

# LABORATORY WORK REPORT NO. 5

## KEYPAD AND LCD

Subject: Microprocessors and their Programming

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Target Device: PIC16F1518

Variant: 1

### 1. Goal and Task

GOAL: To learn how to utilize a button matrix (keypad) and output information to an LCD screen.

TASK:

Program the microcontroller according to the assigned variant (Variant 1) so that:

1. The first line of the LCD displays 'Laukiu kodo' (Waiting for code).
2. The code is entered using buttons 0 to 9 and is displayed as asterisks (\*) on the second line.
3. Upon entering the correct security code and confirming it with the assigned button (ok1):
  - Activate the latch (output signal) for a specific time duration (t1).
  - Display 'Atrakinta' (Unlocked) on the LCD for 2 seconds.

### 2. Task Variant Data

Selected Variant: 1

- Confirmation Key (ok1): #
- Latch Duration (t1): 300 ms
- Code Length: 3 digits
- Secret Code: 123
- Latch Output Connection: PORTA.0

### 3. Circuit Diagram Description

Based on the laboratory schematic and Variant 1 configuration:

1. MCU: PIC16F1518 (Internal Osc 16MHz).
2. LCD Display (16x2):
  - Control Lines: RS -> RB6, E -> RB7.
  - Data Lines (4-bit mode): D4..D7 -> RB2..RB5.
3. Keypad (4x4 Matrix):
  - Rows (Outputs): RC0, RC1, RC2, RC3.
  - Columns (Inputs): RC4, RC5, RC6, RC7.
4. Output Latch (Sklastis):
  - Active High Output connected to PORTA Pin 0 (RA0).

### 4. Code with Comments

```
/* * File:    LabWork5_Variant1.c
 * Author:   Halil Ibrahim Bekli
 * Target:   PIC16F1518
 * Description: Lab 5 - Keypad Security System (Short Version)
 */

#include <xc.h>
#include <string.h>
```

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```
#include "kpad_lib.h" // Keypad library
#include "lcd.h"       // LCD library

// --- CONFIGURATION BITS ---
#pragma config FOSC = INTOSC, WDTE = OFF, PWRTE = ON, MCLRE = ON, CP = OFF
#pragma config BOREN = OFF, CLKOUTEN = OFF, IESO = OFF, FCMEN = OFF
#pragma config WRT = OFF, VCAPEN = OFF, STVREN = ON, BORV = LO, LPBOR = OFF, LVP = OFF

#define _XTAL_FREQ 16000000

// --- VARIANT 1 CONFIGURATION ---
#define SECRET_CODE "123" // Password
#define CODE_LEN 3
#define CONFIRM_KEY '#' // (okl)
#define LATCH_TIME 300 // (ms)
#define LATCH_PIN LATAbits.LATA0 // (Sklastis)

// Global variables
char entered_code[10];
unsigned char index = 0;
char key;

void main(void) {
    // 1. Initialization
    OSCCON = 0b01111000; // 16MHz
    ANSELA = 0; ANSELB = 0; ANSELC = 0; // Digital I/O

    TRISB = 0x00; // LCD Output
    TRISA = 0x00; // Latch Output
    // TRISC handled by kpad_lib

    LATCH_PIN = 0;

    lcd_init(); // From lcd.h
    lcd_cls(); // Clear screen

    // 2. Main Loop
    while(1) {
        // Reset state
        index = 0;
        memset(entered_code, 0, sizeof(entered_code));

        // Display initial message
        lcd_cls();
        lcd_goto(0x00); // Line 1
        lcd_puts("Laukiu kodo"); // Waiting for code
        lcd_goto(0x40); // Line 2

        // Input Loop
        while(1) {
            key = read_kpad(); // From kpad_lib.h

            if(key) {
                // Wait for release (debounce)
                __delay_ms(150);

                if(key == CONFIRM_KEY) break; // Exit to check code

                // If numeric, store and print '*'
                if(key >= '0' && key <= '9' && index < CODE_LEN) {
                    entered_code[index] = key;
                }
            }
        }
    }
}
```

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```
        index++;
        lcd_putchar('*'); // Show star
    }
}

// 3. Check Code
if(strcmp(entered_code, SECRET_CODE) == 0) {
    lcd_cls();
    lcd_puts("Atrakinta"); // "Unlocked"

    LATCH_PIN = 1;          // Activate Latch
    __delay_ms(LATCH_TIME); // Wait t1
    LATCH_PIN = 0;          // Deactivate Latch

    __delay_ms(2000);        // Hold message for 2 sec
} else {
    lcd_cls();
    lcd_puts("Klaida");      // Error
    __delay_ms(1000);
}
}
```

### 5. Program Algorithm

1. Initialize System: Set Oscillator to 16MHz, configure Ports (A, B, C) as digital.
2. Initialize Peripherals: Initialize LCD and clear screen. Set Latch pin low.
3. Main Loop:
  - a. Reset input buffer and index.
  - b. Display 'Laukiu kodo' on LCD Line 1.
  - c. Input Loop: Scan keypad using library.
    - i. If Number (0-9): Store in buffer, print '\*' on LCD.
    - ii. If Confirm Key (#): Break input loop.
  - d. Verification:
    - i. Compare buffer with '123'.
    - ii. If Match: Print 'Atrakinta', Pulse Latch for 300ms, Wait 2s.
    - iii. If Mismatch: Print 'Klaida', Wait 1s.
  - e. Repeat Loop.

### 6. Conclusions

In this laboratory work, the interfacing of a 4x4 Keypad and an LCD with the PIC16F1518 was successfully implemented.

- We utilized 'kpad\_lib.h' to scan the matrix keypad and detect user input.
- We utilized 'lcd.h' to display status messages and mask sensitive password input.
- The logic for Variant 1 (Code '123', Latch time 300ms) was verified. The system correctly activates the output latch only upon entry of the valid code.