# CT Lab: Control Structures - Calculator

## 1 Introduction

In this lab you will implement a simple calculator on the target hardware. The operands can be entered through the dip switches and the operation can be selected through the rotary switch.

## 2 Learning Objectives

- You can implement a switch-case statement with a jump table in assembly.
- You strengthen your skills in the application of arithmetic and logic instructions.

## 3 Task

Implement a program, which reads 8-bit values from the DIP-switches and performs different operations on them. The result shall be displayed on the LEDs. Use the given project frame.

- Read the comments in the given program frame. They will show you where to enter your code.
- Implement the switch-case statement based on the lecture slides.

The program shall meet the following requirements (See **Table 1**, **Figure 1**):

- The first operand (op1) shall be entered through the DIP-switches S15 to S8.
- The second operand (op2) shall be entered through the DIP-switches S7 to S0.
- The 8 bit operands shall be zero-extended to 32 bit.
- The operation shall be selected through the rotary switch, according to Table 1.
- The position of the rotary switch shall be displayed on the 7-segment display. The operands 1 and 2 shall be displayed on LED15 to LED0 (above the corresponding DIP-switches).
- The 16 bit result shall be displayed on LED31 to LED16.
- A logical “1” shall mean that the corresponding LED is on.
- The program shall use a jump table.

| Hex-Switch | Operation | Hex-Switch | Operation |
|---|---|---|---|
| 0x00 | all 16 dark | 0x08 | !(op1 & op2) → NAND |
| 0x01 | op1 + op2 | 0x09 | !(op1 # op2) → NOR |
| 0x02 | op1 – op2 | 0x0a | !(op1 $ op2) → XNOR |
| 0x03 | op1 * op2 (unsigned) | 0x0b | all 16 bright |
| 0x04 | op1 & op2 → AND | 0x0c | all 16 bright |
| 0x05 | op1 # op2 → OR | 0x0d | all 16 bright |
| 0x06 | op1 $ op2 → XOR | 0x0e | all 16 bright |
| 0x07 | !op1 → NOT | 0x0f | all 16 bright |

**Table 1: Operations overview**

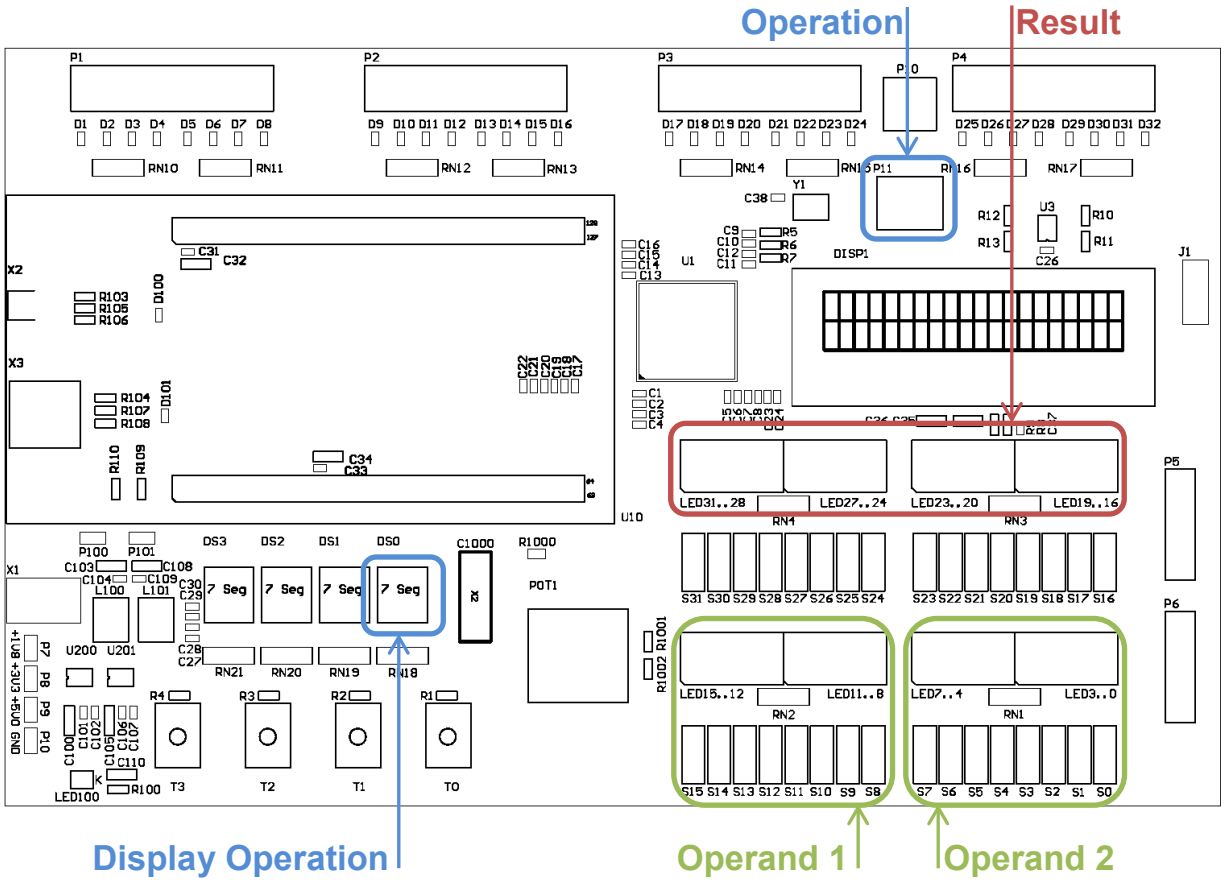


**Figure 1**: In- and output of operands, operation and result

# 4 Grading

The working program has to be presented to the lecturer. The student has to understand the solution / source code and has to be able to explain it to the lecturer.

| Task | Criteria | Weight |
|---|---|---|
| 3 | The program meets the required functionality. | 4/4 |