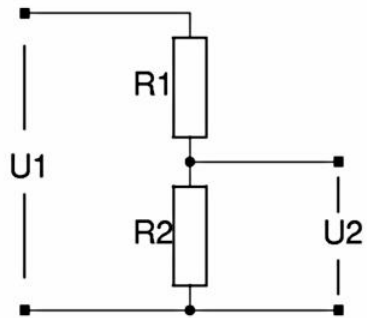


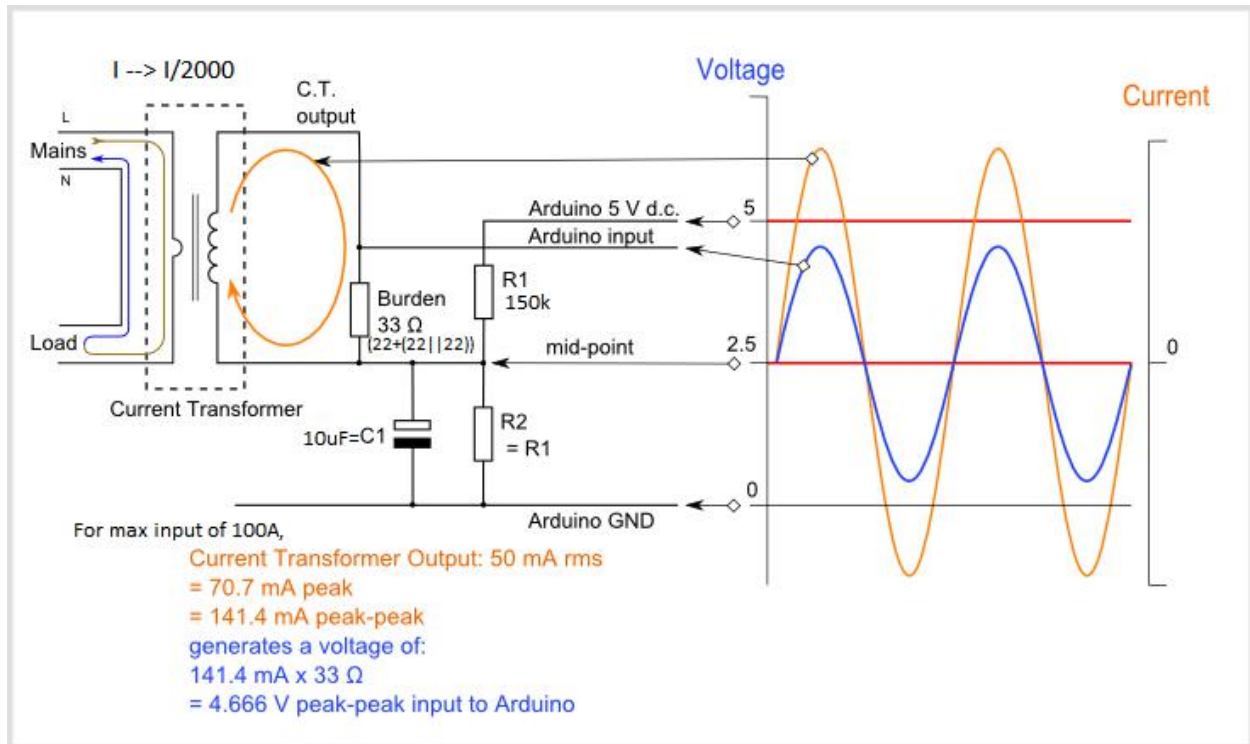
## Circuit Explanation

1. Each of the transformers step-down the voltage/current respectively, to a level at which we can work with a breadboard circuit.
  2. The Arduino/ESP8266 can only deal with **voltages**. The input voltage range is 0 to 5V for an Arduino, while it is 0 to 3.3V for the ESP8266. We therefore have three things to take care of:
    - a. The current signal has to be represented as a voltage signal.
    - b. Both signals should have a peak-to-peak value less than 5V or 3.3V, respectively.
    - c. The voltages shouldn't be negative. Since both the actual waveforms of current and voltage swing between a negative maximum and a positive maximum, we need to shift them completely above the X-axis.
- a. We let the current emerging from the Current Transformer(CT) flow through a "burden" resistor, and take the voltage across that resistor. This voltage is proportional to the current, and is fed to the Arduino/ESP. In this way, the current is represented by a voltage signal.
- b. We step-down the voltage signals before they enter the Arduino/ESP, to below 5V/3.3V peak-to-peak, respectively. The burden resistor ensures this in case of the CT's circuit, while we use a potential divider circuit in case of the Voltage measurement circuit. The calculations related to the step-down of voltages are shown in the images of the respective circuits. We need to use a different burden resistor for the ESP, to get values below 3.3V.
- c. We use potential divider circuits having equal resistances in both the circuits(150k+150k or 440k+440k) to divide the Vcc by 2. In case of Arduino, we get 2.5V by dividing 5V equally. We connect the second terminal of either transformer in both circuits to the 2.5V point, instead of directly to ground. This shifts the voltage going to the Arduino input **up** by 2.5V. Since the signals were already stepped-down to less than 5V peak-to-peak, they were oscillating between -2.5V and 2.5V. Now they have been shifted up to oscillate between 0V and 5V. The same thing can be done for an ESP, using the same set of resistors, which only have to be equal. They would divide the 3.3V Vcc by two.

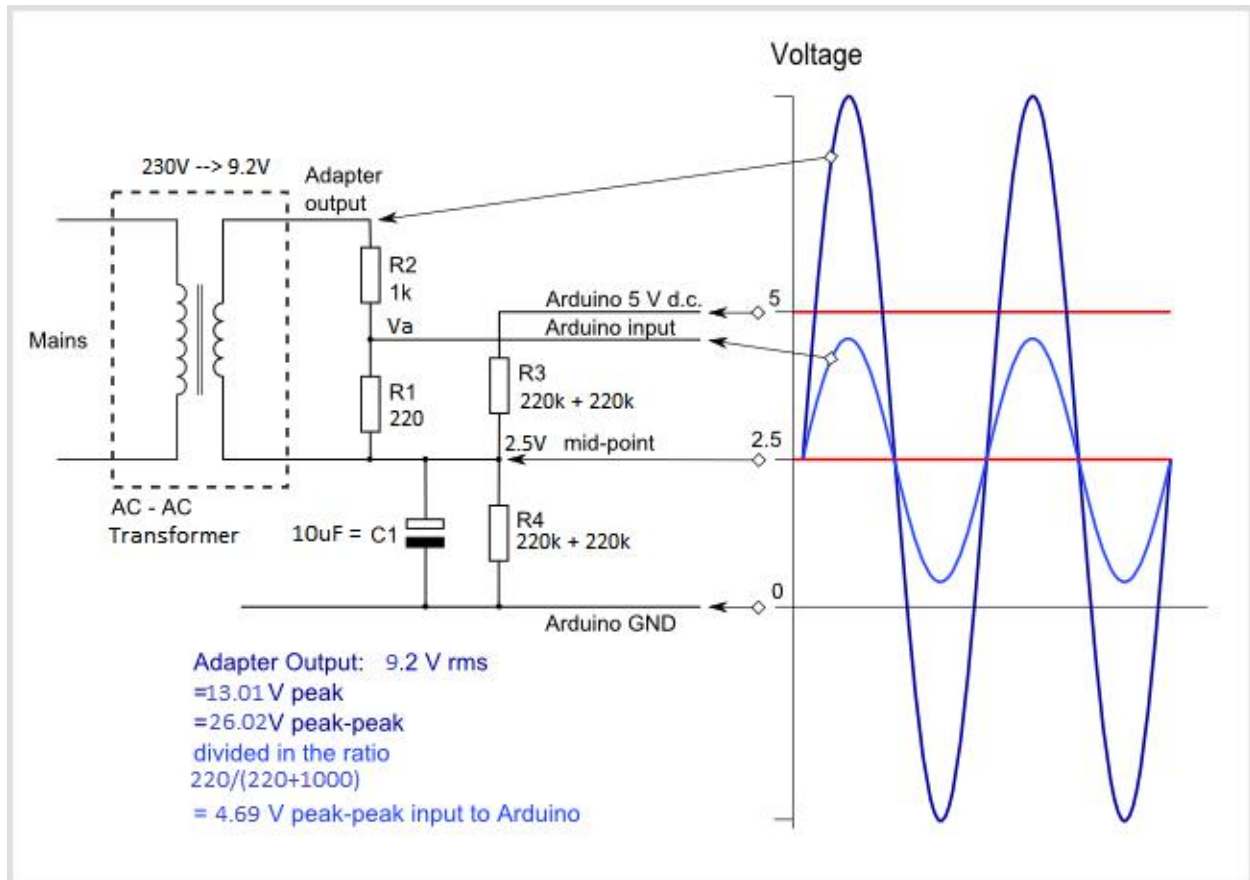
### Voltage divider circuit



$$U_2 = \frac{U_1 \cdot R_2}{R_1 + R_2}$$



Current Measurement part of the circuit



Voltage Measurement part of the circuit