Introduction

Force sensing resistors (FSR) are thin sheets that can be used to measure a force being applied to the sensor. The sensors are polymer thick film (PTF) devices meaning they are made of tracks of conductive plastic. The sensor works because a pressure on the top of the sheet compresses the device causing particles to touch the internal conducting electrodes, lowering the resistance. (http://www.media.mit.edu/resenv/classes/MAS965/week03/skinFSRs.ppt#258,3,FSRs How they work)

The end result for these sensors is that they work by having a variable resistance between the two terminals, where the resistance decreases with increased force on the pad. The interlink FSR kit comes with 5 different sensor shapes that vary in size and sensitivity. Each pad is made out of the same material but requires different calibrations since the resistance output for each varies with differing shapes and sizes. Figure 1 shows the internal construction of an example FSR. As the active area is pressed down through the spacer opening, it contacts the substrate, decreasing the resistance between the terminals. You can see that the tail contains two different traces which, once attached to pins, make the electrical connection terminals for the FSR.

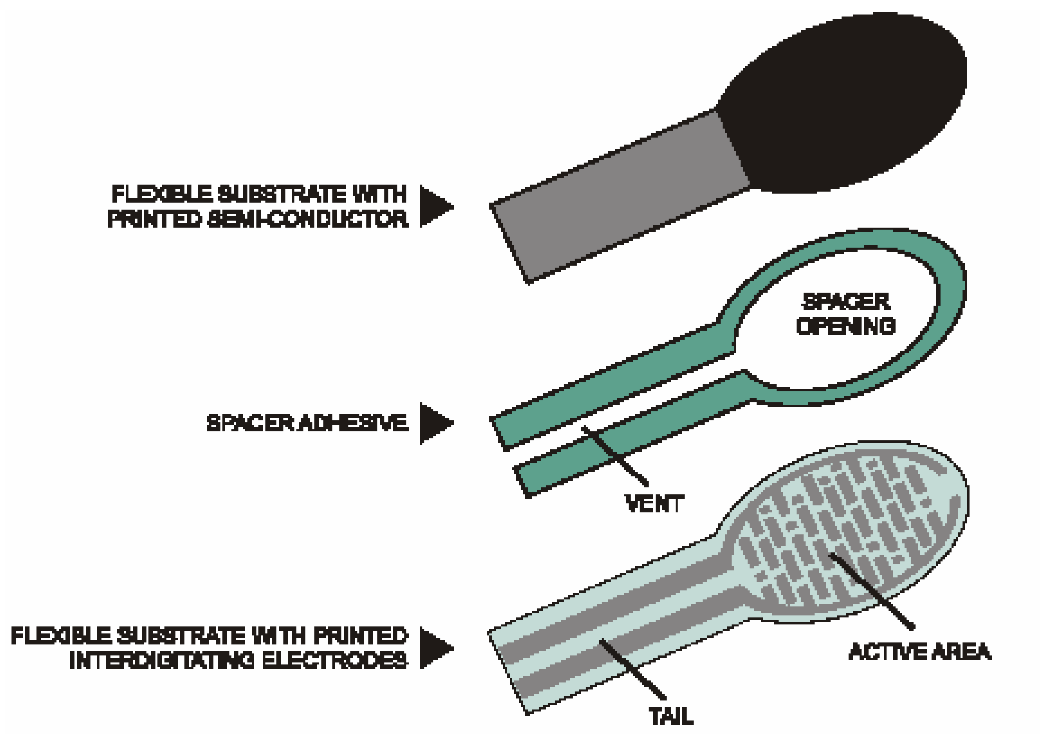


Figure 1: FSR internal construction (http://www.interlinkelec.com/documents/usersguides/fsrguide.pdf)

Implementation

To detect the force applied you can set up a voltage divider between the FSR and a calibration resistor (Example configuration shown in Schematic 1). Then by measuring the analog voltage level between the resistance components you can determine the force being applied to the FSR. Figure 2 shows an example of how the force sensor reacts to different amounts of weight. This particular graph is not accurate for any of the sensors in the kit, but shows what type of resistance values are normal. For the sensors in the kit, the smaller the size, the less precise it is at discerning between two similar high force values. However, these FSRs are great for detecting between no force and an applied force. The rest of this document contains a sample schematic along with PIC assembly code to run an FSR. The example program takes the analog value of the voltage from a voltage divider between a FSR and a potentiometer (shown in Schematic I), converts it to an 8 bit digital value using the PIC's A/D converter, and displays that digital value on the 8 LEDs available through port D of the Harrisboard.

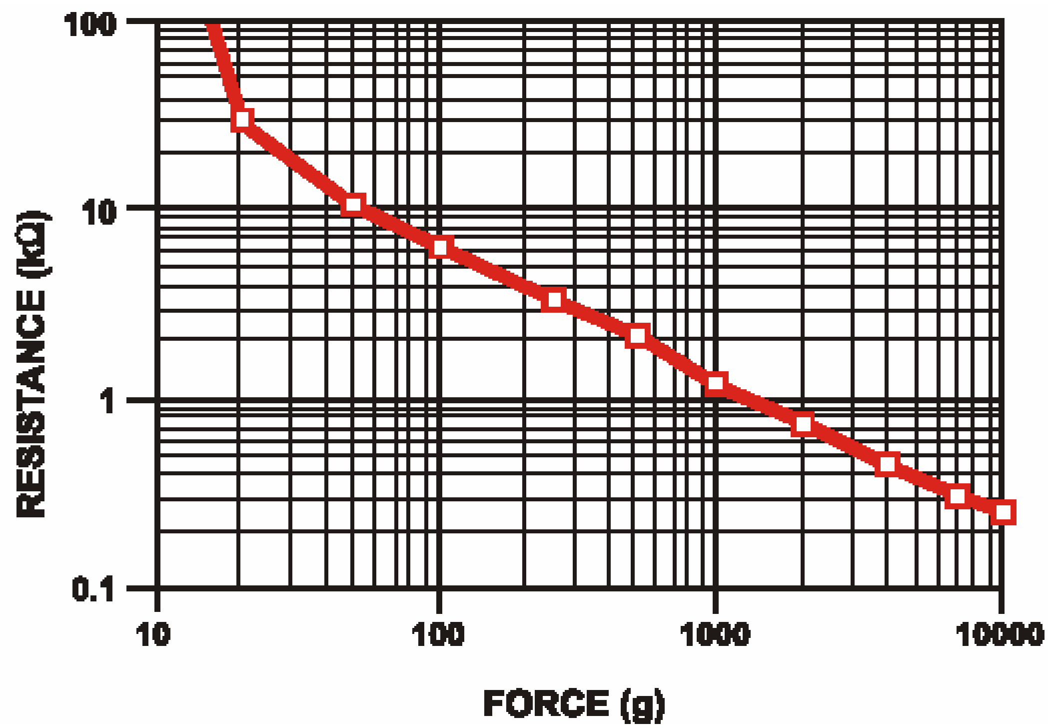


Figure 2: Force vs Resistance graph
(http://www.interlinkelec.com/documents/usersguides/fsrguide.pdf)

The graph above is taken directly from the Interlink Users Guide, the units for the x-axis are grams. The graph is not representative of any of the particular force sensors included in the kit.

Specifications

Force Sensing Resistors Integration guide and Catalog
www.interlinkelec.com/documents/usersguides/fsrguide.pdf

Supplier

Part	Vendor	Part #	Price
FSR Design Kit	Interlink Electronics	50-76247	$79.95

www.interlinkelectronics.com

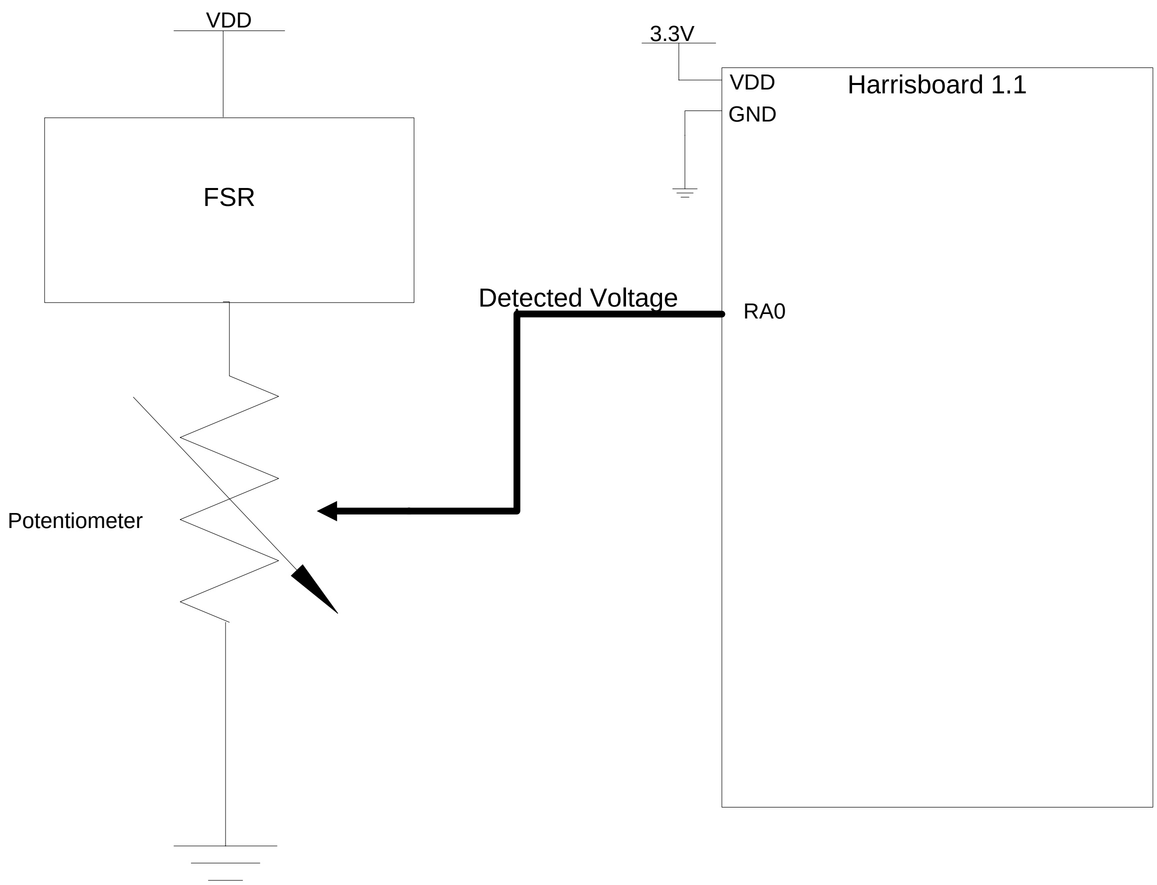
Additional Resources

http://www.interlinkelec.com/documents/datasheets/fsrdatasheet.pdf

http://ccrma.stanford.edu/CCRMA/Courses/252/sensors/node8.html

Schematics

Schematic 1: FSR Voltage Divider into Harrisboard



Sample Code

Listing 1: FSR.asm

```
;Daniel Rinzler
;drinzler@hmc.edu
;04-26-05
;This file will take an analog voltage value from a voltage
;divider between an FSR and a potentiometer and use the PIC’s
;built-in A/D converter to ;digitize the voltage to an 8 bit
;digital value. Then it will ;display the digital value on the
LEDs through port D.
      LIST p=18F452
      include "p18f452.inc"

;Variables
I     EQU 0x00
J     EQU 0x01
TEMP EQU 0x02

org 0
;initialize A/D
  movlw 0x01            ;This turns on the A/D converter
  movwf ADCON0
  movlw 0x4E            ;This sets the A/D converter to use RA0
                        ;as the input voltage and
  movwf ADCON1          ;Vdd and Gnd as the reference voltages

  clrf TRISD            ;this sets port D to be an output
  clrf PORTD            ;this clears the output so that no LED’s
                        ;are on

main
      bsf ADCON0,2            ;start A/D conversion
wait  btfsc ADCON0,2          ;wait for conversion to complete
      bra wait

      movff ADRESH, PORTD     ;display value on PORTD LEDs
      call idleShort
      bra main

;This idle period displays each A/D value on port D for a
;period of ~.1seconds(2.3x10^6 cycles @ Clk = 20Mhz) before the
;program moves on to the next value
idleShort
      movlw 0
      movwf I
L3
      movlw 0xF0   ;run outer loop
      cpfslt I
      return
      clrf J
L4
      movlw 0xF0 ; run inner loop
      cpfslt J
      bra innerdone2
```

```
            NOP     ;10 no operations lines to take up time (2 us)
            NOP
            NOP
            NOP
            NOP
            NOP
            NOP
            NOP
            NOP
            NOP

      incf J
      bra L4
innerdone2
      incf I
      bra L3
end
```