ULTRA PRECISION CURRENT AND VOLTAGE MEASUREMENT SYSTEM

The aim of this project is to design an embedded system to measure precise currents and voltages. We can measure the currents ranging from $1\mu A$ to 100 mA and voltages ranging from 1V to 12V. In this project, we use the STM32F411CEU6 microcontroller. The input signal for STM32F411CEU6 microcontroller is divided in to 4096 discrete levels. We use FDTI – TTL converter to transfer data to computer. The values are transferred to the computer by using the UART communication. Also, we can store the current and voltage values. We can read the current and voltage values from the OLED display. Analog signals are converted into digital signals for represent the current and voltage values.

MECHANISM OF THE CURRENT SENSING CIRCUIT

After the two terminals of the current sensing circuit are connecting to the device under test in series, the voltage across the input resistance of circuit is amplified by LM358N op amp. The output voltage is transferred in to STM32F411CEU6 microcontroller. Then, the output voltage is converted in to digital value. The current value is calculated using above digital value as below.

For the mili range circuit,

Here, the maximum input voltage for STM32 board is 3.3V. We use 12 V and 120 Ω load resistor to calibrate mili range circuit. In here, the maximum current is 100 mA. When we are calibrating the circuit, the output voltage is 3.03 V.

$$A\text{DC value} = \frac{\text{Output voltage } \times 4095}{3.3}$$

The actual current value is generated as below.

$$\text{Current value} = \frac{\text{Current ADC value } \times 100}{\text{ADC value}}$$

MECHANISM OF THE VOLTAGE SENSING CIRCUIT

After the two terminals of the voltage sensing circuit are connecting to the device under test, the voltage is displayed as below procedure. According to the below figure, the voltage across the load resistor is divided by 4 and voltage across the one resistor is transferred in to STM32F411CEU6 microcontroller. Then, the output voltage is converted in to digital value. The voltage value is calculated using above digital value. Voltage value is calculated as above calculation procedure.

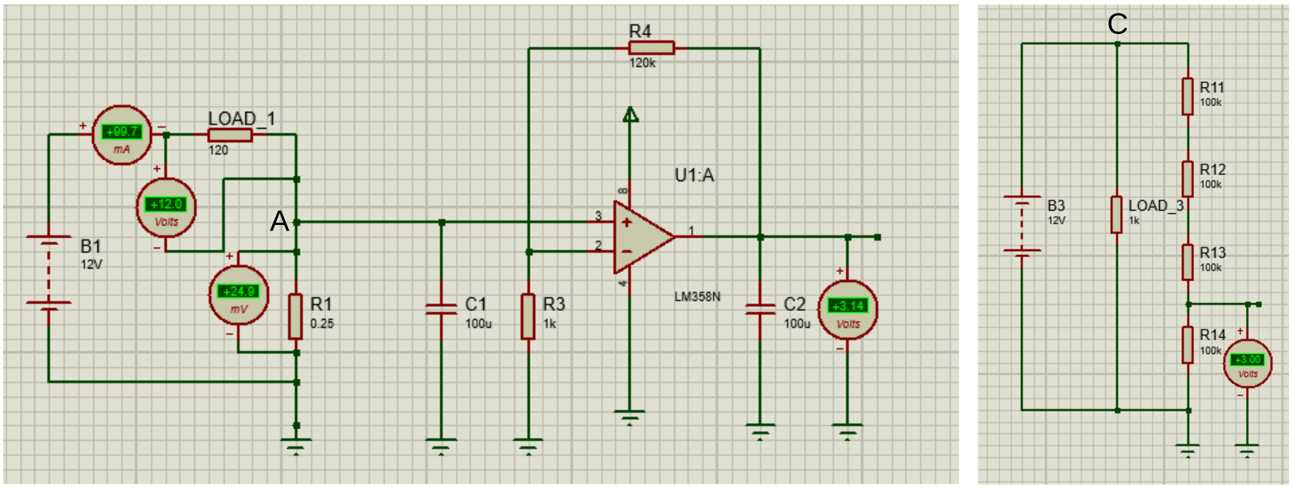

Figure 01: Mili ampere sensing circuit and voltage sensing circuit

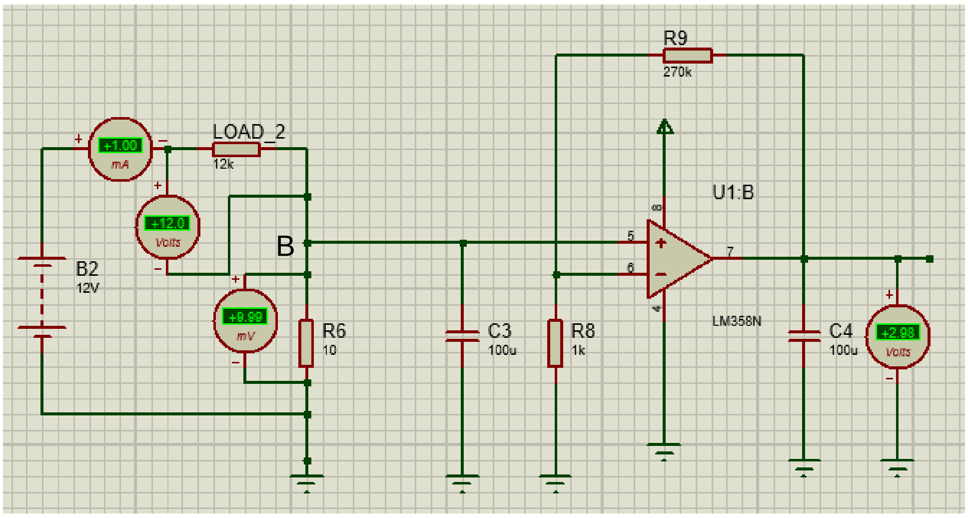

Figure 02: Micro ampere sensing circuit

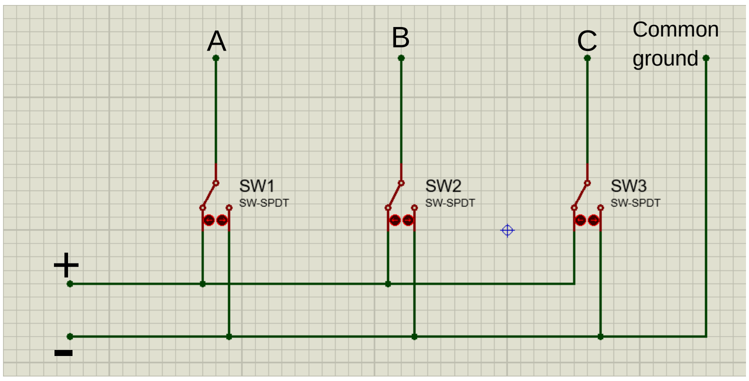

Figure 03: Switch configuration of the final circuit

Here, the A, B and C points are connected to the above three circuits. Point A is connected to the mili ampere sensing circuit, the point B is connected to the micro ampere sensing circuit and the point C is connected to the voltage sensing circuit. These three points are in above sensing figures. All the sensing circuits are connected to the common ground.

PROJECT COMPONENTS

- STM32F411CEU6 microcontroller
- ST-Link V2 debugger
- LM358N dual op-amp IC
- FDTI - TTL converter with jack
- OLED display
- 3 pin slide switches
- Bread board
- Resistors
- Capacitors
- Jumper wires

GROUP NO : 05

GROUP MEMBERS : 22/ENG/026,22/ENG/095,
22/ENG/117, 22/ENG/112,
22/ENG/126, 22/ENG/130