

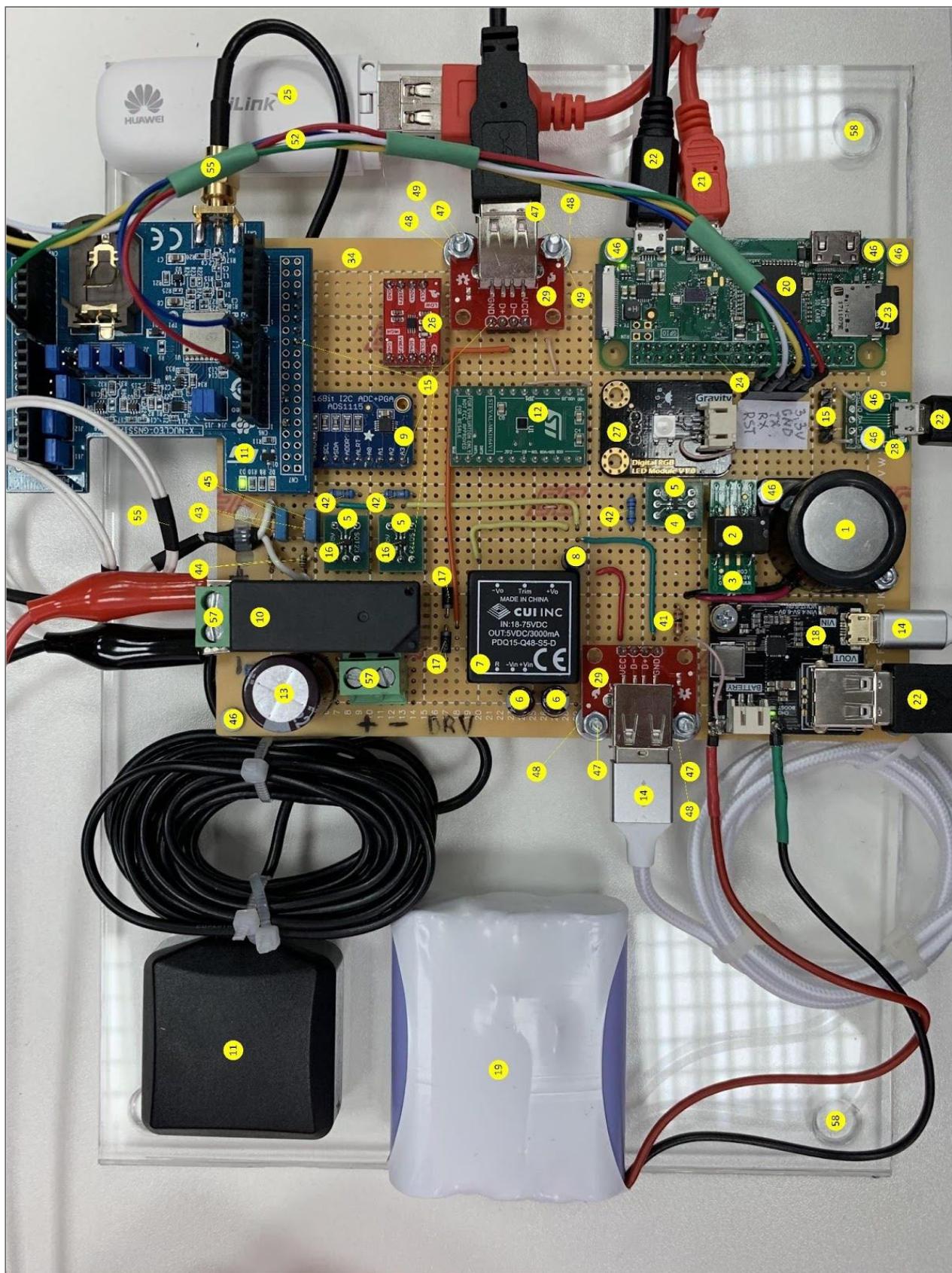


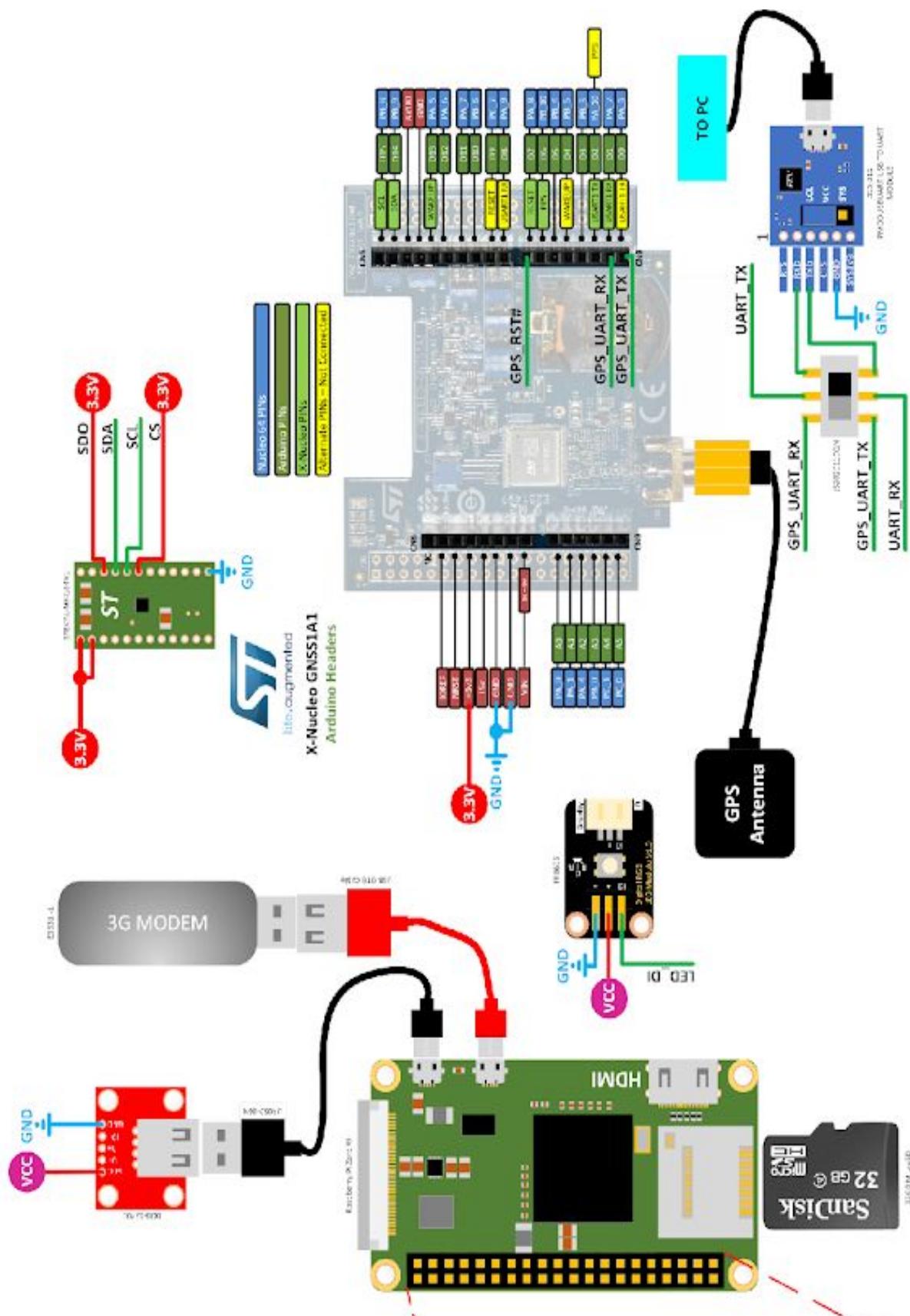
# **Open Mobility Platform**

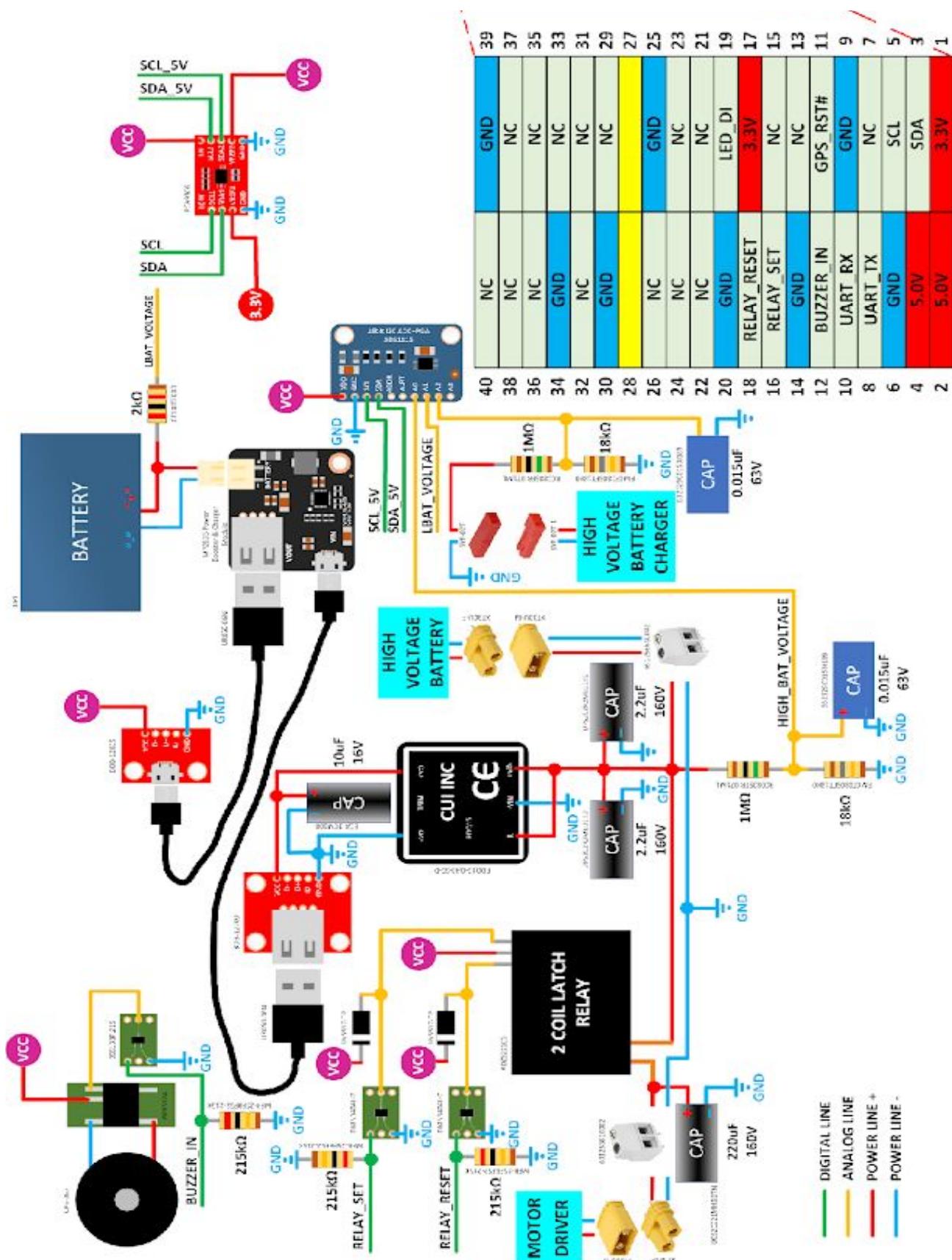
## **IoT Prototyping Guidebook**

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# Bill of Materials

Table.1 Prototype components list

|    | <b>Description</b>   | <b>Manufacturer</b> | <b>Manufacturer PN</b> | <b>Q-ty</b> |
|----|--|---------------------|------------------------|-------------|
| 1  | AUDIO PIEZO INDICATOR 6-14V CHAS   | CUI Inc.            | CPE-267                | 1           |
| 2  | DC DC CONVERTER 12V 1W   | XP Power            | ISE0512A               | 1           |
| 3  | SOP-8 TO DIP-8 SMT ADAPTER   | Chip Quik           | IPC0142                | 1           |
| 4  | MOSFET N-CH 60V 360MA TO-236AB   | Nexperia USA Inc.   | BSS138P,215            | 1           |
| 5  | SOCKET ADAPTER SOT-23 TO 6DIP  | Aries Electronics   | LCQT-SOT23-6           | 3           |
| 6  | CAP ALUM 2.2UF 20% 160V RADIAL   | Nichicon            | UPS2C2R2MED1TD         | 2           |
| 7  | Isolated Module DC DC Converter 5V 3A<br>18V - 75V Input                             | CUI Inc.            | PDQ15-Q48-S5-D         | 1           |
| 8  | CAP ALUM 10UF 20% 16V RADIAL   | Panasonic           | ECA-1CM100I            | 1           |
| 9  | ADS1115 16BIT ADC 4CH PROG GAIN  | Adafruit            | 1085                   | 1           |
| 10 | RELAY GEN PURPOSE SPST 50A 5V  | Panasonic           | ADJH23005              | 1           |
| 11 | X-NUCLEO-GNSS1A1   | STMicroelectronics  | X-NUCLEO-GNSS1A1       | 1           |
| 12 | ADAPTER BOARD LIS2HH12 DIL24   | STMicroelectronics  | STEVAL-MKI164V1        | 1           |
| 13 | CAP ALUM 220UF 20% 160V RADIAL   | Nichicon            | 493-13277-3-ND         | 1           |
| 14 | USB 2.0 Cable A Male to Micro B Male 0.50'   | Tripp Lite          | UR050-06N              | 2           |
| 15 | CONN HEADER VERT 40POS 2.54MM  | Sullins             | PREC040SABN-RC         | 4           |
| 16 | MOSFET N-CH 30V 5.8A SOT-23  | Diodes Incorporated | DMN3404L-7             | 2           |
| 17 | DIODE SCHOTTKY 20V 1A DO41   | Micro Commercial Co | 1N5817-TP              | 2           |
| 18 | MP2636 Power Booster & Charger Module  | DFRobot             | DFR0446                | 1           |
| 19 | BATTERY LITHIUM 3.7V 4.4AH   | Adafruit            | 354                    | 1           |
| 20 | Raspberry Pi Zero W  | sparkfun            | Raspberry Pi Zero W    | 1           |
| 21 | USB OTG Cable - Female A to Micro B - 5in  | sparkfun            | USB OTG Cable          | 1           |
| 22 | Raspberry Pi micro-USB power cable<br>microSD Card with Adapter - 32GB<br>(Class 10) | reichelt            | AK67421-0.5            | 2           |
| 23 |  | sparkfun            | 32GB MicroSD           | 1           |
| 24 | CONN HEADER VERT 40POS 2.54MM  | Amphenol ICC (FCI)  | 67997-240HLF           | 1           |
| 25 | 3G GSM modem Huawei E3531i-1   | Huawei              | E3531i-1               | 1           |
| 26 | SPARKFUN LEVEL TRANSLATOR BREAKOUT - PCA9306   | sparkfun            | PCA9306                | 1           |
| 27 | Gravity: Digital RGB LED Module  | dfrobot             | FR0605                 | 1           |
| 28 | SparkFun microB USB Breakout   | sparkfun            | BOB-12035              | 1           |
| 29 | SparkFun USB Type A Female Breakout  | sparkfun            | BOB-12700              | 2           |
| 30 | Slide Switch DPDT Through Hole   | C&K                 | JS202011CQN            | 1           |
| 31 | DC supply male plug  | AMASS               | AMASS XT30U-M          | 2           |

|    |  |                           |   |    |
|----|--|---------------------------|---|----|
| 32 | DC supply female plug                                      | AMASS                     | AMASS XT30U-F                             | 2  |
| 33 | PMODUSUART USB TO UART MODULE                              | Digilent, Inc.            | 410-212                                   | 1  |
| 34 | BREADBOARD GENERAL PURPOSE PTH                             | SCI                       | PC-01LAM                                  | 1  |
| 35 | Black colored power 16AWG lead cable                       | STÄUBLI                   | 60.7031-21                                | 1  |
| 36 | Red colored power 16AWG lead cable                         | STÄUBLI                   | 60.7031-22                                | 1  |
| 37 | RCY receptacle housing (for pin contact)                   | JTS                       | SYR-02T                                   | 1  |
| 38 | RCY plug housing (for socket contact)                      | JTS                       | SYP-02T-1                                 | 1  |
| 39 | RCY pin contact  | JTS                       | SYM-001T-P0.6(N)<br>SYF-001T-P0.6(LF)(SN) | 2  |
| 40 | RCY socket contact   | JTS                       | )   | 2  |
| 41 | RES 2K OHM 1/4W 5% AXIAL                                   | Stackpole                 | CF14JT2K00                                | 1  |
| 42 | RES 215K OHM 1/4W 1% AXIAL                                 | Yageo                     | MFR-25FBF52-215K                          | 3  |
| 43 | RES 18K OHM 1/4W 1% AXIAL                                  | Stackpole                 | RNMF14FTC18K0                             | 2  |
| 44 | RES 1M OHM 1/4W 1% AXIAL                                   | Stackpole                 | RNF14FTD1M00                              | 2  |
| 45 | CAP FILM 0.015UF 5% 63VDC RADIAL                           | EPCOS (TDK)               | B32529C0153J189                           | 2  |
| 46 | M3 Pan Head Machine Screw Phillips<br>Drive Nylon          | Wurth<br>Electronics Inc. | 97790603111                               | 16 |
| 47 | M3 Pan Head Machine Screw Phillips<br>Drive Nylon          | Essentra<br>Components    | NMS-310                                   | 6  |
| 48 | M3 Flat, Retaining Washer 0.055"<br>(1.40mm) Thick Plastic | Essentra<br>Components    | 015003000503                              | 16 |
| 49 | M3 Hex Nut 0.217" (5.50mm) Nylon                           | Wurth<br>Electronics Inc. | 709940300                                 | 16 |
| 50 | Hex Standoff Threaded M3 Nylon 0.394"<br>(10.00mm) Natural | Keystone<br>Electronics   | '25510                                    | 4  |
| 51 | uxcell AWG30 1000.7FT Breadboard<br>Wrapping Wire          | uxcell                    | AWG30                                     | 1  |
| 52 | Jumper Wires Standard 7" M/M - 30 AWG<br>(30 Pack)         | sparkfun                  | Jumper Wires                              | 2  |
| 53 | Heavy Duty Mounting Tape Clear                             | Amazon                    | VHB                                       | 1  |
| 54 | Multi-Purpose Cable Tie (100 Piece), 8",<br>Black          | TR                        | TR88302                                   | 1  |
| 55 | HEATSHRINK 3/16 IN X 4FT BLACK                             | Alpha Wire                | F22IB3/16 BK100                           | 1  |
| 56 | HEATSHRINK 3/16" X 4' RED                                  | Panduit Corp              | HSTTI9-48-Q2                              | 1  |
| 57 | TERM BLK 2P SIDE ENT 10.16MM PCB                           | Wurth<br>Electronics Inc. | 691256610002                              | 2  |
| 58 | BUMPER CYLINDRICAL 0.5" DIA CLR                            | Essentra<br>Components    | RBS-6                                     | 4  |
| 59 | PCB terminal DG381-3.81-02P-12-00A(H)                      | DEGSON<br>ELECTRONICS     | DG381-3.81-02P-12-0<br>0A(H)              | 1  |

## 1. High Power Switch Assembly

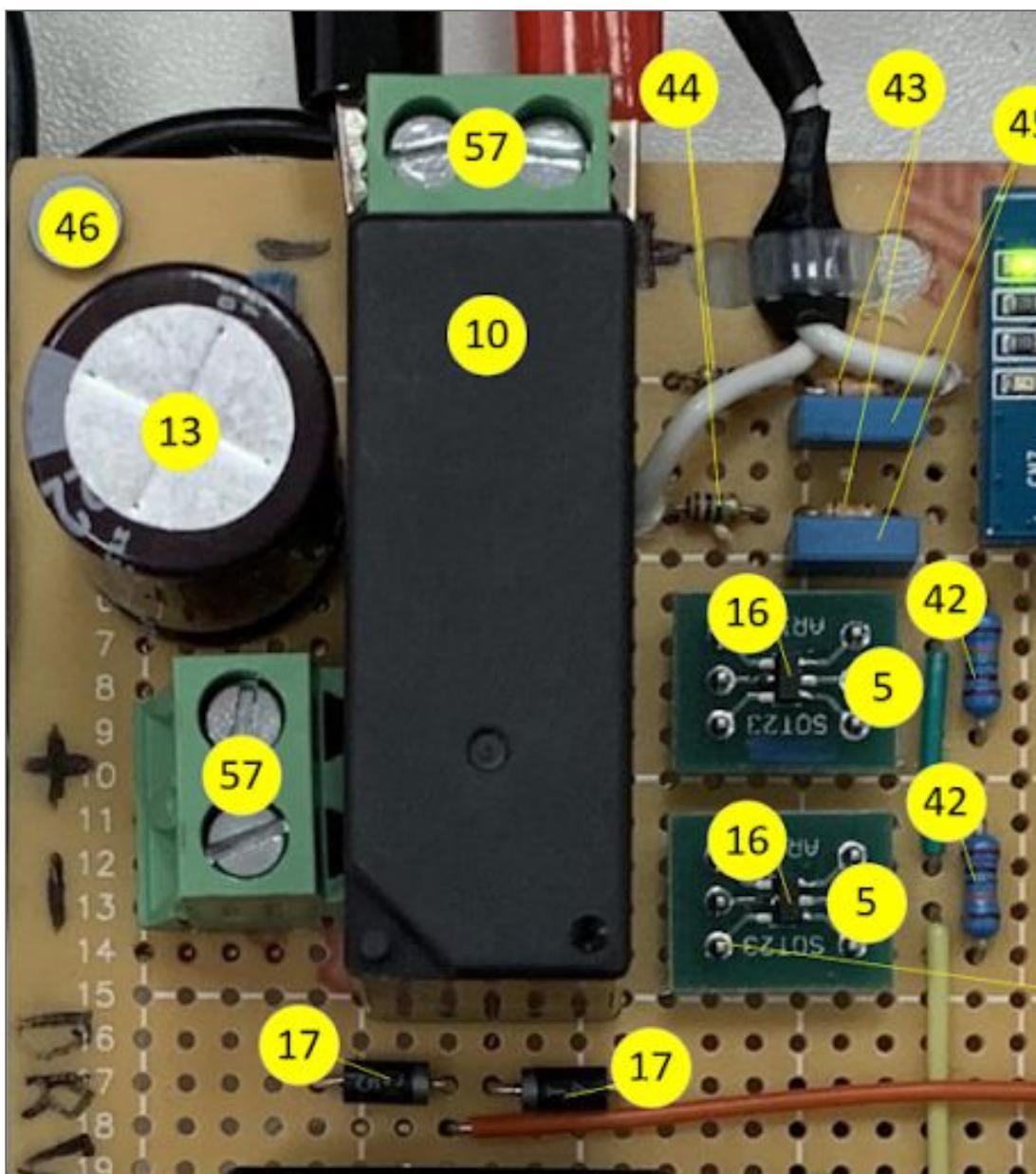


Figure 4. High power switch prototype view

All components in Table.1 mount and solder as shown on the Figure 4.

*Table 2. High power switch main components*

| Number | Description                          | Company                | Part number       | Quantity |
|--------|--------------------------------------|------------------------|-------------------|----------|
| 5*     | SOCKET ADAPTER SOT-23 TO 6DIP        | Aries Electronics      | LCQT-SOT23-6      | 2        |
| 10     | RELAY GEN PURPOSE SPST 50A 5V        | Panasonic              | ADJH23005         | 1        |
| 13     | CAP ALUM 220UF 20% 160V RADIAL       | Nichicon               | 493-13277-3-ND    | 1        |
| 16     | MOSFET N-CH 30V 5.8A SOT-23          | Diodes Incorporated    | DMN3404L-7        | 2        |
| 17     | DIODE SCHOTTKY 20V 1A DO41           | Micro Commercial Co    | 1N5817-TP         | 2        |
| 42     | RES 215K OHM ¼W 1% AXIAL             | Yageo                  | MFR-25FBF52-21 5K | 2        |
| 57     | TERM BLK 2P SIDE ENT 10.16MM PCB     | Wurth Electronics Inc. | 691256610002      | 2        |
| 31     | DC supply male plug                  | AMASS                  | AMASS XT30U-M     | 1        |
| 32     | DC supply female plug                | AMASS                  | AMASS XT30U-F     | 1        |
| 35     | Black colored power 16AWG lead cable | STÄUBLI                | 60.7031-21        | 1        |
| 36     | Red colored power 16AWG lead cable   | STÄUBLI                | 60.7031-22        | 1        |

After components mounting, use the functional schematic on the Figure.5 for signal wires soldering

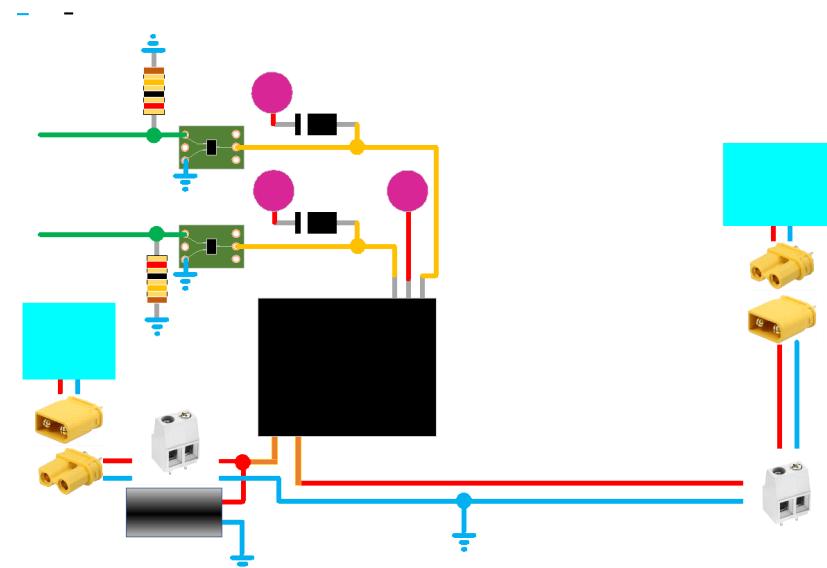


Figure.5 high power switch with connector and driver functional schematic part

## 2. Voltage Sense Assembly

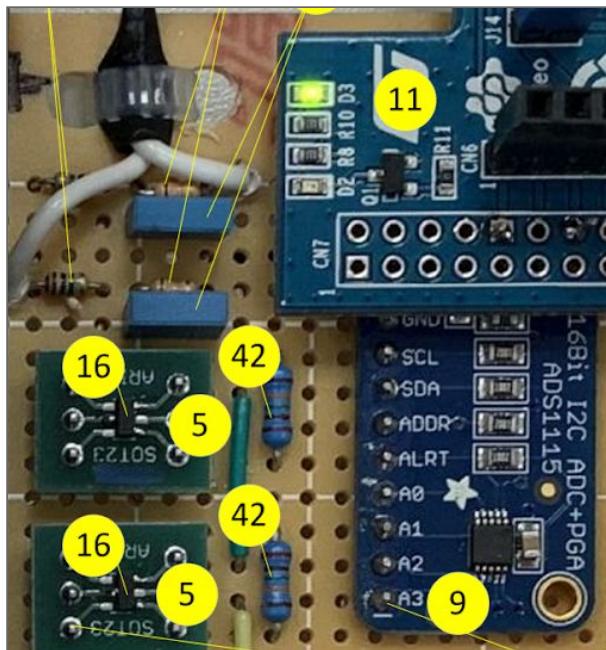


Figure.6 Voltage sense prototype view

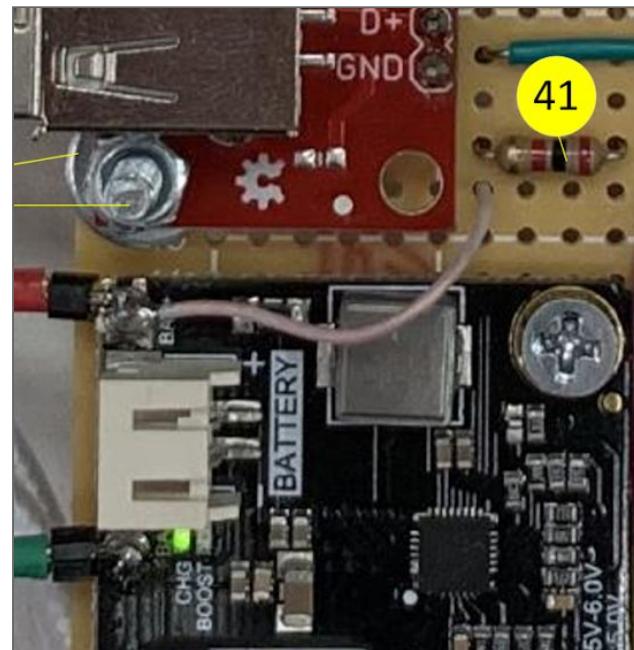


Figure.7 Voltage sense prototype view

All components in Table.2 mount and solder as shown on the Figure.6, Figure.7

Table.3 Voltage sense main components

| Number | Description                         | Company        | Part number     | Quantity |
|--------|-------------------------------------|----------------|-----------------|----------|
| 43     | RES 18K OHM 1/4W 1% AXIAL           | Stackpole      | RNMF14FTC18K0   | 2        |
| 44     | RES 1M OHM 1/4W 1% AXIAL            | Stackpole      | RNF14FTD1M00    | 2        |
| 45     | CAP FILM 0.015UF 5% 63VDC<br>RADIAL | EPCOS<br>(TDK) | B32529C0153J189 | 2        |
| 9      | ADS1115 16BIT ADC 4CH PROG<br>GAIN  | Adafruit       | 1085            | 1        |
| 41     | RES 2K OHM 1/4W 5% AXIAL            | Stackpole      | CF14JT2K00      | 1        |

After components mounting, use the functional schematic on the Figure.8 for signal wires soldering

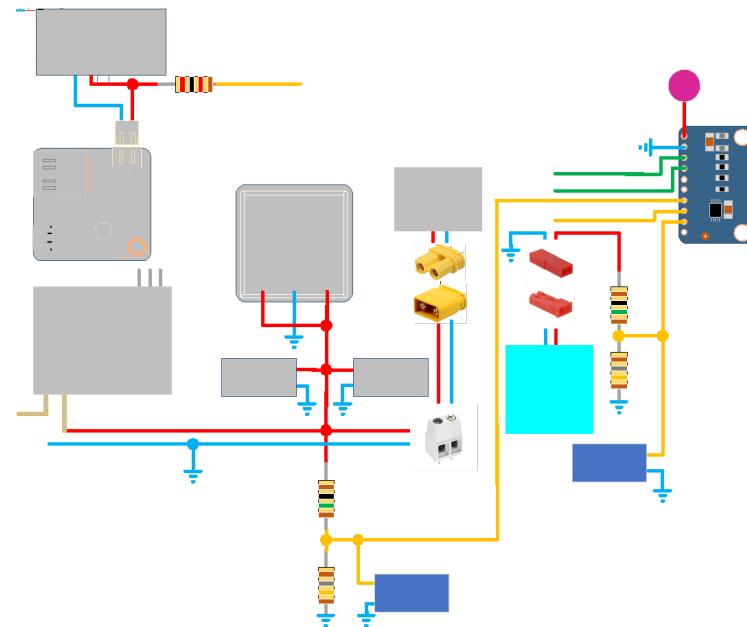


Figure.8 voltage sense functional schematic part

### 3. High Voltage DCDC Assembly

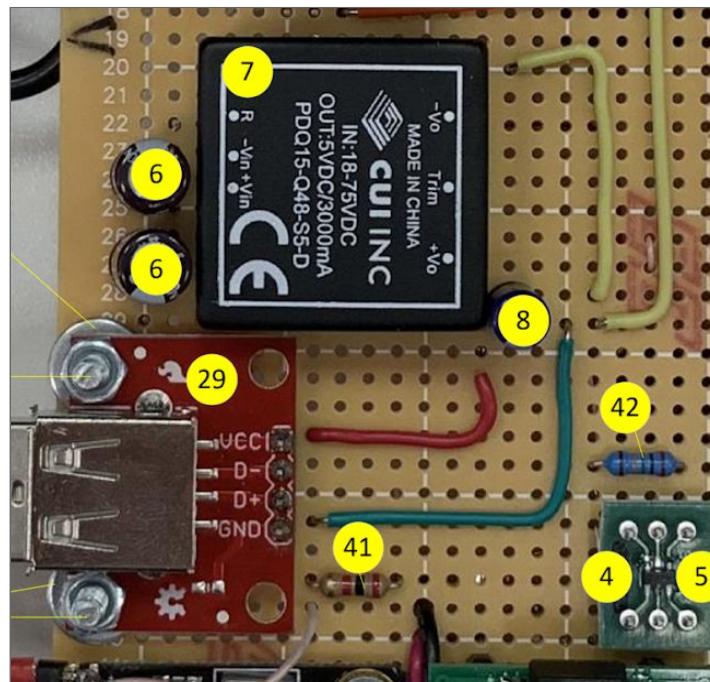


Figure.9 High voltage DCDC prototype view

All components in Table.3 mount and solder as shown on the Figure.9

Table.4 High voltage DCDC main components

| Number | Description  | Company                      | Part number    | Quantity |
|--------|--|------------------------------|----------------|----------|
| 7      | Isolated Module DC DC Converter 5V<br>3A 18V - 75V Input   | CUI Inc.                     | PDQ15-Q48-S5-D | 1        |
| 6      | CAP ALUM 2.2UF 20% 160V RADIAL                             | Nichicon                     | UPS2C2R2MED1TD | 2        |
| 8      | CAP ALUM 10UF 20% 16V RADIAL                               | Panasonic                    | ECA-1CM100I    | 1        |
| 15     | CONN HEADER VERT 40POS 2.54MM                              | Sullins                      | PREC040SABN-RC | 1        |
| 29     | SparkFun USB Type A Female<br>Breakout                     | sparkfun                     | BOB-12700      | 1        |
| 47     | M3 Pan Head Machine Screw Phillips<br>Drive Nylon          | Essentra<br>Components       | NMS-310        | 2        |
| 48     | M3 Flat, Retaining Washer 0.055"<br>(1.40mm) Thick Plastic | Essentra<br>Components       | 015003000503   | 4        |
| 49     | M3 Hex Nut 0.217" (5.50mm) Nylon                           | Wurth<br>Electronics<br>Inc. | 709940300      | 2        |
| 14     | USB 2.0 Cable A Male to Micro B Male<br>0.50'              | Tripp Lite                   | UR050-06N      | 1        |

After components mounting, use the functional schematic on the Figure.10 for signal wires soldering

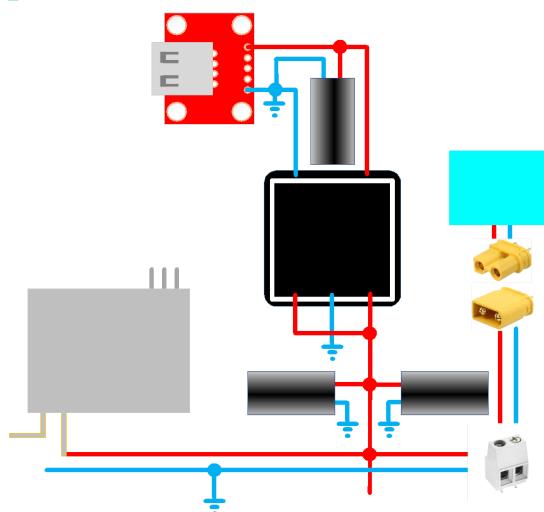


Figure.10 High voltage DCDC functional schematic part

## 4. Buzzer driver assembly

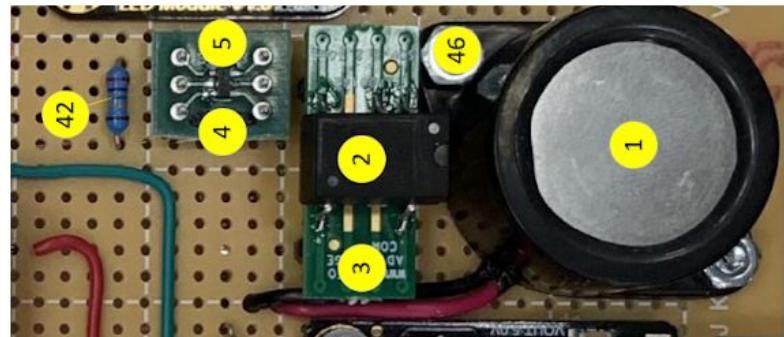


Figure.11 Buzzer driver

All components in Table.4 mount and solder as shown on the Figure.11

Table.5 Buzzer driver main components

| Number | Description                                    | Company                | Part number  | Quantity |
|--------|--|------------------------|--------------|----------|
| 1      | AUDIO PIEZO INDICATOR 6-14V CHAS               | CUI Inc.               | CPE-267      | 1        |
| 2      | DC DC CONVERTER 12V 1W                         | XP Power               | ISE0512A     | 1        |
| 3      | SOP-8 TO DIP-8 SMT ADAPTER                     | Chip Quik              | IPC0142      | 1        |
| 4      | MOSFET N-CH 60V 360MA TO-236AB                 | Nexperia USA Inc.      | BSS138P,215  | 1        |
| 5      | SOCKET ADAPTER SOT-23 TO 6DIP                  | Aries Electronics      | LCQT-SOT23-6 | 1        |
| 46     | M3 Pan Head Machine Screw Phillips Drive Nylon | Wurth Electronics Inc. | 97790603111  | 2        |
| 49     | M3 Hex Nut 0.217" (5.50mm) Nylon               | Wurth Electronics Inc. | 709940300    | 2        |

After components mounting use the functional schematic on the Figure.12 for signal wires soldering

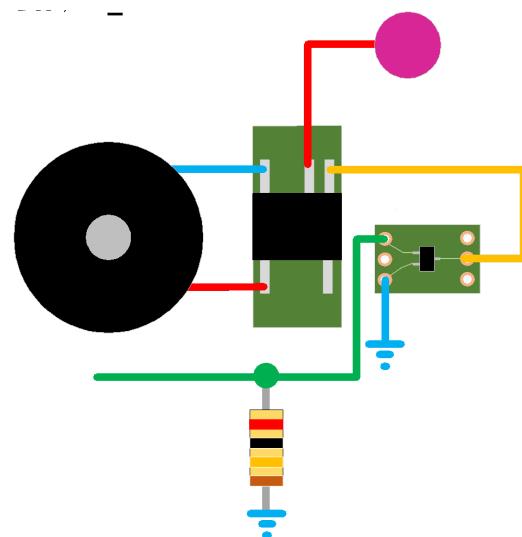
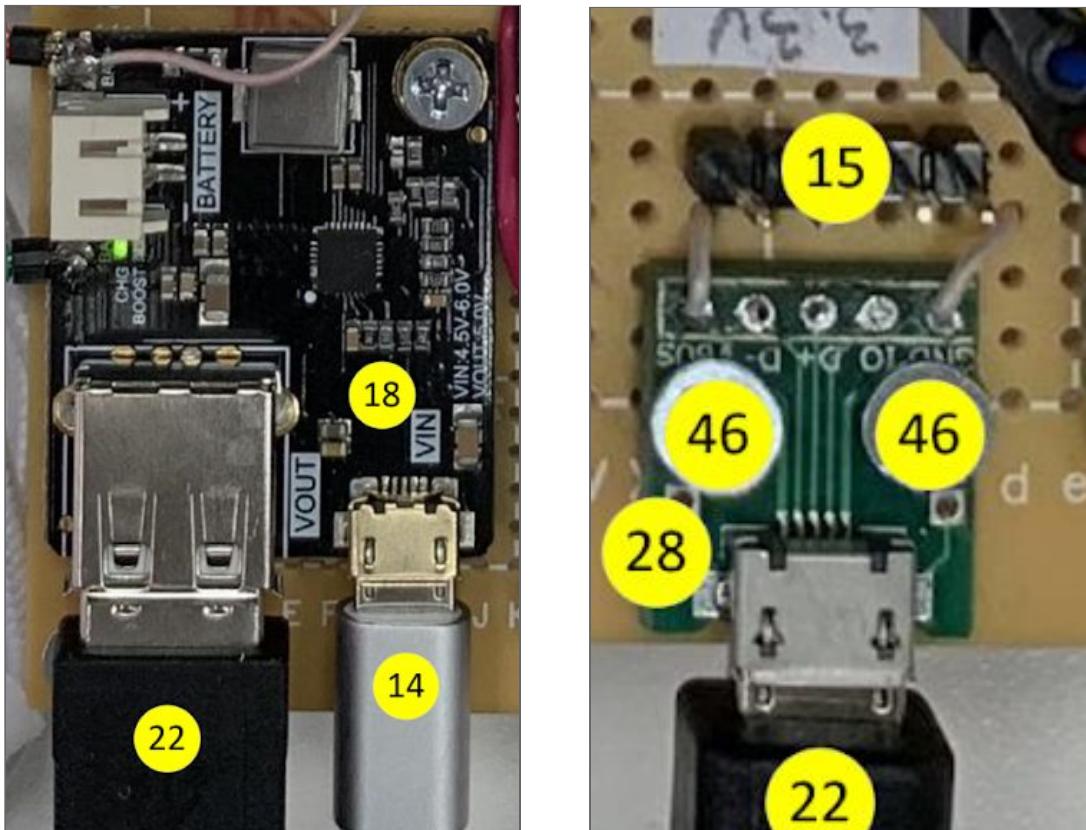


Figure. 12 Voltage sense main components

## 5. Internal Battery Controller



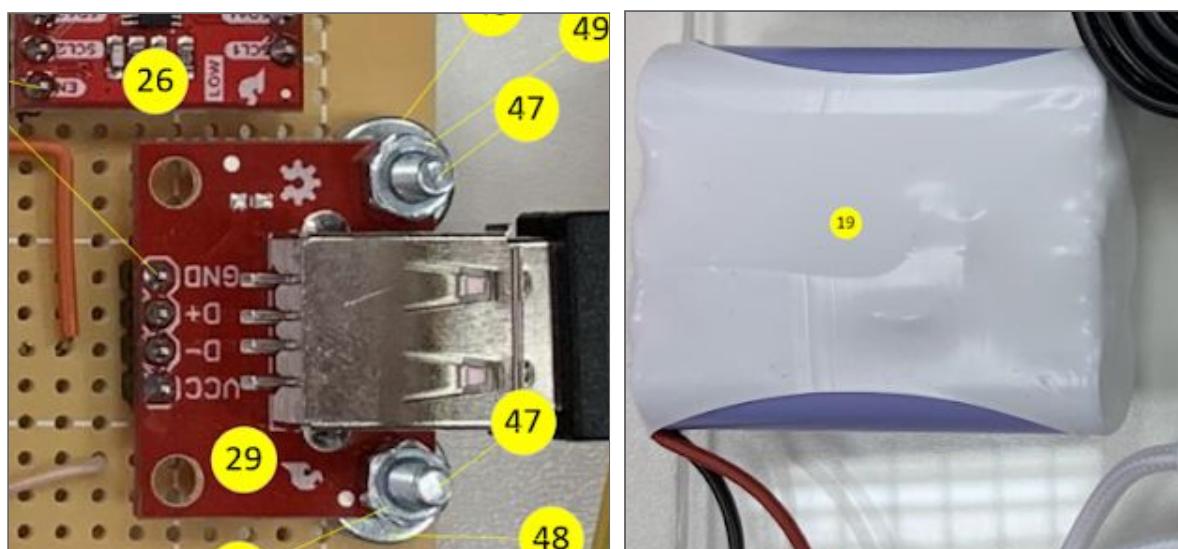


Figure.13 Internal battery controller with power connectors prototype view

All components in Table.5 mount and solder as shown on the Figure.13

Table.6 Internal battery controller components

| Number | Description   | Company                | Part number    | Quantity |
|--------|---|------------------------|----------------|----------|
| 18     | MP2636 Power Booster & Charger Module                   | DFRobot                | DFR0446        | DFRobot  |
| 28     | SparkFun microB USB Breakout                            | sparkfun               | BOB-12035      | sparkfun |
| 29     | SparkFun USB Type A Female Breakout                     | sparkfun               | BOB-12700      | sparkfun |
| 15     | CONN HEADER VERT 40POS 2.54MM                           | Sullins                | PREC040SABN-RC | Digikey  |
| 47     | M3 Pan Head Machine Screw Phillips Drive Nylon          | Essentra Components    | NMS-310        | 4        |
| 48     | M3 Flat, Retaining Washer 0.055" (1.40mm) Thick Plastic | Essentra Components    | 015003000503   | 9        |
| 49     | M3 Hex Nut 0.217" (5.50mm) Nylon                        | Wurth Electronics Inc. | 709940300      | 5        |
| 49     | M3 Hex Nut 0.217" (5.50mm) Nylon                        | Wurth Electronics Inc. | 709940300      | 1        |

After components mounting, use the functional schematic on the Figure.14 for signal wires soldering

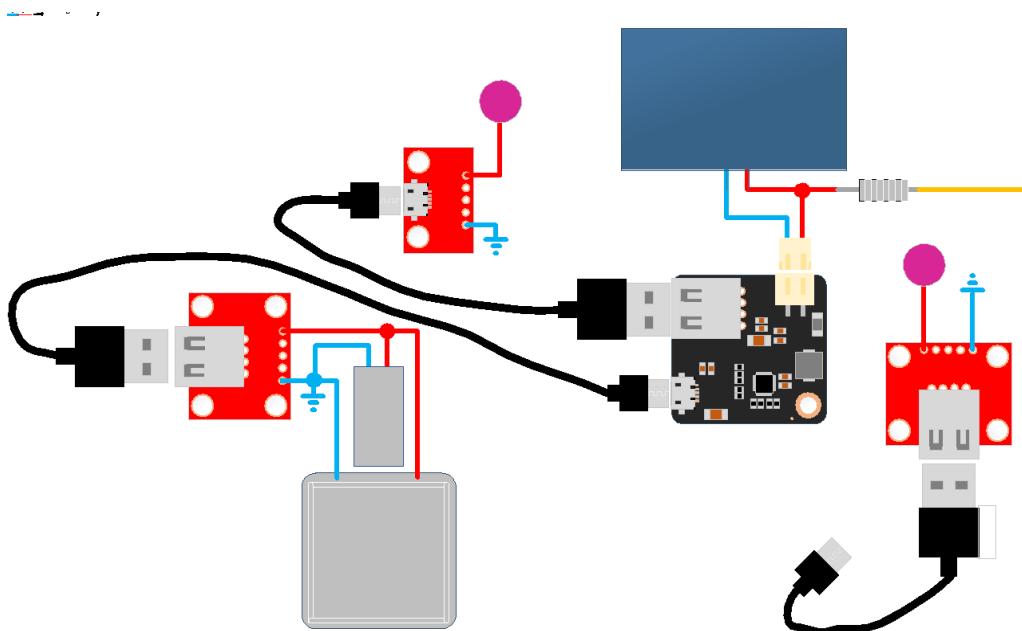


Figure. 14 Internal battery controller with connectors functional schematic part

## 6. LED Indication Assembly

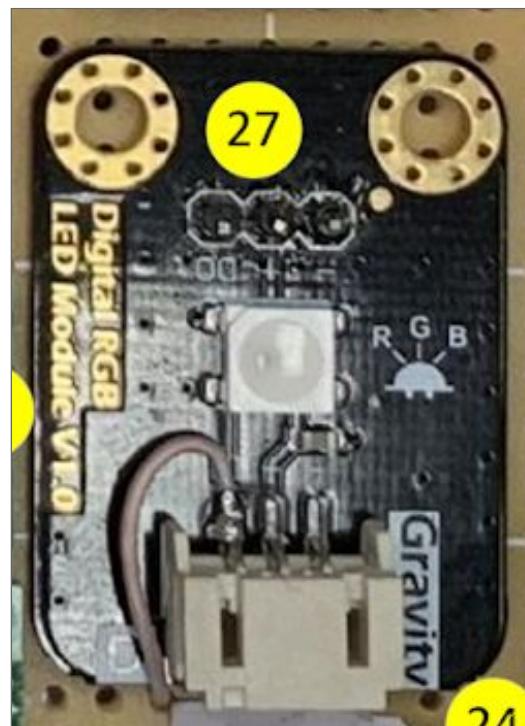


Figure. 15 LED indication module ptototype view

All components in Table.6 mount and solder as showed on the Figure.15

Table.7 LED indication components

| Number | Description                     | Company | Part number    | Quantity |
|--------|---------------------------------|---------|----------------|----------|
| 27     | Gravity: Digital RGB LED Module | dfrobot | FR0605         | 1        |
| 15     | CONN HEADER VERT 40POS 2.54MM   | Sullins | PREC040SABN-RC | 1        |

After components mounting, use the functional schematic on the Figure.16 for signal wires soldering

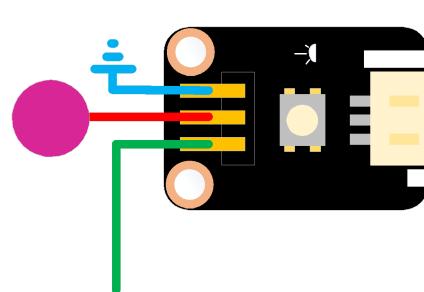


Figure. 16 LED indication module functional schematic part

## 7. Accelerometer Assembly



Figure. 17 Accelerometer module ptootype view

All components in Table.7 mount and solder as shown on the Figure.17

Table.8 Accelerometer components

| Number | Description                     | Company                | Part number     | Quantity |
|--------|---------------------------------|------------------------|-----------------|----------|
| 12     | ADAPTER BOARD LIS2HH12<br>DIL24 | STMicroelectronic<br>s | STEVAL-MKI164V1 | Digikey  |

After components mounting, use the functional schematic on the Figure.18 for signal wires soldering

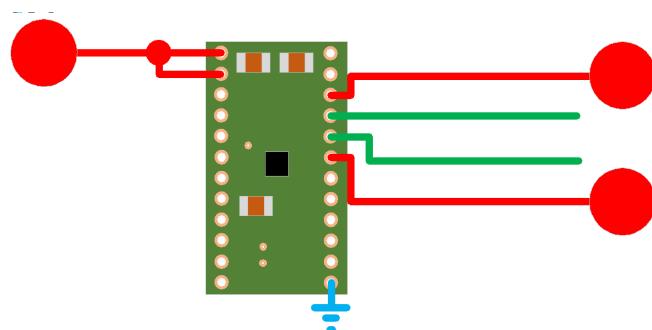


Figure. 18 LED indication module functional schematic part

## 8. GPS Module and USB UART Bridge Assembly

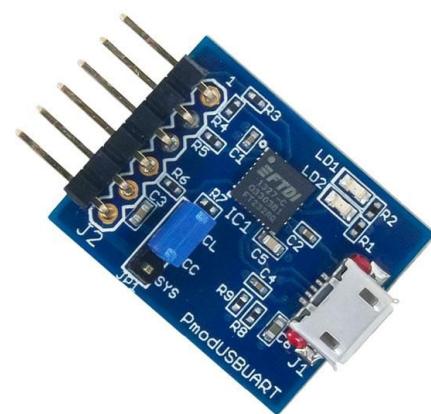
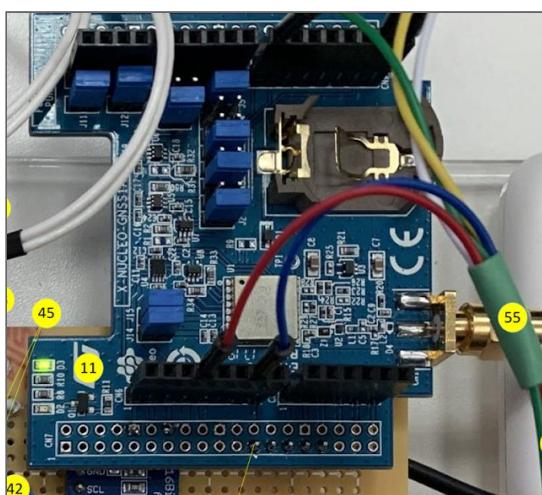


Figure.19 GPS module and USB to UART bridge prtototype view

All components in Table.7 mount and solder as shown on the Figure.19

Table.9 GPS module connection components

| Number | Description                                     | Company            | Part number          | Quantity |
|--------|---|--------------------|----------------------|----------|
| 11     | X-NUCLEO-GNSS1A1                                | STMicroelectronics | X-NUCLEO-G<br>NSS1A1 | 1        |
| 52     | Jumper Wires Standard 7" M/M - 30 AWG (30 Pack) | sparkfun           | Jumper<br>Wires      | 1        |
| 14     | USB 2.0 Cable A Male to Micro B Male 0.50'      | Tripp Lite         | UR050-06N            | 1        |
| 30     | Slide Switch DPDT Through Hole                  | C&K                | JS202011CQN          | 1        |
| 33     | PMODUSBUART USB TO UART MODULE                  | Digilent, Inc.     | 410-212              | 1        |

After components mounting, use the functional schematic on the Figure.20 for signal wires soldering

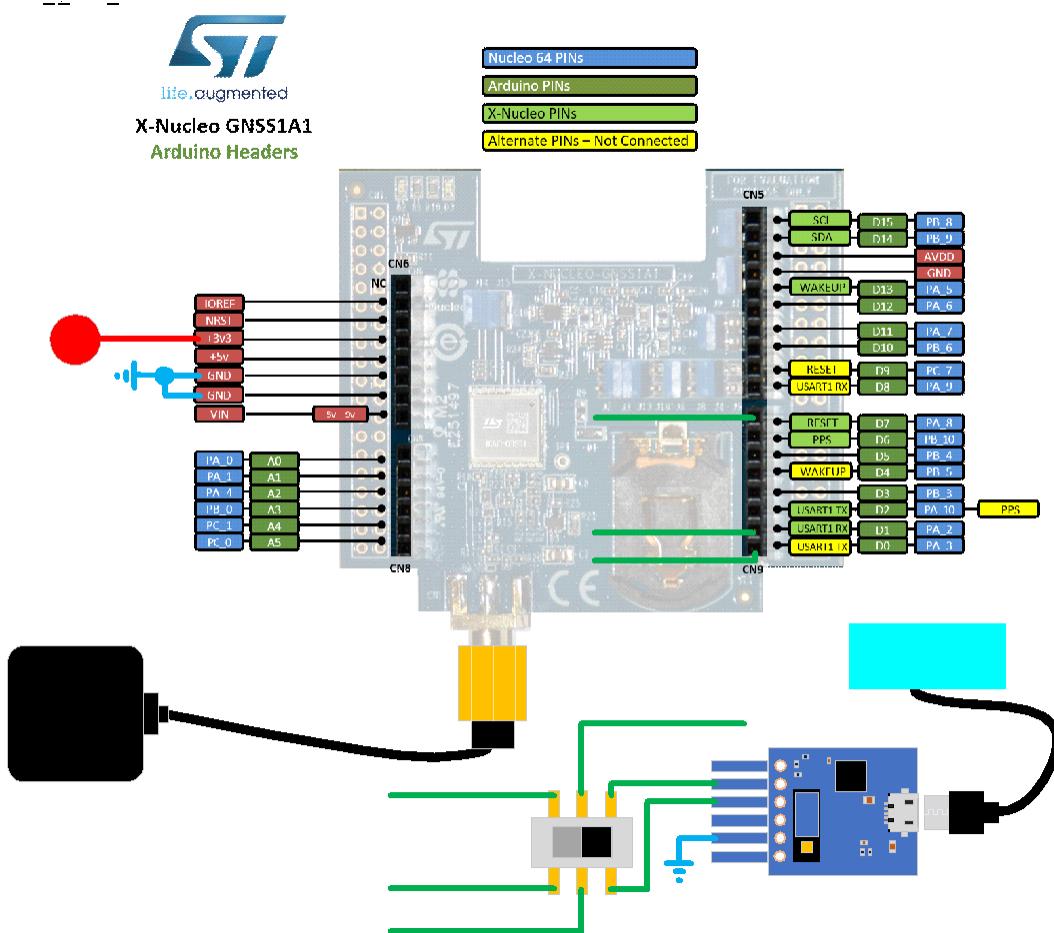


Figure. 20 GPS module functional schematic connection

## 9. Logic Level Translator Assembly

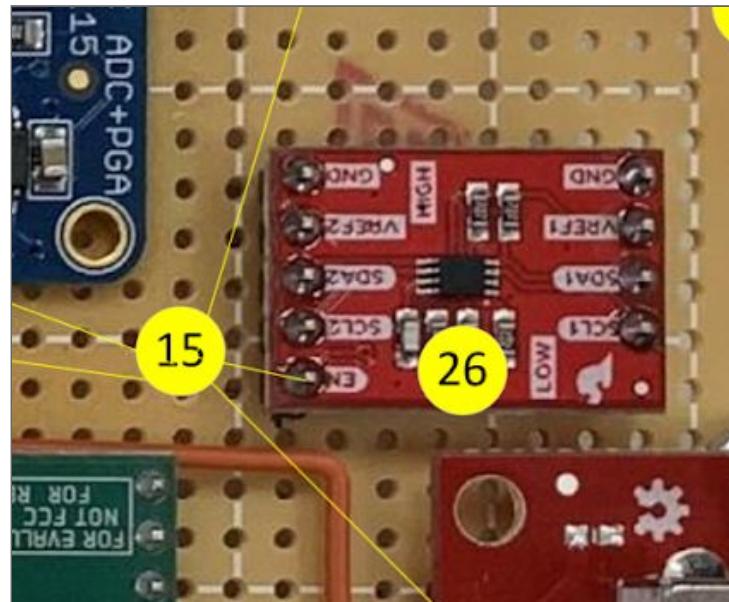


Figure. 21 Logic level translator module prototype view

All components in Table.9 mount and solder as showed on the Figure.21

Table.10 Logic level translator module components

| Number | Description                                  | Company  | Part number    | Quantity |
|--------|--|----------|----------------|----------|
| 26     | SPARKFUN LEVEL TRANSLATOR BREAKOUT - PCA9306 | sparkfun | PCA9306        | 1        |
| 15     | CONN HEADER VERT 40POS 2.54MM                | Sullins  | PRECO40SABN-RC | 1        |

After components mounting, use the functional schematic on the Figure.22 for signal wires soldering

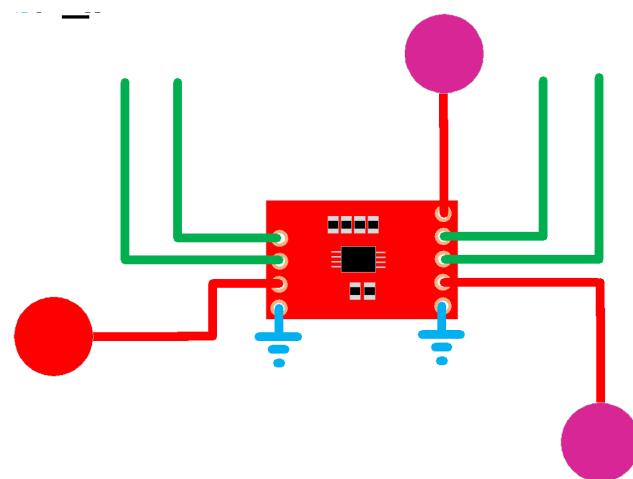


Figure. 22 Logic level translator module functional schematic connection

## 10.Raspberry Pi and 3G Modem

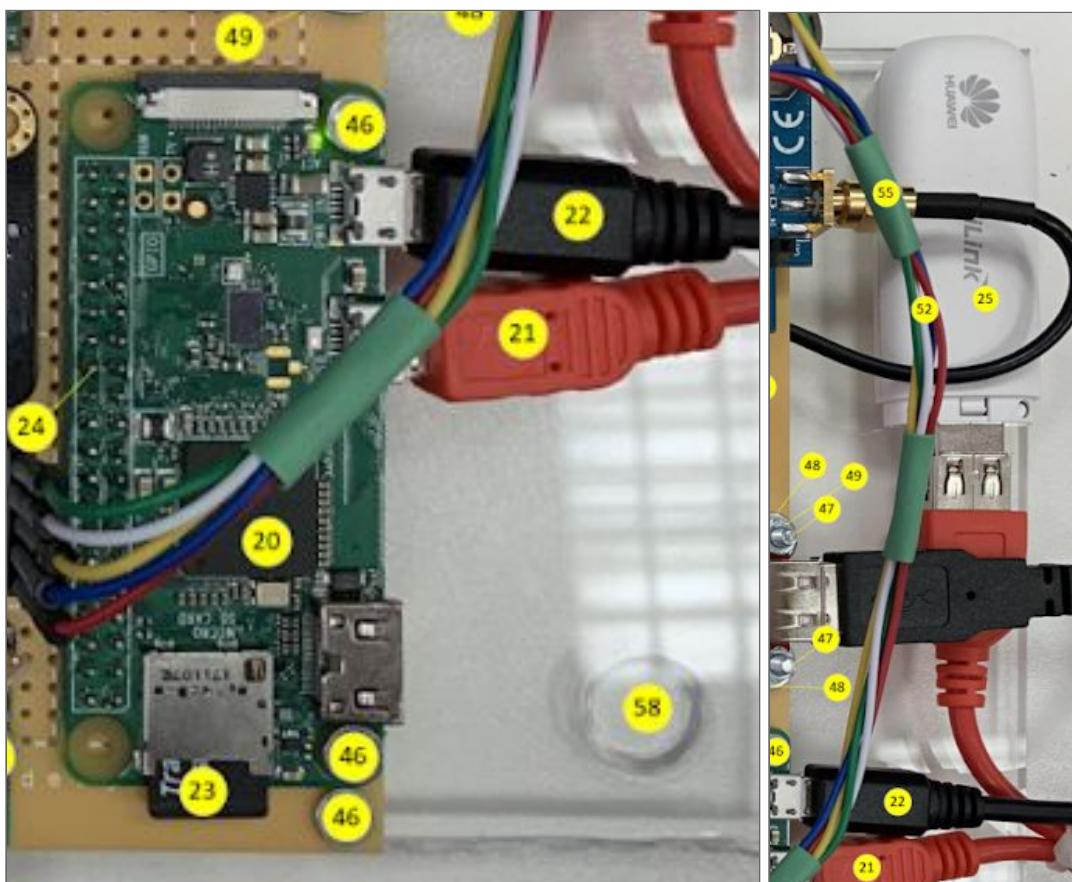


Figure. 23 Raspberry Pi and 3G modem prototype view

All components in Table.7 mount and solder as shown on the Figure.23

Table.11 Raspberry Pi and 3G modem connection components

| Number | Description                                 | Company            | Part number         | Quantity |
|--------|---|--------------------|---------------------|----------|
| 23     | microSD Card with Adapter - 32GB (Class 10) | sparkfun           | 32GB MicroSD        | 1        |
| 24     | CONN HEADER VERT 40POS 2.54MM               | Amphenol ICC (FCI) | 67997-240HLF        | 1        |
| 25     | 3G GSM modem Huawei E3531i-1                | Huawei             | E3531i-1            | 1        |
| 21     | USB OTG Cable - Female A to Micro B - 5in   | sparkfun           | USB OTG Cable       | 1        |
| 22     | Raspberry Pi micro-USB power cable          | reichelt           | AK67421-0.5         | 1        |
| 20     | Raspberry Pi Zero W                         | sparkfun           | Raspberry Pi Zero W | 1        |

After components mounting, use the functional schematic on the Figure.24 for signal wires soldering

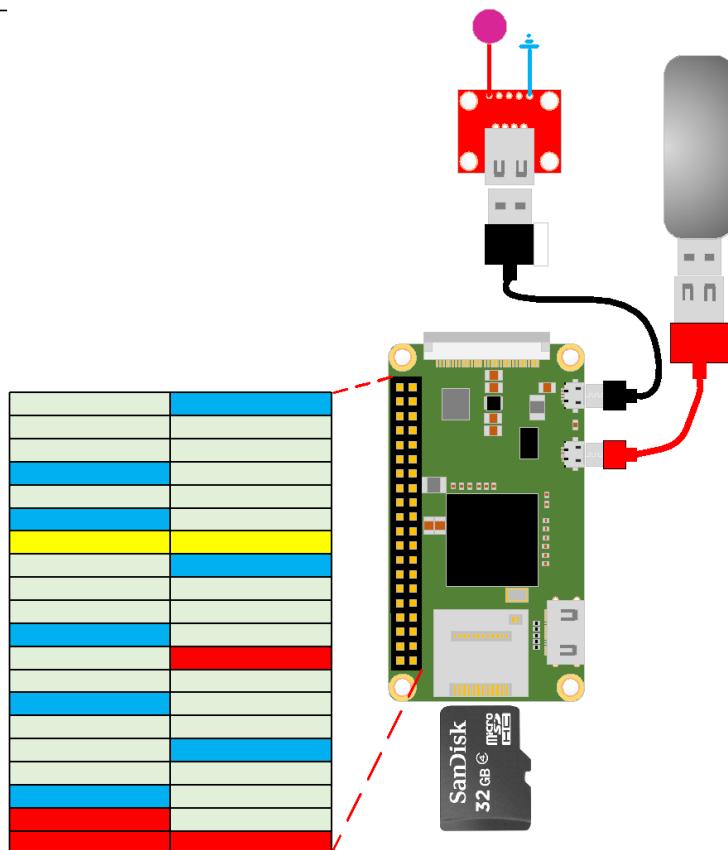
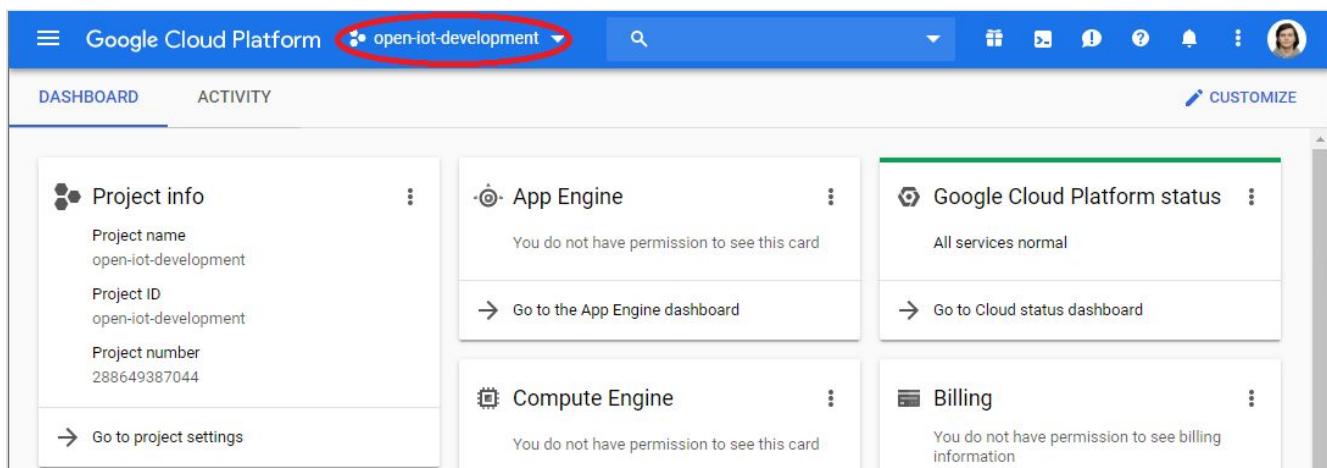


Figure. 24 Raspberry Pi and 3G functional schematic connection

# Connecting Your Device to Cloud

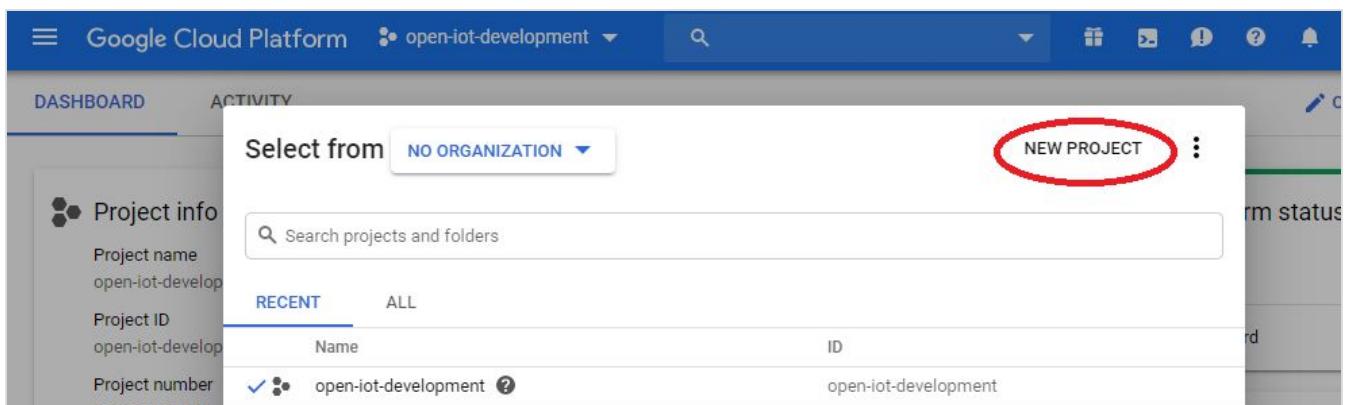
At first, create a Google Cloud account by visiting <https://cloud.google.com/> and clicking on the “Get started for free” button. After you have finished the registration you should head to Console, if it has not been automatically done, click on the Console button which is located on the top right corner of the screen.

- 1) If you haven't already, create a project in Google Cloud. To create a project, click here:



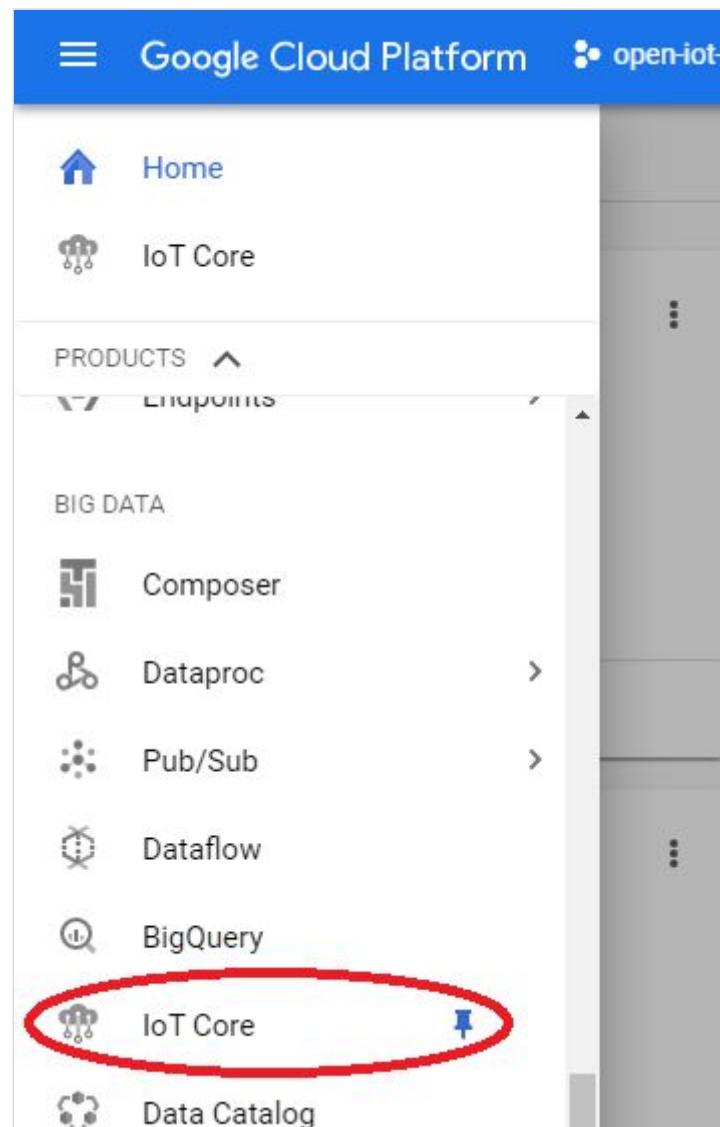
The screenshot shows the Google Cloud Platform dashboard for the project "open-iot-development". The top navigation bar is blue with the project name "open-iot-development" highlighted. Below the navigation bar, there are several cards: "Project info" (with details like Project name: open-iot-development, Project ID: open-iot-development, Project number: 288649387044), "App Engine" (with a message: "You do not have permission to see this card" and a link to "Go to the App Engine dashboard"), "Google Cloud Platform status" (with a message: "All services normal" and a link to "Go to Cloud status dashboard"), "Compute Engine" (with a message: "You do not have permission to see this card"), and "Billing" (with a message: "You do not have permission to see billing information").

After, click on NEW PROJECT button and enter your Project name and location:

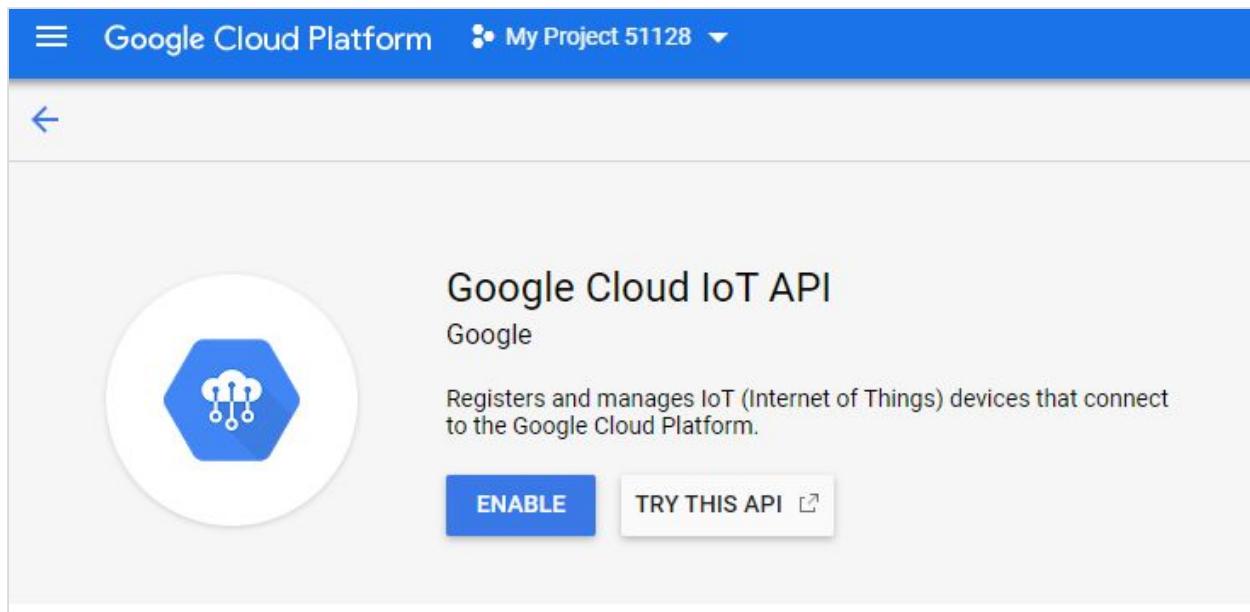


The screenshot shows the Google Cloud Platform dashboard again, but now with a modal window open over the "Project info" card. The modal title is "Select from NO ORGANIZATION". It features a search bar labeled "Search projects and folders", a "RECENT" tab, and a list of recent projects. One project, "open-iot-development", is listed with a checkmark next to its name. In the top right corner of the modal, there is a red circle highlighting the "NEW PROJECT" button.

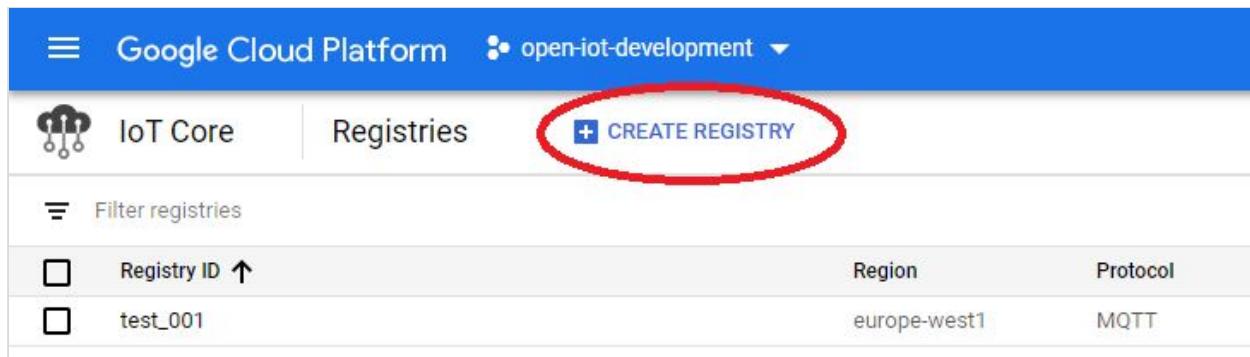
- 2) After you have a project, go to the navigation menu in the top left corner and find IoT Core or just type IoT in the search bar.



If you are entering Cloud IoT API for the first time, you need to click on the “ENABLE” button.



Now you should see the Registries page. Here, click on a “create registry” button.



For topic fields, you have to create a topic. You can use one topic for telemetry and state fields, or create topics for each of them. Here is an example of filled out registry:

Set shared properties for devices in this registry.

**Registry ID**

test\_001

**Region**

europe-west1

**Protocol**

Select the protocols your devices will use to connect to Cloud IoT Core. [Learn more](#)

MQTT

HTTP

**Cloud Pub/Sub topics**

Cloud IoT Core routes device messages to Cloud Pub/Sub for aggregation. You can route messages to different topics and subfolders in Cloud Pub/Sub based on the type of data in the messages. [Learn more](#)

**Default telemetry topic**

Device telemetry events will be published to this topic by default. Add more topics if you want these events to be published to separate topics.

projects/open-iot-development/topics/telemetry



[▼ Add more telemetry topics](#)

**Device state topic (Optional)**

State events published by MQTT devices are stored in the registry by default. You can also select a Cloud Pub/Sub topic where these messages will be published on a best-effort basis. [Learn more](#)

projects/open-iot-development/topics/state



**Stackdriver Logging**

Set the default logging for all devices in this registry. You can apply a different setting or debug at the device level. [Learn more](#)

- None
- Error
- Info
- Debug

You must fill out all required fields and hit the Create button.

- 3) For a device to function properly you need to enter keys that are generated on the device. Read the instructions [here](#) on how to generate keys on the device.

In the process of setting up your device, you will do these steps:

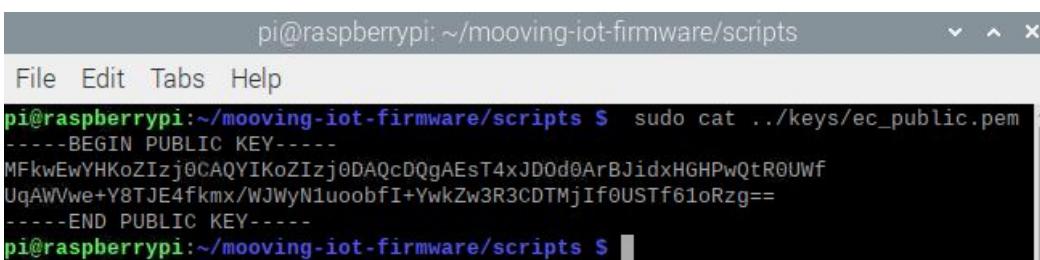
8. Generate ES256 encryption keys:

```
sudo sh generate_keys.sh
```

9. Add device public key on Google Cloud IoT. To display the generated device public key, enter:

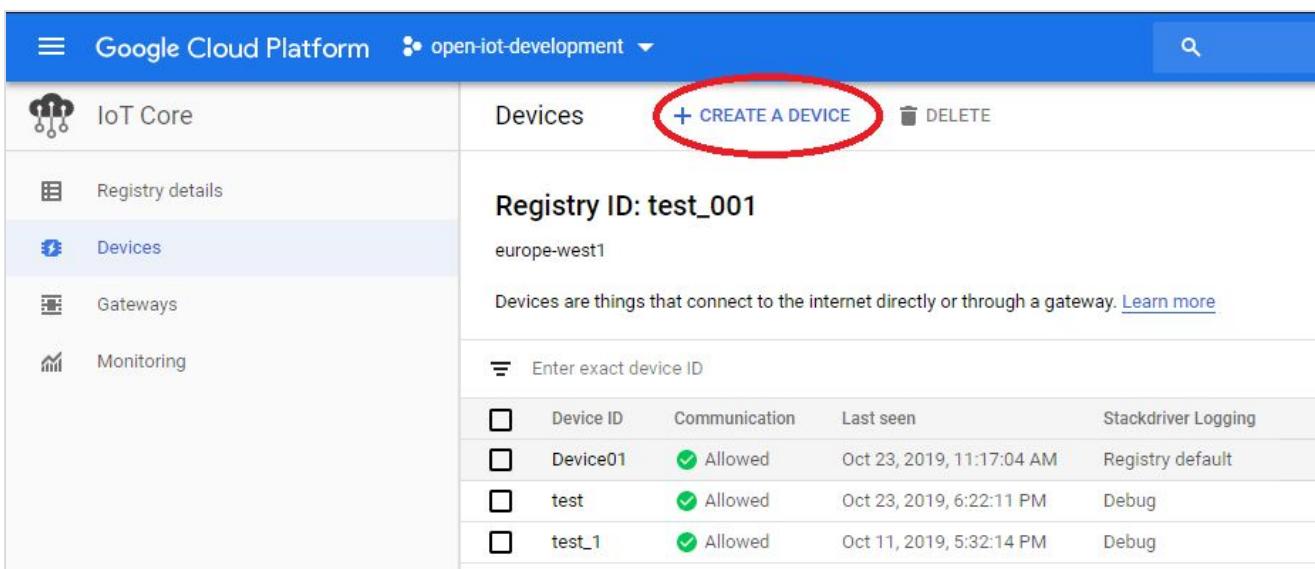
```
sudo cat ./keys/ec_public.pem
```

After doing them, you should see in your console generated security key:



```
pi@raspberrypi:~/mooving-iot-firmware/scripts
File Edit Tabs Help
pi@raspberrypi:~/mooving-iot-firmware/scripts $ sudo cat ./keys/ec_public.pem
-----BEGIN PUBLIC KEY-----
MFkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDQgAEsT4xJD0d0ArBJidxHGHPwQtR0UWF
UqAWVwe+Y8TJE4fkmx/WJWyN1uoobfI+YwkZw3R3CDTMjIf0USTf61oRzg==
-----END PUBLIC KEY-----
pi@raspberrypi:~/mooving-iot-firmware/scripts $
```

Copy them and go to the Devices tab on left and create a new device.



| Registry details | Registry ID: test_001   |                           |                     |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |
|------------------|---|---------------------------|---------------------|-----------|---------------------|----------|---|---------------------------|------------------|------|---|--------------------------|-------|--------|---|--------------------------|-------|
| Devices          | europe-west1  |                           |                     |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |
| Gateways         | Devices are things that connect to the internet directly or through a gateway. <a href="#">Learn more</a>   |                           |                     |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |
| Monitoring       | <input type="text"/> Enter exact device ID<br><table border="1"> <thead> <tr> <th>Device ID</th> <th>Communication</th> <th>Last seen</th> <th>Stackdriver Logging</th> </tr> </thead> <tbody> <tr> <td>Device01</td> <td><input checked="" type="checkbox"/> Allowed</td> <td>Oct 23, 2019, 11:17:04 AM</td> <td>Registry default</td> </tr> <tr> <td>test</td> <td><input checked="" type="checkbox"/> Allowed</td> <td>Oct 23, 2019, 6:22:11 PM</td> <td>Debug</td> </tr> <tr> <td>test_1</td> <td><input checked="" type="checkbox"/> Allowed</td> <td>Oct 11, 2019, 5:32:14 PM</td> <td>Debug</td> </tr> </tbody> </table> | Device ID                 | Communication       | Last seen | Stackdriver Logging | Device01 | <input checked="" type="checkbox"/> Allowed | Oct 23, 2019, 11:17:04 AM | Registry default | test | <input checked="" type="checkbox"/> Allowed | Oct 23, 2019, 6:22:11 PM | Debug | test_1 | <input checked="" type="checkbox"/> Allowed | Oct 11, 2019, 5:32:14 PM | Debug |
| Device ID        | Communication   | Last seen                 | Stackdriver Logging |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |
| Device01         | <input checked="" type="checkbox"/> Allowed   | Oct 23, 2019, 11:17:04 AM | Registry default    |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |
| test             | <input checked="" type="checkbox"/> Allowed   | Oct 23, 2019, 6:22:11 PM  | Debug               |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |
| test_1           | <input checked="" type="checkbox"/> Allowed   | Oct 11, 2019, 5:32:14 PM  | Debug               |           |                     |          |   |                           |                  |      |   |                          |       |        |   |                          |       |

In the opened window enter device ID, in the “Public key format” select ES256 and in the “Public key value” field enter the generated key.

The final result should look like this:

Create a device in registry test\_001.

Device ID 

test

Device communication 

- Allow
- Block

Authentication (Optional) 

Input method

- Enter manually
- Upload

Public key format

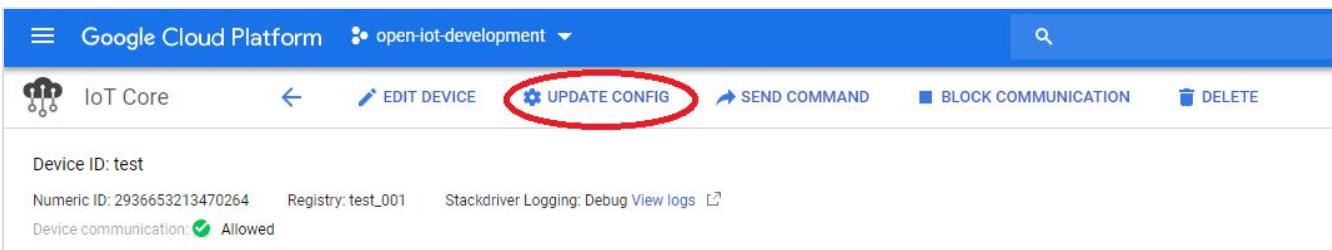
- RS256 
- ES256 
- RS256\_X509 
- ES256\_X509 

Public key value

```
-----BEGIN PUBLIC KEY-----  
MFkwEwYHKoZIzj0CAQYIKoZIzj0DAQcDQgAEsT4xJD0d0ArBJidxHGHPwQtR0UWF  
UqAWVwe+Y8TJE4fkmx/WJWyn1uoobfI+YwkZw3R3CDTMjIf0USTf61oRzg==  
-----END PUBLIC KEY-----
```

After you finished filling out all required fields, click on the “Create” button and you will be transferred to your created device page.

- 4) Before sending any commands to the device you need to send the configuration to it.  
For this, click on “UPDATE CONFIG” button:



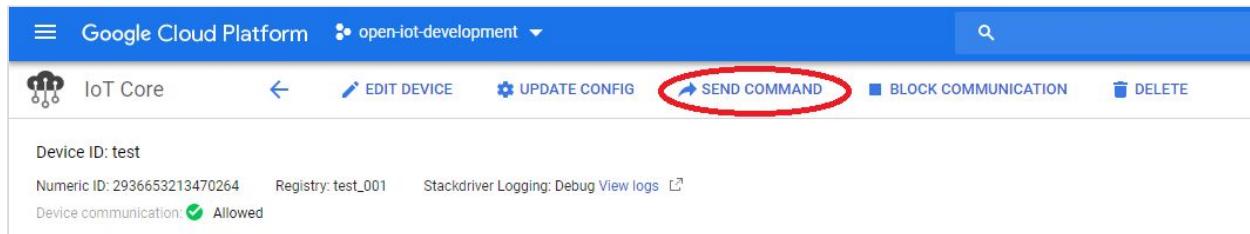
The screenshot shows the Google Cloud Platform IoT Core interface. At the top, there's a navigation bar with 'Google Cloud Platform' and a dropdown for 'open-iot-development'. Below the navigation bar, there are several buttons: 'EDIT DEVICE', 'UPDATE CONFIG' (which is circled in red), 'SEND COMMAND', 'BLOCK COMMUNICATION', and 'DELETE'. Underneath these buttons, there's a summary section with the following information:  
- Device ID: test  
- Numeric ID: 2936653213470264  
- Registry: test\_001  
- Stackdriver Logging: Debug View logs  
- Device communication:  Allowed

In the appeared “Update configuration” window message enter this JSON:

```
{
  "telemetryIntervalPowerOn": 10,
  "telemetryIntervalPowerOff": 10
}
```

And click on “Send to device” button.

To send commands you need to click on the “SEND COMMAND” button.



And in the appeared “Update configuration” window message enter the command from the list below and click on “Send command” button:

*In “vehicleId” field you should enter the name of your device ID, so if your Device ID is “test”, the commands are:*

To unlock:

```
{
  "command": "unlock",
  "vehicleId": "test"
}
```

To lock:

```
{
  "command": "lock",
  "vehicleId": "test"
}
```

To set to unavailable:

```
{
  "command": "unavailable",
  "vehicleId": "test"
}
```

To make a constant beep pattern (volume is from 1 to 100):

```
{
  "command": "beep",
  "volume": 100
}
```

```
"volume": 50,  
"vehicleId": "test"  
}
```

To make a constant alarm pattern (volume is from 1 to 100):

```
{  
  "command": "alarm",  
  "volume": 50,  
  "vehicleId": "test"  
}
```

## Firmware Installation

### Getting Started

1. Download and install on SD card latest Raspbian Buster Lite image:

[Raspbian Buster Lite.](#)

[Install Raspbian Buster Lite on SD card using Etcher.](#)

2. Enable WIFI and SSH on Raspberry Pi:

[How to enable WIFI and SSH.](#)

3. Connect to Raspberry Pi via SSH:

[More details about SSH on Raspberry Pi.](#)

4. Enter commands to install Git client:

*sudo apt-get update*

*sudo apt-get install git*

5. Clone mooving-iot-firmware repository using Git client.

6. Move to the repository scripts folder:

*cd mooving-iot-firmware/scripts*

7. Run setup script:

*sudo sh setup\_project.sh*

8. Generate ES256 encryption keys:

*sudo sh generate\_keys.sh*

9. Add device public key on Google Cloud IoT. To display the generated device public key, enter:

```
sudo cat ./keys/ec_public.pem
```

10. Open file run\_project.sh and change Google Cloud IoT details for the device to your own. Here you must enter **project\_id** (ID of your project, can be found on the main Google Cloud Console page), **registry\_id** (name of your registry, can be found in IoT Core tab), **device\_id** (name of your device, can be found in IoT Core tab) and **region** (location of your project, can be found on the main page or in IoT Core tab).:

```
CLOUD_REGION="region"  
PROJECT_ID="project_id"  
REGISTRY_ID="registry_id"  
DEVICE_ID="device_id"
```

11. Reboot device:

```
sudo reboot
```

# Sample connection instructions: Xiaomi M365

This document offers step-by-step instructions for how to set up the IoT device on a test vehicle – we'll use the Xiaomi M365 electric scooter as an example.

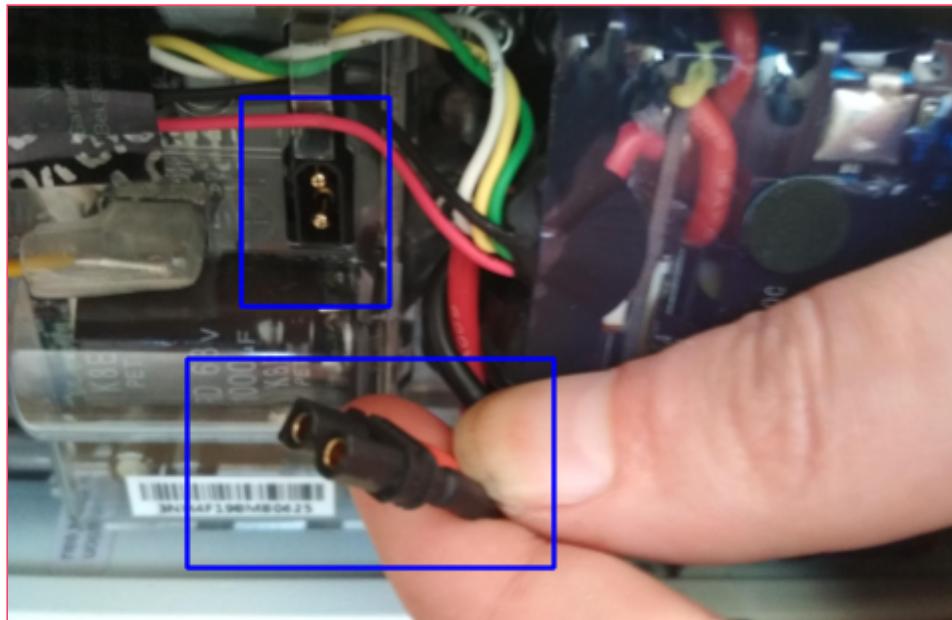
- 1) First of all, you need to turn off your scooter. After that, you have to disassemble the scooter's bottom lid. For this operation you will need a Torx screwdriver.



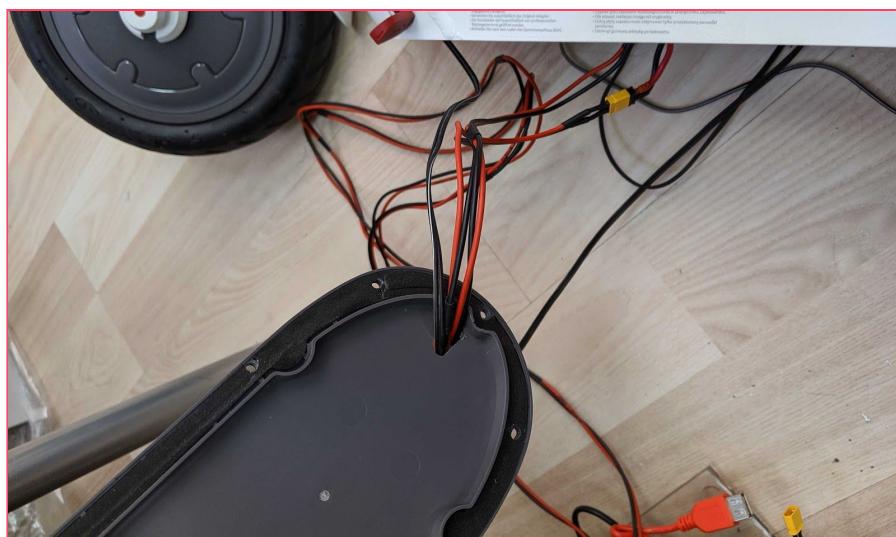
After you take off the bottom lid you will be able to see the battery (right) and main circuit board (Left).



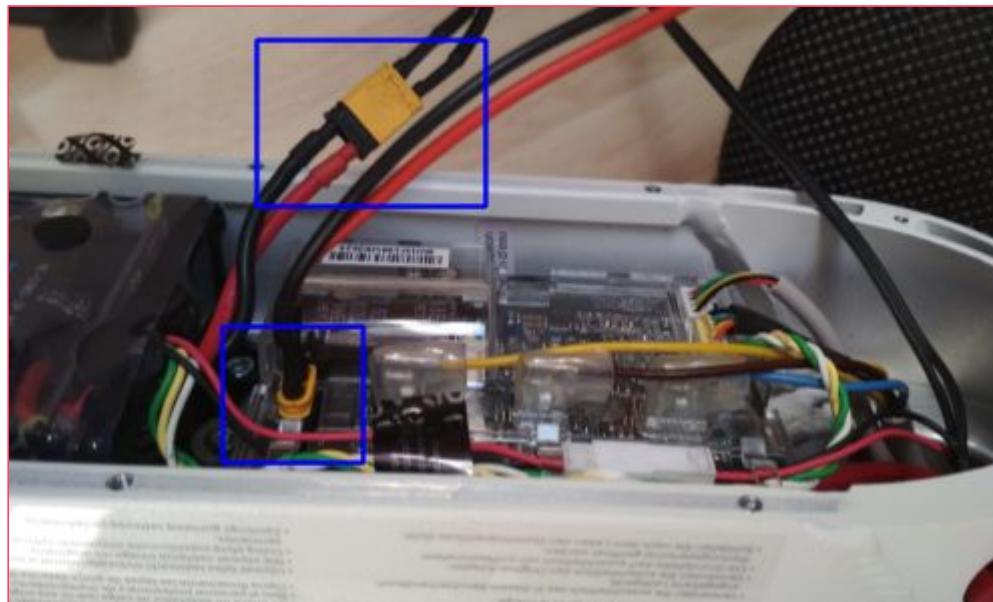
2) Pull out the battery connector from the main circuit board.



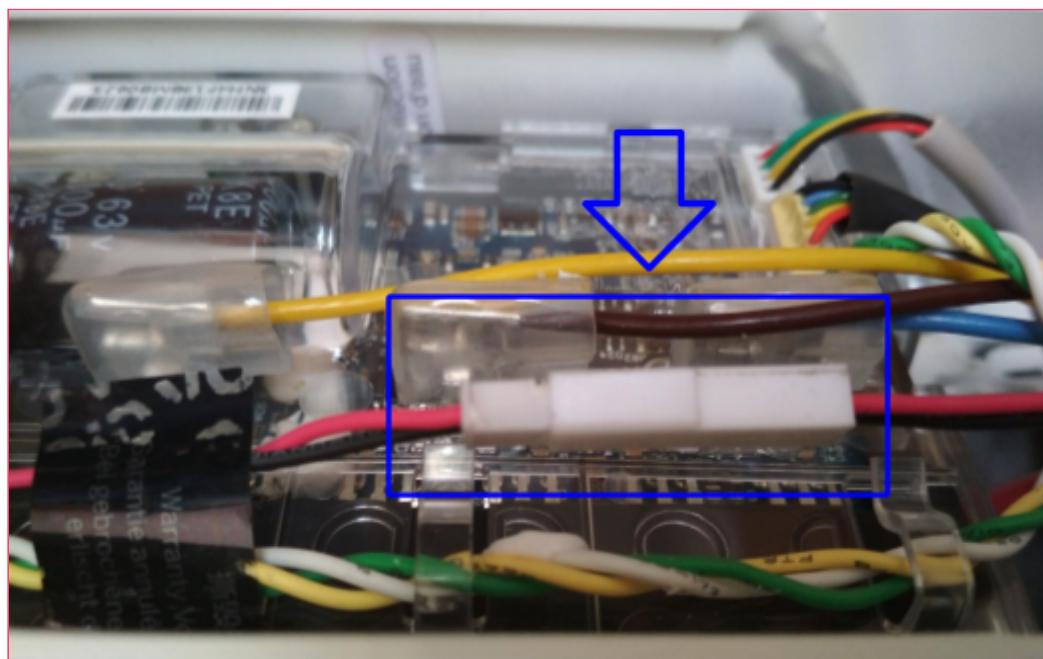
3) Make a hole in the rear part of the bottom lid. Then pass all wires from the IoT device through this hole. Wires should go from the outside to inside the scooter.



4) Connect power wires from the IoT device to battery and main circuit board (in the split). Connectors have special shape to follow polarity and avoid short circuit.



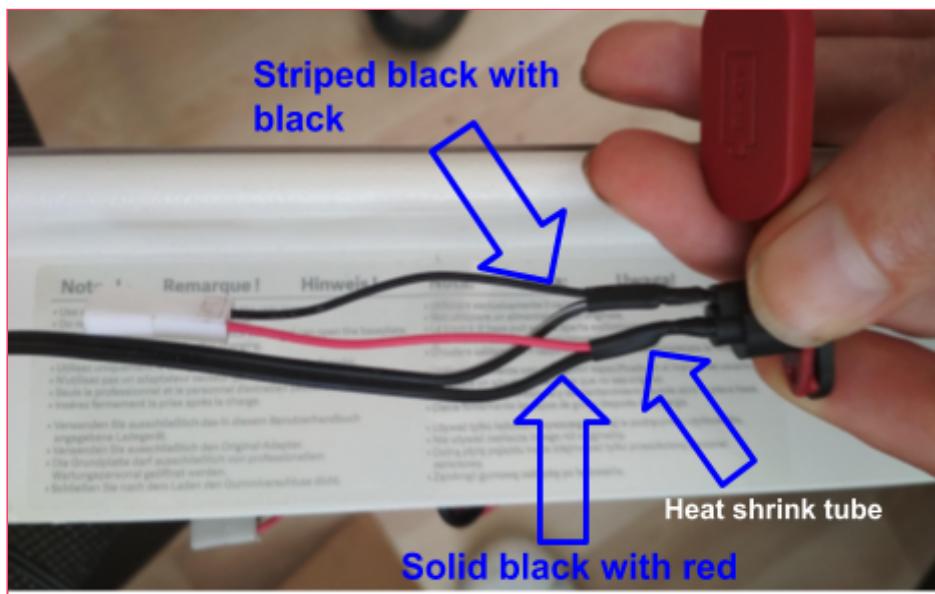
5) Disconnect charger connector.



6) Disassemble a charger port connector from the hole using a screwdriver.



7) Now part of charging cable could be pulled out from the scooter. You should solder 2 wires from the IoT device to charger port as it is shown in the image below. Stripped (or black) wire should be connected with black wire at the charger socket and solid (or red) wire should be connected with red wire at the charger socket. Before soldering please ensure that wire from the IoT device goes through the charger port hole. Use heat shrink tube to isolate and protect connectors and wires after soldering.



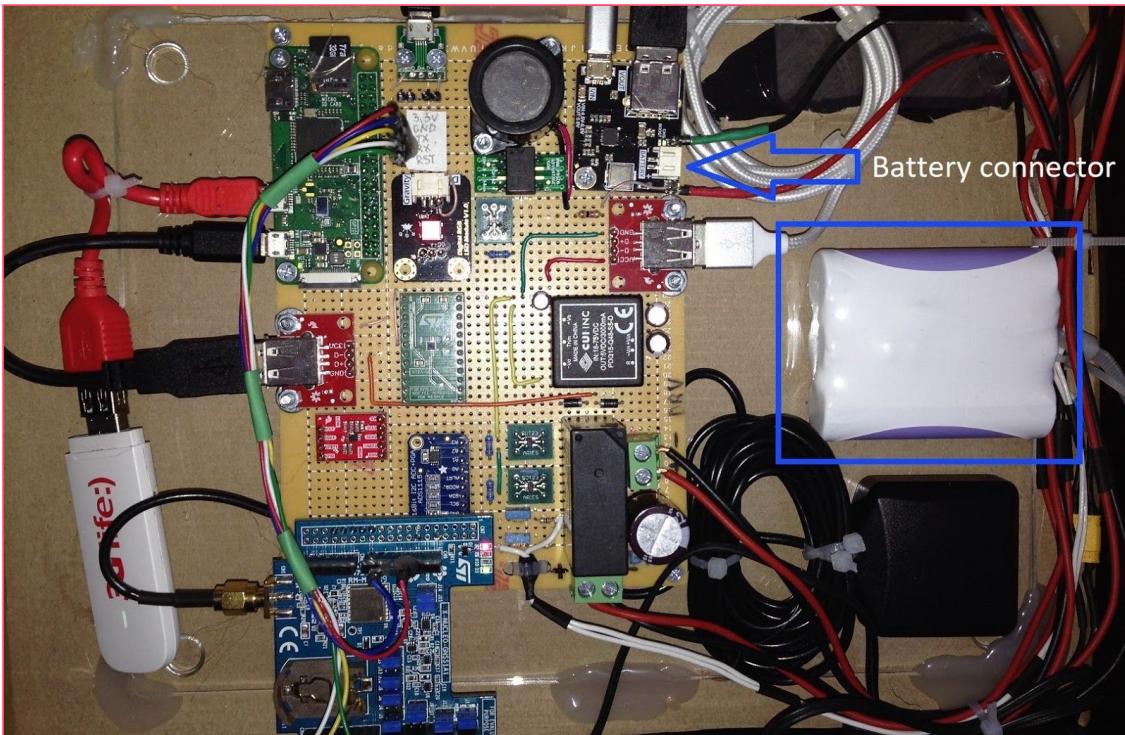
8) Mount charger wire back to the hole and fix using a screwdriver.



9) Close the bottom lid and fix using a screwdriver.



- 10) Place the box with the device on a plane surface. Fix power wires with scotch tape. You should also place the battery and attach the battery connector to the board.



Attach the IoT device to the scooter pole.