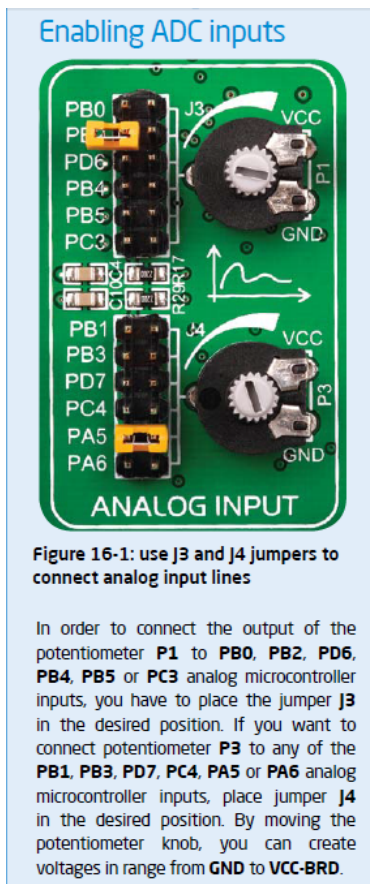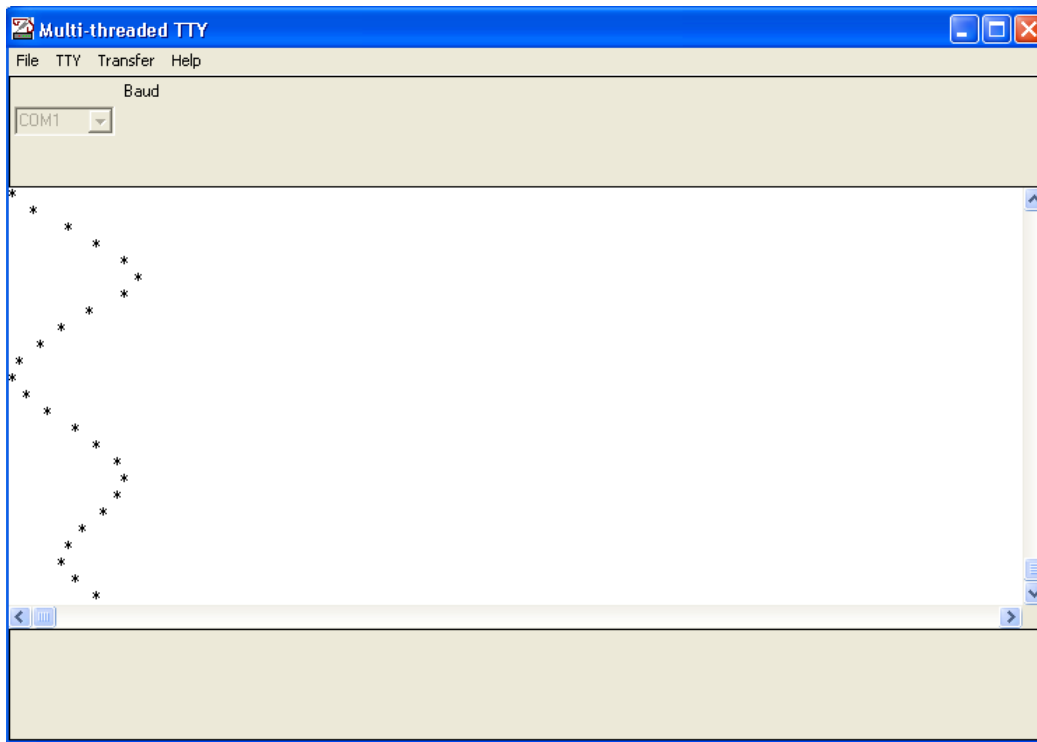# Lab 4 - A/D Conversion

In this lab, you are going to experiment with using A/D converters. It is better if you read the whole Lab Manual first before you start the lab. If you need any help don't hesitate to ask the TAs.

1. Implement the "Simple A/D Converter" described in lectures. Display the conversion result using the LEDs on the board. An RC circuit would be provided to you, you can plug the RC circuit in your board. Take the analog input from the potentiometer on the board as shown in the figure below. The code for this task has been provided in *'Lab4_task1.asm'* file. Create a separate text file and explain in detail step by step working of the code. Try to optimize it for best results. Check the conversion accuracy by applying 10 different input voltages and recording the corresponding results. Are they as expected?

Figure 16-1: use J3 and J4 jumpers to connect analog input lines

In order to connect the output of the potentiometer **P1** to **PB0**, **PB2**, **PD6**, **PB4**, **PB5** or **PC3** analog microcontroller inputs, you have to place the jumper **J3** in the desired position. If you want to connect potentiometer **P3** to any of the **PB1**, **PB3**, **PD7**, **PC4**, **PA5** or **PA6** analog microcontroller inputs, place jumper **J4** in the desired position. By moving the potentiometer knob, you can create voltages in range from **GND** to **VCC-BRD**.

2. Use the UART connection to send the conversion results to a terminal program running on the PC so that it prints a "*" after a number of "blanks" that is proportional to the conversion result. Send a "line feed" after each conversion to obtain a digital scope display that looks like:

Multi-threaded TTY

File TTY Transfer Help

Baud

COM1

```
*
 *
   *
    *
     *
      *
      *
    *
   *
 *
 *
*
 *
   *
    *
     *
     *
      *
    *
   *
   *
    *
```

3. Repeat Tasks 1 & 2 using the in-built ADC in ATmega32. Create a Text file and explain in each part above what values you set to the following registers and why:

- ADMUX
- ADCSRA

Preliminary work:

- Read the code provided in the Lecture 12 and understand how it works.
- Read how the analog comparator works and which pins to use for it in ATMega32.
- Read from which pins you can read analog input in the ATMega32 datasheet.
- Read ADC section of the datasheet (Page # 201). You should learn functionality of the 2 registers: ADMUX and ADCSRA.
- Read the UART section of the datasheet of your microprocessor.

Procedure:

- Create a new folder, **last_name1-last_name2-lab4**, in your home directory
- Do your programming on the source code. Assemble.
- Answer all the questions in tasks (1-3) at the top of your source code under comment lines.
- Compress your entire **last_name1-last_name2-lab4** project folder, and submit the compressed folder to ku.blackboard.com web page.
- Write up a lab report including flow charts of your implemented algorithms and a discussion of challenges and learning outcomes. Submit your report separately to ku.blackboard.com web page.

Each group should work independently! Copying or idea exchanges are not allowed!

Good luck!