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## Report – Basic Microcontroller (Part 2 - Ohmmeter)

### Introduction

The purpose of this module is to further explore the PIC microcontroller through a circuit with a more practical application. For this second part of the module, an ohmmeter circuit is to be designed and implemented. The circuit shall consist primarily of an LCD which will display the resistance of a resistor placed into the circuit by the user. An ADC in conjunction with a voltage divider will be used to calculate the resistance.

### Design

This circuit consists of digital signal connections on port B for the LCD, a resistor ladder connected to the ADC, and was implemented directly on a breadboard. Power was supplied to the board via an Arduino.

The LCD was connected using a 4-bit digital signal connection, as well as two extra connections for the enable pin and register select. The resistor ladder consists of a 100K ohm resistor in series with whatever value resistor is selected by the user to measure. The ADC reads the value between the two and calculates the resistance of Rx using the known value of R1. The schematic below shows the layout of the circuit.

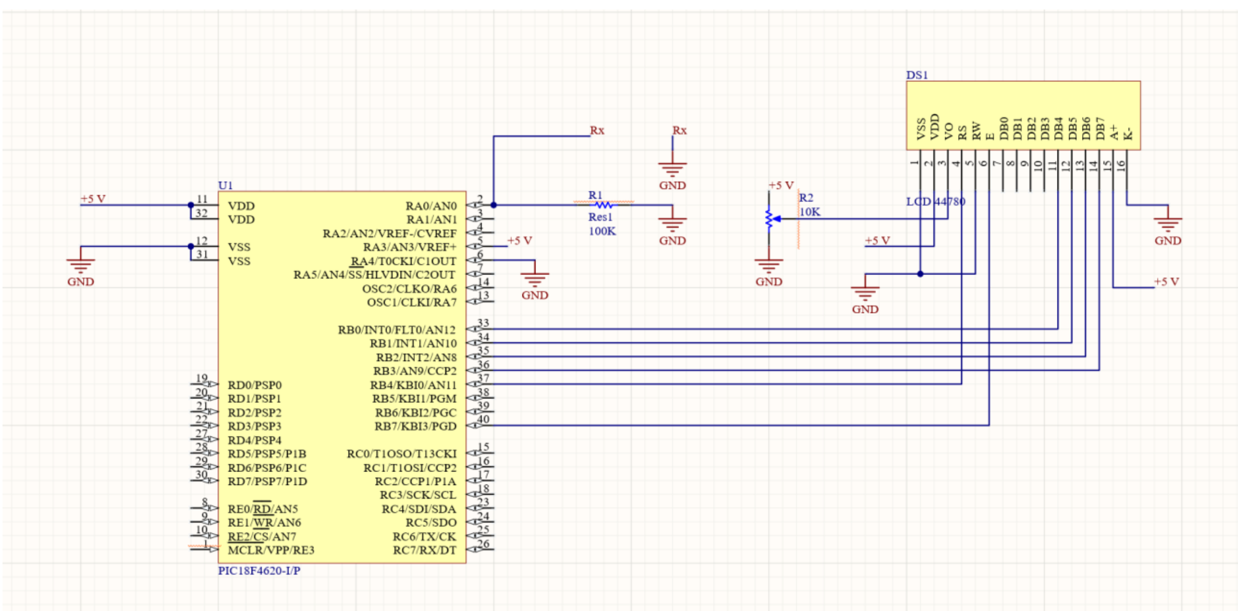


Figure 1. Altium schematic

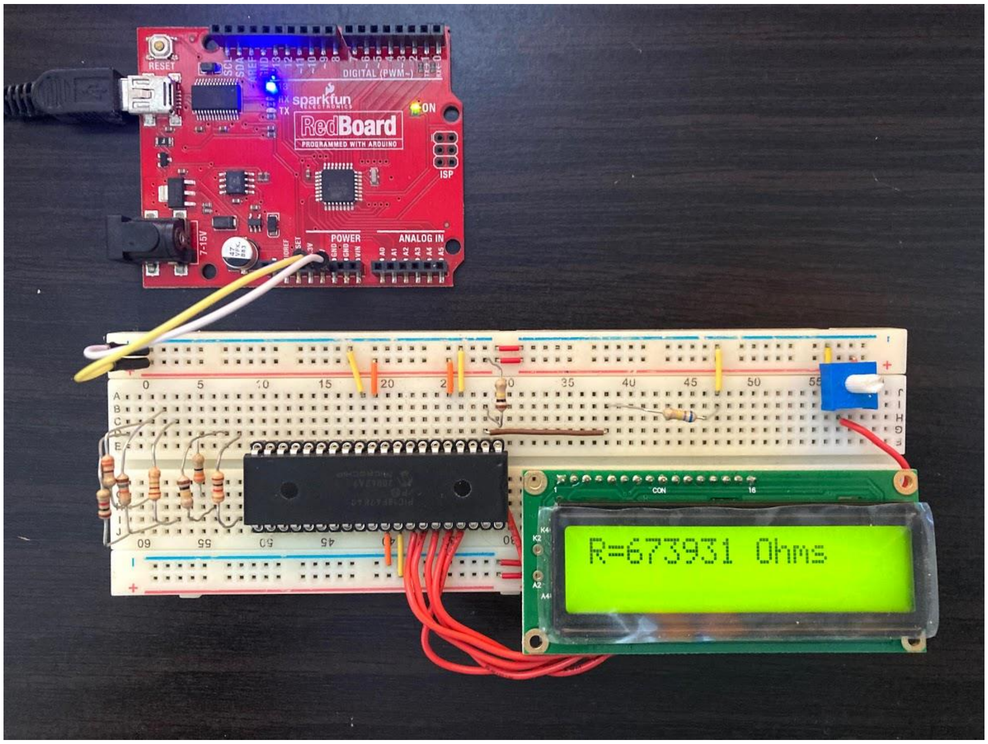


Figure 2. Physical circuit implementation

The software controlling the circuit is also rather simple, with most of the code being used for initialization of the LCD and ADC. The initialization of the LCD takes place by first configuring the appropriate pins on port B as inputs. Next, the data pins are written to in a 4-bit configuration. Relevant commands for initializing the LCD are then sent to the display. These commands include setting the size and type of display, number of data bits, configuring the cursor, and other small settings. Other functions are utilized to make writing to the LCD more efficient, like in the case where more than one character needs to be written in succession.

The ADC uses a fixed value resistance and known reference voltage to calculate the unknown resistor's value using a simple voltage divider. The ADC configuration uses mostly default values, except for the use of an external voltage reference. The ADC is constantly being read and updated.

Once initialized, a continuous loop will update the value seen by the ADC and calculate the resistance of Rx. In accordance with the design requirements, the LCD will only display the calculated resistance when it falls between 1000 and 1000000 Ohms. Otherwise, the LCD will display "Out of Range". The PIC was programmed using the SNAP programmer included with the lab kit. The code utilized is shown below.

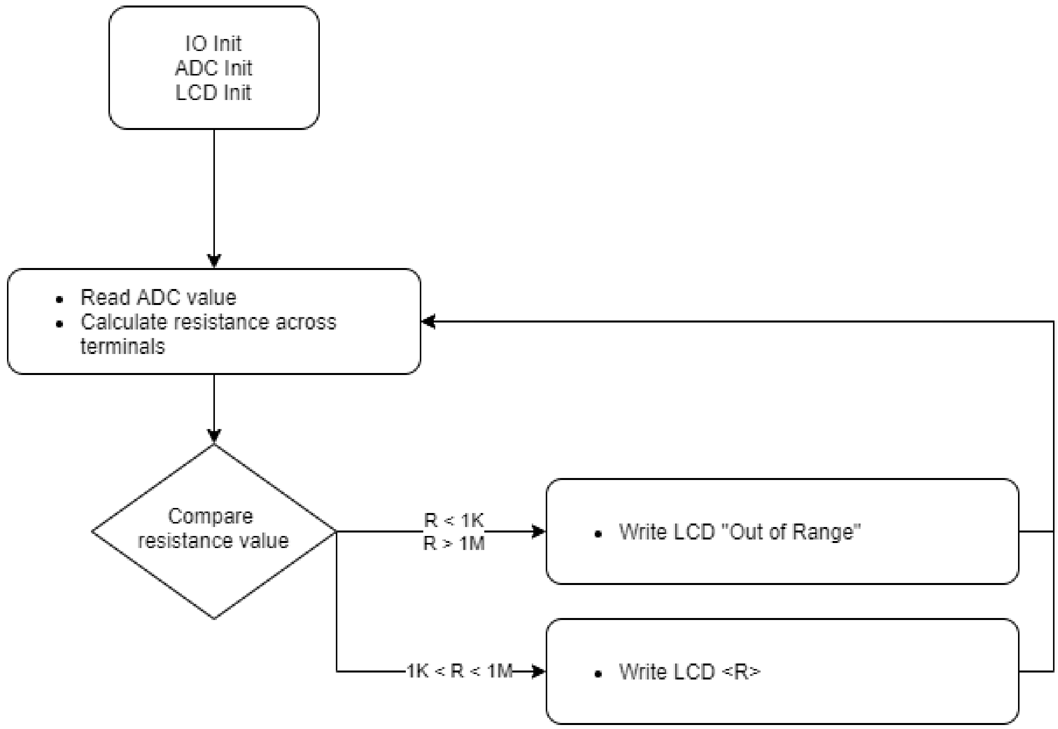


Figure 3. Software flowchart


Figure 4. Hardware block diagram

**Conclusion**

The design and implementation of this module was overall a success. While the physical implementation of the circuit was straightforward, certain challenges were encountered along the way. The example code for the LCD used port A, however an error caused port A to not work with the LCD and port B had to be utilized. The watchdog timer also had to be disabled. Another interesting challenge arose with the ADC where the voltage reference was inaccurate and so the external VREF pins had to be utilized in order to guarantee a proper reading. Ultimately, though, the final design produced accurate readings and the system fully meets all design requirements.