

Refer to Prof. Dinesh Sharma's slides and notes on serial peripheral interface (SPI) to do this lab. See <https://ee337.github.io/dks.html#serial-io>

1. [20 points] In this lab session, you will use the serial port interface (SPI) to interface an analog-to-digital converter (ADC) MCP3008 with the 8051 micro-controller. The MCP3008 is part of the lab kit. You will use this setup to measure temperature using an LM35 sensor, which is also part of the lab kit.

Use the given `main.c`, `spi.c`, `mcp3008.h` and `lcd.h` to complete this lab. **Make sure that all the DIP switches are OFF.**

- i) The micro-controller is to be configured for serial communication with the ADC MCP3008. Complete the function `spi_init` in `spi.c` to configure the SPI so that the microcontroller is the master and the ADC is the slave.
- ii) You will next test the ADC setup using a potential divider circuit (series of resistors provided in the kit can be connected between supply and ground terminals) as shown in Fig 1. By varying the point at which the output is taken, voltages ranging from 0 to 3.3 volts can be obtained as output. As shown this output is connected to CH4 of the ADC. By compiling the project and running the code on the Pt-51 kit, the measured output voltage will be displayed on the LCD in the format shown.

Volt.: 03229 mV

Verify that the displayed voltage corresponds to the potential divider circuit's resistor values.

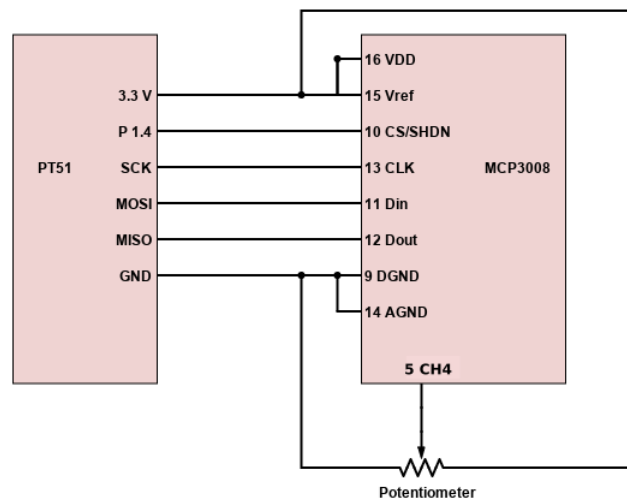


Figure 1: Pt51 interfacing with ADC and potential divider.

- iii) Once the ADC setup is verified using the potential divider circuit, it can be used for sensing and displaying the temperature in $^{\circ}\text{C}$. Connect the sensor output to CH3 of the ADC as shown in Fig. 2. This setup measures the voltage output from the sensor and displays the measured room temperature on the LCD. The output provided by the sensor is $10\text{mV}/^{\circ}\text{C}$. Uncomment and update the relevant sections in `main.c`, compile the code and run it on the Pt51 kit. The room temperature will be displayed on the second row of the LCD as shown. Verify that this value matches approximately your room temperature. The first row will continue to display the voltage corresponding to the potential divider circuit's output.

Volt.: 03229 mV
Temp.: xxx.x °C

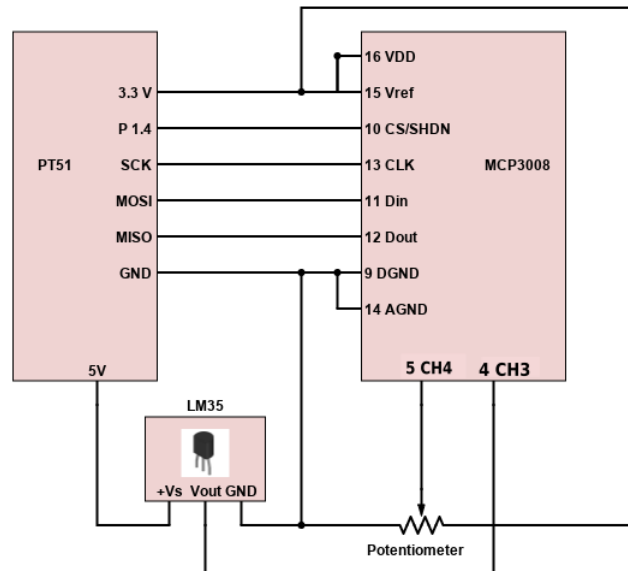


Figure 2: Pt51 interfacing with ADC and temperature sensor.

TA Checkpoints

1. Verify that the student can demonstrate the SPI setup to measure the output of the potential divider circuit.
2. Verify that the student can demonstrate the SPI setup to measure the room temperature.