
**MUĞLA SITKI KOÇMAN UNIVERSITY**
**ELECTRICAL & ELECTRONICS ENGINEERING**

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# Logic Design and Circuits Lab Final Report

# 4-Bit Adder/Subtractor

# Contents

# Introduction

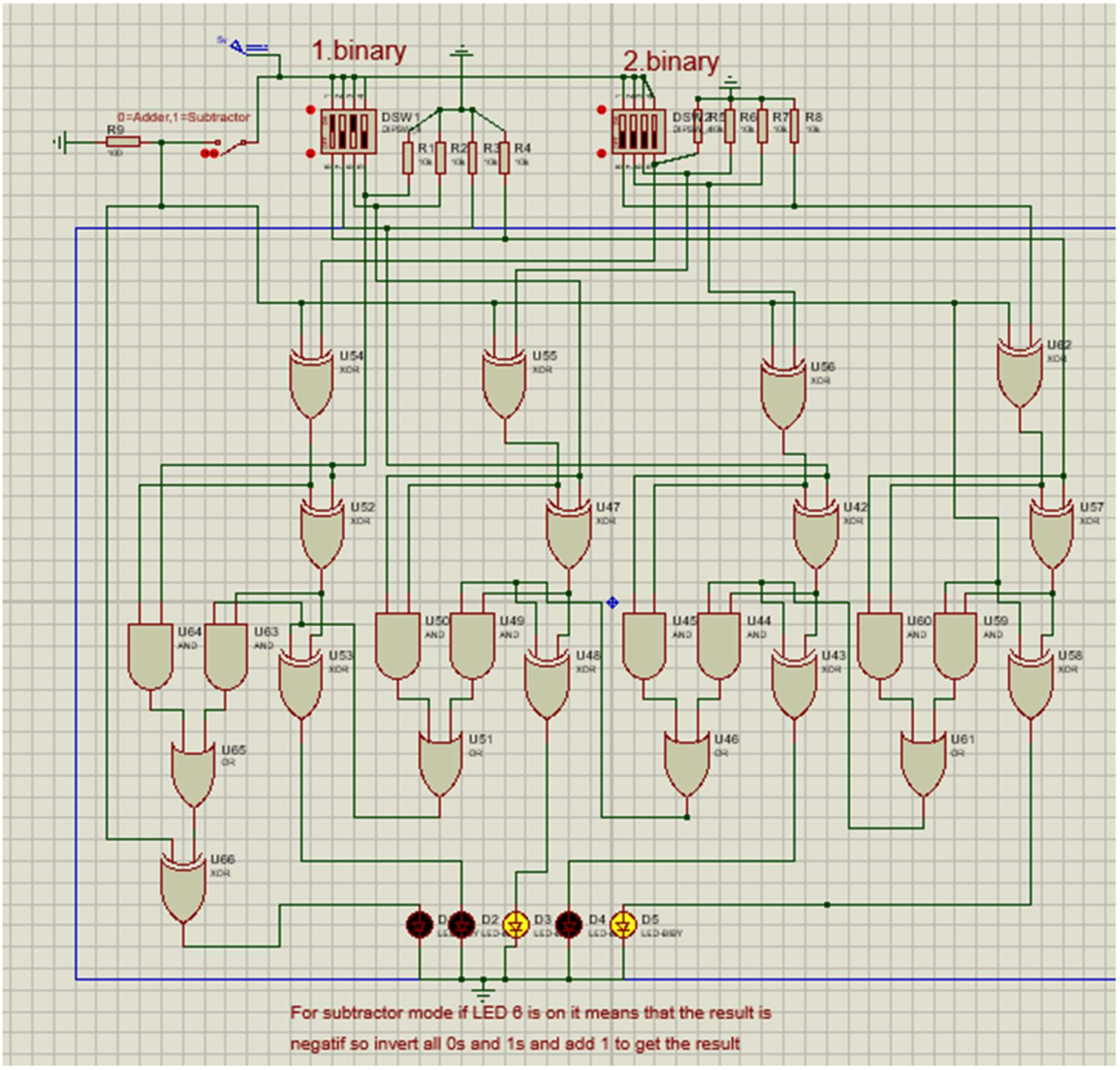


Figure 1:Schematic 1

1.Binary=A , 2.Binary=B

I created a 4 bit adder/subtractor (A+B or A-B) with 4 full adders that are made out two XOR, two AND, and one OR gates. As seen I have a switch that switches form adder to subtractor mode.

I used the basic principle of subtracting with the 2's complement and if it is in subtractor mode the upper first row of XOR gates are there to take the 1's complement of B and with the extra carry of a value 1 that takes the 2's complement of B . Thus if added to A with the full adders the result will be A-B. To determine if the value is negative we need to look at the leftmost LED if the LED is on the result is negative and to get the right result we need to take the 1's complement and add 1 to the complement.

# Adder Mode

## Truth table of the Adder

| A | B | Carry In (C_i) | Sum (S) | Carry Out (C_o) |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 | 1 |

**Sum (S): $S = A \oplus B \oplus C_i$**

**Carry Out: $C_o = (A \cdot B) + (C_i \cdot (A \oplus B))$**

As seen the switch is off thus it is in adder mode

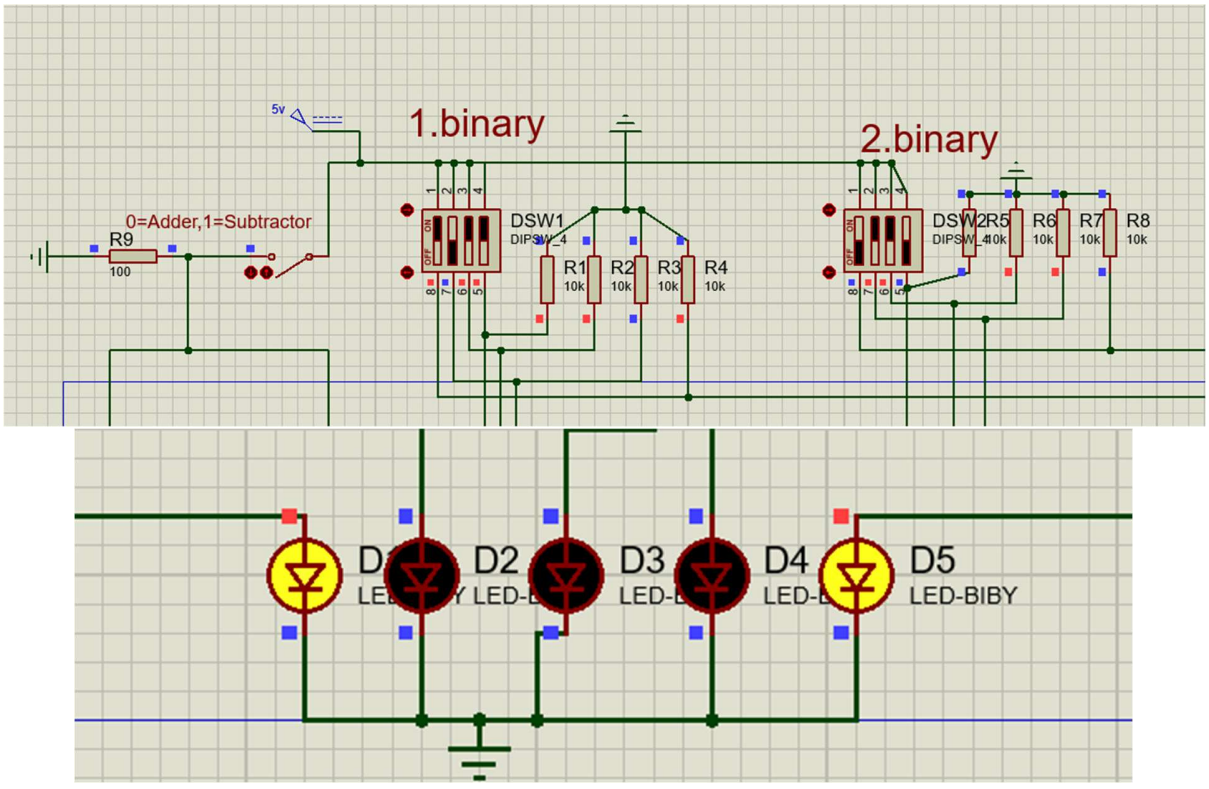


Figure 2: Adder Mode

# Subtractor Mode

## Truth table of Subtractor

| A | B | Borrow In (B_i) | Difference (D) | Borrow Out (B_o) |
|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 0 | 0 |
| 1 | 1 | 1 | 1 | 1 |

**Difference (D): $D = A \oplus B \oplus B_i$**

**Borrow Out: $B_o = (-A \cdot B) + (B_i \cdot (-A \oplus B))$**

As seen the switch is on thus in subtractor mode

**Positive result**

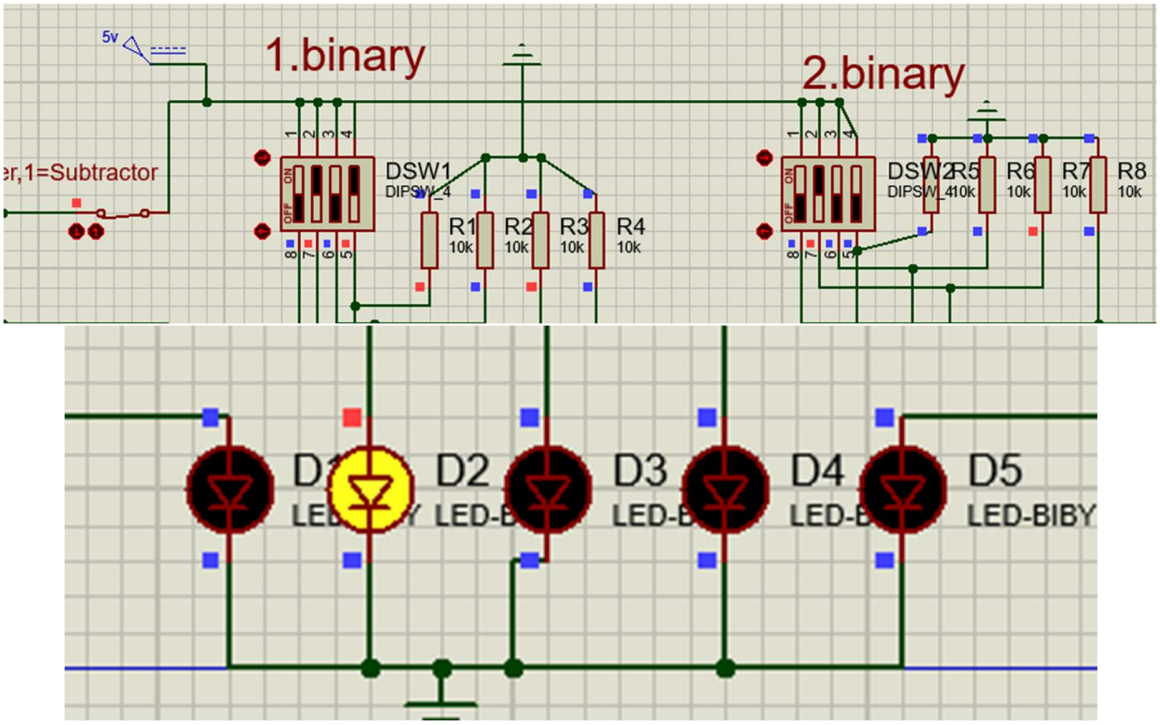


Figure 3: Subtractor Mode with positive result

The result is positive so no need to change anything

## Negative Result

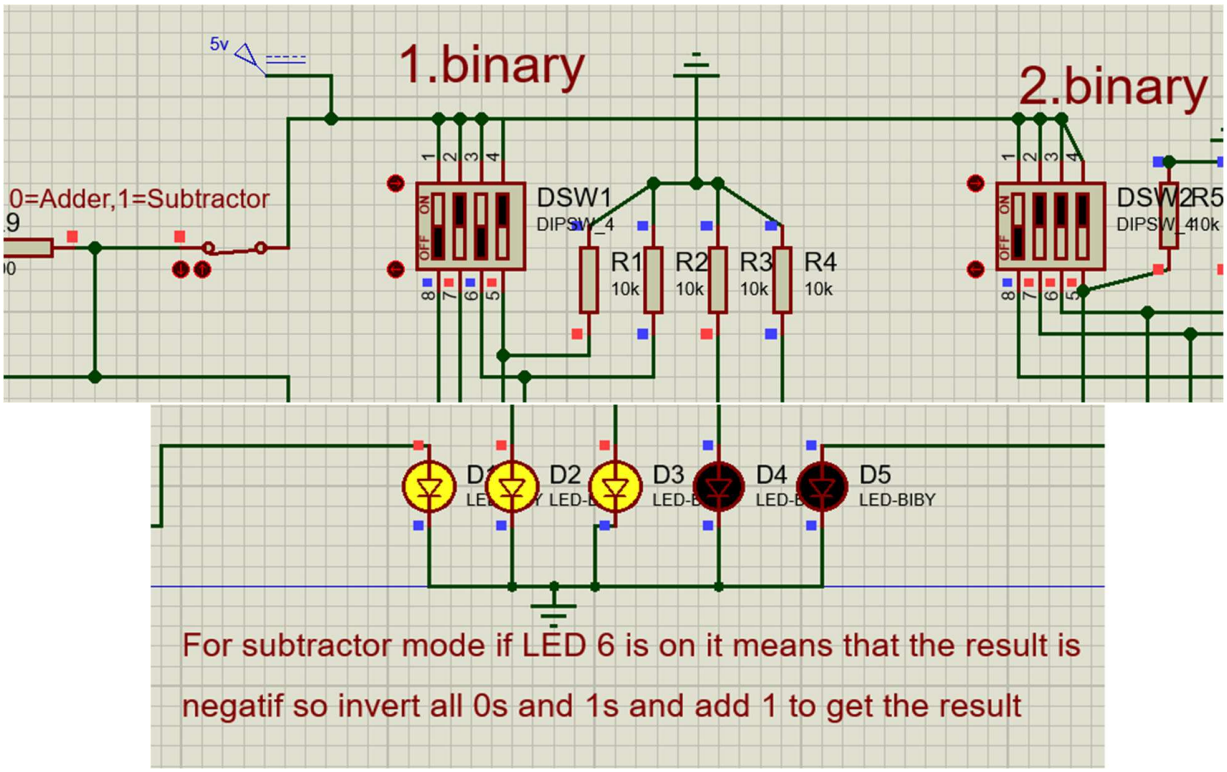


Figure 4: Subtractor Mode with negative result

The result is negative and to get the real result we need to take the 1's complement and add 1to the result

# Schematic and PCB

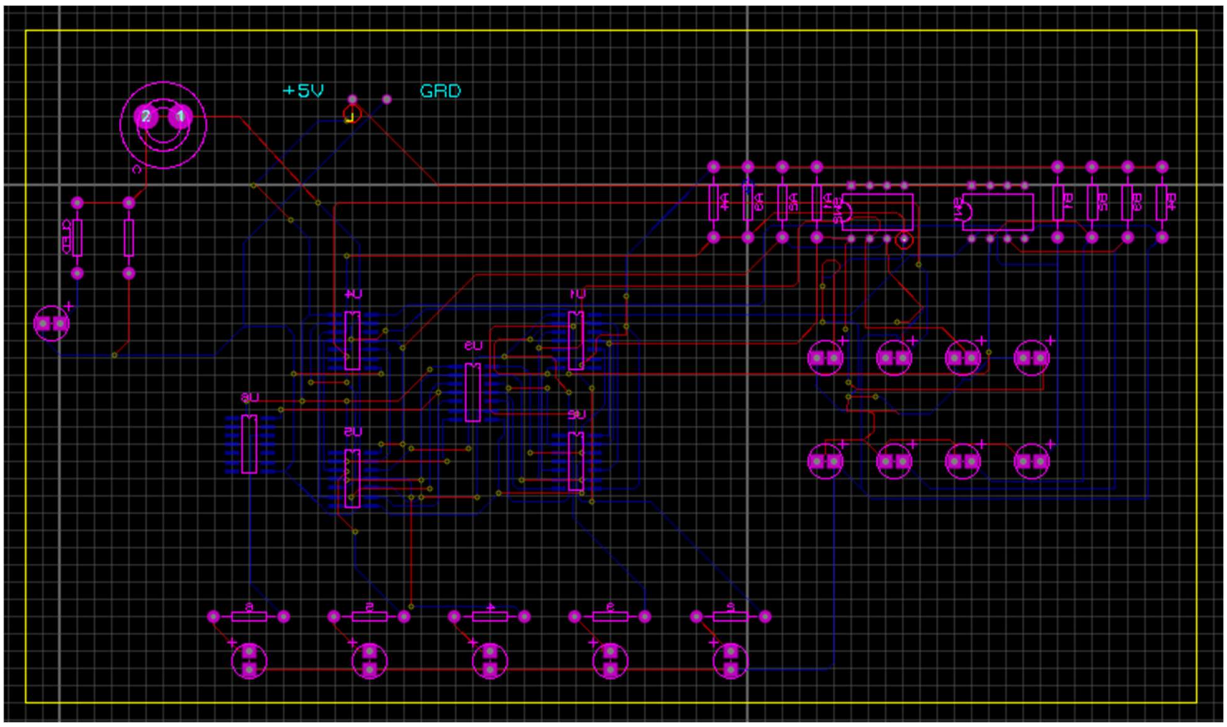


Figure 5: PCB Schematic

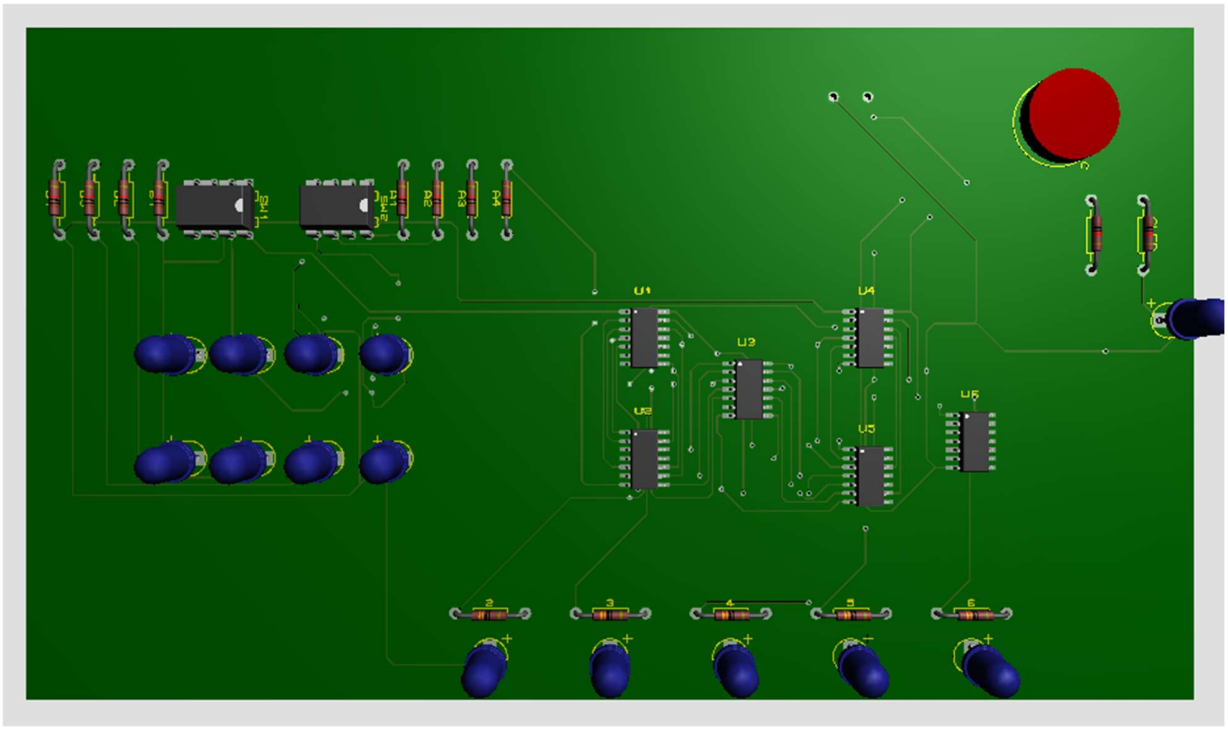

Figure 6: PCB Front view

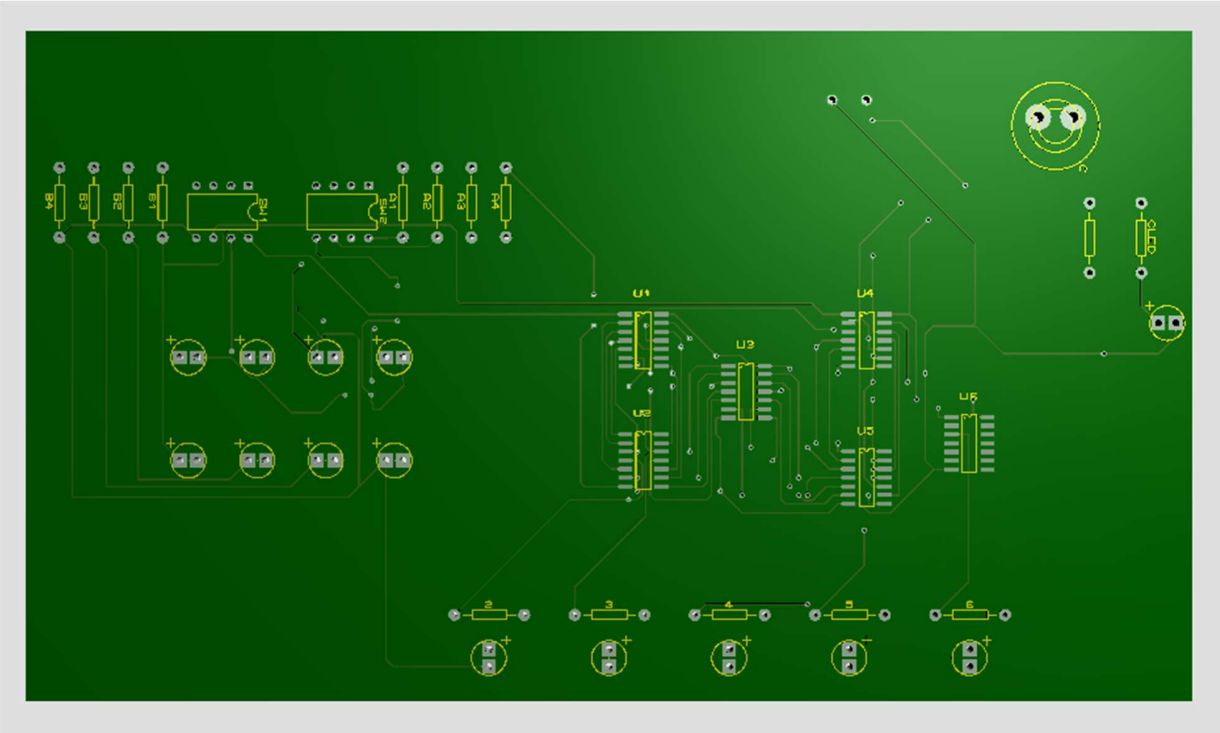


Figure 7: PCB Front view without components

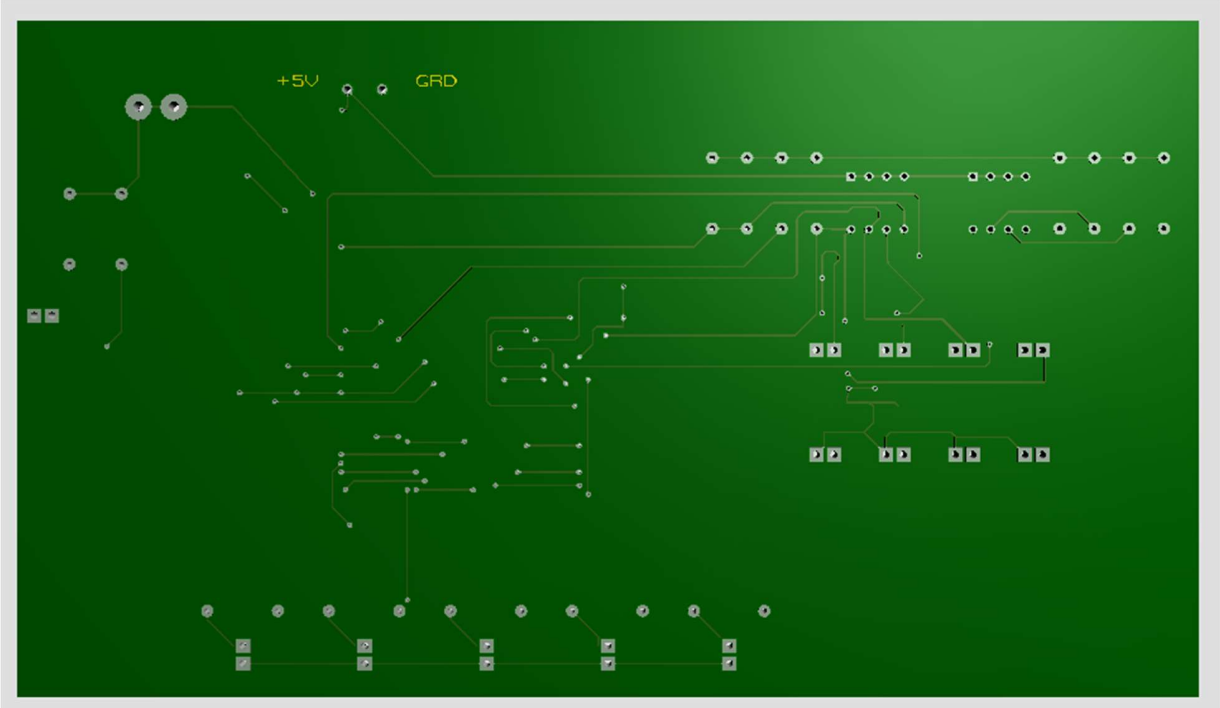


Figure 8: PCB Back view

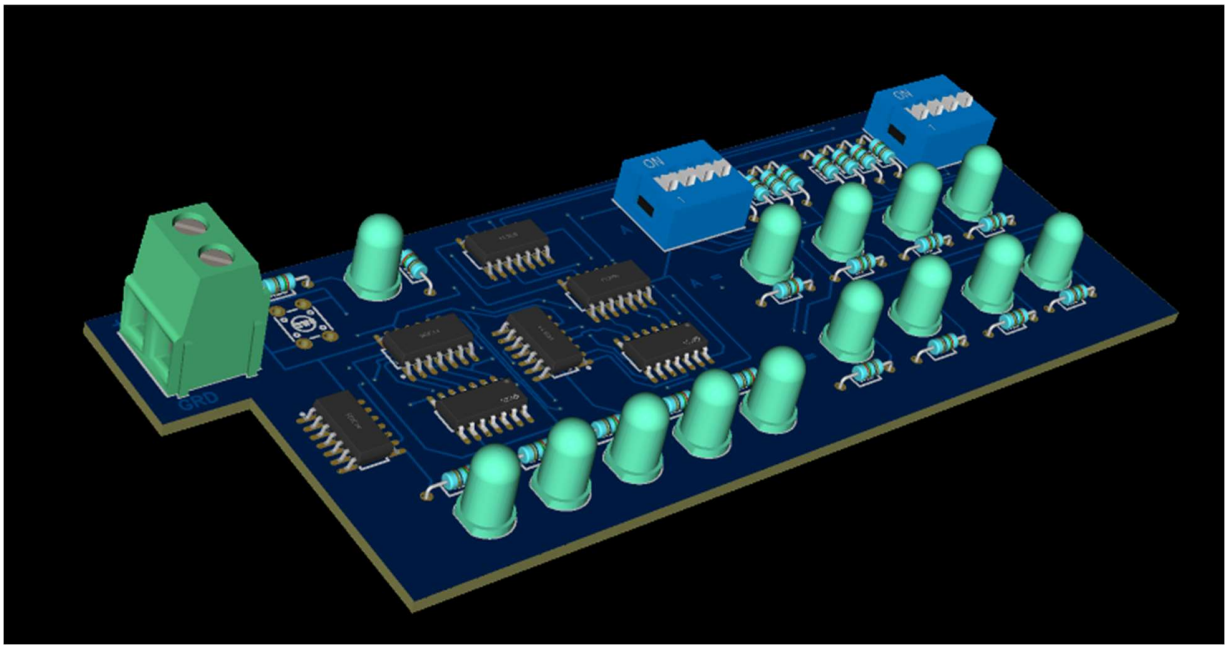


Figure 9: Final Product