EMBEDDED SYSTEM PROJECT- Ultra precision current and voltage measurement system

GROUP MEMBERS

A.M.S.W.S. Atapaththu-22/ENG/014

D.J.P. Senevirathna-22/ENG/031

L.R.Y.M. HERATH-22/ENG/089

N.A.S. Harshima-22/ENG/108

ULTRA-PRECISION CURRENT SENSING CIRCUIT

This Ultra-precision current sensing circuitry was built using a circuit made with shunt resistors, amplifiers, and capacitors.

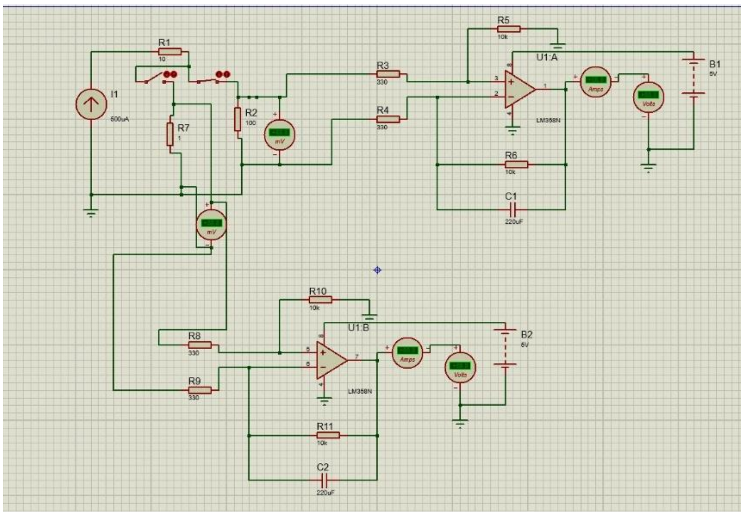


Figure 01: CURRENT SENSING CIRCUIT

PRECISION VOLTAGE SENSING CIRCUIT

This Precision voltage sensing circuitry was built using a circuit made with a voltage divider.

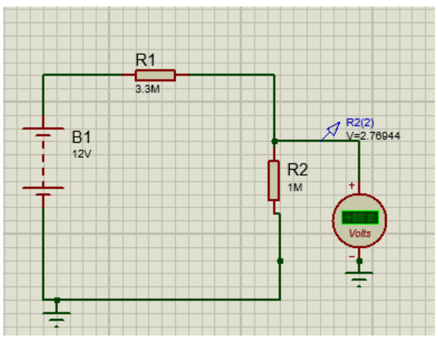
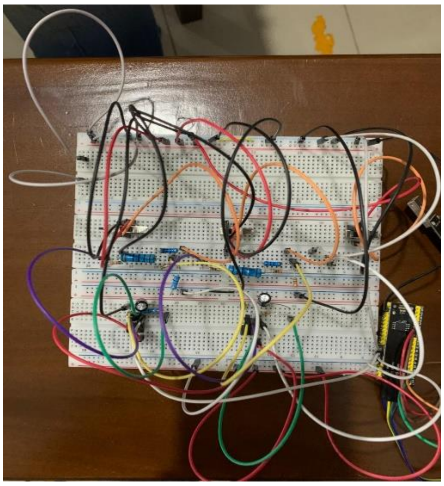


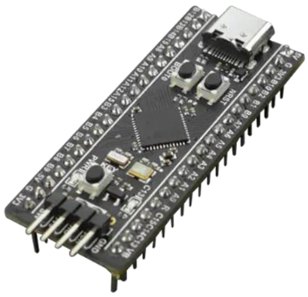
Figure 02: VOLTAGE SENSING CIRCUIT

THE WORKING PROTOTYPE OF THE PROJECT



COMPONENTS

STM32F411Board

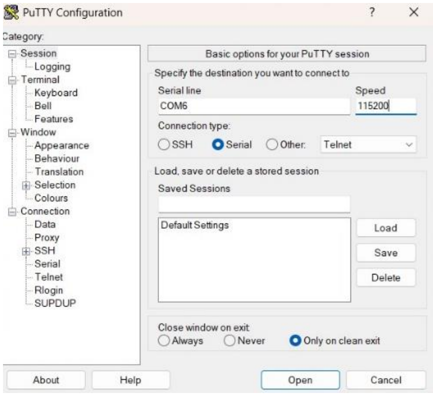


ST link Debugger

- UART TTL Series Convertor

- Operational Amplifier (LM358N)
- Shunt Resistors (1 Ω for milli range ,100 Ω for micro range)
- Capacitors (220 microfarad)
- Resistors (1MΩ, 3.3MΩ, 330Ω,10 Ω)
- Bread Board
- Jumper Wires
- 3 Toggle Switches

Putty configuration



Operation

Output logic for voltage sensing circuit

$$V_{out} = V_{in}\frac{R2}{R1 + R2}$$

R_1 = 3.3MΩ R_2= 1MΩ

$R_1 + R_2 = 4.3$

$$2.79 = 12 \times \frac{1}{3.3 + 1}$$

When the maximum voltage to be measured is given a voltage of 2.79V which is lesser than 3.3V is provided to the STM board. We chose these resistor values based on the ratio needed and how practical values came.

$$\text{voltage} = \frac{\text{ADC\_VAL}[0]\times 3.3\times 4.3}{4095.0\times 1.04}$$

Output logic for current sensing circuit (milli range)

$$Gain = \frac{R_2}{R_1} = \frac{10000}{330}$$

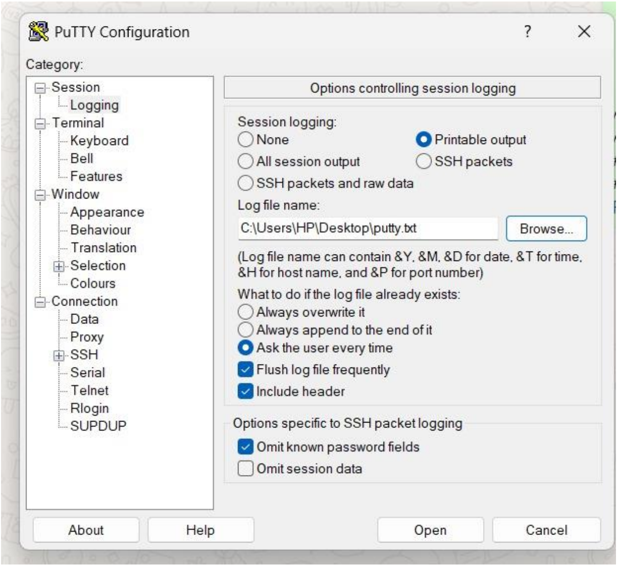
$$\text{current\_1} = \frac{\text{ADC\_VAL}[1]}{30.03\times 1.25}$$

Output logic for current sensing circuit (milli range)

$$Gain = \frac{R_2}{R_1} = \frac{2000}{330}$$

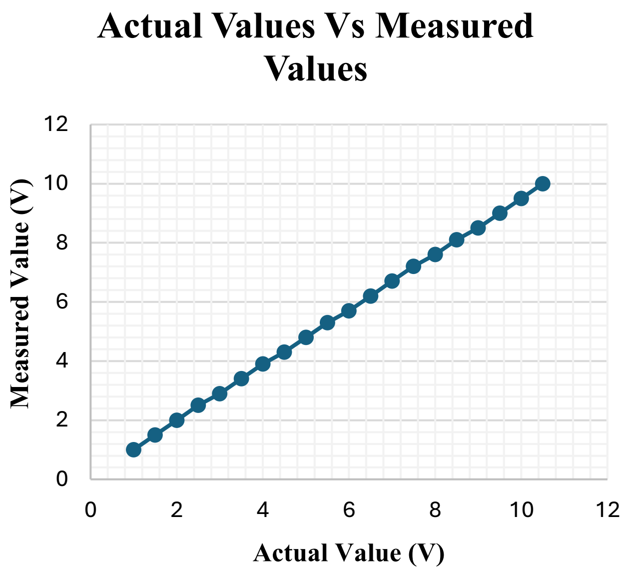
$$\text{current\_2} = \frac{\text{ADC\_VAL}[2]\times 2000}{330\times 100.0}$$

Data storing using putty software



ACCURACY TEST

Following the development of a precise current and voltage measurement system, discrepancies were identified during testing between the supplied values and the measured outputs. To address this issue, a correction factor was applied to align the measured values with the actual inputs.



$$V_{out} = x \times \frac{(12-1)}{(11.5-1)}$$

$$V_{out} = 1.04x$$

Therefore, the calculated correction factor is 1.04.