PARTICLE PHOTON2 TUTORIAL

Power Monitor

FireFli PTY LTY ~ FE Basson

BEFORE YOU START!!!

The project uses MAINS VOLTAGE, please take the necessary precautions! If you are not familiar with MAINS VOLTAGES, please do not attempt this tutorial.

Even though the ACS37800 can monitor high voltages (as will be demonstrated in this tutorial) and up to 90A current, the Sparkfun Module used in this tutorial is rated for 60VDC and has a maximum current rating of 30A. Please do not exceed these values as you might damage the module and harm yourself in the process. For the purpose of this tutorial, I will used 240V MAINS voltage as this is what we use, but please do not replicate this unless you are comfortable using MAINS VOLTAGE.

Take care to use appropriate wire gauges for your application.

Introduction

The purpose of this project is to build a power monitor providing the user with Current, Voltage, Power and Power Factor readings.

Allegro's Hall-effect-based, galvanically isolated current sensing technology achieves reinforced isolation ratings in a small PCB footprint. These features enable isolated current sensing without expensive Rogowski coils, oversized current transformers, isolated operational amplifiers, or the power loss of shunt resistors.

The ACS37800 power monitoring IC offers key power measurement parameters that can easily be accessed through its digital interface. Dedicated and configurable I/O pins for voltage/current zero crossing, undervoltage and overvoltage reporting, and fast overcurrent fault detection are available. User configuration of the IC is available through on-chip EEPROM.

We will use a 2" TFT screen to display the readings.

Prerequisites

You should have a basic understanding of Particle WebIDE or Visual Studio Code and how to import libraries.

You should have a Particle Photon2 and a Particle account. If you do not have an account, visit https://www.particle.io and register and account.

You should have at least one Particle Photon2 claimed and active on your account.

Bill of materials

Items you will need to complete this turorial

1	x	1 x Particle Photon2
1	x	1 x Breadboard
1	x	1 x USB cable
1	x	1 x SparkX Power Meter - ACS37800
1	x	1 x 3.7V LiPo battery (or suitable power supply)
1	x	1 x Jumper Wires (male2-male and male-2-female)
1	x	1 x 2” WAVE TFT Display
6	x	6 x 2mm x 6mm Machine screws
1	x	1 x 2mm x 8mm Machine screws
2	x	2 x M6 x 20mm Bolt and washers
3	x	2 x M6 Dome nut

7	x	2mm x 3.4mm Heat Inserts
1	x	3D printed enclosure (STL’s provided)
2	x	RGB LEDs
1	x	Heat Shrink (or something similar)

Software used

Visual Studio Code

Cura Slicer

Autodesk Fusion360

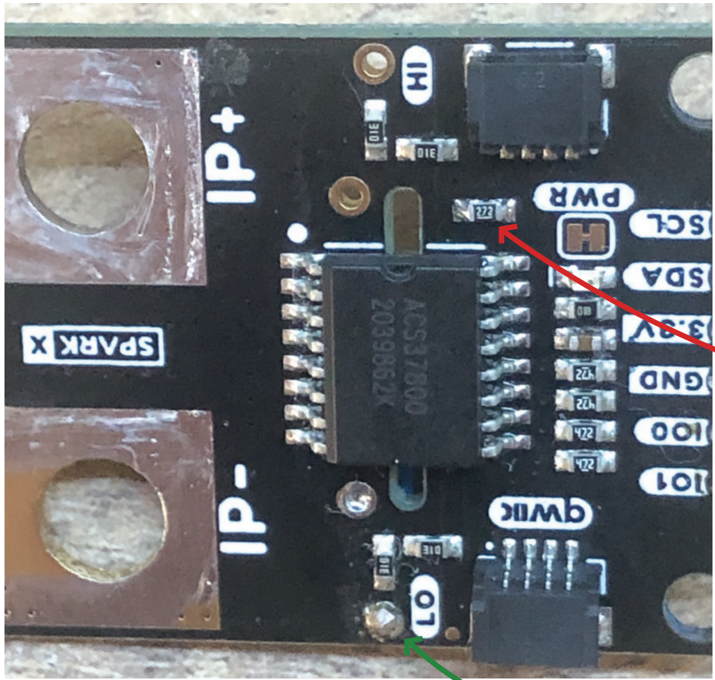


Fig 1.1

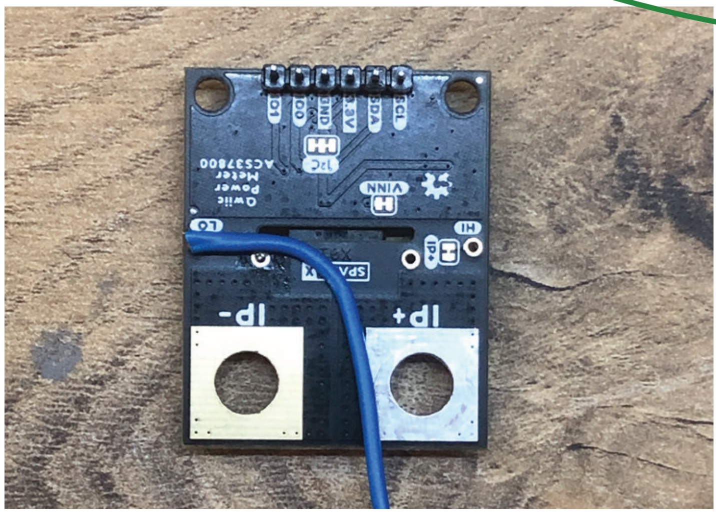


Fig 1.2

Step 1

Preparing the ACS37800 Sensor

We need to make some modifications to the module to be able to measure Voltage. First you need to might need to swop out the Sense Resistor marked by the red arrow. The datasheet provides the formula to determine this, but I will list a couple of popular voltage ranges below (fig 1.1):

12V →	~85kΩ
24V →	42.1kΩ
60V →	16.8kΩ
120V →	5.9kΩ
240V →	2.7kΩ

Next, solder a wire onto the LO plated through hole indicated by the green arrow.

This does not have to be a low gauge wire as it will not be carrying a lot of current. I used 16AWG as it was something I had on hand.

NOTE: Sense Resistor calculation

$$R_{SENSE} = \frac{\Delta V_{INR(MAX)}}{V_{LINE(MAX)} - \Delta V_{INR(MAX)}} * R_{ISO}$$

Where $\Delta V_{INR(MAX)}$ = 250 mV, $V_{LINE(MAX)}$ is the maximum V_{LINE} voltage to be measured, and R_{ISO} is the sum of all of the isolation resistors.

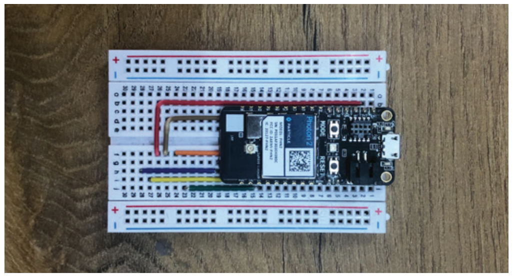
Step 2

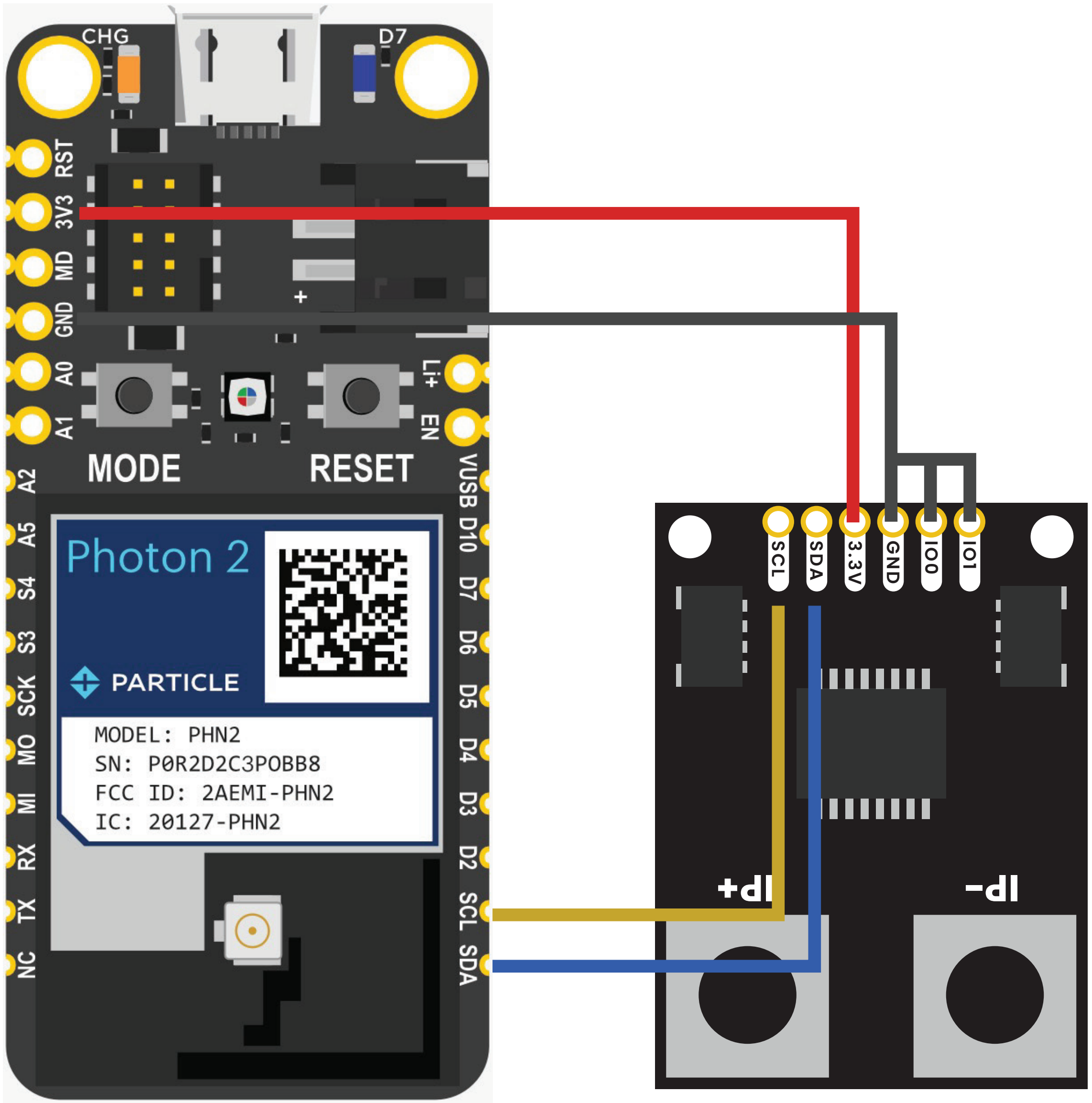
Connecting the ACS37800 Sensor

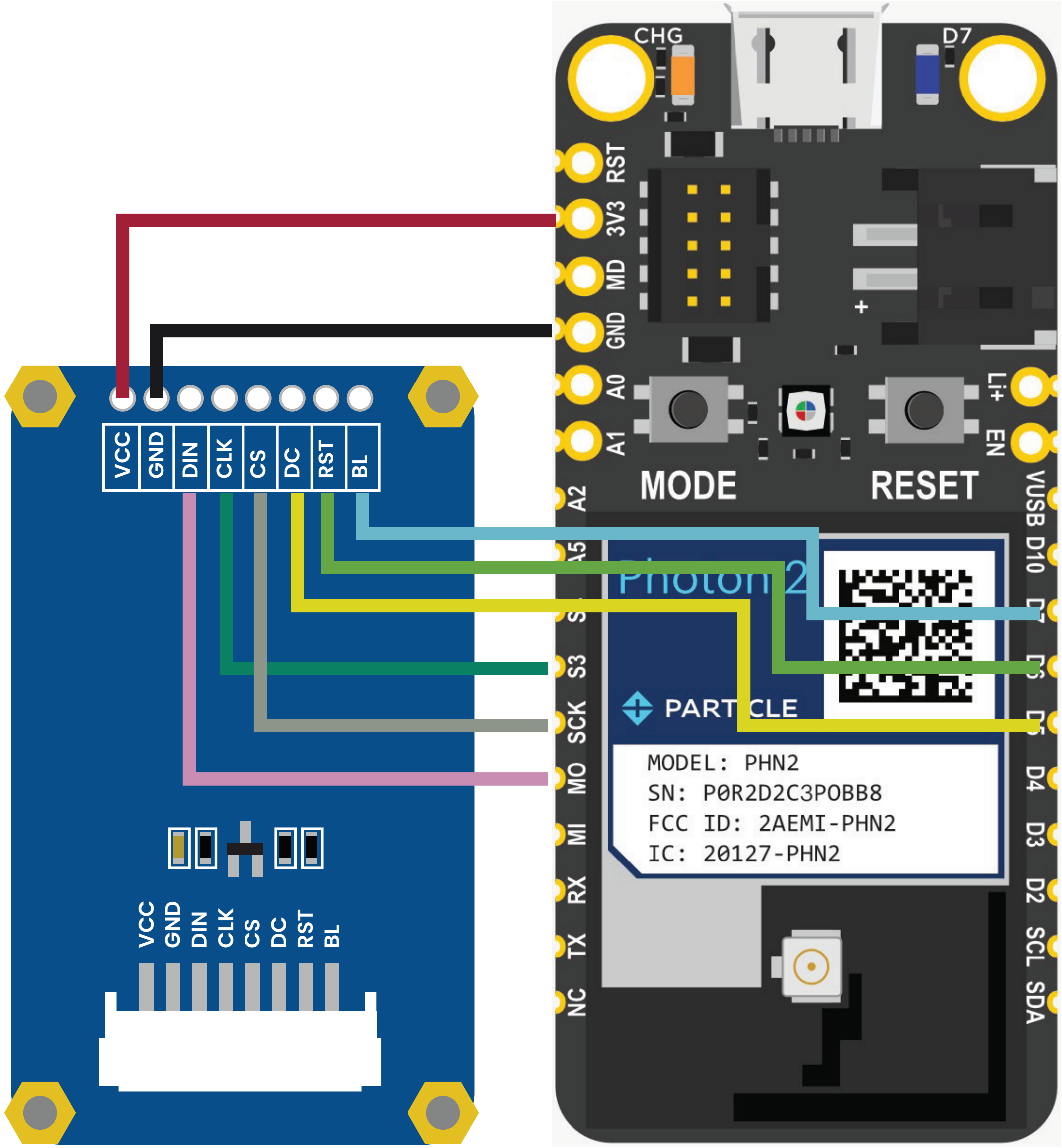
Place your Particle Photon2 on the breadboard and ensure there are exposed holes on either side as we will be connecting wired on both sides of the Photon2.

Make the necessary connections between die Photon2 and the ACS37800 module

Photon 2		VL53L1
3V3	→	3.3V
GND	→	GND
SDA	→	SDA
SCL	→	SCL
GND	→	IO0
GND	→	IO1







Step 3

Connecting the TFT Dispay

This part can be a little more involved so pay careful attention to the wiring.

Photon 2	WAVE 2”
3V3	VCC
GND	GND
DIN	MO
CLK	SCK
CS	S3
DC	D5
RST	D6
BL	D7

NOTE

You can use either the connector and wire harness that came with the screen, or solder headers onto board depending on you connection preference.

Step 4.2

After placing the ACS37800 module and Particle Photon on the PCB, you should have something resembling **Fig 4.5**

Mount the TFT display in place using two (or four) M2 6mm screws **Fig 4.6**

Once you have both ACS37800 module and TFT display wired up to the Photon 2, your project should look something like **Fig 4.7**

Next place the LED lenses in the two holes in the lid **Fig 4.8**. Place the two LEDs in place and take note of the wiring below:

VAC Led+	⟶	3V3
VAC Led RED	⟶	A2
VAC led GREEN	⟶	A5

NOTE

We will only use the Line Voltage LED (VAC) in this tutorial.

Use ~330Ω resistor in series between 3V3 and the Common Anode on the RGB LED.

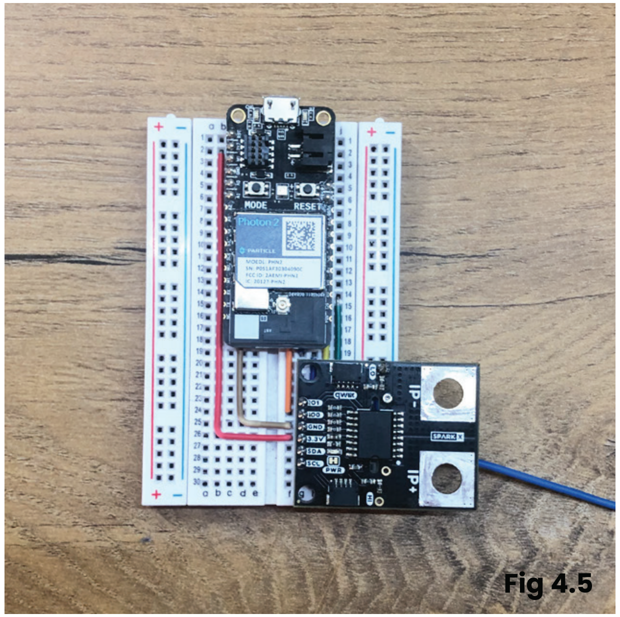


Fig 4.5

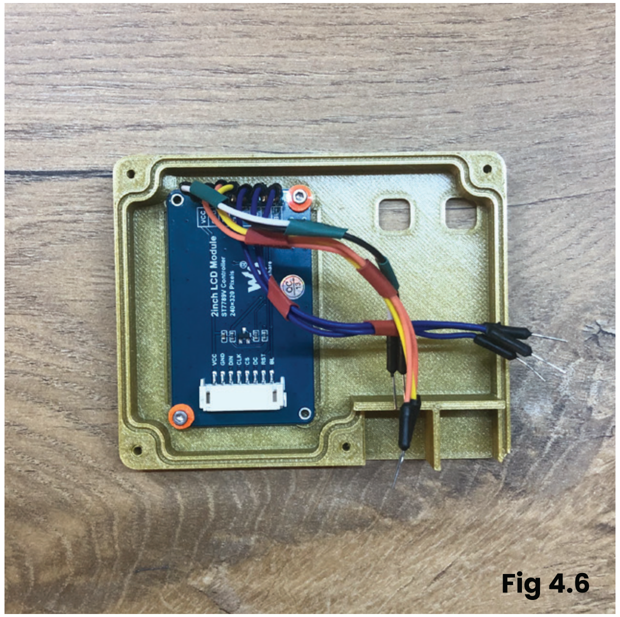


Fig 4.6

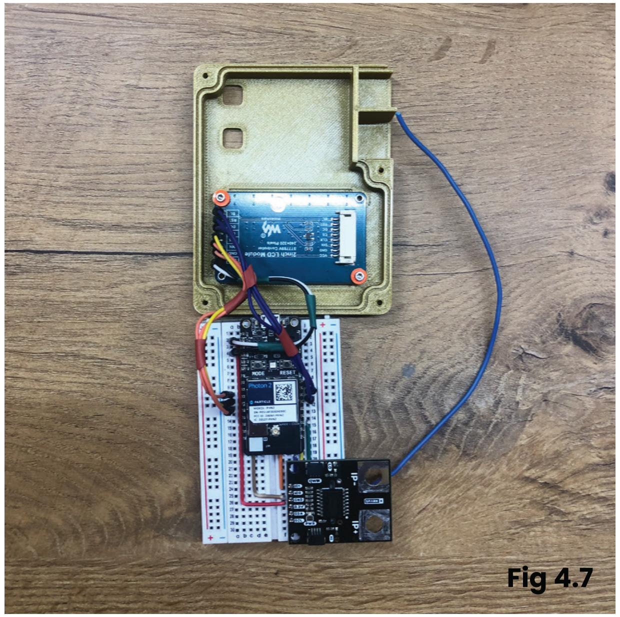


Fig 4.7

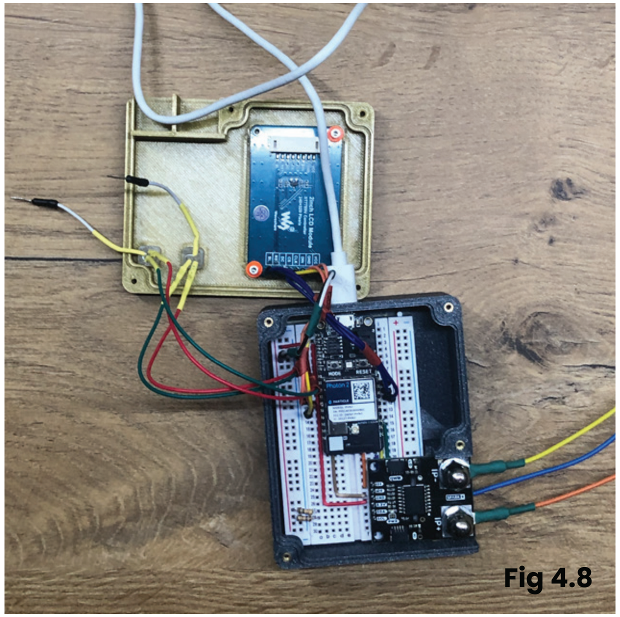


Fig 4.8

Step 4.1

Installing into the enclosure

Using you soldering iron, install the heat inserts into the designated areas as per the images on the right **Fig 4.1**. and **Fig 4.2**.

Next insert the two M6 bolt into the allocated area. **Fig 4.3**

Place the Module support bracket over the two M6 bolts to secure them in place. **Fig 4.4**

Use the 8mm M2 screw to secure the Module support bracket in place.


Fig 4.1

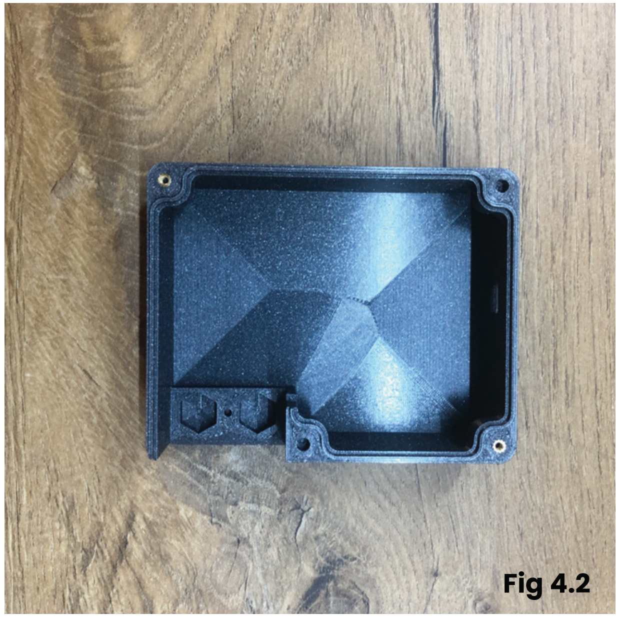


Fig 4.2

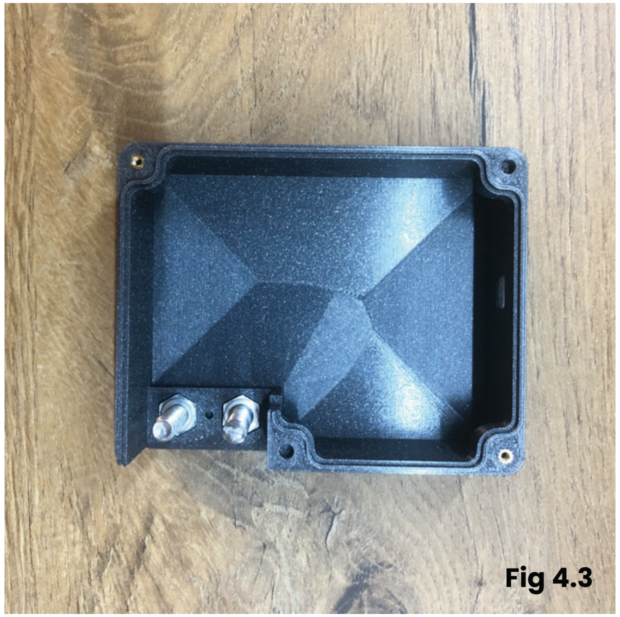


Fig 4.3

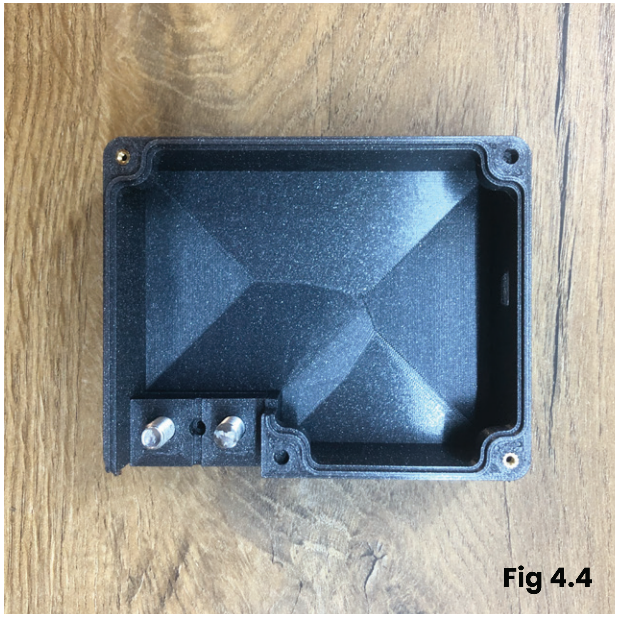


Fig 4.4

Step 5

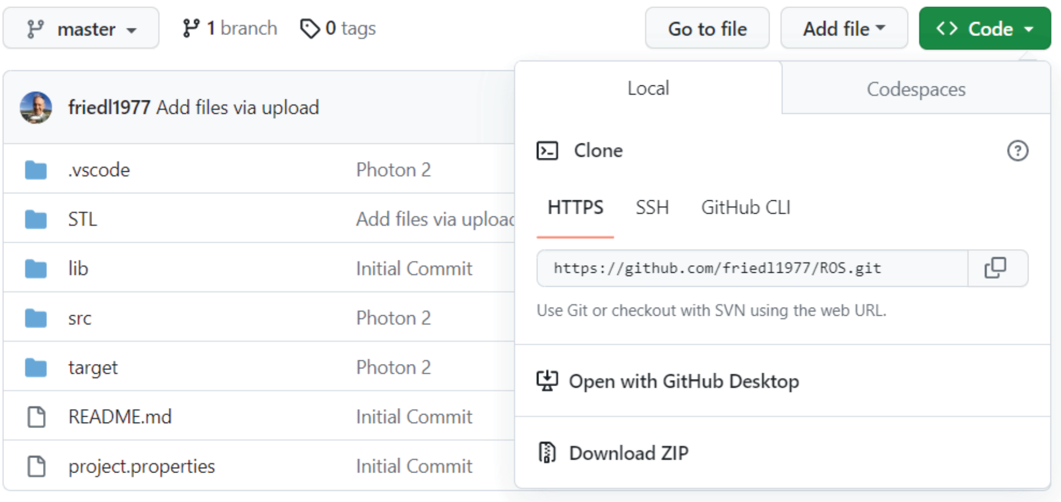
Code

Everything has been done for you. Simply follow the link below and download the entire project from the Github repository.

https://github.com/friedl1977/Power_Monitor

The repository also includes a folder with STL and STEP files if you want to print the enclosure or need to make some modifications on the design.

The code is quite heavily commented for informational purposes. You are welcome to remove these, but please keep all mentions of contributors in place if you intend to publish this code as some parts are loosely based on existing libraries even though quite heavily amended.



NOTE

If you are using Visual Studio Code, make sure to use a USB cable to flash. If you use cloud flash, the libraries hosted on the sever will be used and your display will not function as intended.

The library in this project has been amended to accommodate the 2" display

Step 6

Working principal

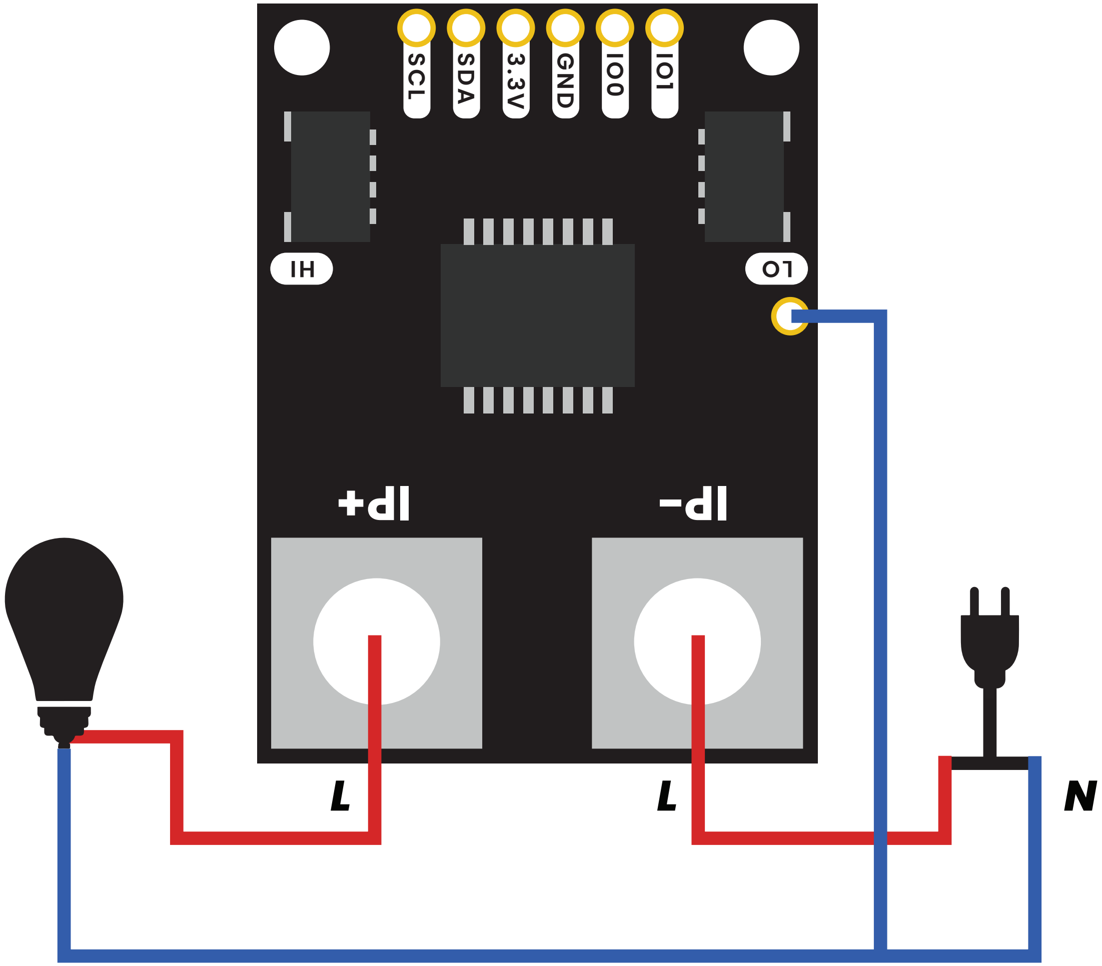
WARNING: When the safety LEDs and/or screen is powered off ALWAYS assume line voltage is live!!!

The device will monitor Line voltage, Current, Power and Power Factor.

We can set Over Voltage or Over Current warnings. **With some added components** we can break the LIVE wire and disconnect the load if any of these fault conditions occur.

- Either Live or Neutral wire can be used to monitor the power. Refer to the diagram for wiring instructions. This is an inline sensor meaning the LIVE (or Neutral) wire will be cut and connected to IP+ and IP- terminals **Fig 7.1**.

In order to monitor Voltage, you will need to connect the BLUE wire to Neutral wire of the load. If this is not done, only current can be monitored.



Room for improvement

this is NOT a production ready design :)

You should NEVER redistribute devices built using breadboard, even more so when mains voltage is involved!!!

This sensor is not ideal for monitoring small currents (< 1A). For this rather use ACS712 sensor, however only the ACS37800 is able to monitor voltage.

Add control to be able to disconnect load if any fault conditions occur.

If you intend to use this product , DESIGN A PCB instead of using a breadboard. While breadboards are acceptable means for rapid prototyping, they present many challenges.

Improvements to enclosure design is possible to ensure user safety. This tutorial is strictly to demonstrate the capabilities of the ACS37800 power monitor.

Some improvements to the libraries are possible.

Use of a different screen technology in order top reduce flickering cause by contant updating of the data.

Enjoy the project!!