

ENGINE



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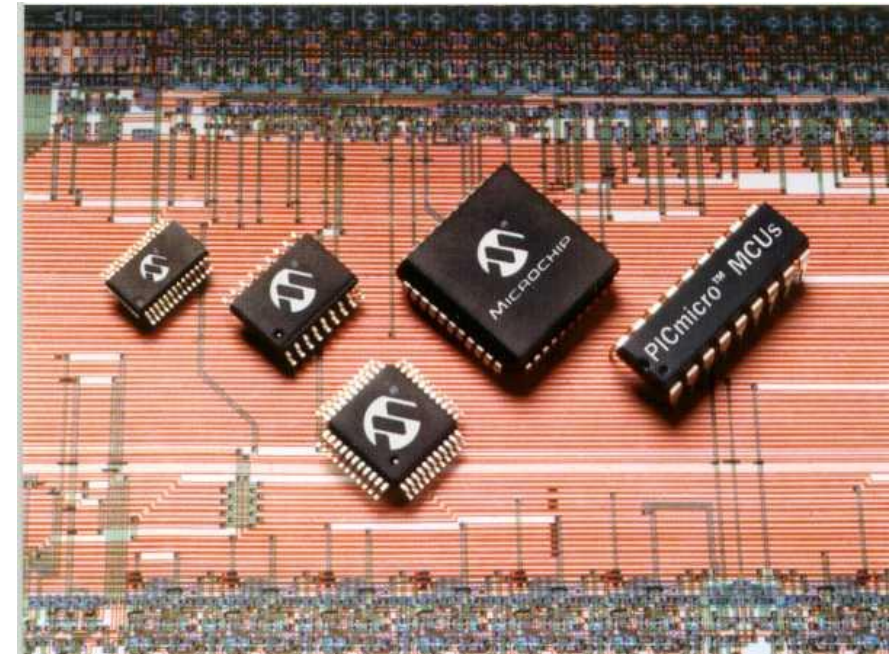
TEACHING ONLINE ELECTRONICS, MICROCONTROLLERS AND PROGRAMMING
IN HIGHER EDUCATION

Module_2-6. Communication - ADC

PIC18F4550 with Proteus Simulation

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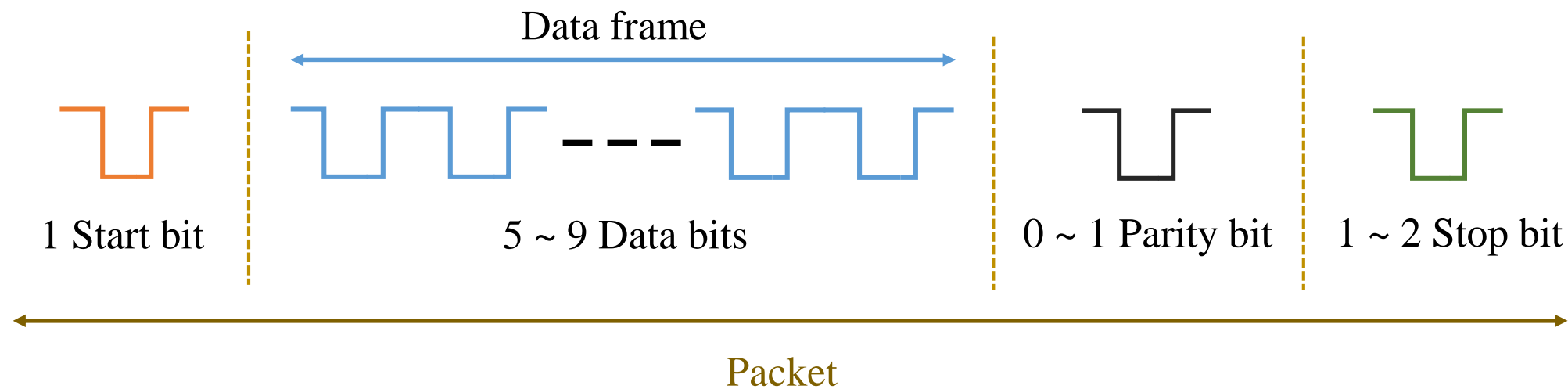
- Serial communication
- Analog to Digital Converter (ADC)
- Example



Module_2-6. Communication - ADC

Serial Communication

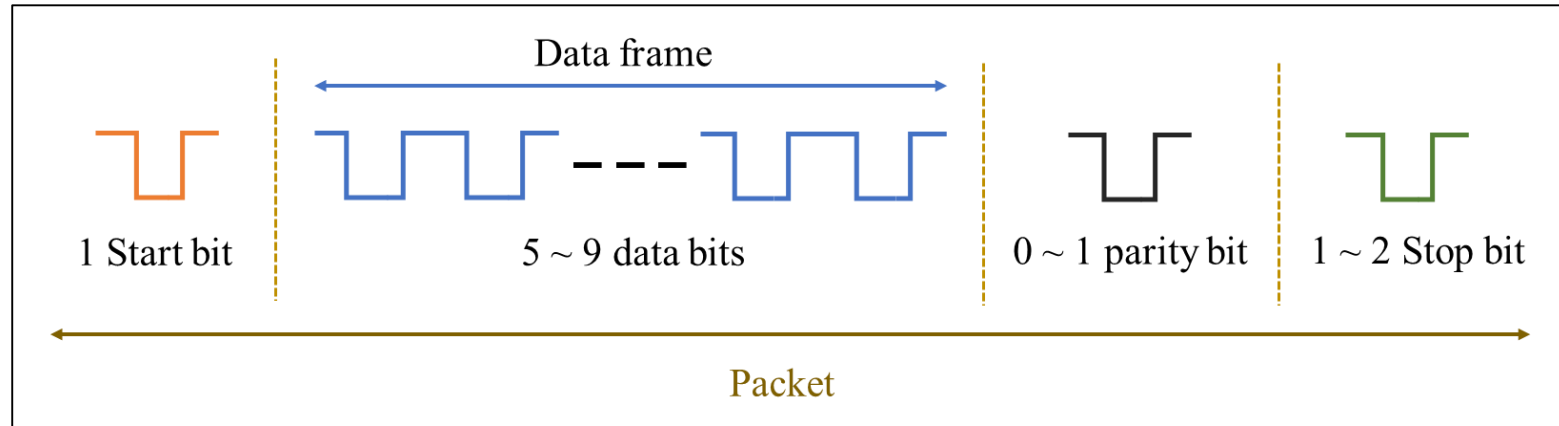
Serial (UART) communication is a widespread way of transmitting data between two devices.



1. <https://www.analog.com/en/analog-dialogue/articles/uart-a-hardware-communication-protocol.html>
2. <https://www.circuitbasics.com/basics-uart-communication/>

Module_2-6. Communication - ADC

Serial Communication



Advantages:

- Communication with **two wires: Rx - Tx**
- Error check: parity bit
- Asynchronous communication

Disadvantages:

- The maximum data range per packet is 9 bits
- It does not support multiple devices

1. <https://www.analog.com/en/analog-dialogue/articles/uart-a-hardware-communication-protocol.html>
2. <https://www.circuitbasics.com/basics-uart-communication/>

Module_2-6. Communication - ADC

Analog to Digital Converter

The analog-to-digital converter (ADC) takes a “snapshot” of the unknown analog signal and converts it to bits.

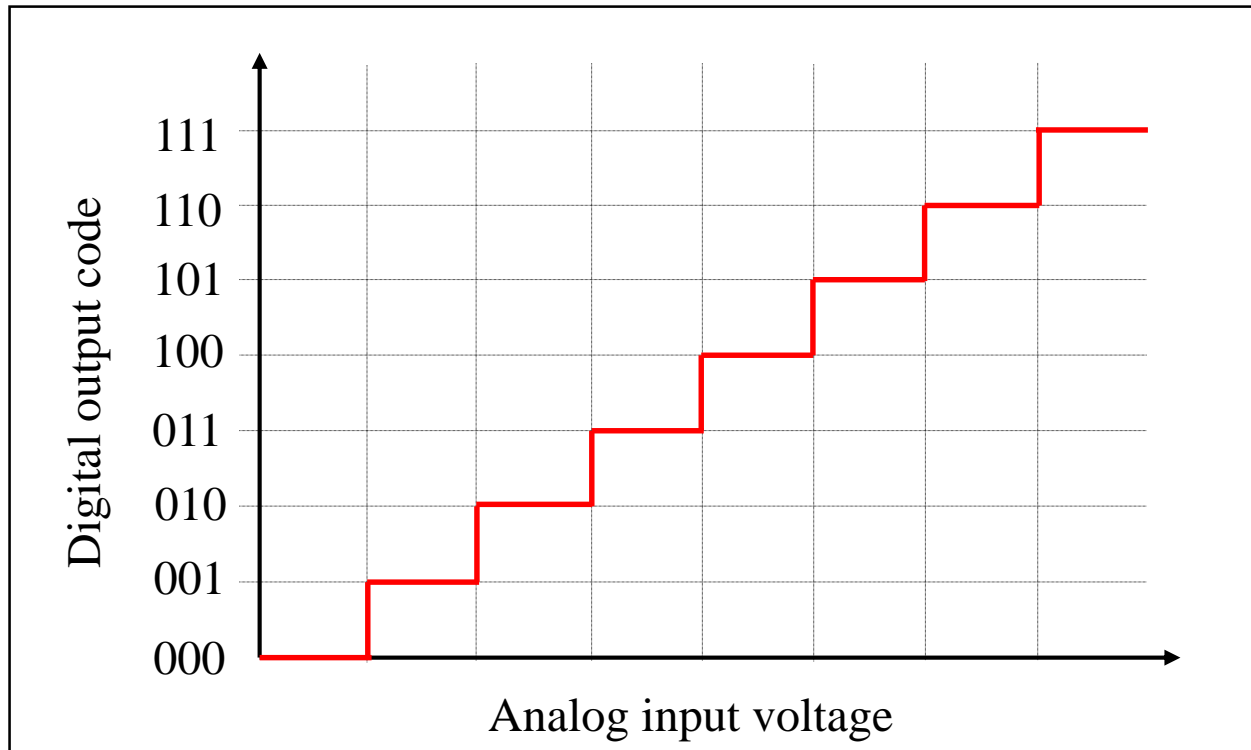


1. <https://www.electronics-tutorials.ws/combinatoin/analogue-to-digital-converter.html>
2. <http://www.onmyphd.com/?p=analog.digital.converter>
3. <https://dewesoft.com/daq/types-of-adc-converters>

Module_2-6. Communication - ADC

Analog to Digital Converter

A 3-bit ADC has $2^3 - 1 = 7$ combinations, that is 8 different states (0 ~ 7). In other words, the ADC can split a voltage range (span) into 8 states. Each state corresponds to 3 bits – digital output code.



The minimum amount of voltage that an ADC can measure and assign to the 1st bit is

$$LSB = \frac{Span}{2^n - 1}$$

where n are the available converter bits.

LSB = Least-Significant Bit

1. <https://www.electronics-tutorials.ws/combinatoin/analogue-to-digital-converter.html>

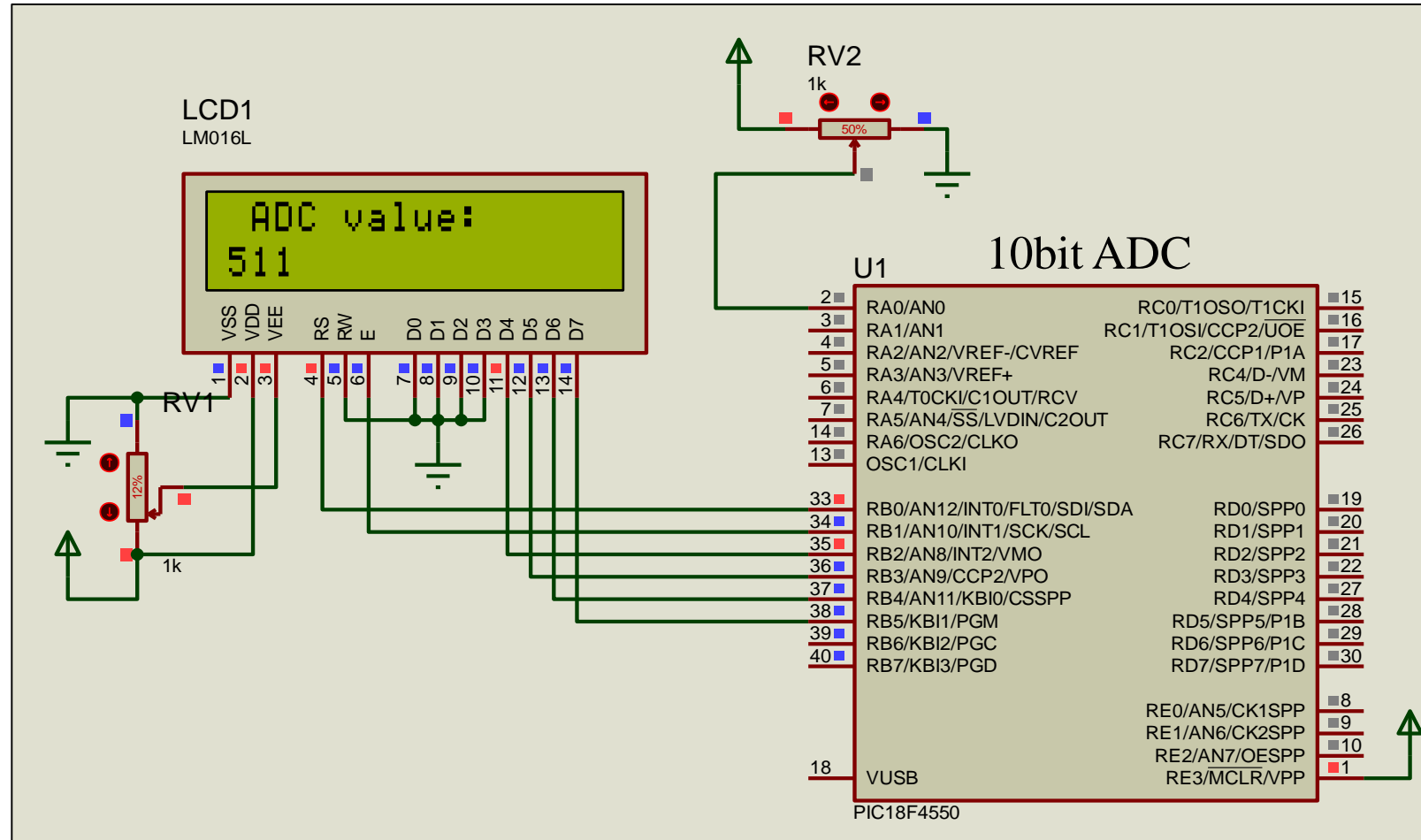
2. <http://www.onmyphd.com/?p=analog.digital.converter>

3. <https://dewesoft.com/daq/types-of-adc-converters>

Module_2-6. Communication - ADC

Example

The purpose of this activity is for the microcontroller to use the built-in Analog to Digital Converter. The PIC18F4550: (a) read the analog voltage of a potentiometer and convert it to a value (0~1023), (b) display the value on a LCD.



Module_2-6. Communication - ADC

Example

```
#include <main.h> // the file main.h with the
// initial settings is included.
// This file must be placed in the same
// folder with the project.
// Also the 18F4550.h file must exist
// in the same folder with the project

#include <flex_lcd.h> // The h file of the lcd driver
// should be in the same folder where we will save our program.
// The #define LCD_DB4 PIN_B4 etc statements in flex_lcd.c
// should be checked and possibly modified.
// These statements determine the pins of the microcontroller
// that are connected to LCD 2x16.

#byte PORTB =0xF81
// We attribute to the memory position 0xF81 the name PORTB.
// This means that we define a 8 bit variable whose value
// will be stored to the memory position F81h.
// The memory position F81h is the PORTD data register.
```

```
//ADC = 10 Bit => values: 0~1023
unsigned int16 ADC_value;

// ***** main program *****
void main() {
    set_tris_b(0x00);    //PORTB is defined as output
    lcd_init();        //initialization routine for the LCD 2x16
    setup_adc(ADC_CLOCK_DIV_8);    // Set ADC conversion time to 8Tosc
    setup_adc_ports(AN0);        // Set RA0 as analog pin
    set_adc_channel(0);        // Select channel 0 (analog input 0)
    while(TRUE){
        delay_ms(1000);    //wait for 1 sec
        lcd_putc("\f");    //clear the screen
        lcd_putc(" ADC value:"); //send a message to the LCD
        lcd_gotoxy(1,2);    //first position of second line
        ADC_value=read_adc();    //read value from ADC
        printf(lcd_putc,"%Lu",ADC_value); //send adc value to the LCD
    }
}
```


ENGINE Partnership

- Warsaw University of Technology (PL) - *coordinator*
- IHU - International Hellenic University (GR)
- EDUMOTIVA - European Lab for Educational Technology (GR)
- University of Padova (IT)
- University of Applied Sciences in Tarnow (PL)



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This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.