CG1112 Engineering Principles and Practice II

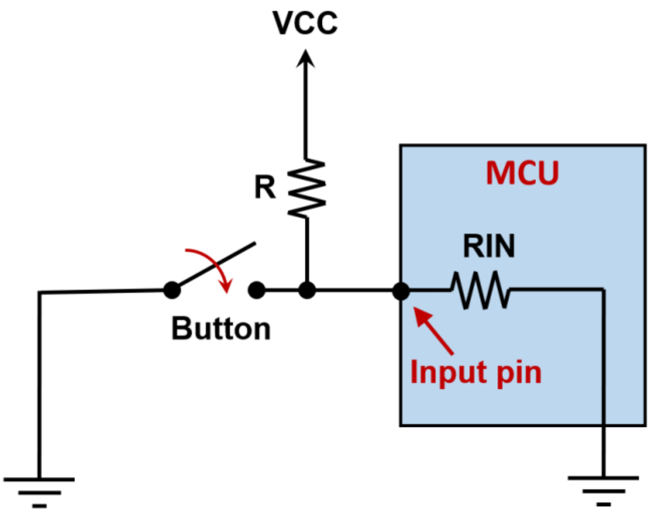
Semester 2, AY2018/19

Week of 01st April 2019

Tutorial 7 Part 2

Power Management

1. Pull-up Resistors



Pull-up (and also pull-down) resistors are very common when using microcontroller units (MCU). In earlier studios, you have used them together with push buttons to control the logic at input pins. Why are they needed? If nothing is connected to an input pin, its voltage will be floating, and the detected logic can go either high or low. To prevent this unknown state, we use these resistors to ensure that the pin is either in a high or low state, while using a small amount of current. In our studios, we always use R = 10 kΩ. For a typical MCU input pin, its input resistance RIN needs to be high, and can be between 1 to 100 MΩ. In this question, we try to understand whether R = 10 kΩ is a good choice. Assume VCC = 5 V, and RIN = 1 MΩ.

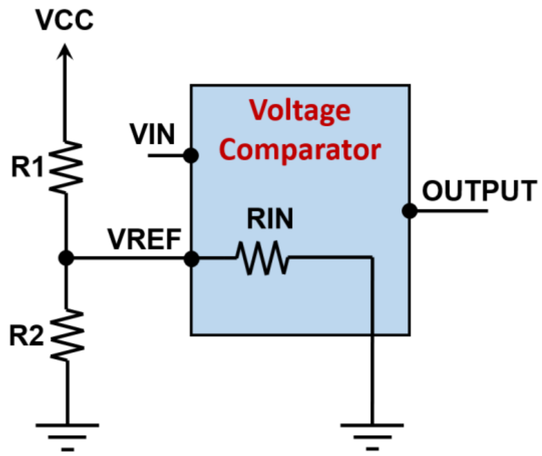
(a) Can R be 0? Why not?

(b) Assuming R = 10 kΩ, what is the voltage at the input pin when the switch is opened, and what is the current drawn from the source VCC?

(c) Repeat (b) when the switch is closed.

(d) Suppose someone thinks that the current calculated in (c) is still too high, and decides to save power by using R = 1 MΩ. what is the voltage at the input pin when the switch is open?

2. Using a Potential Divider to Provide Reference Voltage



Suppose you are working on an intelligent system that requires the use of a reference voltage for decision making. One possibility is to use a potential divider to obtain this reference voltage. Also suppose that low-power consumption is an important consideration in your design. If VCC = 5V, the required VREF is 2.5 V, and the input resistance RIN of the voltage comparator is 1 MΩ, assess the suitability of each of the following choices of R1 and R2:

(a) R1 = R2 = 100 Ω
(b) R1 = R2 = 10 kΩ
(c) R1 = R2 = 1 MΩ
(d) R1 = R2 = 10 MΩ