

EE Fundamentals Lab - Assignment 2

Selected resistors and the calculations

Voltage Calculations

1. First Output Voltage (VOUT1)

- Formula: $VOUT1 = 2V + 0.01 \times \text{Day of the Month}$
- Calculation: $VOUT1 = 2 + 0.01 \times 5 = 2.05V$

2. Second Output Voltage (VOUT2)

- Formula: $VOUT2 = VOUT1 + 0.1$
- Calculation: $VOUT2 = 2.04 + 0.1 = 2.15V$

3. Third Output Voltage (VOUT3)

- $VOUT3 = VOUT2 = 2.15V$

Resistor Calculations

Using $R1 = 240\Omega$:

- Given: $VOUT = 2.05V$,
- $R1 = 240\Omega$

Using Formula $VOUT = Vref(1+(R2/R1)) + (I_{adj} \cdot 2)$

$$0.64 = R2/240\Omega$$

$$R2 = 153.6\Omega$$

$$\text{Closest} = 160 \Omega$$

LED Specifications

Key Information from Datasheet

1. Forward Voltage (VF):
 - Typical VF: 2.0V
 - Maximum VF: 2.5V (at IF = 20mA)
2. Recommended Forward Current (IF):
 - Typical IF: 20mA (0.02A)
 - Maximum IF: 25mA (0.025A)

Current-Limiting Resistor (R7) Calculation

- Formula: $R7 = (VOUT - VF)/IF$
- Given values:
 - VF = 2.0V (typical forward voltage at IF = 20mA)
 - IF = 20mA = 0.02A
- Calculation: $R7 = (2.05 - 2.0)/0.02 = 2.5\Omega$

TPS79301 Voltage Regulator Calculations

Key Information

1. Output Voltage Formula: $VOUT = VREF \times (1 + R3/R4)$
 - VREF = 1.224V (internal reference voltage)
 - Required VOUT = 2.15V

Resistor Calculations

Step 1: Calculate R3 and R4

1. Formula rearranged: $R3/R4 = (VOUT/VREF) - 1$
2. Calculation: $R3/R4 = 2.15/1.224 - 1 = 0.7558187$
3. Using $R4 = 30.1\text{k}\Omega$
 - $R3 = 0.7558187 \times 30.1 \text{ k}\Omega = 22.75 \text{ k}\Omega$
 - Standard values:
 - $R3 = 22\text{k}\Omega$
 - $R4 = 30\text{k}\Omega$

Step 2: Calculate R8 (LED Current-Limiting Resistor)

- Formula: $R8 = (VOUT - VF)/IF$
- Values:
 - VOUT = 2.15V
 - VF = 2.0V
 - IF = 20mA = 0.02A

- Calculation: $R8 = (2.15 - 2.0)/0.02 = 5\Omega$

~~Q1~~ VOUT1 Calculation *Mauri*

$$\begin{aligned}
 V_{OUT1} &= 2V + 0.01 \times 5 \text{ Day Bias} \\
 &= 2V + 0.01 \times 5 \\
 &= 2V + 0.05 \\
 &= 2.05V
 \end{aligned}$$

$$\begin{aligned}
 V_{OUT2} &= V_{OUT1} + 0.1 \\
 &= 2.05 + 0.1V \\
 &= 2.15V
 \end{aligned}$$

$$\begin{aligned}
 V_{OUT3} &= V_{OUT2} \\
 &= 2.15V
 \end{aligned}$$

V_{OUT} = LM1317 + Regulator

①

$$V_{OUT1} = V_{REF} \times \left(1 + \frac{R_2}{R_1}\right) + (1 \text{ mV/g} \times R_2)$$

$$2.05 = 1.2246 \times \left(1 + \frac{R_2}{R_1}\right) + (0 \times R_2)$$

$$\frac{2.05}{1.2246} = 1 + \frac{R_2}{R_1}$$

~~$$1.64 = 1 + \frac{R_2}{R_1}$$~~

~~$$0.64 = \frac{R_2}{240}$$~~

~~$$R_2 = 153.6$$~~

~~$$0.64 = \frac{R_2}{240}$$~~

~~$$R_1 = \frac{240}{0.64}$$~~

~~$$= 375$$~~

~~$$1.64 = R_1 + 240$$~~

~~$$1.64 R_1 = 240$$~~

~~$$1.64 - 1 = \frac{240}{R_1}$$~~

~~$$0.64 R_1 = 240$$~~

TPS79301 Regulator

$$V_{REF} = 1.2246V$$

$$R_4 = 30.1k\Omega$$

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_L}{R_2}\right)$$

$$V_{OUT2} = V_{REF} \times \left(1 + \frac{R_3}{R_4}\right)$$

$$2.15 = 1.2246 \times \left(1 + \frac{R_3}{30.1k\Omega}\right)$$

$$\frac{2.15}{1.2246} = 1 + \frac{R}{30.1 \times 10^3 \Omega}$$

$$0.7558187 = \frac{R_3}{30.1 \times 10^3}$$

$$\boxed{\begin{aligned} R_3 &= 22.75 \text{ k}\Omega \\ R_Y &= 30.1 \text{ k}\Omega \end{aligned}} \Rightarrow 1700V$$

MIC 5376 - Regulator

$$V_{\text{OUT}} = V_{\text{REF}} \left(1 + \frac{R_1}{R_2} \right) = V_{\text{REF}} \left(1 + \frac{R_G}{R_E} \right)$$

$$2.15 = 1 \left(1 + \frac{150 \text{ k}\Omega}{R_E} \right)$$

$$2.15 = 1 + \frac{150 \text{ k}\Omega}{R_E}$$

$$1.15 = \frac{150 \text{ k}\Omega}{R_E}$$

$$(R_E = \frac{150 \times 1000}{1.15})$$

$$R_E = 130.434 \text{ k}\Omega$$

$$\frac{1}{2.15} \times 21.5 = 21.5$$

LED Calculations → LSR 976. (3)

Forward Voltage = 2.00V

$$R_7 = \frac{V_{out} - V_f}{I_f}$$

$$I_f = 20mA$$

$$R_7 = \frac{2.05 - 2.00V}{20 \times 10^{-3}}$$

$$R_7 = \frac{0.05}{20 \times 10^{-3}}$$

$$R_7 = 2.5\Omega$$

V_{BD} = LTST

$$V_f = 2.00V$$

$$I_f = 30mV$$

$$R_8 = \frac{V_{out} - V_f}{I_f}$$

$$= \frac{2.15 - 2.00}{30 \times 10^{-3}}$$

$$= \frac{0.15}{30 \times 10^{-3}} = 5\Omega$$

Screenshot of the exported BOM spreadsheet

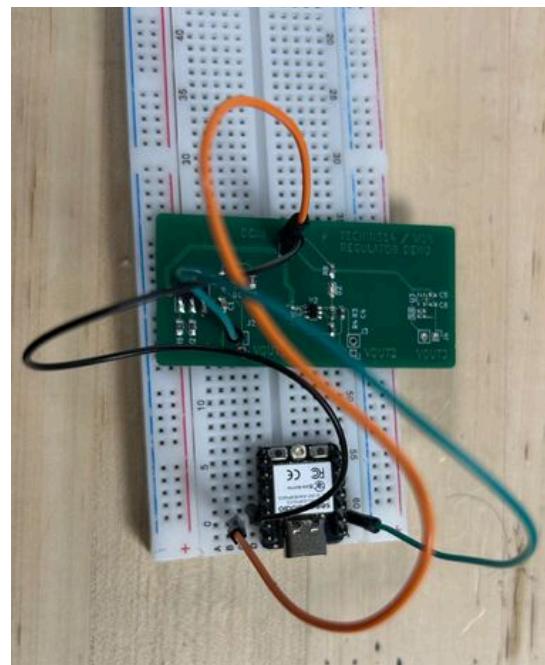
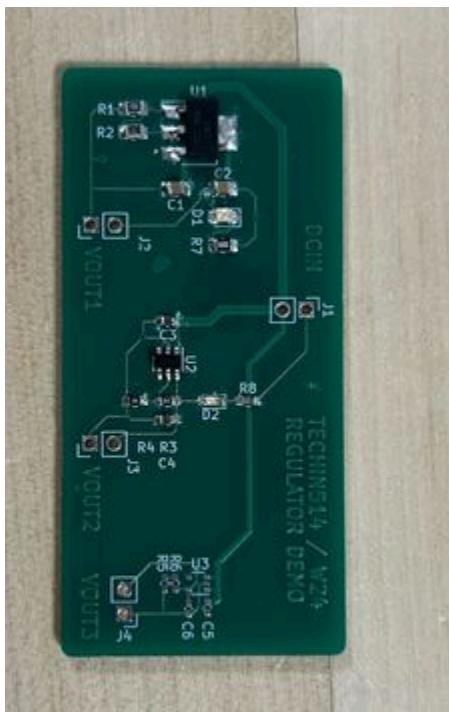
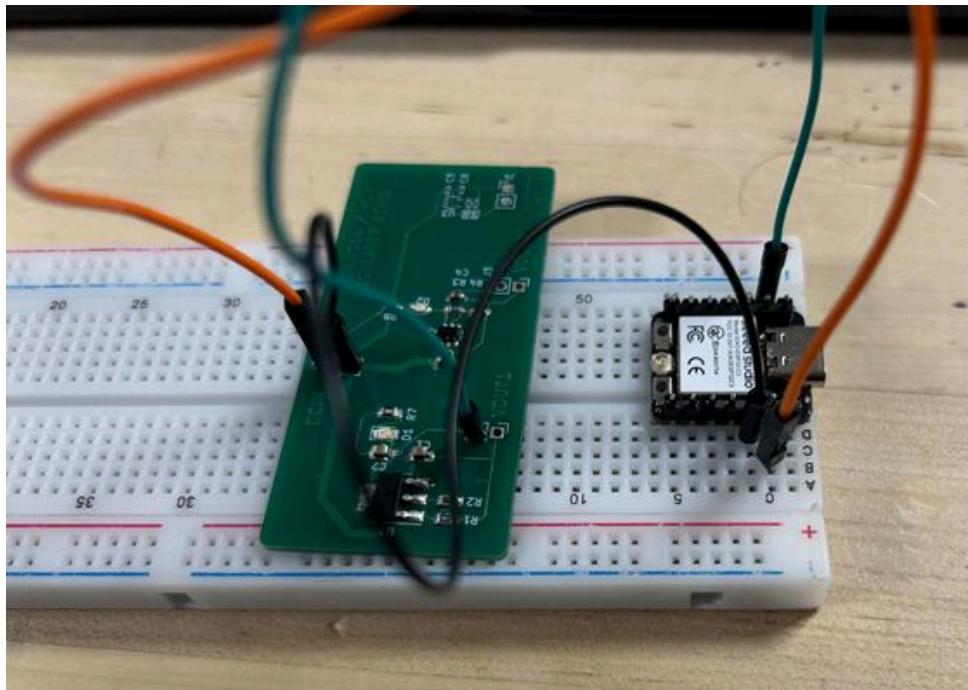
#	Reference	Qty	Value	Footprint	DNP
1	C1, C2	2	1uF	Capacitor_SMD:C_0805_2012Metric_Pad1.18x1.45mm_HandSolder	
2	C3, C4	2	1uF	Capacitor_SMD:C_0603_1608Metric_Pad1.08x0.95mm_HandSolder	
3	C5, C6	2	1uF	Capacitor_SMD:C_0402_1005Metric_Pad0.74x0.62mm_HandSolder	
4	D1	1	LED	LED_SMD:LED_0805_2012Metric_Pad1.15x1.40mm_HandSolder	
5	D2	1	LED	LED_SMD:LED_0603_1608Metric_Pad1.05x0.95mm_HandSolder	
6	J1, J2, J3, J4	4	n.m.	Connector_PinHeader_2.54mm:PinHeader_1x02_P2.54mm_Vertical	
7	R1	1	240 Ω	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	
8	R2	1	153.6 Ω	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	
9	R3	1	22.75 kΩ	Resistor_SMD:R_0603_1608Metric_Pad0.98x0.95mm_HandSolder	
10	R4	1	30.1 kΩ	Resistor_SMD:R_0603_1608Metric_Pad0.98x0.95mm_HandSolder	
11	R5	1	150 kΩ	Resistor_SMD:R_0402_1005Metric_Pad0.72x0.64mm_HandSolder	
12	R6	1	130.434 kΩ	Resistor_SMD:R_0402_1005Metric_Pad0.72x0.64mm_HandSolder	
13	R7	1	2.5 Ω	Resistor_SMD:R_0805_2012Metric_Pad1.20x1.40mm_HandSolder	
14	R8	1	5 Ω	Resistor_SMD:R_0603_1608Metric_Pad0.98x0.95mm_HandSolder	
15	U1	1	LM317_SOT-223	Package_TO_SOT_SMD:SOT-223-3_TabPin2	
16	U2	1	TPS79301-EP	Package_TO_SOT_SMD:SOT-23-6	
17	U3	1	MIC5377	Package_TO_SOT_SMD:SOT-353_SC-70-5	



Final Adjustment Note

The output voltage (VOUT2) was adjusted from 2.15V to 2.5V to ensure the proper functioning of the LTST-C191KRKT LED. This change was necessary because the LED has a forward voltage (VF) requirement of up to 2.4V to illuminate, and the original VOUT was not sufficient to forward-bias the LED. The higher VOUT ensures stable LED operation while minimizing the effect on the rest of the circuit.

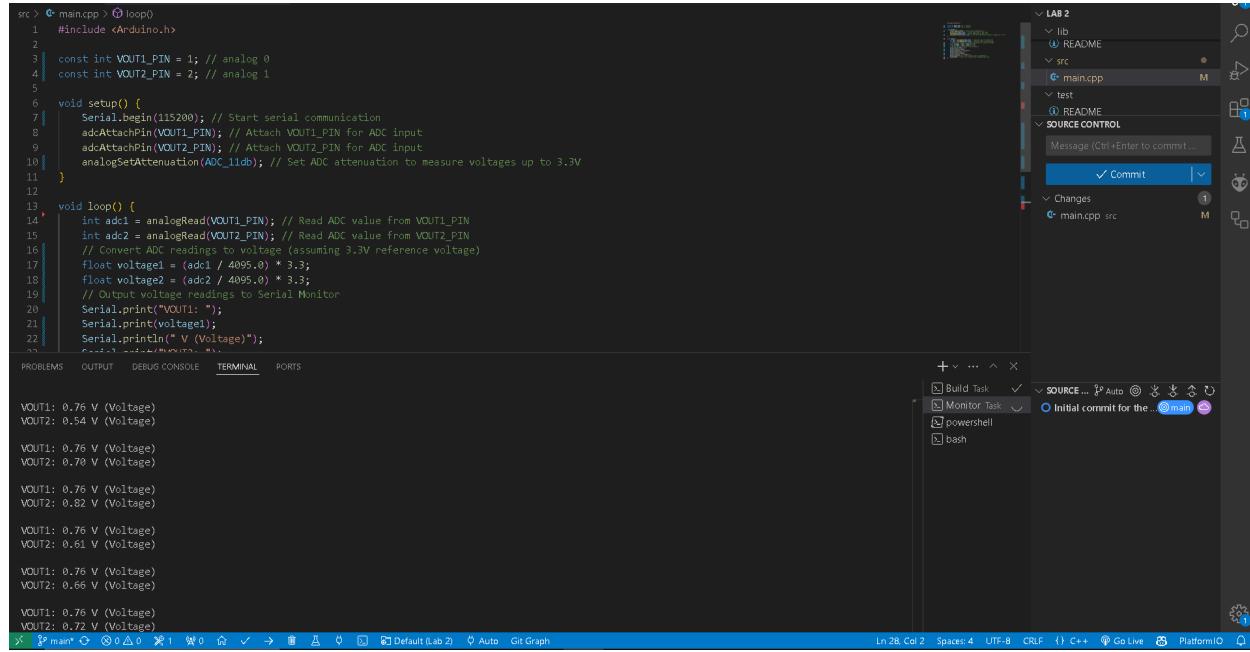
Board Images



Link to github repo:

<https://github.com/prunus77/TECHIN514-Hardware-Software-Lab/blob/main/PlatformIO/Projects/lab2/src/main.cpp>

Screenshot of the serial output



The screenshot shows a code editor interface with the following details:

- Code Area:** The main area displays Arduino C++ code for reading two analog inputs (VOUT1 and VOUT2) and printing their values to the Serial Monitor.
- Code Content:**

```
src > C main.cpp > loop()
1   #include <Arduino.h>
2
3   const int VOUT1_PIN = 1; // analog 0
4   const int VOUT2_PIN = 2; // analog 1
5
6   void setup() {
7     Serial.begin(115200); // Start serial communication
8     adcAttachPin(VOUT1_PIN); // Attach VOUT1_PIN for ADC input
9     adcAttachPin(VOUT2_PIN); // Attach VOUT2_PIN for ADC input
10    analogSetAttenuation(AOC_11db); // Set ADC attenuation to measure voltages up to 3.3V
11  }
12
13  void loop() {
14    int adc1 = analogRead(VOUT1_PIN); // Read ADC value from VOUT1_PIN
15    int adc2 = analogRead(VOUT2_PIN); // Read ADC value from VOUT2_PIN
16    // Convert ADC readings to voltage (assuming 3.3V reference voltage)
17    float voltage1 = (adc1 / 4095.0) * 3.3;
18    float voltage2 = (adc2 / 4095.0) * 3.3;
19    // Output voltage readings to Serial Monitor
20    Serial.print("VOUT1: ");
21    Serial.print(voltage1);
22    Serial.println(" V (Voltage)");
23
24    Serial.print("VOUT2: ");
25    Serial.print(voltage2);
26    Serial.println(" V (Voltage)");
27
28  }
```
- Toolbars:** The toolbar at the bottom includes buttons for PROBLEMS, OUTPUT, DEBUG CONSOLE, TERMINAL, and PORTS.
- Terminal:** The terminal window shows the serial output:

```
VOUT1: 0.76 V (Voltage)
VOUT2: 0.54 V (Voltage)

VOUT1: 0.76 V (Voltage)
VOUT2: 0.70 V (Voltage)

VOUT1: 0.76 V (Voltage)
VOUT2: 0.82 V (Voltage)

VOUT1: 0.76 V (Voltage)
VOUT2: 0.61 V (Voltage)

VOUT1: 0.76 V (Voltage)
VOUT2: 0.66 V (Voltage)

VOUT1: 0.76 V (Voltage)
VOUT2: 0.72 V (Voltage)
```
- Git Integration:** The right side of the interface shows a Git repository view for "LAB 2". It shows a file tree with "src/main.cpp" selected, a commit message field, and a "Commit" button.
- Status Bar:** The status bar at the bottom provides build information: "Ln 28, Col 2", "Build Task: ✓", "Monitor Task: powershell", and "Initial commit for the main branch".

Help Section:

Given:

Kelly helped me debug the code

And Shareef helped me while I was getting a build error

Received:

I helped Shareef with soldering