4.0 - Inputs

About Inputs

Input circuits often convert a physical input, such as touch (from a pushbutton closing), light, or temperature, into a changing potential that can be sensed by a microcontroller input pin. Inputs are either digital – providing either a high or low potential represented in programming as either 1 or 0 – or analogue, consisting of a range of potential, usually from 0V to 5V.

Digital input - Switch activity

1. The reset circuit is a digital switch composed of S1, R1, and an internal pull-up resistor inside the microcontroller. Re-draw the circuit below, using a 10 kΩ resistor as the pull-up resistor, and showing all three parts connected vertically, in a straight line between + 5 V and ground.

2. Where does the input to the microcontroller connect? Which of the switch components will the microcontroller input be in parallel with? Show this as a tap, or connection, in your circuit.

3. From your diagram, it should be apparent that the input circuit is a series circuit which functions as a voltage divider. Think of the switch as a resistor with two possible states, namely infinitely high resistance (open) and zero resistance (closed). Predict the potential sensed by the microcontroller when the switch is open and closed.

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

4. Build the circuit on a breadboard, using a 10 kΩ resistor, a 100 Ω resistor, and a switch or a wire. Measure the potential that would be seen at the microcontroller's input.

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

5. Does your prediction agree with your measurement?

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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) =

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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 an 8-bit digital number using the microcontroller's A-D converter. If 5V is equivalent to the number 255, calculate the potential representing each digit.