4.0 - Inputs

About Inputs

Input circuits often convert a physical input into a change in resistance. This change in resistance alters the current flow through a series resistor divider circuit, resulting in a change in potential that will be sensed by some other circuit, often at the input pin of a microcontroller.

Digital input - Switch activity

1. Examine a digital input circuit on your schematic. Re-draw the circuit below, using a 10 kΩ resistor as the pull-up resistor, and show the parallel tap to the microcontroller.

2. From the diagram, it should be apparent that the input circuit is a series circuit functioning as a voltage divider. Predict the potential at the microcontroller when the switch is open and closed.

   V_{in} (S1 open) = V_{in} (S1 closed) =

3. Build the circuit on a breadboard. Measure the potential that would be fed to the microcontroller's input pin.

   V_{in} (S1 open) = V_{in} (S1 closed) =

4. Does your prediction agree with your measurement?

5. Calculate the amount of current that flows through the input circuit when the switch is open and closed.

   I (S1 open) = I (S1 closed) =

6. What purpose does this current serve? Does the current flow through any load?

Teacher Check ☐

Analogue input - Phototransistor activity

1. Either a phototransistor or an ambient light sensor can be installed for Q1. Both of these components change their resistance in response to the intensity of light. Obtain Q1, and measure its resistance in both forward and reverse orientation, and in dark and light conditions. Shield the phototransistor from light with your hand to get a dark measurement, and aim the phototransistor at a light source or window for the light measurement.

   R_{Q1} (fwd-dark) = R_{Q1} (rev-dark) =

   R_{Q1} (fwd-light) = R_{Q1} (rev-light) =

2. Draw a phototransistor bias circuit, composed of a 10 kΩ resistor and a phototransistor connected in forward bias, connected to a 5 V potential. Note the polarity of the pins.

3. Build the phototransistor circuit you drew on a breadboard, and measure the potential drop across the phototransistor in dark and light conditions.

   V_{Q1} (dark) = V_{Q1} (light) =

   Teacher Check ☐

Input analysis

1. Inputs need to fall within specific levels to be accurately sensed. Look up the DC characteristics of the PIC16F1459 I/O port pins in its data sheet. What is the input potential range for low (0) and high (1) signals?

2. Analogue inputs can be converted to 8-bit or 10-bit digital numbers using the microcontroller's A-D converter. Assuming the microcontroller's 5V power supply is the maximum reference, calculate the potential of a 1-bit change in an 8-bit and 10-bit conversion.