1. **Preparation tasks** (done before the lab at home). Submit:
    - Table with voltage divider, calculated, and measured ADC values for all buttons.

| Push button | PC0[A0] voltage | ADC value (calculated) | ADC value (measured in simulation) |
|---|---|---|---|
| Right | 0 V | 0 | 0 |
| Up | 0.495 V | 101 | 101 |
| Down | 1.203 V | 246 | 245 |
| Left | 1.970 V | 403 | 402 |
| Select | 3.182 V | 651 | 650 |
| none | 5 V | 1023 | 1022 |

| Operation | Register(s) | Bit(s) | Description |
|---|---|---|---|
| Voltage reference | ADMUX | REFS1:0 | 01: AVcc voltage reference, 5V |
| Input channel | ADMUX | MUX3:0 | 0000: ADC0, 0001: ADC1, ... |
| ADC enable | ADCSRA | ADEN | 1: enables the ADC |
| Start conversion | ADCSRA | ADSC | 1: start conversion in single mode and start first conversion in free mode. |
| ADC interrupt enable | ADCSRA | ADIE | 1: interrupt is enabled … When the I-bit in SREG is set, „ADC completed" interrupt is activated |
| ADC clock prescaler | ADCSRA | ADPS2:0 | 000: Division factor 2, 001: 2, 010: 4, ... (for us: 111) |
| ADC result | ADCH ADCL | ADCH7:0 ADCL7:0 | When an ADC conversion is complete, the result is found in these two registers. |

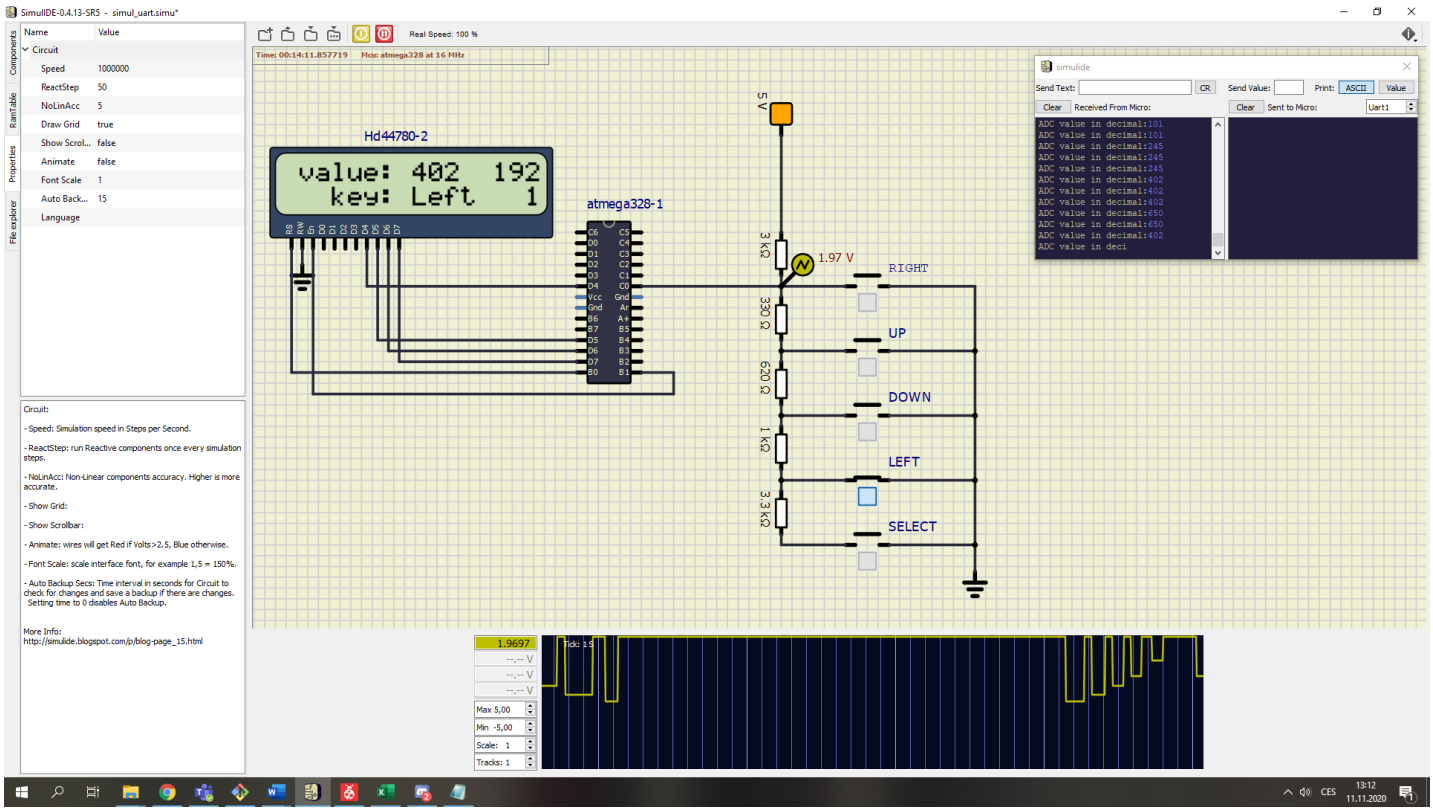
| Function name | Function parameters | Description | Example |
|---|---|---|---|
| `uart_init` | UART_BAUD_SELECT (9600, F_CPU) | Initialize UART to 8N1 and set baudrate to 9600 Bd | `uart_init(UART_BAUD_SELECT(9600, F_CPU));` |
| `uart_getc` | - | get data from UART | `uart_getc(` |
| `uart_putc` | c | Send one symbol to UART | `uart_putc(a);` |
| `uart_puts` | "string" | Send given string to UART | `uart_putc("DE_2");` |

2. ADC. Submit:
    - Listing of `ADC_vect` interrupt routine with complete code for sending data to the LCD/UART and identification of the pressed button.

```
/* ------------------------------------------------------------------*/
/**
 * ISR starts when ADC completes the conversion. Display value on LCD
 * and send it to UART.
 */
ISR(ADC_vect)
{
	uint16_t value = 0;
	char lcd_string[4] = "    ";

	// Copy ADC result to 16-bit variable
	value = ADC;

	// Print to LD in decimal
	itoa(value, lcd_string, 10);    // Convert to string in decimal
	lcd_gotoxy(8, 0);
	lcd_puts("    ");
	lcd_gotoxy(8, 0);
	lcd_puts(lcd_string);

	// Send to uart in decimal
	if (value < 700)
	{
		uart_puts("ADC value in decimal:");
		uart_puts(lcd_string);
		uart_puts("\n");           // \n... next line , \r line before
	}


	// Print on lcd in hex
	itoa(value, lcd_string, 16);
	lcd_gotoxy(13, 0);
```

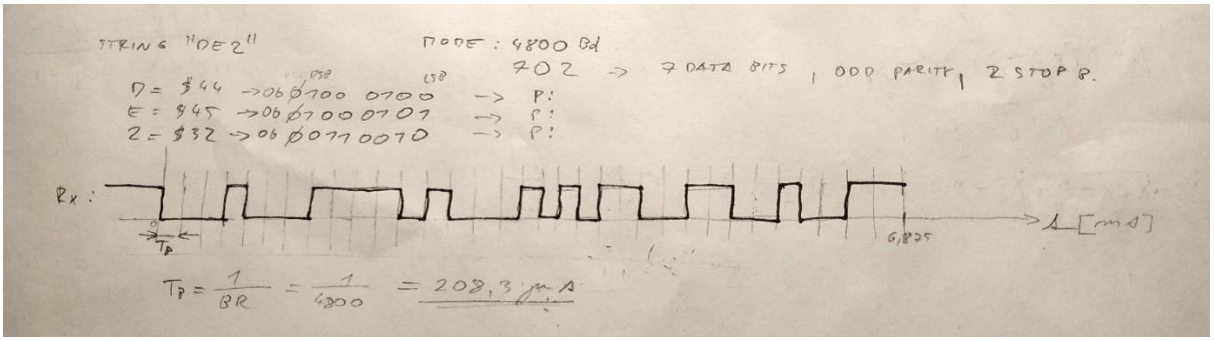
```
        lcd_puts("    ");
        lcd_gotoxy(13, 0);
        lcd_puts(lcd_string);


        // Odd Parity bit counter
        if(value %2 == 0)
        {
               lcd_gotoxy(15,1);
               lcd_puts("1");
        }
        else
        {
               lcd_gotoxy(15,1);
               lcd_puts("0");
        }


        // print pressed key
        lcd_gotoxy(8, 1);
        lcd_puts("      ");
        if (value >= 1016)
        {
               lcd_gotoxy(8, 1);
               lcd_puts("None");          // None
        }
        else if (value == 0)
        {
               lcd_gotoxy(8, 1);
               lcd_puts("Right");         // Right
        }
        else if (value == 101)
        {
               lcd_gotoxy(8, 1);
               lcd_puts("Up");                  // Up
        }
        else if (value == 245)
        {
               lcd_gotoxy(8, 1);
               lcd_puts("Down");          // Down
        }
        else if (value == 402)
        {
               lcd_gotoxy(8, 1);
               lcd_puts("Left");          // Left
        }
        else if (value == 650)
        {
               lcd_gotoxy(8, 1);
               lcd_puts("Select");        // Select
        }

}
```

- Screenshot of SimulIDE circuit when "Power Circuit" is applied.




3. UART. Submit:

- (Hand-drawn) picture of UART signal when transmitting data DE2 in 4800 7O2 mode (7 data bits, odd parity, 2 stop bits, 4800 Bd),




- Listing of code for calculating/displaying parity bit.

```
// Odd Parity bit counter
if(value %2 == 0)
{
	lcd_gotoxy(15,1);
	lcd_puts("1");
}
else
{
	lcd_gotoxy(15,1);
	lcd_puts("0");
}
```