

5.0 - Digital Inputs

About Digital Inputs

Digital input circuits enable microprocessors to sense on-off signal inputs. Unlike common home electrical circuits, in which a switch (the input device) actually controls current passing through it to a light (the output device), digital inputs in electronics are often designed to create a change in potential that will be sensed by the microprocessor. In other words, the input device controls the potential at the microprocessor input pin, but does not conduct any load current to the output device.

Digital input activity

1. The reset circuit is composed of D2, R2, R3 and S1. Find the reset circuit on your schematic diagram. Re-draw the circuit below, but instead of copying how it was drawn on the schematic, re-draw the circuit showing R2, D2 and S1 in a straight line connected between +5 V and GND.

The purpose of resistor R3 is to limit current caused by static discharge when a finger contacts the reset switch. In normal operation the microprocessor RE3 pin has a high impedance, so the effect of R3 on the circuit is negligible. As a result, you can simplify your diagram by omitting R3.

2. From your diagram it should be apparent that the input circuit is a series circuit which functions as a voltage divider, although it's made up of a resistor, a diode and a switch instead of two resistors. Think of the switch as a resistor with two possible states, namely infinitely high resistance (open) and zero resistance (closed). Predict the potential across the switch for each state.

$$E_{S1} \text{ (open) } =$$

$$E_{S1} \text{ (closed) } =$$

3. Install D2, R2, R3, and S1 into your CHRP circuit board. Connect your CHRP circuit to a power supply and measure the potential at pin 1 of U2 corresponding to each switch state.

$$E_{S1} \text{ (open) } =$$

$$E_{S1} \text{ (closed) } =$$

4. Does your prediction agree with your measurement?

Teacher Check

- In the reset circuit, R2 is known as a pull-up resistor. The switch circuits connected to Port B of the microcontroller (pins RB0-RB7) also need pull-up resistors to function properly, but their pull-up resistors are found inside the microcontroller instead of being connected externally.

All eight Port B switch circuits are identical. Re-draw a schematic diagram showing just one of the Port B switch circuits, including an internal 20 kΩ pull-up resistor, and the external resistor and switch.

Teacher Check

Digital input analysis

- Calculate the potential drop across the external switch and resistor, both when the switch is open and when it is closed.

E_s (open) =

E_s (closed) =

- The microcontroller's Port B pins connect to multiple devices. List all of the Port B devices here, and state whether they would be considered input or output devices.
- Assuming a Port B is set as an output and a switch gets pressed, calculate the current flow through the switch and the external resistor.
- What purpose does the external resistor serve?
- Install the remaining switches, starting from S2, and their associated resistors into your CHRP.