

ELEC ENG – 2EI4

Design Project #2 - Research

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A switch is an electrical component that is capable of connecting or disconnecting a conducting path present within an electrical circuit. When a switch is in its on-state, the switch acts like a wire that allows the flow of current through it. It acts similarly to a wire. When a switch is in the off-state, it acts like an open-circuit which prohibits the flow of current through the switch [1]. It features a resistance value equivalent to infinity resulting in current being zero. Within this project, an ideal switch is being designed and tested. An ideal switch operates similarly to a regular switch through its control of the current flow but consists of unique properties. The ideal switch should be able to switch between closed and open states without featuring a delay. When an ideal switch is closed or turned on, it features zero resistance. This enables the switch to feature a zero voltage and power drop across it meaning that when on, $V_1 = V_2$. In addition, an ideal switch is bidirectional which allows for the current to flow in both directions. The ideal switch can also tolerate an infinite amount of voltage without breaking, resulting in an infinite voltage range for V_1 and V_2 . There is also no limit to the amount of current that can be tolerated when the ideal switch is in its on-state [2].

On the other hand, in reality, switches tend to diverge from their ideality and attract their non-idealities. Switches feature many non-idealities. Primarily, switches feature a switch timing meaning that there is a delay present when switching from one state to the other. This creates issues that must be accounted for within a circuit design as they can create switching delays [3]. Similarly to other components, switches are not perfect, they feature inconsistencies and we do not live in a perfect world. As a result, when switches are placed in the on-state, they feature a slight resistance value. This resistance value may not seem like a problem; however, this can create many problems such as a voltage drop across the switch or power loss. This is a key divergence from the ideal property of a switch [4]. In addition, switches also feature a voltage and current rating. In reality, switches are not capable of withstanding infinite amounts of voltage and current, after a certain threshold, they begin to degrade until they are entirely broken [5]. Finally, switches also feature current that leaks through the switch when it is in its off-state. This is known as leakage current, this current should not exist with the properties of a unique switch; however, in reality, they do exist and can create complications in circuits [6]. Throughout the design project, these non-idealities should be accounted for and designed against.

Works Cited

- [1] "Button and switch basics," Button and Switch Basics - SparkFun Learn, <https://learn.sparkfun.com/tutorials/button-and-switch-basics/what-is-a-switch> (accessed Feb. 18, 2024).
- [2] 3.General switching characteristics 3.1 the ideal switch, https://www.uobabylon.edu.iq/eprints/publication_7_25213_6046.pdf (accessed Feb. 18, 2024).
- [3] Express Electrical Services, "9 most common light switch problems," Express Electrical Services, <https://expresselectricalservices.com/most-common-light-switch-problems/> (accessed Feb. 18, 2024).
- [4] J. Fu, "Fundamentals of On-Resistance in Load Switches," Texas Instruments, https://www.ti.com/lit/an/slva771/slva771.pdf?ts=1701791734784&ref_url=https%253A%252F%252Fwww.google.com%252F (accessed Feb. 18, 2024).
- [5] Person, "The story of Electrical Switch and socket power rating standards," Schneider Electric, [https://eshop.se.com/in/blog/post/story-of-electrical-switch-and-socket-rating-standards.html#:~:text=The%20voltage%20rating%20of%20a,expressed%20in%20volts%20\(V\).](https://eshop.se.com/in/blog/post/story-of-electrical-switch-and-socket-rating-standards.html#:~:text=The%20voltage%20rating%20of%20a,expressed%20in%20volts%20(V).) (accessed Feb. 18, 2024).
- [6] "Leakage current in opened switch," VFD, <http://www.vfds.org/leakage-current-in-opened-switch-699821.html#:~:text=Wherever%20%26%20whenever%20a%20voltage%20is,called%20the%20'leakage%20current'> (accessed Feb. 18, 2024).