

# Power Meter

AC and DC real power measuring.

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## Brief

Device functionality:

- It is a device aims to measure Power for a source and a load (resistive or inductive).
- Source may be AC and DC.
- Measuring Voltage and Current and calculate the phase shift to get the power factor and the Real Power value.
- send these values to a cloud service to observe and analyze the consumption.

Specifications:

- rated AC (0 up to 250 V) max 10A.
- rated DC (0 up to 48 V) max 10A.
- 2 Channels
  - Channel 1 DC only.
  - Channel 2 AC or DC selected by switch on the Board.

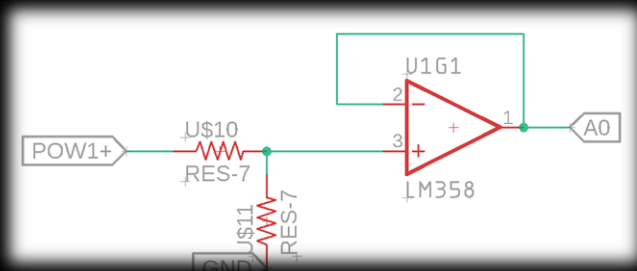
## Hardware

Used hardware:

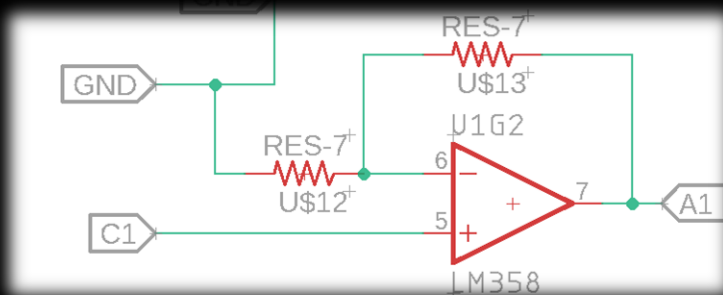
- ESP32 (microcontroller)
- LM358 (OPAMP).
- Character LCD (16\*2)
- Switching Relay 5V/10A
- CT (current transformer) 1:1000 turns ratio.
- Fuses, Res, Cap.

Measuring techniques:

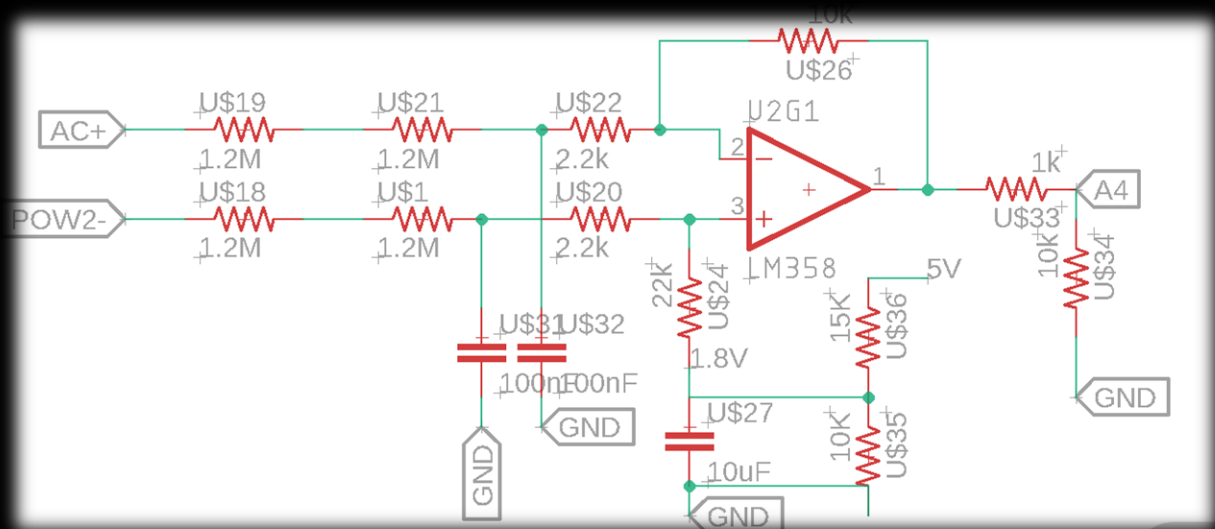
- DC Voltage
  - Voltage divider with buffered OPAMP



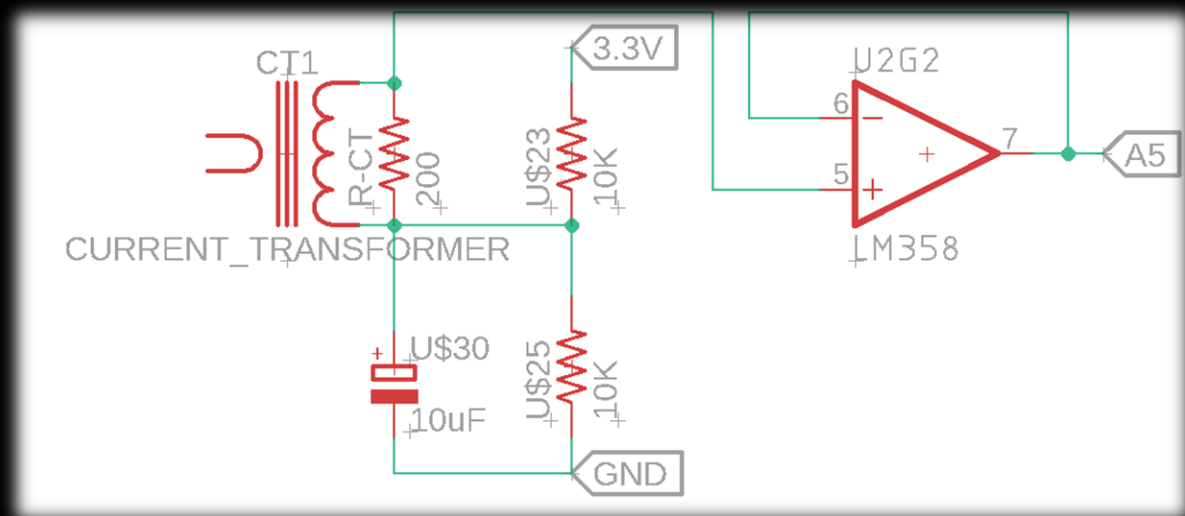
- DC Current
  - Using current sensing and gained OPAMP



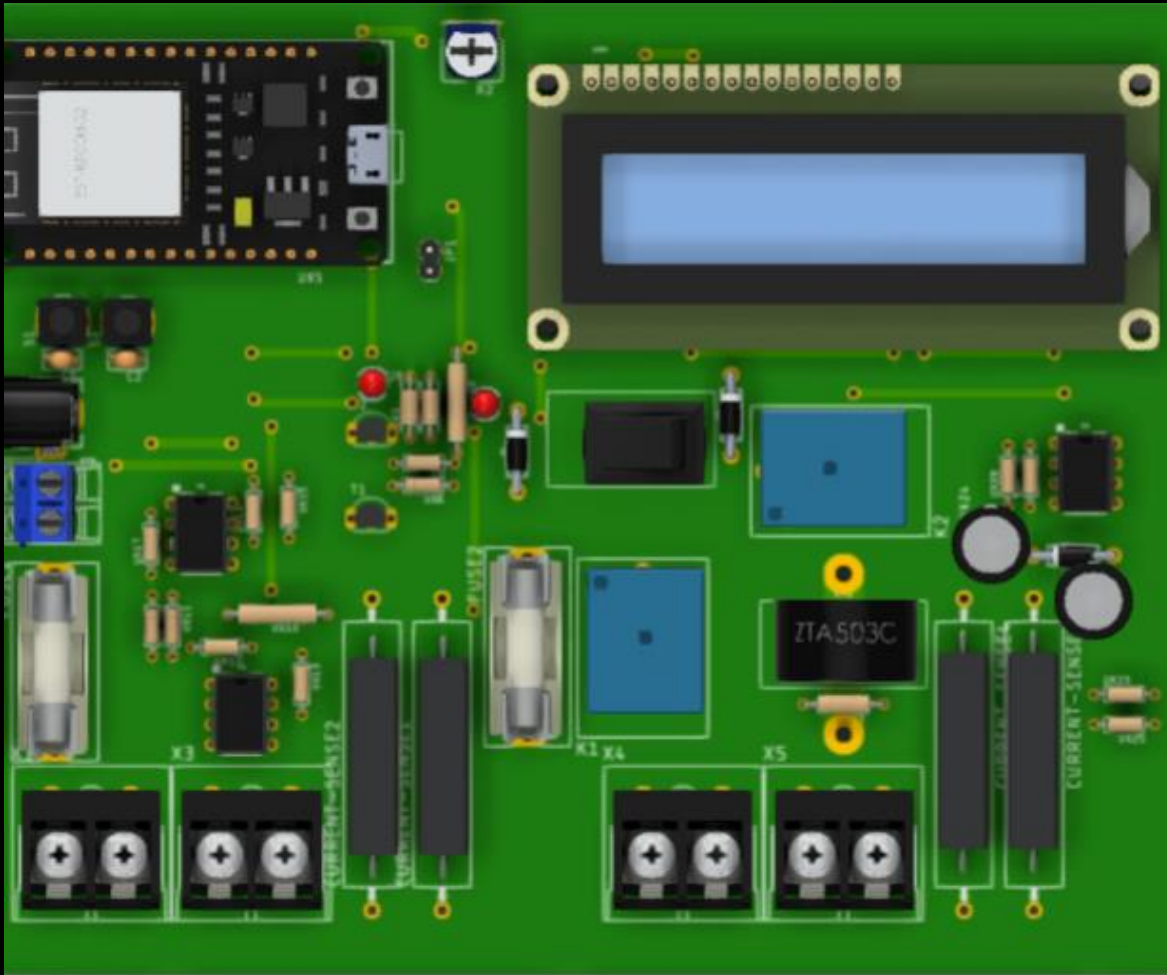
- **AC Voltage**
  - Gained OPAMP less than 1

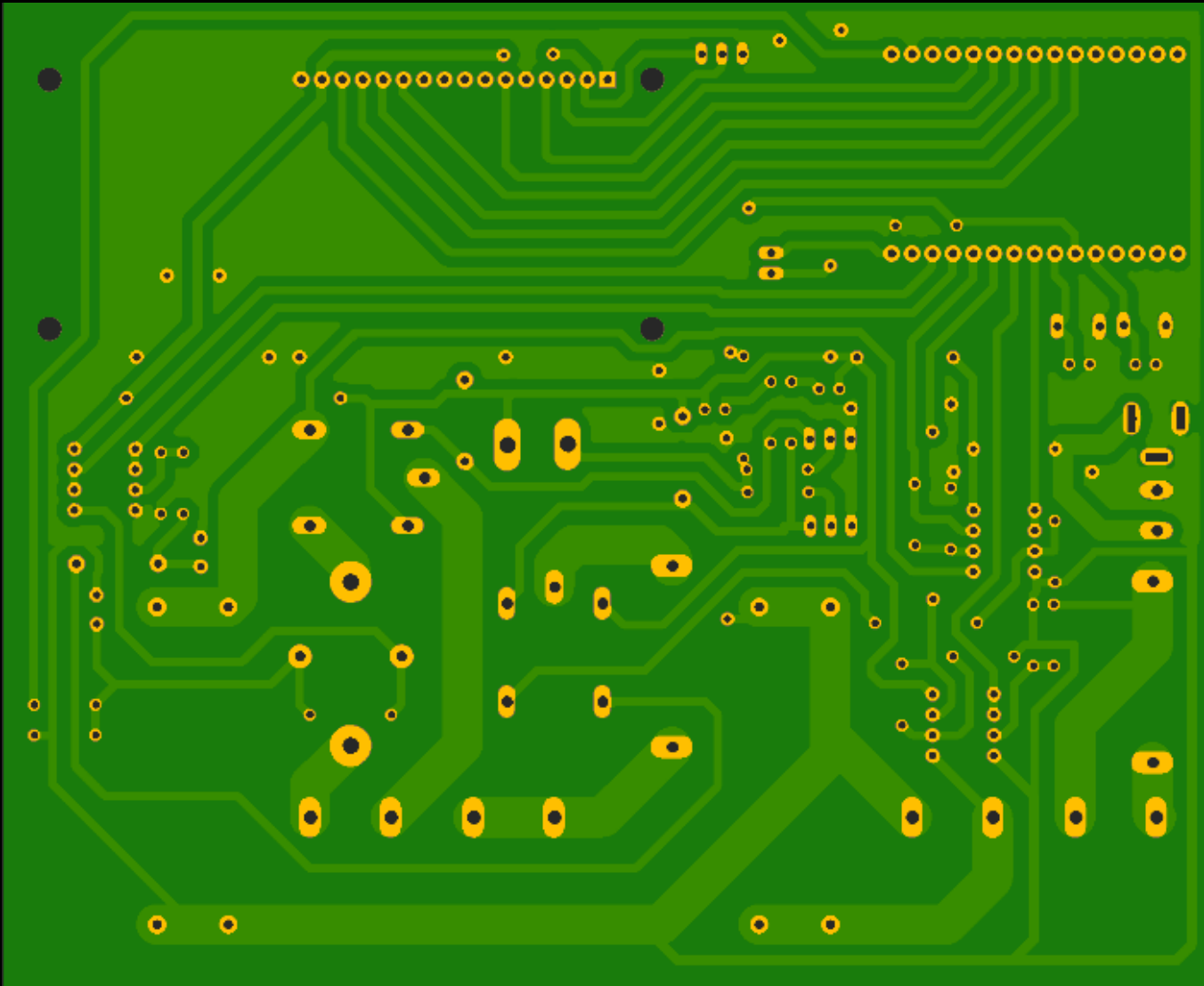


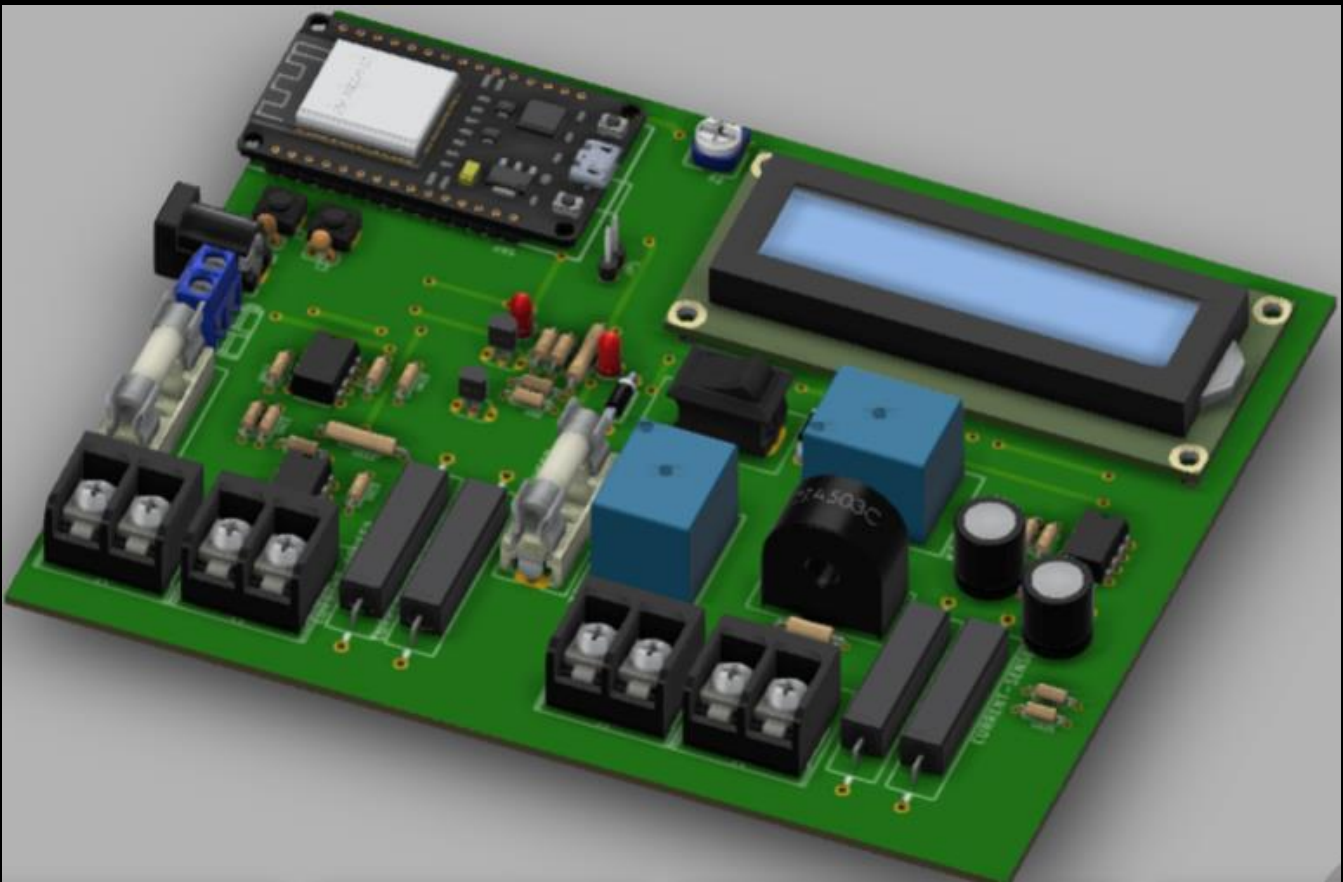
- **AC Current**
  - CT and buffered OPAMP



# Design

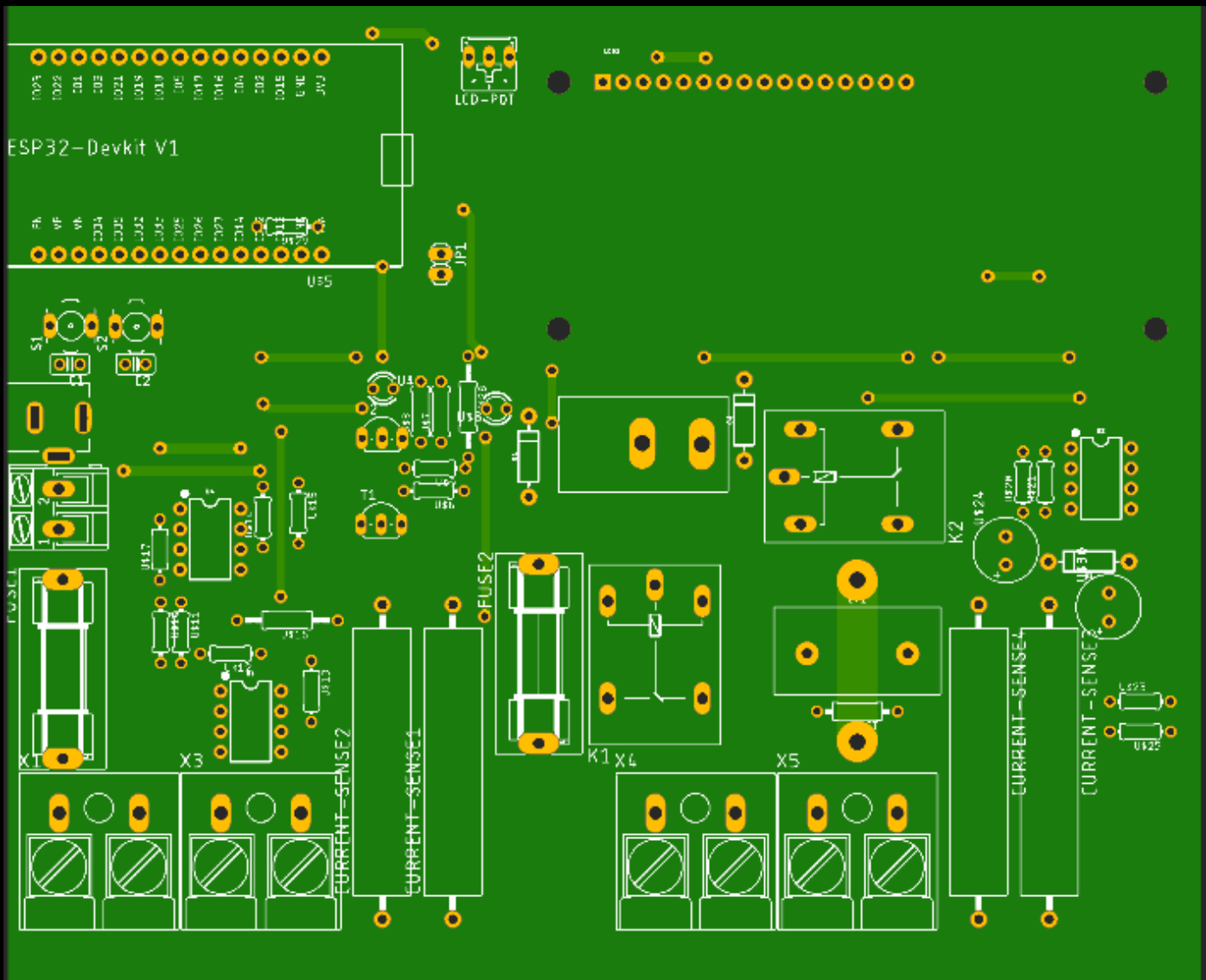


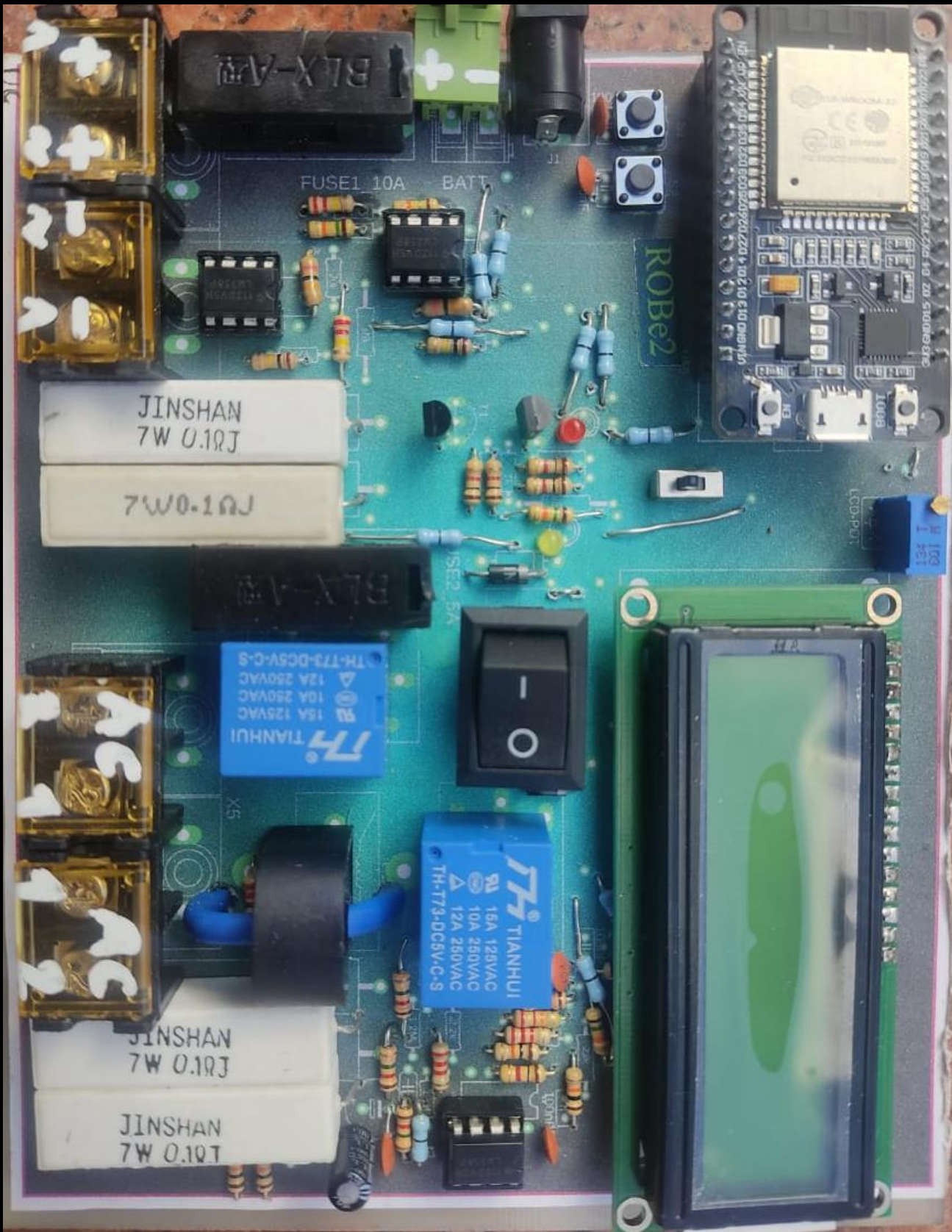




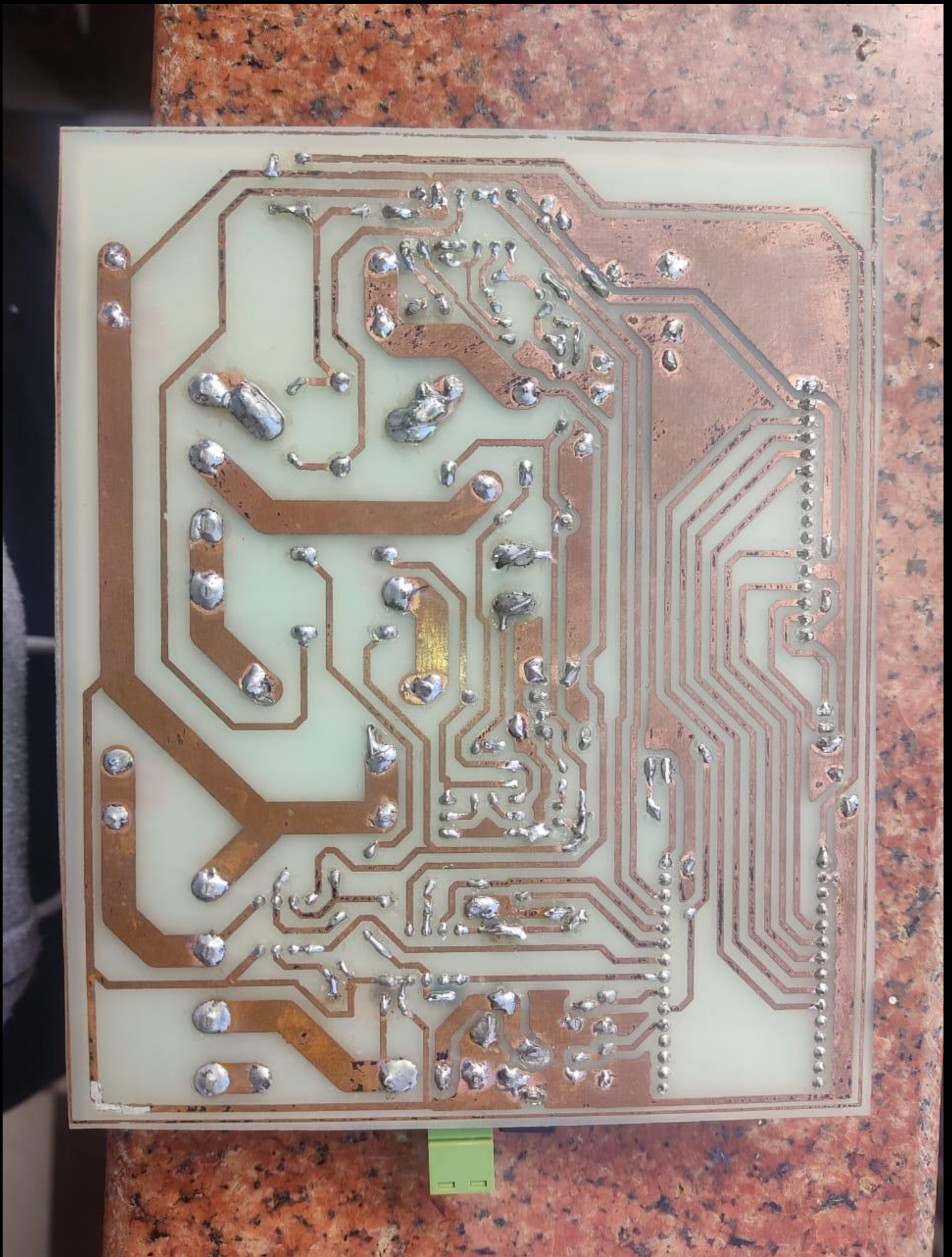












Power Meter Based on IoT concept.

## Testing

\*multimeter used for experiment UNI-T(UT33A+)

\*measured values written after ratio calculations

Testing DC Source and Load(channel2)											
		Voltage						Current			
Source	Load	external Multimeter		ourBoard		ESP(Readings)		external Multimeter		ourBoard	
		Vsource	Vload	Vopamp	V			Csource	Cload	Vopamp	Cload
9V-2A power supply	yellow motor(450mA)	9.15	9.15	0.588	9.21			No load			
		9.15	8.88	0.572	8.9						
		9.05	9.05	0.582	9.05						
9V-2A power supply	1k-10W resistor	9.04	9.04	0.58	9.02			9.11mA	4.2mV		
12V-2A	car window motor										

	editable						
Rin				Rf			Gain
1	M	2.2	k	10	k		0.004995
DC offset voltage divider					Dc offset	Vin	Vout
dc Vin	R1		R2(out)		2	350	3.748077
5	15	k	10	k			

Voltage divider rule						
dc Vin	R1		R2(out)		Vout	Ratio
9.15	220	k	15	k	0.584043	0.06383

Current Sensing				
	R1		R2(feedback)	Gain
	20 k		100 k	6
Vopamp	Vsens	Rsens		Load Current
0.06	0.01	0.05		0.2