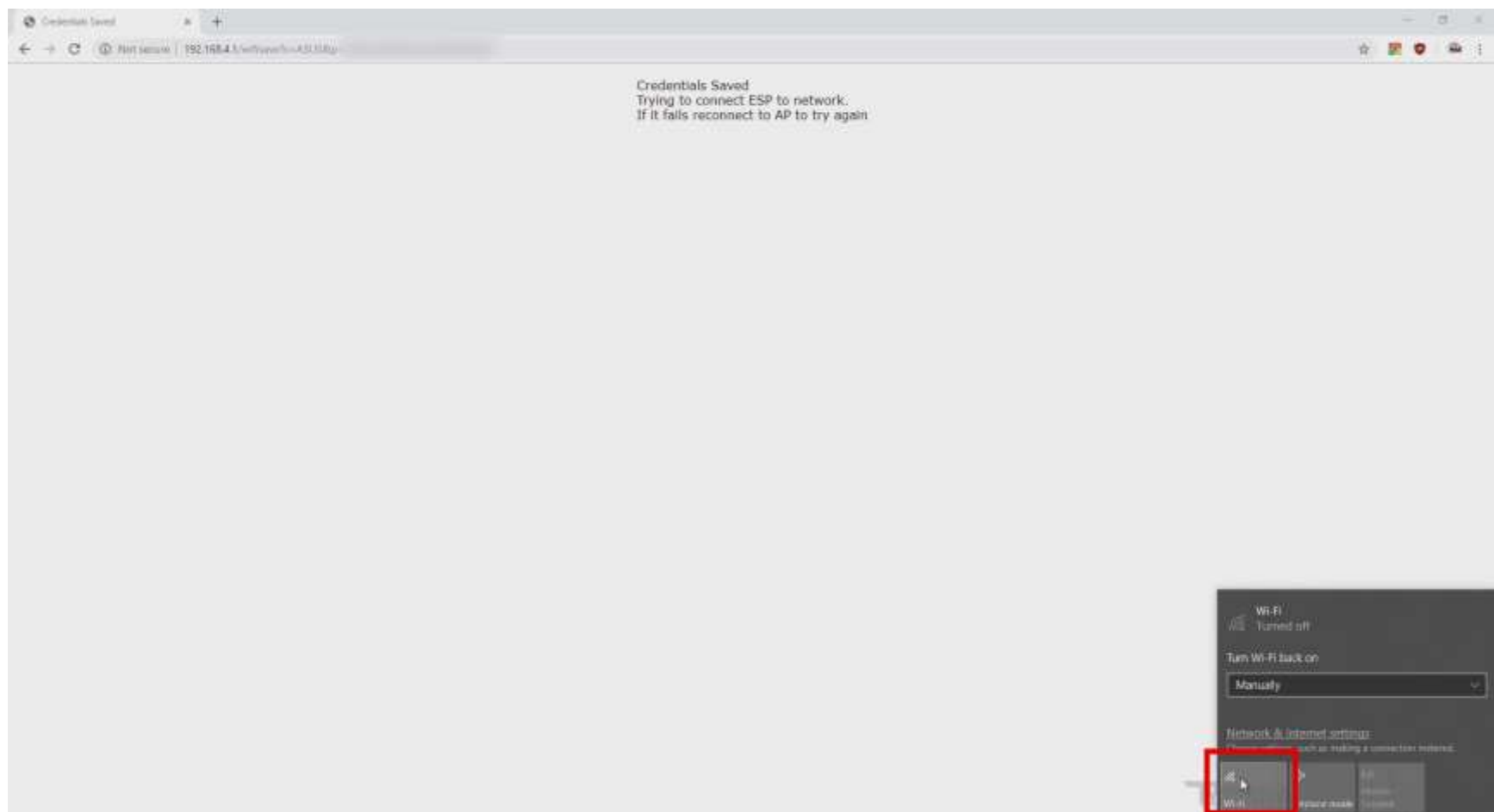


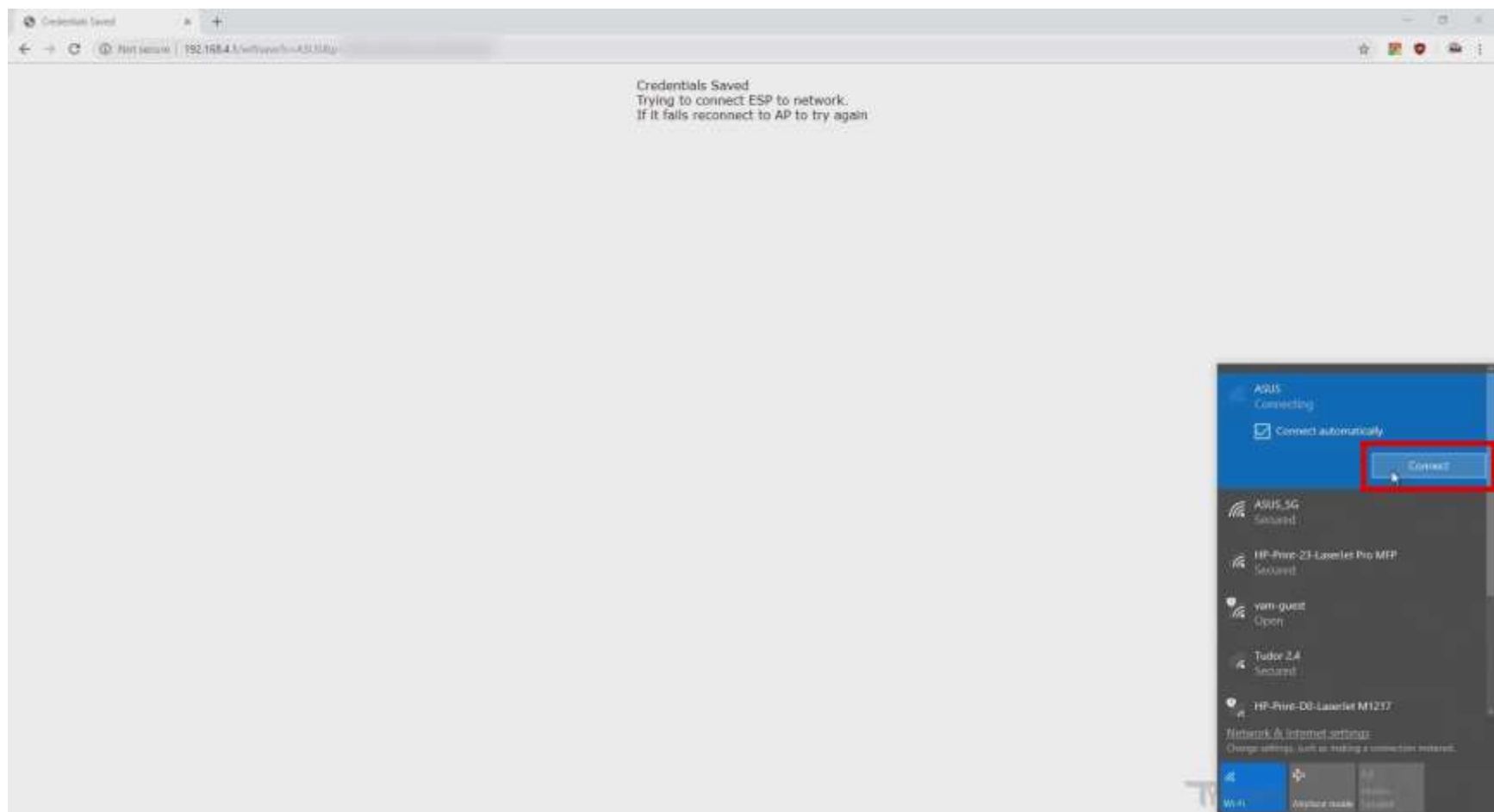
Click Save and the device will reboot and connect to your local network so you can access it from a phone or computer easily.

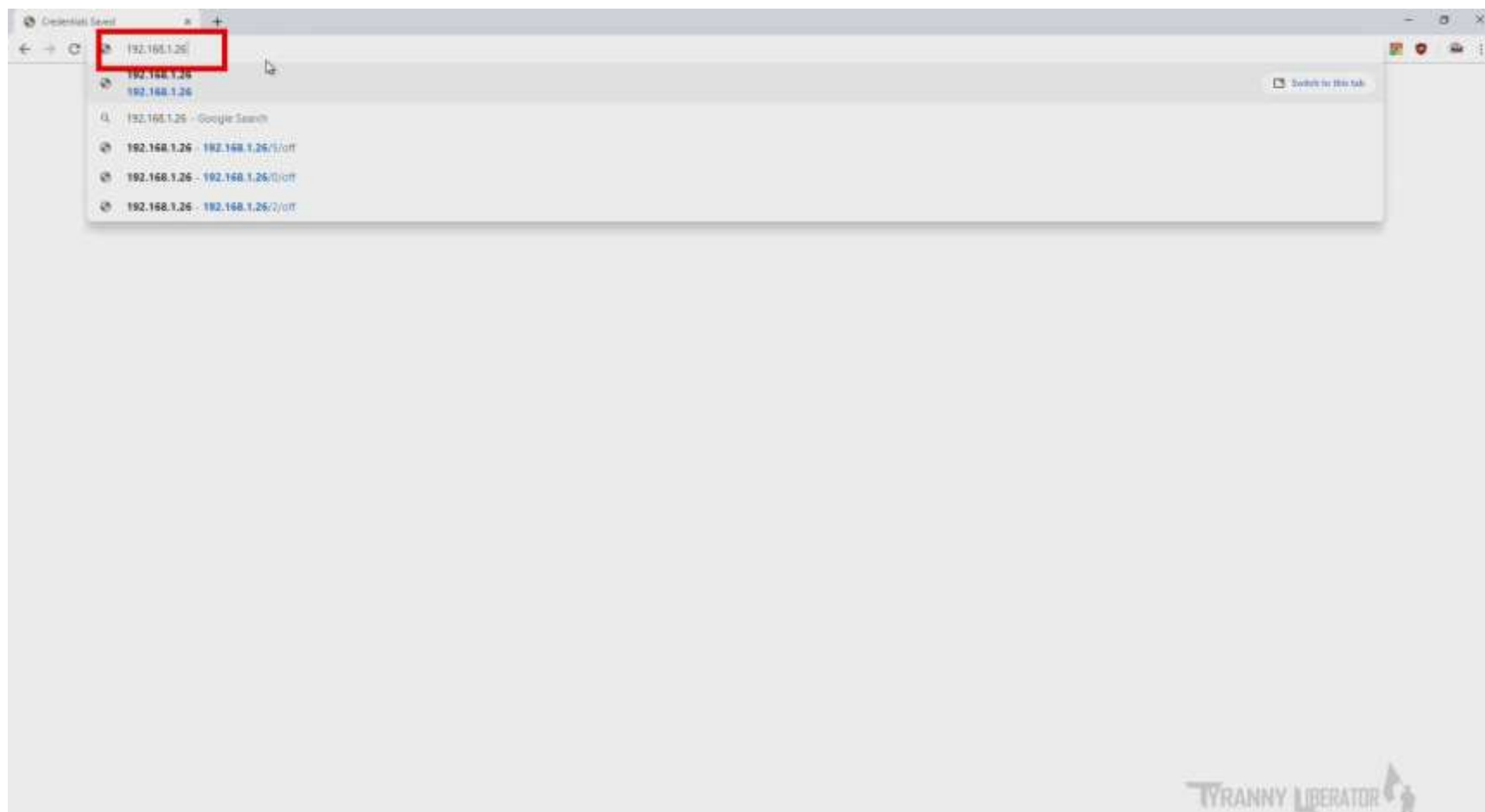


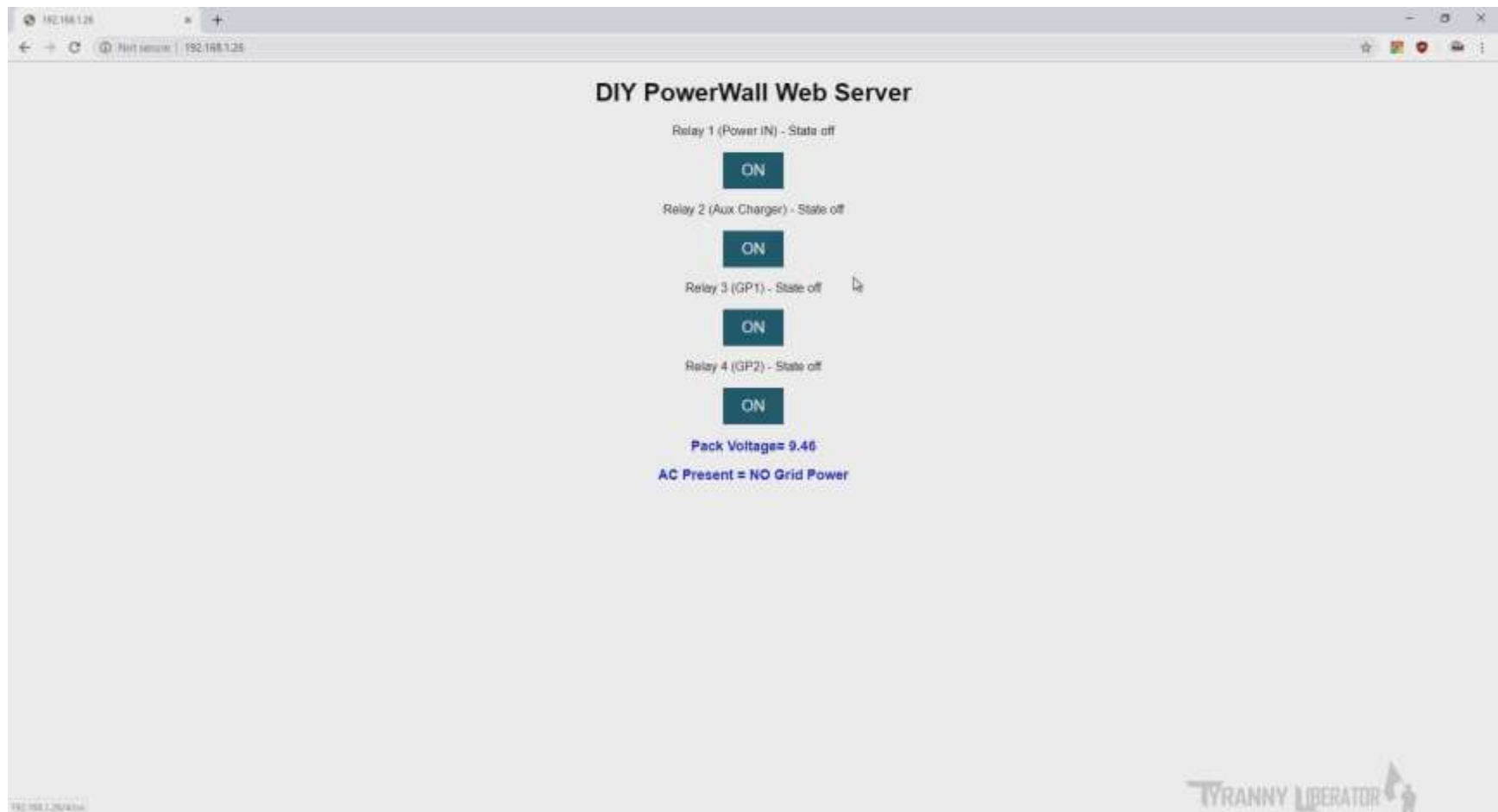
Turn WiFi off and on, connect to your main network and now you can access the IP which has been assigned automatically by your router to get the options for the powerwall.





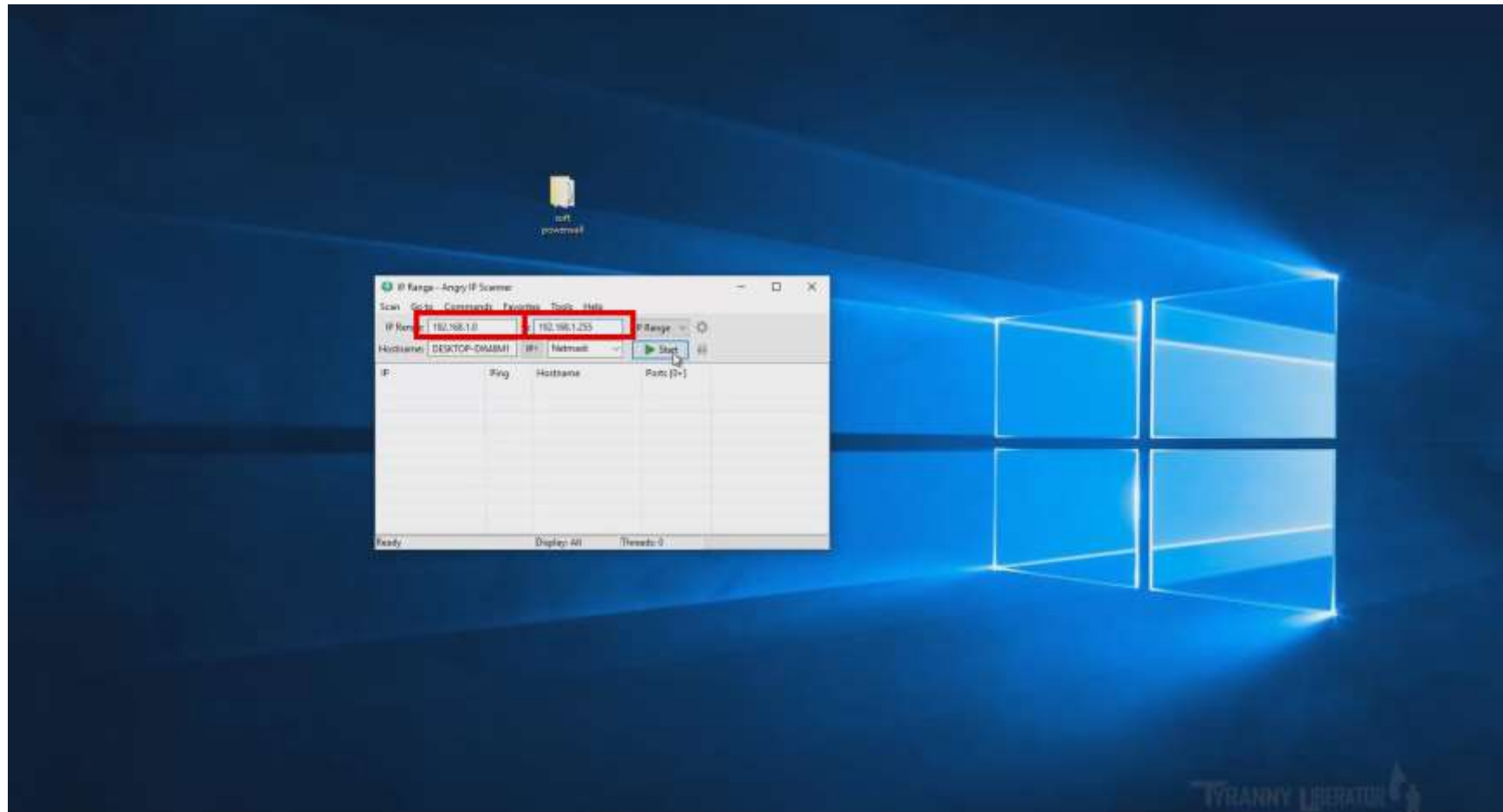


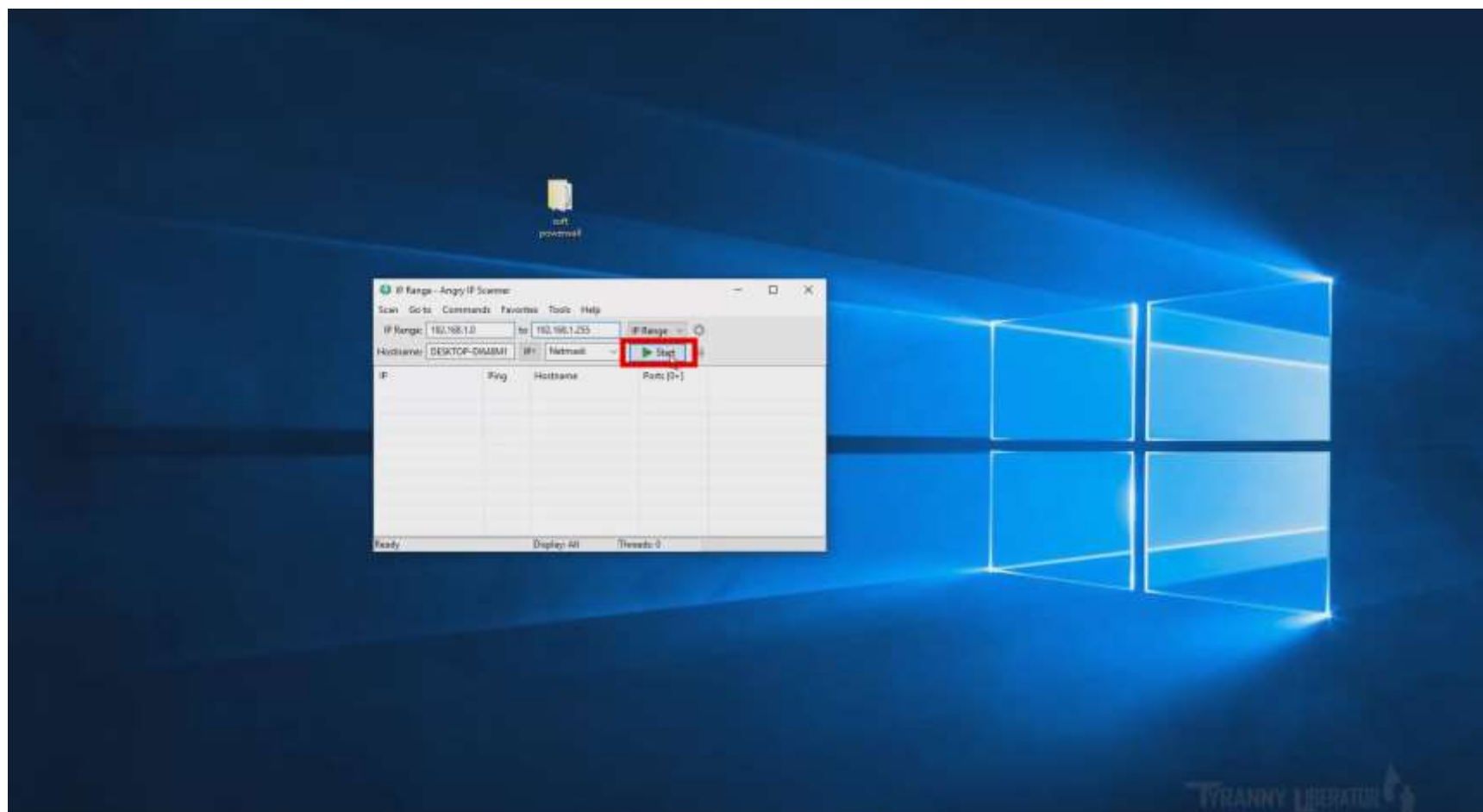


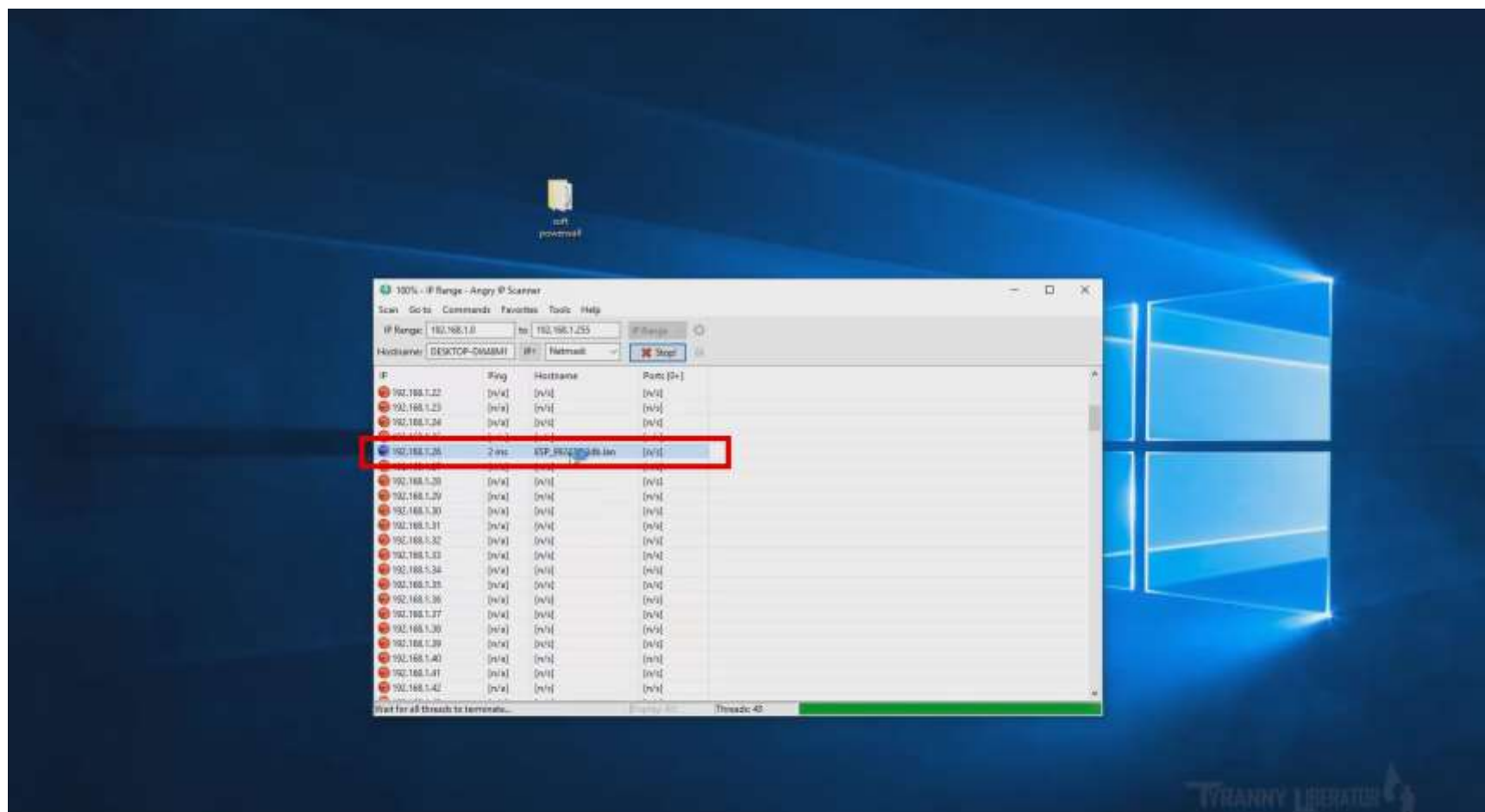


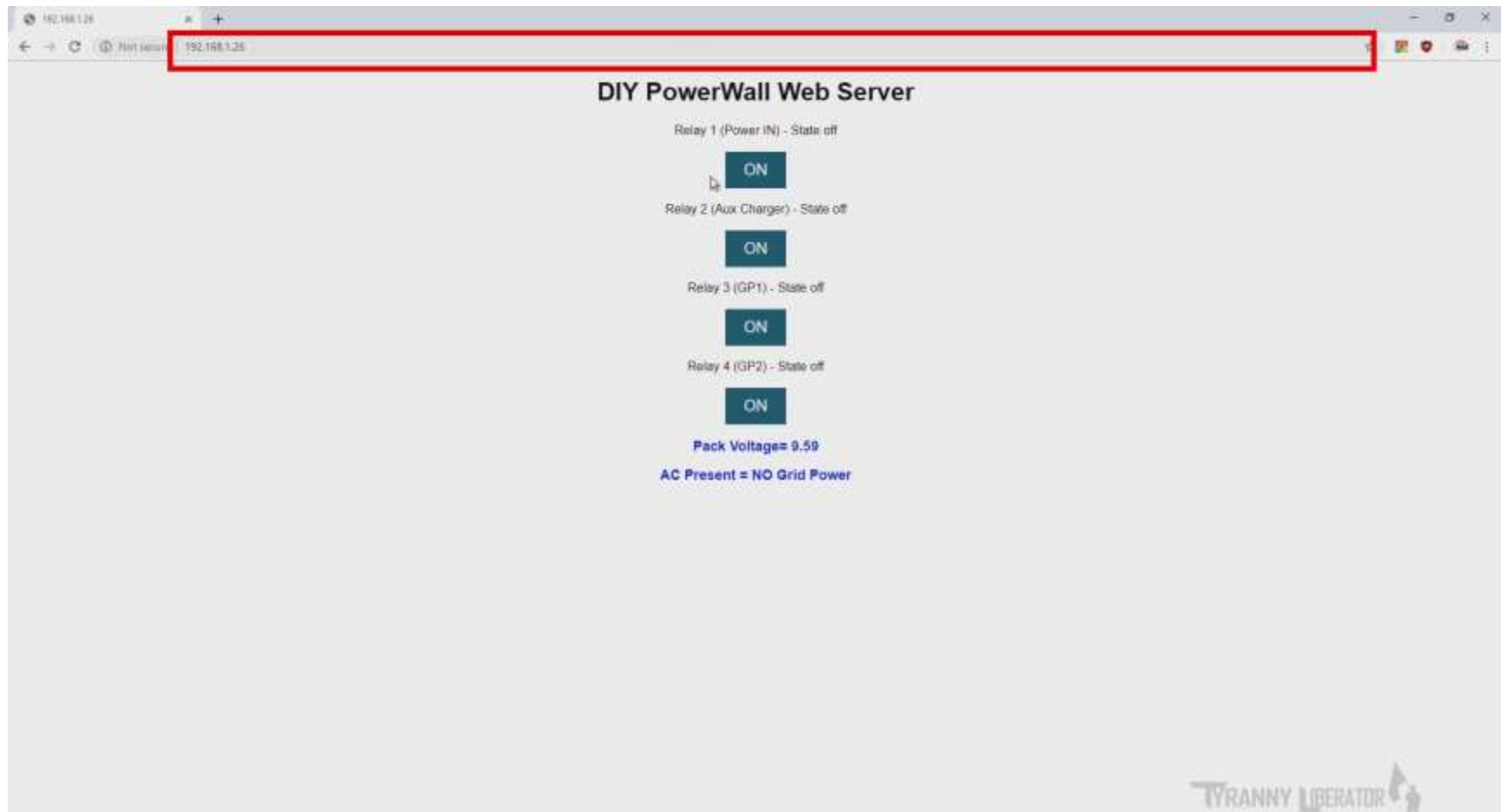
Scan for IP:

To get the IP address you can either connect to your router or check IP's of all connected devices, or you use a network scanning software that's going to list all the devices from your network.









I know that it might look overwhelming for some users, but if you pay attention and follow the video step-by-step, you should not have any problems setting this up. The nice thing is that you set it once and forget about it.

Once the brain of the unit is programmed, I place it inside the circuit that I built.