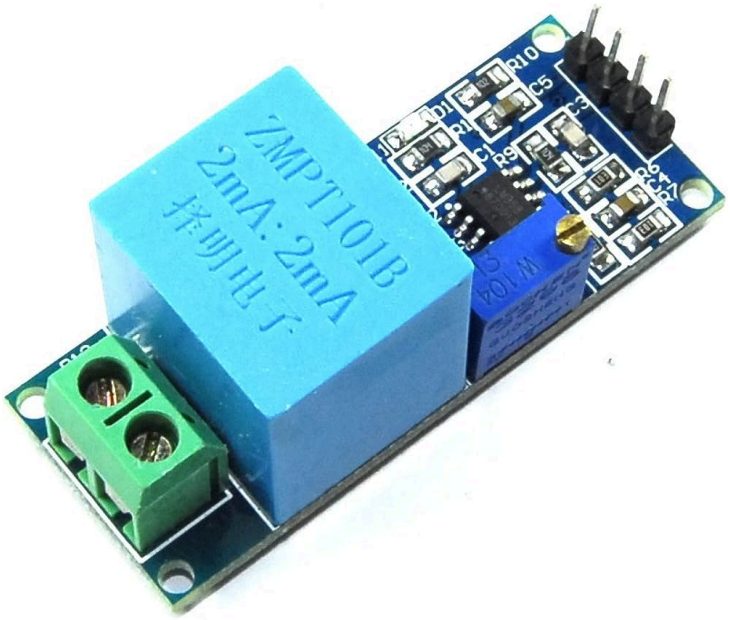


ZMPT101B - High-Precision AC Voltage Sensor

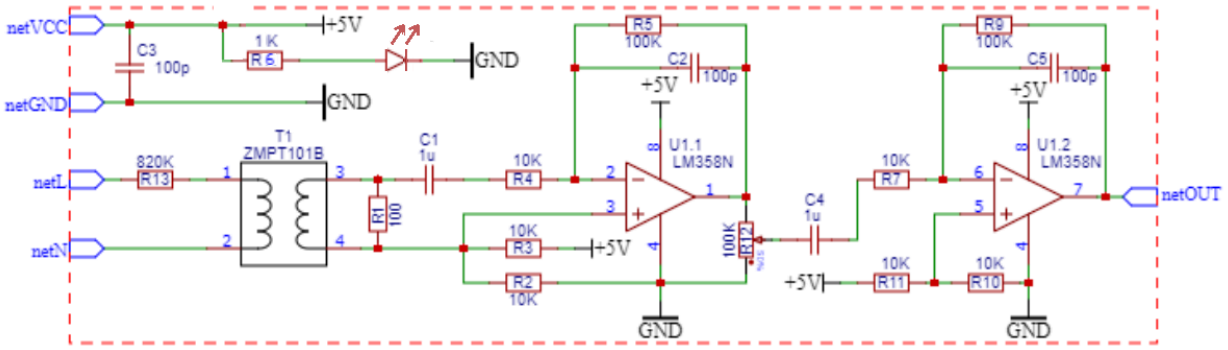
The ZMPT101B is a high-precision AC voltage sensor designed for accurate measurement of AC mains voltage. Equipped with a built-in operational amplifier LM358 circuit, the ZMPT101B provides a reliable and linear output signal proportional to the measured AC voltage. This makes it highly suitable for applications such as energy meters, smart home devices, and industrial automation systems, where precise voltage measurement is crucial.

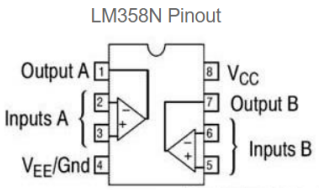
The ZMPT101B's small form factor and easy integration with microcontrollers like the ESP32, Arduino, and other embedded systems enable seamless implementation in a wide range of projects.

Parameters of the ZMPT101B Module:

- Supply voltage: 3.3V - 5V
- Measurable input AC voltage: 0-1000 V.
- Maximum insulation breakdown voltage: 4000 V.
- Transformer transformation ratio: 1000:1000 (2 mA : 2 mA).
- Rated primary winding current of the transformer: 2 mA.
- Rated secondary winding current of the transformer: 2 mA.
- Transformer winding resistance: 100 ohms (at 20 °C).
- Transformer insulation resistance: over 100 MΩ.
- Linearity: 0.1%.
- Accuracy class: 0.2.
- Module dimensions: 49.5 x 19.4 mm.
- Operating temperature: -40 ~ +70 °C.

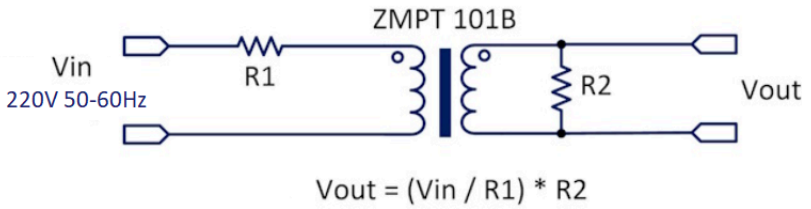
The schematic of the ZMPT101B module is shown below.



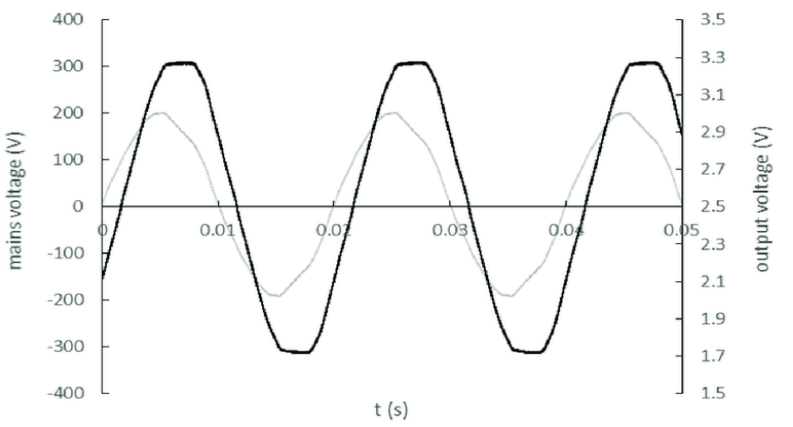


The schematic includes two operational amplifiers that also function as active low-pass filters. Each filter has a gain of 10, resulting in a total gain of 100. The measured voltage at the output of transformer T1 will be 26.8 mV with an input of 220 V (determined by resistors R13 = 820 kΩ and R1 = 100 Ω). The amplified output voltage of the module will vary relative to a 2.5 V level, which corresponds to zero voltage.

The connection diagram of the ZMPT101B transformer for measuring AC voltage is shown below.

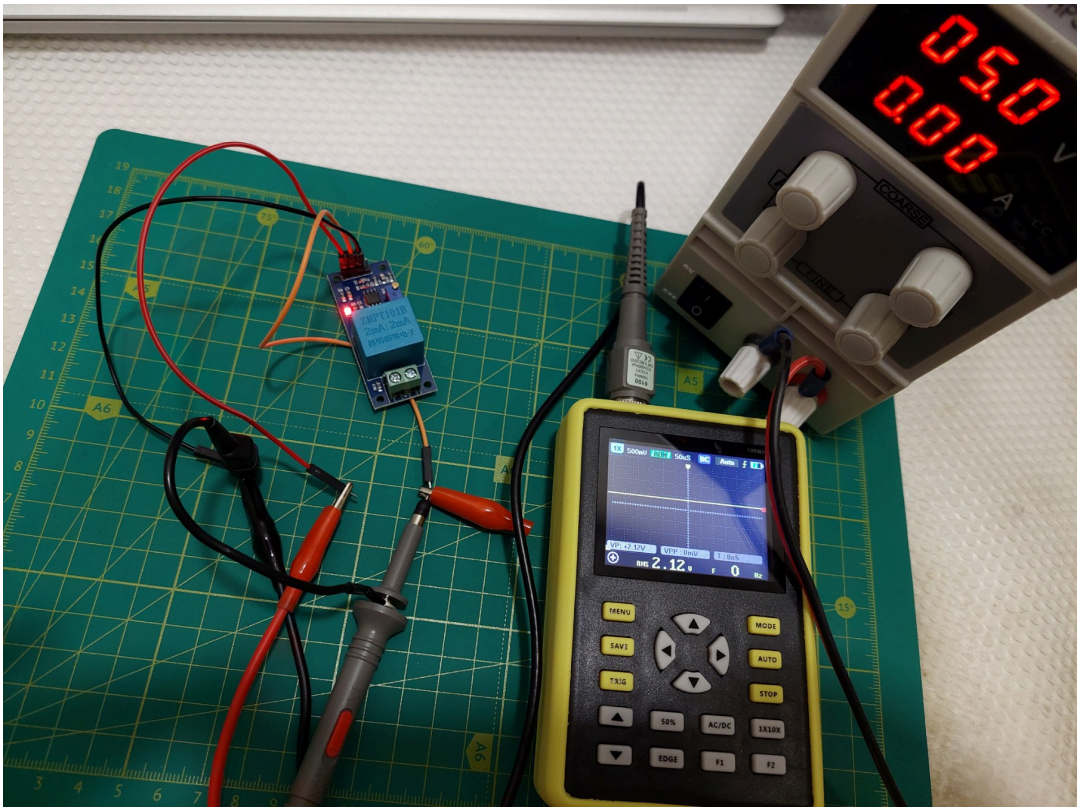


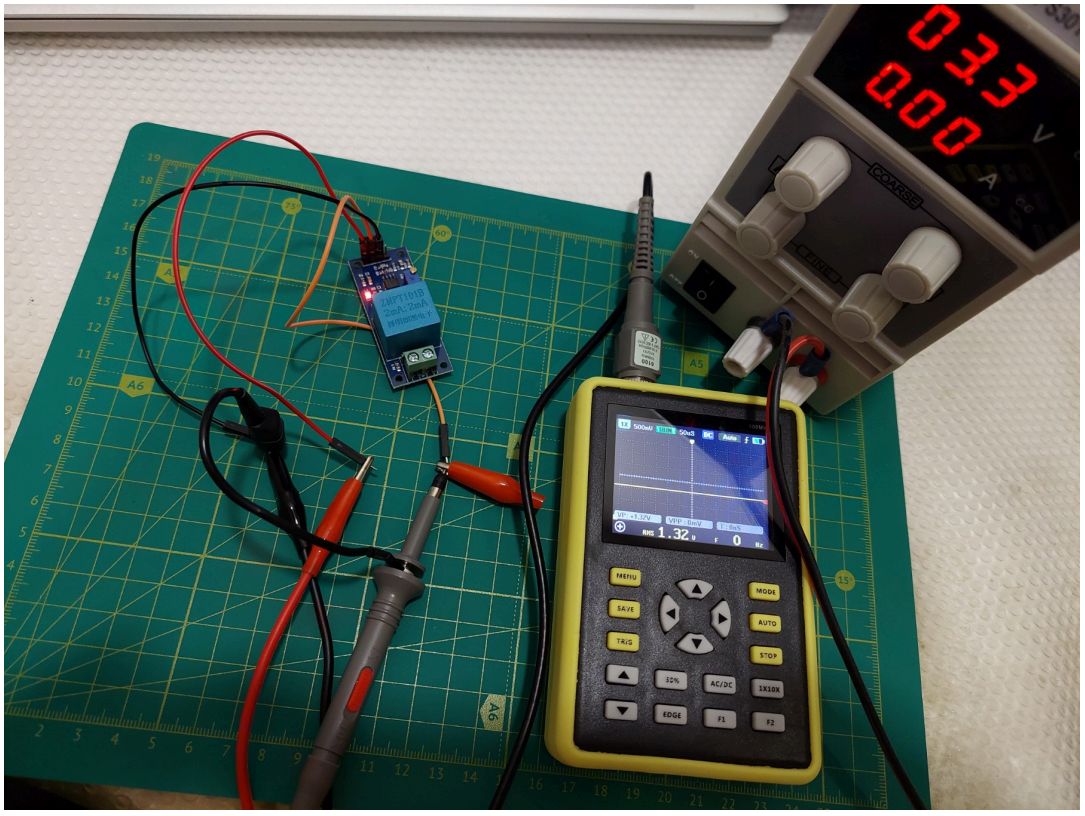
An example of an oscilloscope waveform of the input and output signals with a reference voltage (supply voltage) of 3.3V.



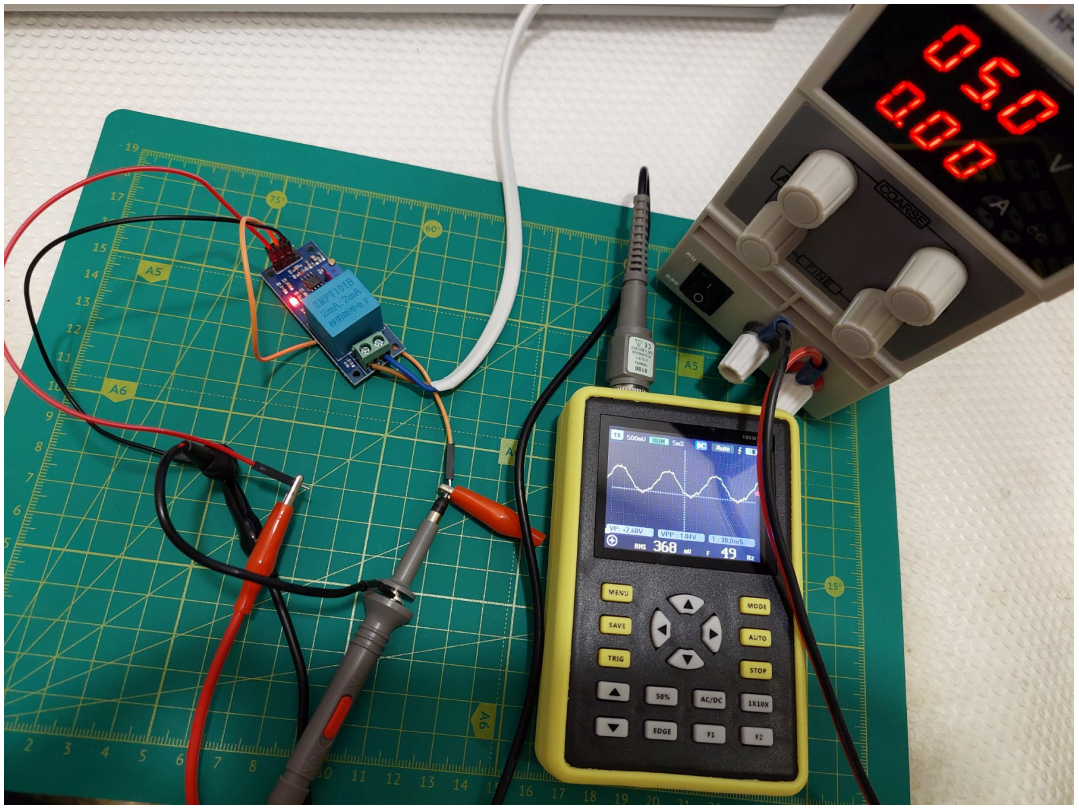
The module's supply voltage range is specified to be from 3.3V to 30V according to specification. However, after testing, the minimum operating voltage was found to be around 2V. It is important to note that the output signal voltage of the sensor will be based on the reference supply voltage.

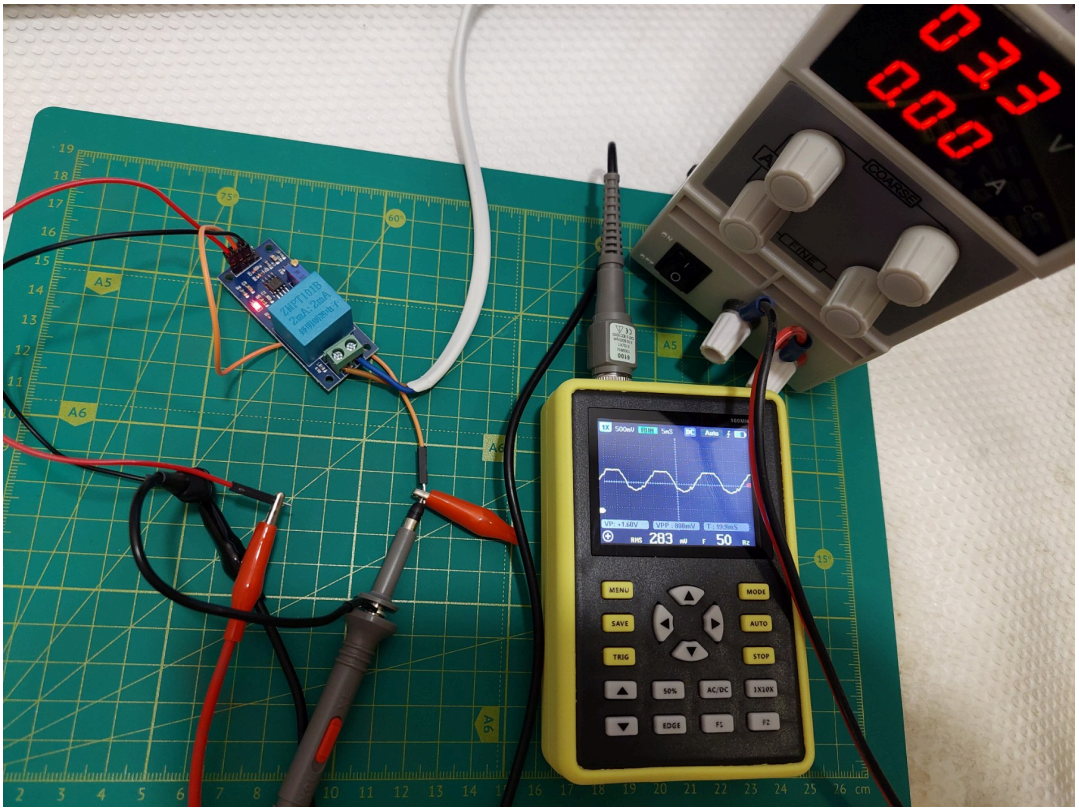
Below is an oscilloscope waveform example of the output signal when the module is powered with 3.3V and 5V, with no input (measuring) signal present.



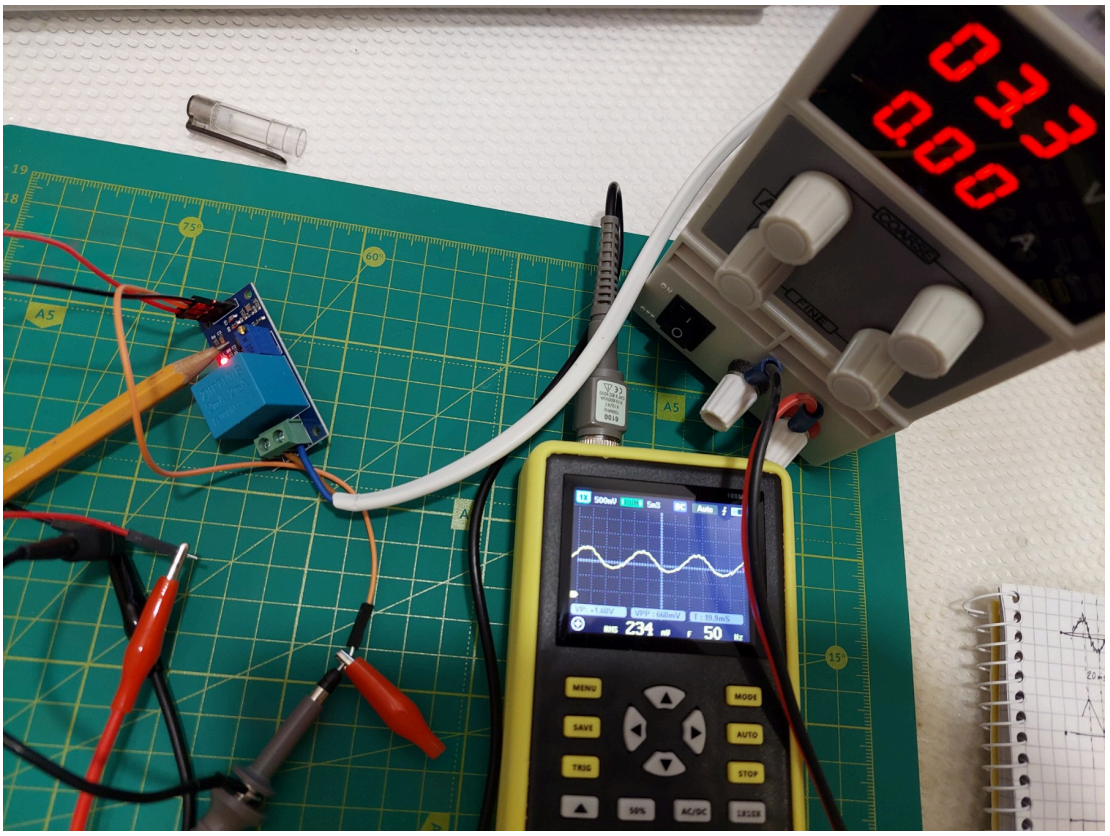


Here is the oscilloscope waveform when an input (measured) signal is present:

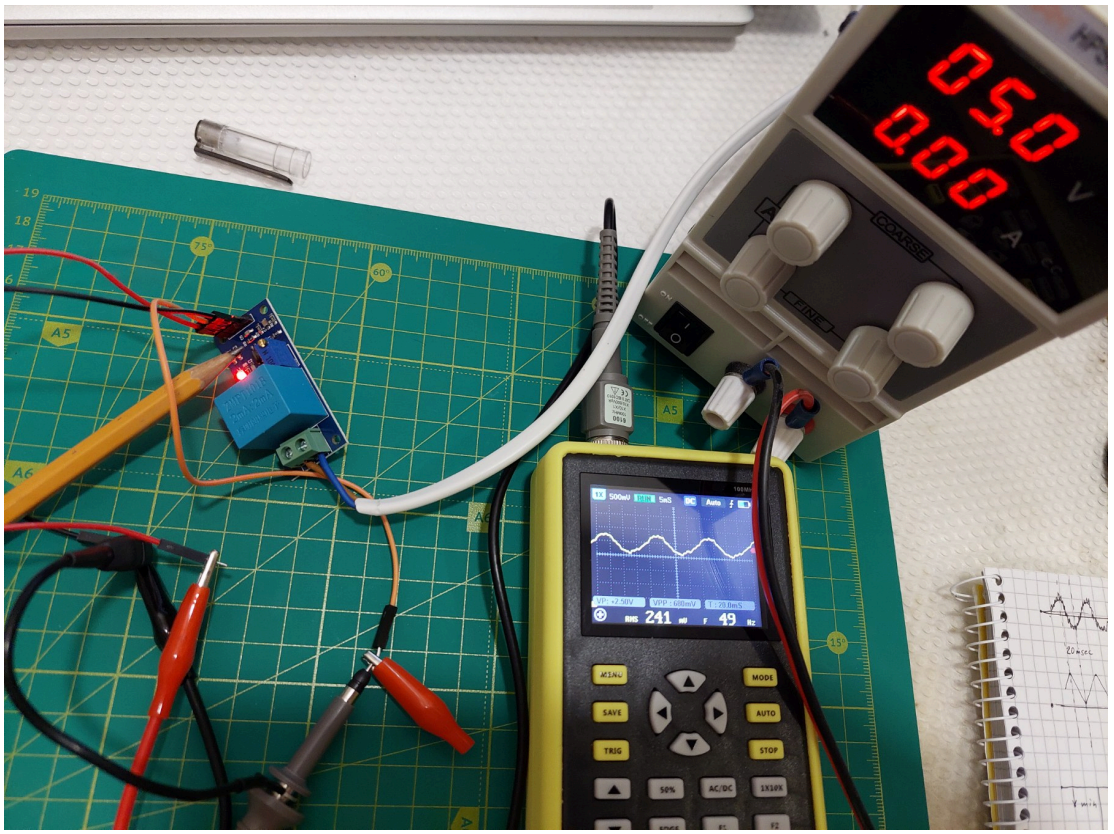




As seen in the oscilloscope waveform, the variable resistor must be adjusted to set the gain coefficient so that the sine wave is not clipped at the peaks. Here is an example of the waveform after tuning with a supply voltage of 3.3V

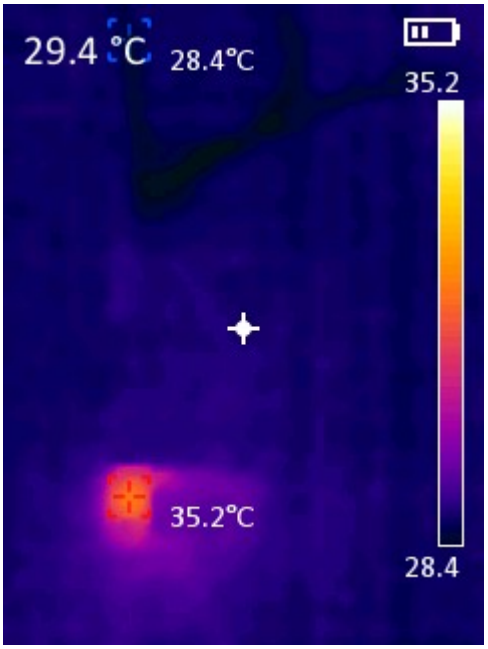


VP: +1.6V VPP: 660mV



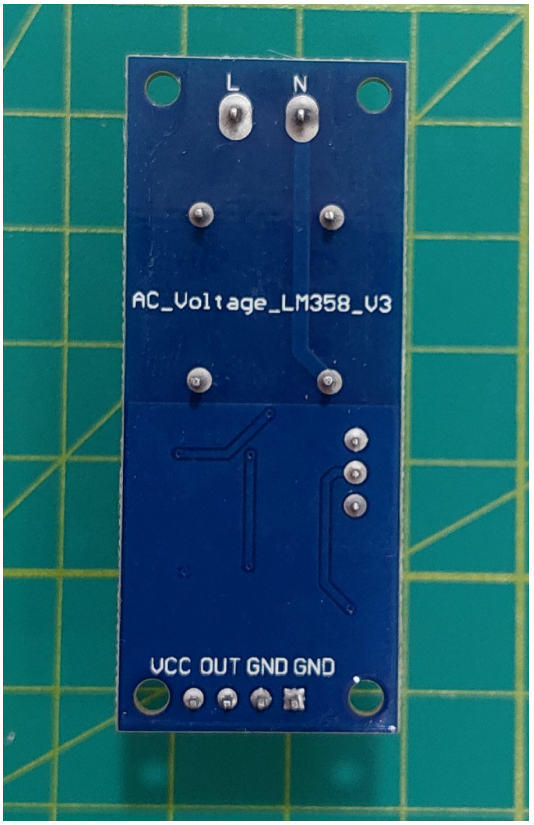
VP: +2.5V VPP: 680mV

Temperature was checked for the sensor after 15 minutes of operation in the input signal measurement mode. As expected, the hottest component was resistor R13



The pinout of the board is indicated on the reverse side of the board. It has four wires:

- GND
- GND
- DATA (output signal)"
- POWER (3.3V, 5V, etc.)



Useful links:

Warning about ZMPT101B Voltage Sensor Modules with active output
https://forum.arduino.cc/t/warning-about-zmpt101b-voltage-sensor-modules-with-active-output/693258

ZMPT101B
https://innovatorsguru.com/wp-content/uploads/2019/02/ZMPT101B.pdf

Calibration of zmpt101b voltage sensor module using polynomial regression for accurate load monitoring
https://www.arpnjournals.org/jeas/research_papers/rp_2017/jeas_0217_5728.pdf

Average Value of an AC Wave
https://www.electronicshub.org/average-value-of-an-ac-wave/