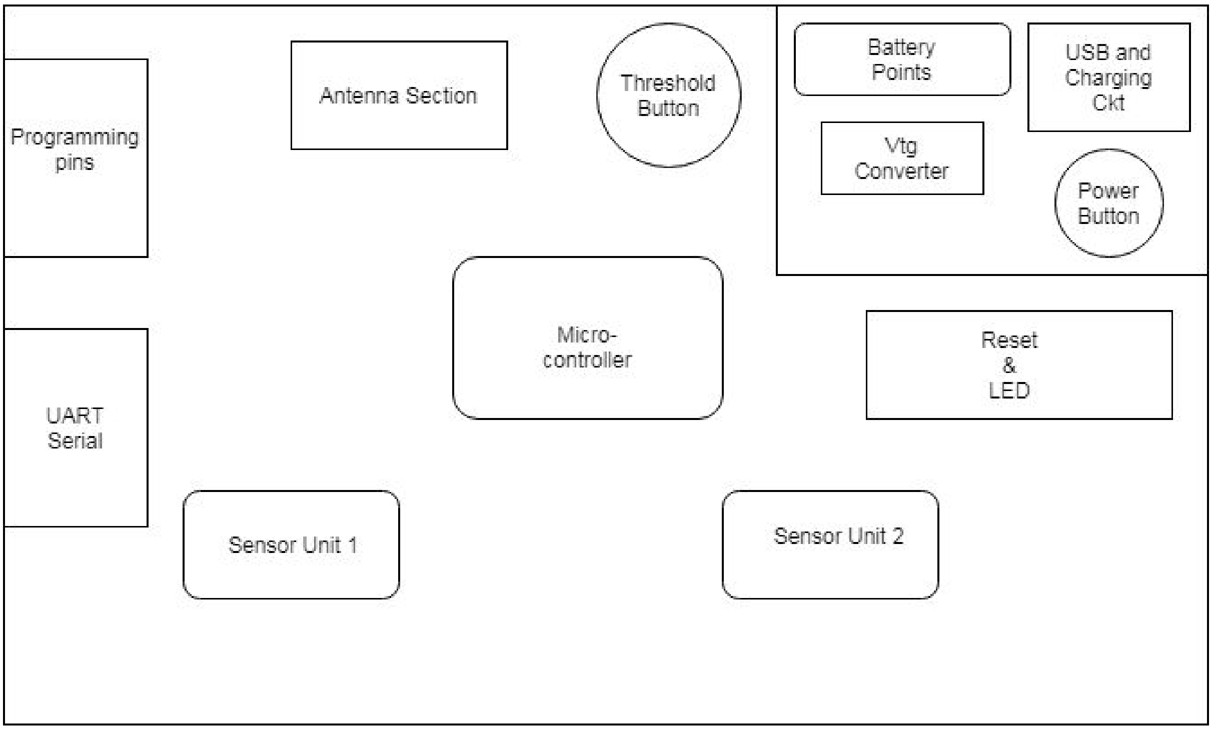
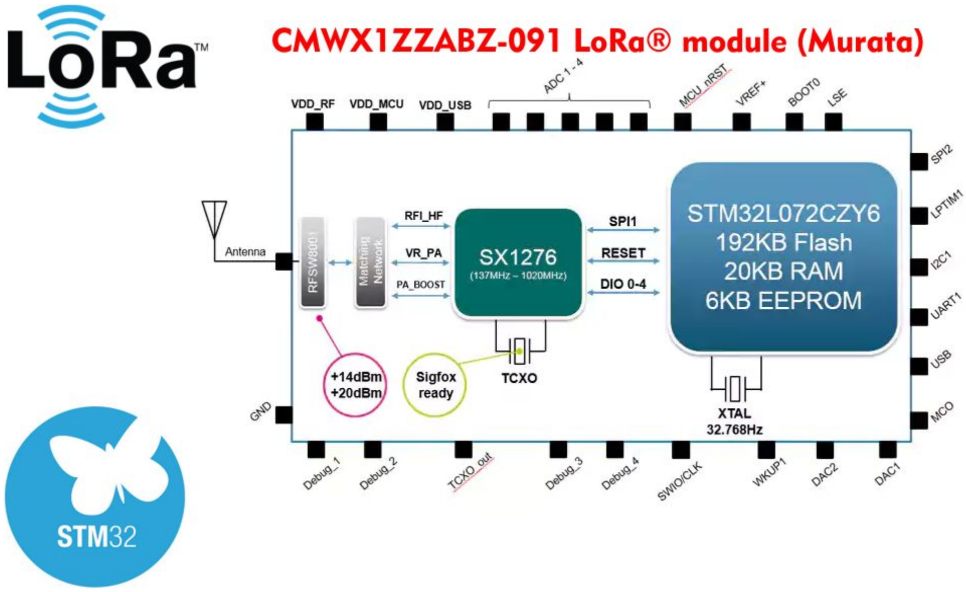
Hardware Section:

Our parking modules contain a LoraWAN module, sensor unit and power circuitry. Below image shows the block diagram of our parking module.

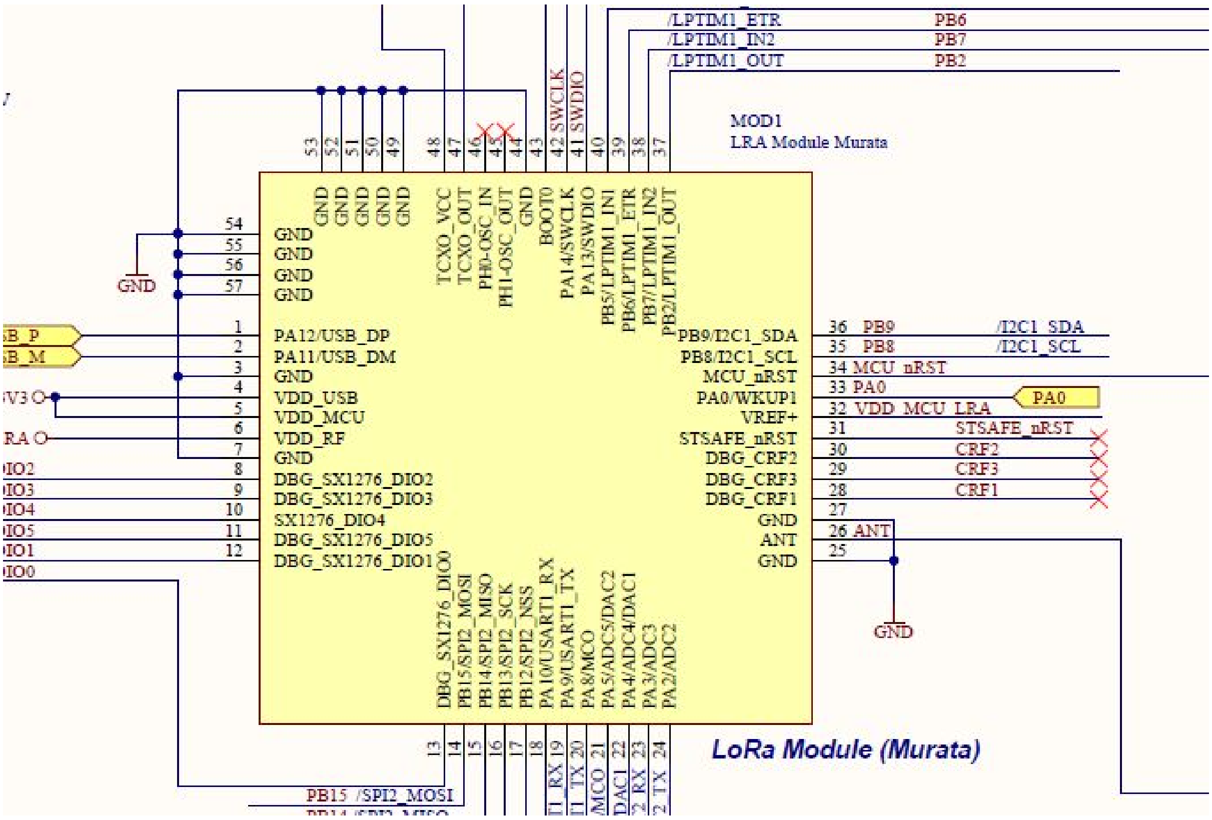


Micro-controller:

We are using cmwx1zzabz-091 chip as a lorawan module and B-L072Z-LRWAN1 for development board.
CMWX1ZZABZ-091 contains an STM32L0 microcontroller with SX-1276 lora chip.



The modules include a Semtech SX1276 ultra-long-range spread-spectrum wireless transceiver and an STMicro STM32L0 series ARM Cortex M0+ 32-bit microcontroller (MCU).



View datasheet of module
https://www.mouser.in/pdfdocs/Murata_11172016_CMWX1ZZABZ-0781.pdf
https://wireless.murata.com/datasheet?/RFM/data/type_abz.pdf
https://www.mouser.in/datasheet/2/389/b-l072z-lrwan1-1848039.pdf

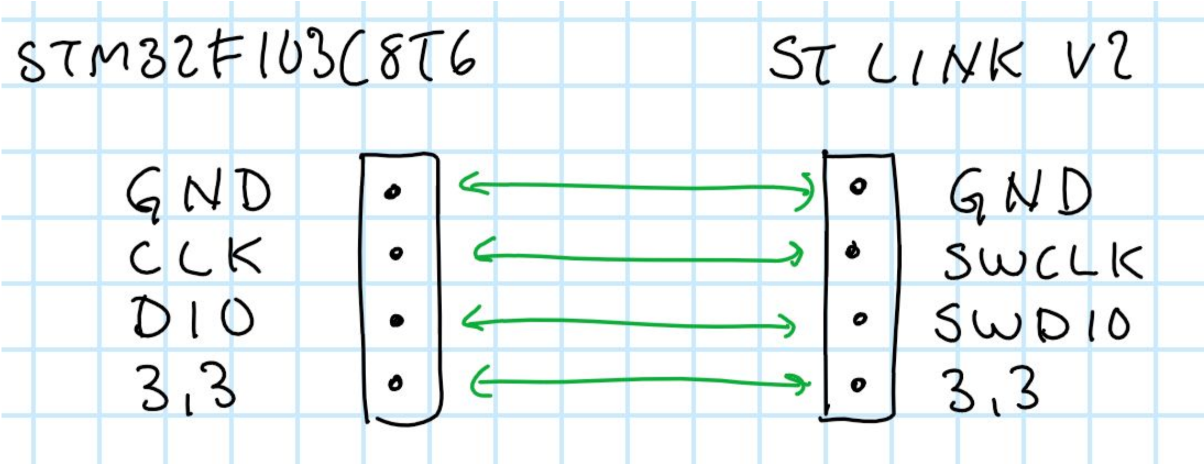
Function of Chip:

- Communicate with sensor and read XYZ values continuously
- Built lorawan functionality to communicate with cloud via gateway
- Implementation of parking algorithm
-

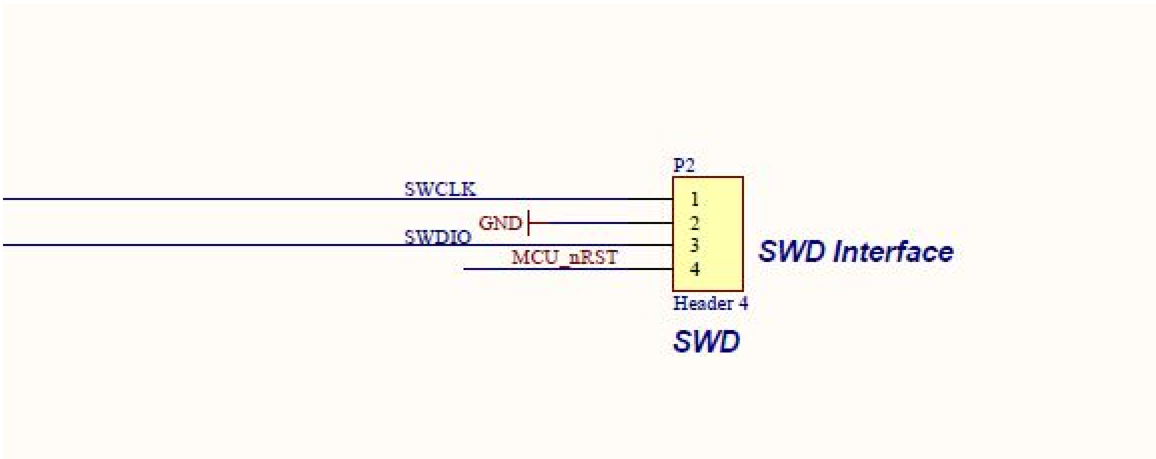
Circuit Explanation:
https://drive.google.com/drive/folders/1-Q0FDvYCanAIVWTYdwk7ubLzm4gECaKY
See parking lora sys 1st page, it contains all information for microcontroller circuit.

For any microcontroller pcb design we require following small circuits:

1. Programming pins(SWD interface)
   In order to program a chip see connection of programming pins(P2 SWD interface pins) with stlink v2



After connection have a look at https://www.youtube.com/watch?v=KgR3uM21y7o video to program our chip. Follow the same procedure.

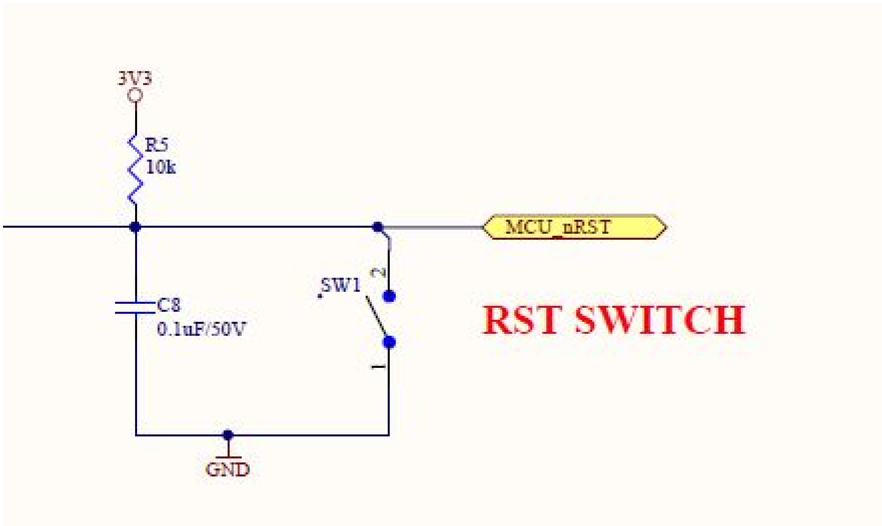


How to program our Chip?

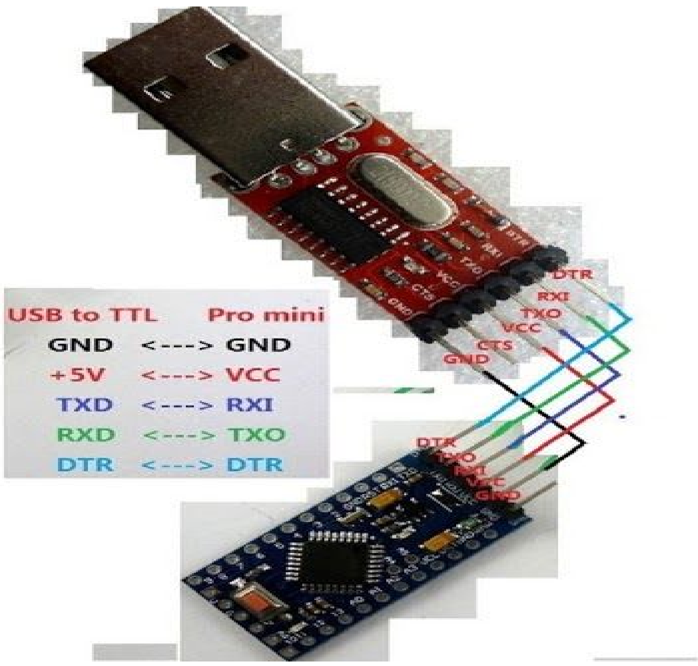
Ans:

1. Connect SWCLK, SWDIO, and GND pin of st link-v2 to SWCLK, SWDIO, and GND pins on P2 SWD interface.
2. Provide 3.3V supply to the microcontroller or attach Battery that will provide 3.3v to the microcontroller.
3. Open ST LINK UTILITY software→ open our bin file→ press connect button is software to connect to pcb board and instantly pull MCU_nRST pin to ground for 2 sec.
4. Go to the target and press the program and verify.

2. Reset button(SW1):
   It resets the microcontroller and the circuit is common for all microcontrollers.



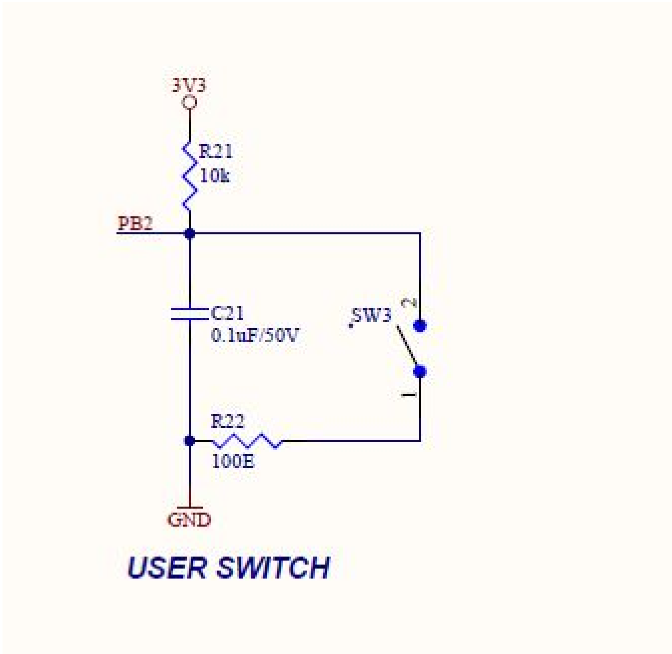
3. Serial UART pins(P6):



Q. How to read data on microcontroller.
Ans.-->
To read data we use serial communication. For our circuit we don’t require DTR and +5V pin connection, keep open. Attach cp2102 to the computer and read values in the Teraterm application with baudrate 115200.

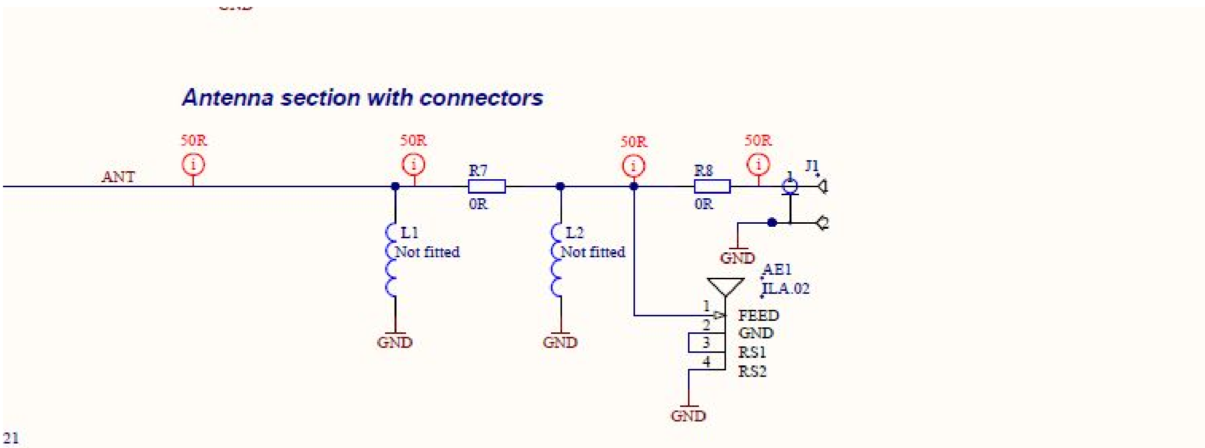
Cp2102 → PCB
RXD → PA2
TXD → PA3
GND → GND

4. User switch (SW3)
   For our circuit it's actually a threshold button, ckt is common for all microcontrollers.



5. Decoupling capacitors:
   ckt is common for all microcontrollers used to reduce noise. A decoupling capacitor is a capacitor used to decouple one part of an electrical network (circuit) from another. Noise caused by other circuit elements is shunted through the capacitor, reducing the effect it has on the rest of the circuit.

6. Antenna ckt:
   We have successfully tested an on board chip antenna to communicate with the gateway. If we notice any noise then according to the RF professor in Akola we will add L1 and L2(currently not fitted in ckt).



7. IO pins:
   For testing purposes, we have taken out IO pins of CMWX1ZZ-091 microcontroller. P1 and P5 contain IO pins.

2nd Page: Power Circuitry

https://drive.google.com/drive/folders/1-Q0FDvYCanAIVWTYdwk7ubLzm4gECaKY

Output of page 2 i.e. power ckt is 3.3v which we require to run our microcontroller and Sensor unit. The power ckt is designed in such a way that we will get output vtg 3.3v from 3 different input vtg sources and our battery will also get charge.

Input voltage sources:

1. Battery(J3)
2. External 5v (CN1)
3. USB (J2)

Power Ckt Explanation:

1) Battery (J3):

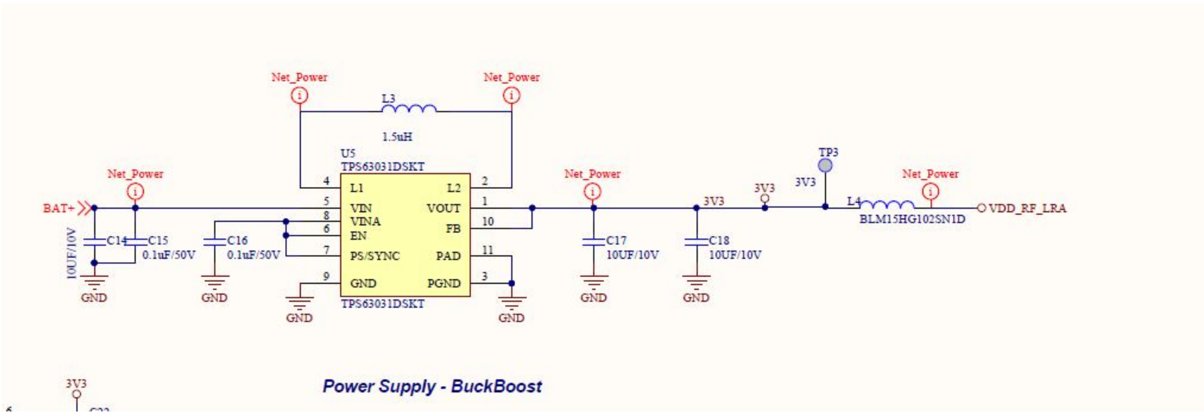
Connect charged battery terminal to J3 connector. The output of J3 pin connector is connected to texas instrument's TPS6303 IC which acts as a buck boost converter and gives final 3.3 V.

Input voltage range of ic is : 1.8 V to 5.5 V

Case 1: When VIN is between 3.6 V to 5.5 V then we will get 800-mA Output current at 3.3 V in step-down mode (VIN = 3.6 V to 5.5 V)

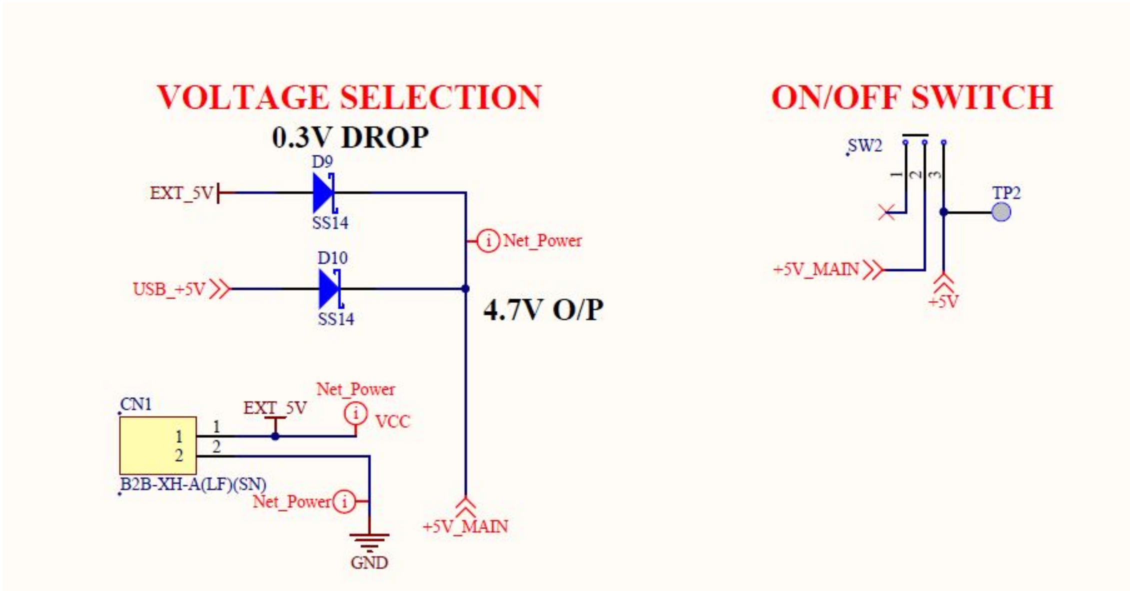
Case 2: When VIN > 2.4 V we will get up to 500-mA output current at 3.3 V in boost mode

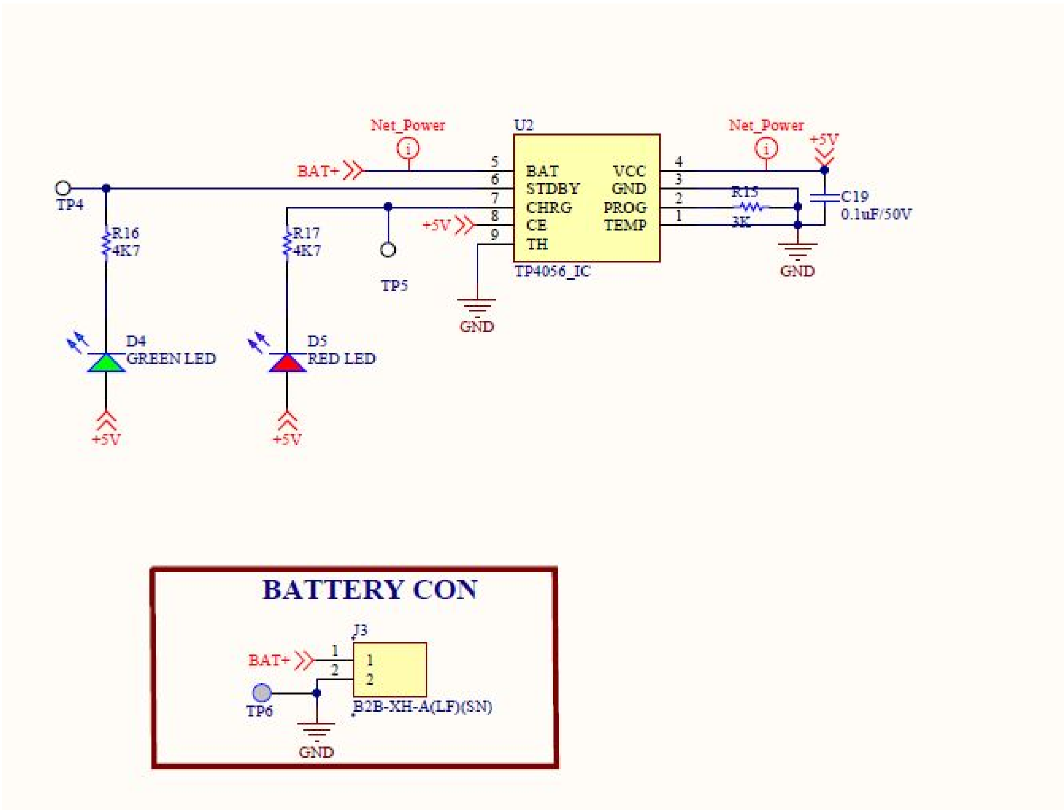
Part detail:
https://www.mouser.in/ProductDetail/Texas-Instruments/TPS63031DSKT?qs=ptj1V1atRArBpxn4nGxMNw==



2. External +5v:

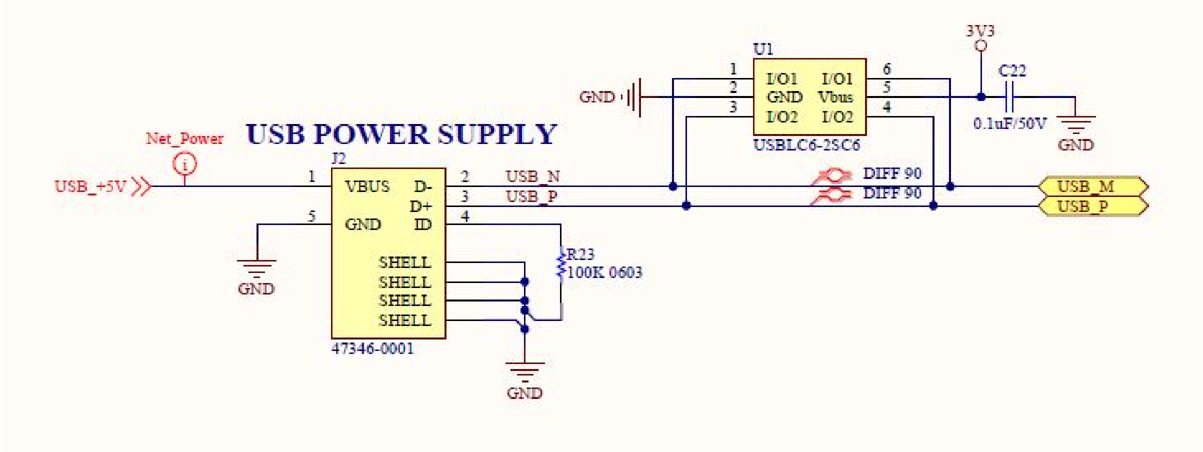
With the help of +5V external power supply, we can give power to our microcontroller besides we can charge our battery. Now connect the external 5v power supply to the CN1 connector and ON the ON/OFF switch. The output of the switch will go to TP4056_IC which is a battery charging IC. The output of the IC will go to TPS6303_DSKT buck boost converter which will convert battery vtg into required 3.3v.

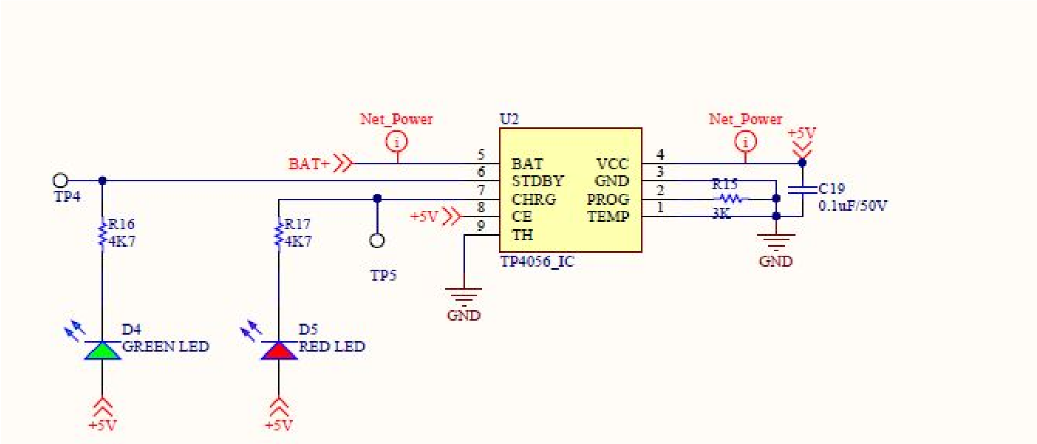


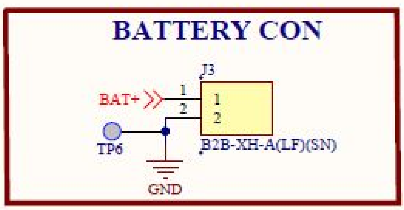


3. USB Power supply:

With the help of USB power supply, we can give power to our microcontroller besides we can charge our battery. Now connect theUSB power supply to the J2 connector and ON the ON/OFF switch. The output of the switch will go to TP4056_IC which is a battery charging IC. The output of the IC will go to TPS6303_DSKT buck boost converter which will convert battery vtg into required 3.3v.







Sensor Unit:(3rd page)

In our current circuit, two magnetic sensors are connected to the microcontroller. Both sensors are connected using I2C protocol and connected to PB8 and PB9 pins.

1.. QMC5883L:

The QMC5883L is a multi-chip three-axis magnetic sensor. QMC5883L enables 1° to 2° compass heading accuracy. The I²C serial bus allows for an easy interface.

Below Ckt shows QMC5883L connection to any microcontroller chip.

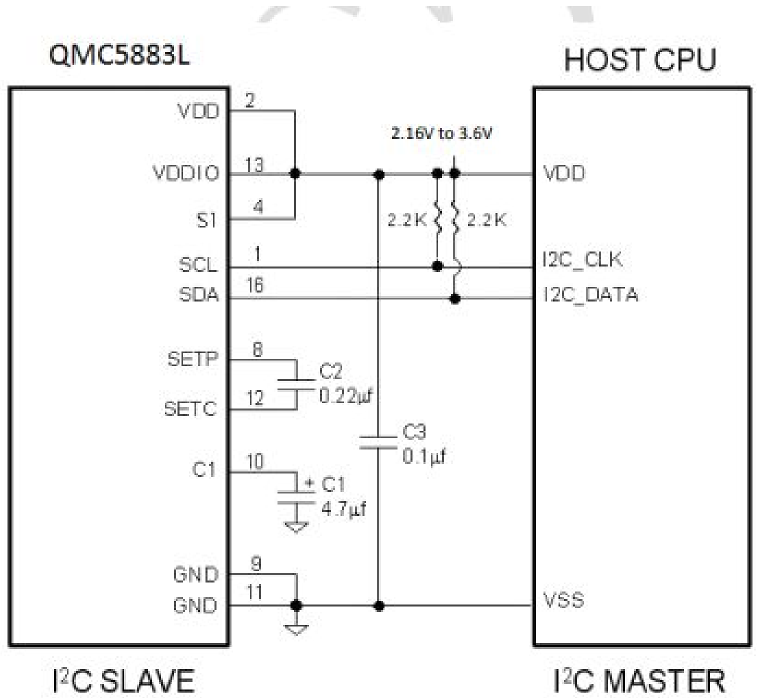
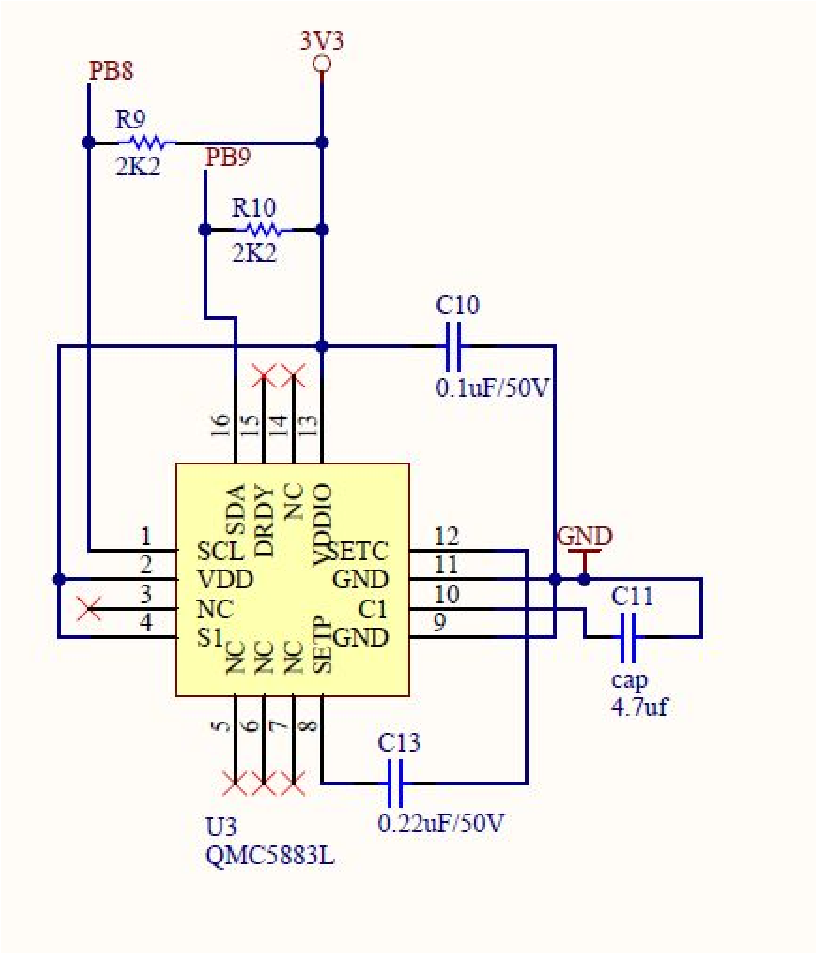


Figure 6. Single Supply Connection

QMC5883L is I2C only sensor,
Connect PB8 to SCL
PB9 to SDA
And attach a pullup register.

For more details see QMC5883L datasheet.

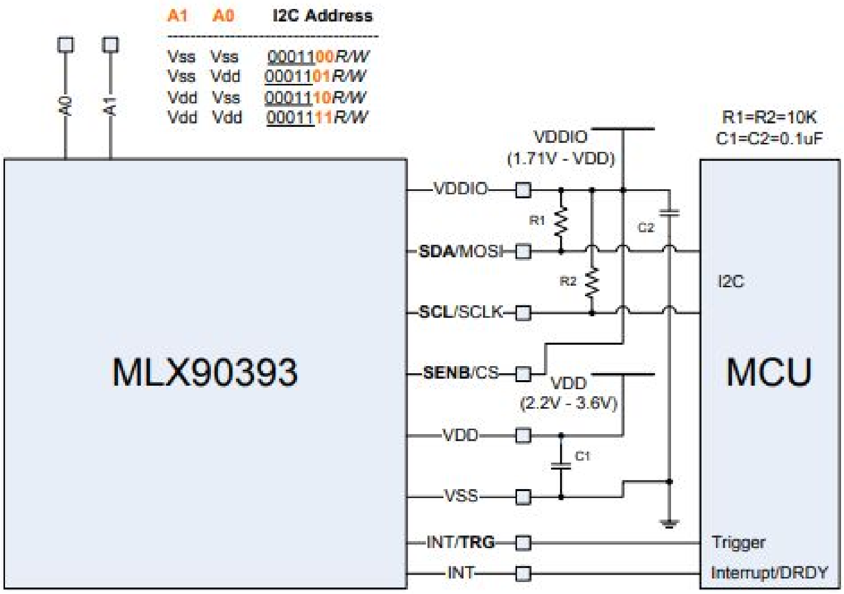
Below image shows QMC5883L connection to CMWX1ZZABZ-091 microcontroller.



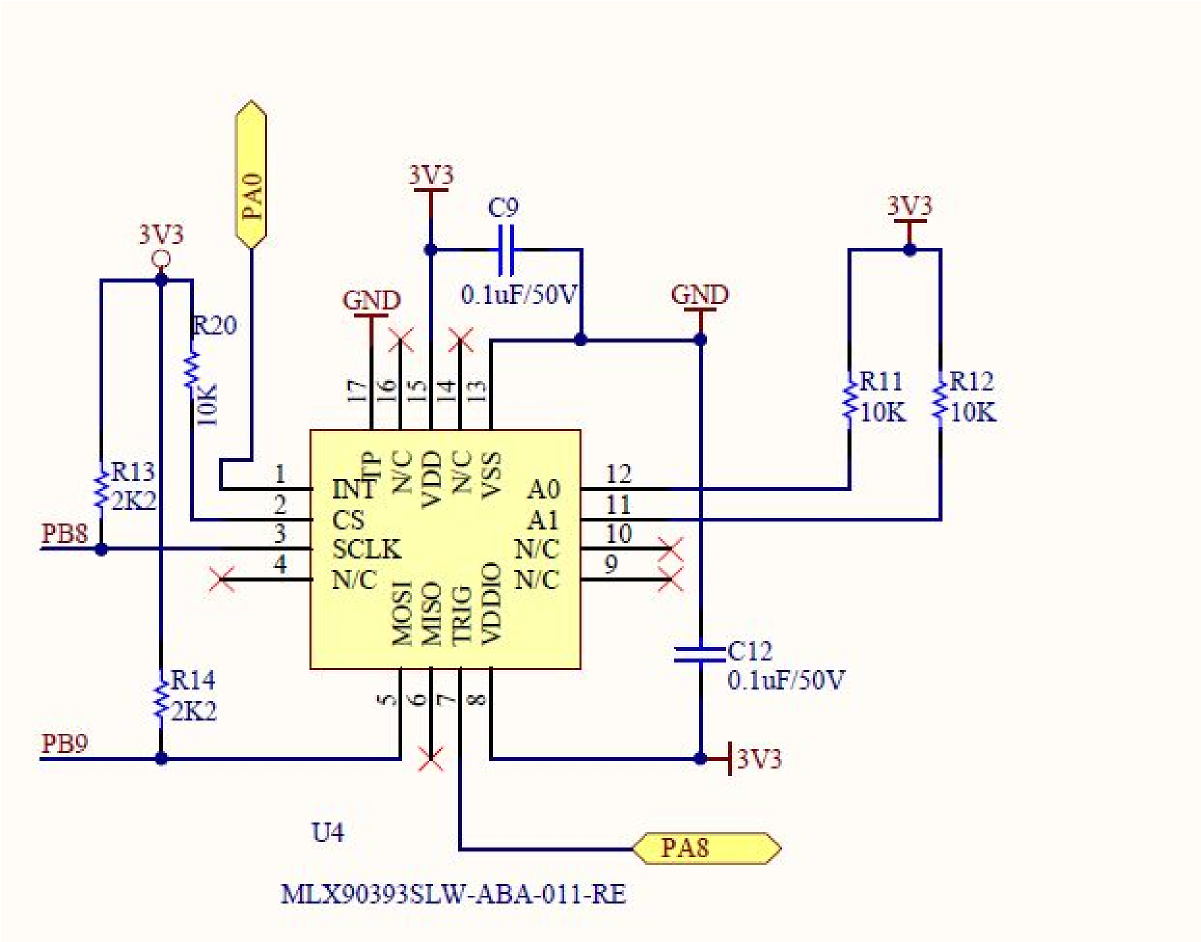
2. MLX90393:

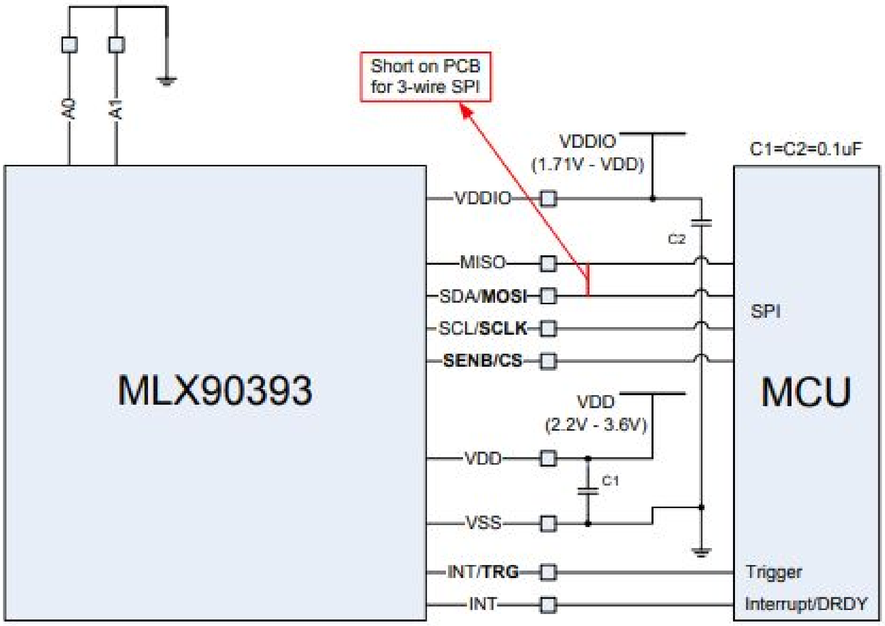
The circuit is a bit complex as it can be programmed in different modes so it requires precise design of the sensor. MLX90393 supports both Selectable SPI and I2C bus protocols. The sensor offers a 16-bit output proportional to the magnetic flux density sensed along the X, Y, and Z axes using the Melexis proprietary Triaxis technology and offers a 16-bit temperature output signal. These digital values are available via I2C and SPI, where the MLX90393 is a slave on the bus.

I2C connection to any microcontroller:



Our I2C implementation





Above image shows SPI protocol connection to MLX90393.