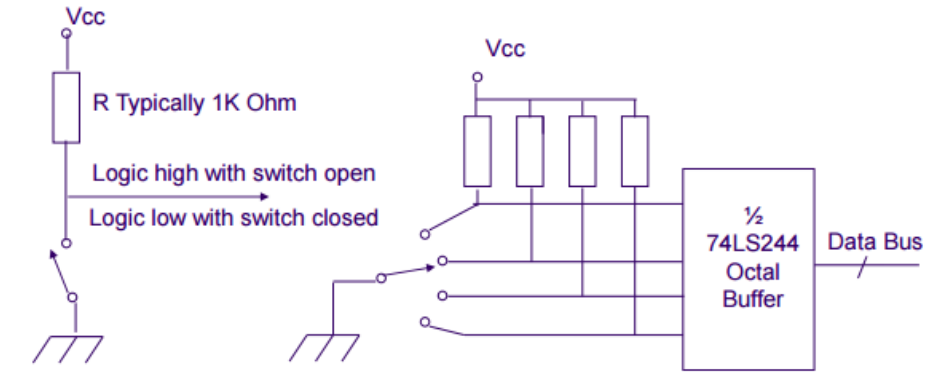
6. I/O Devices

COMP2121 • KC Notes

6.1 Input Switches

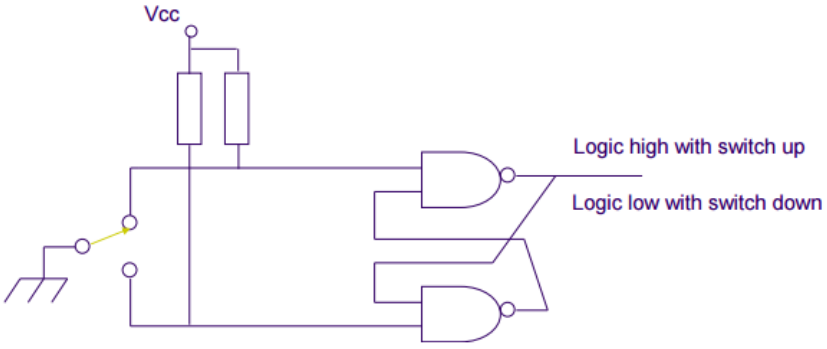
- **Input Switches**: Most basic binary input devices – **high or low** depending on switch position
- **Pull-up resistors** are needed in each switch to **provide high logic level when switch is open**



(a) Single-pole, single-throw (SPST) logic switch Data Bus

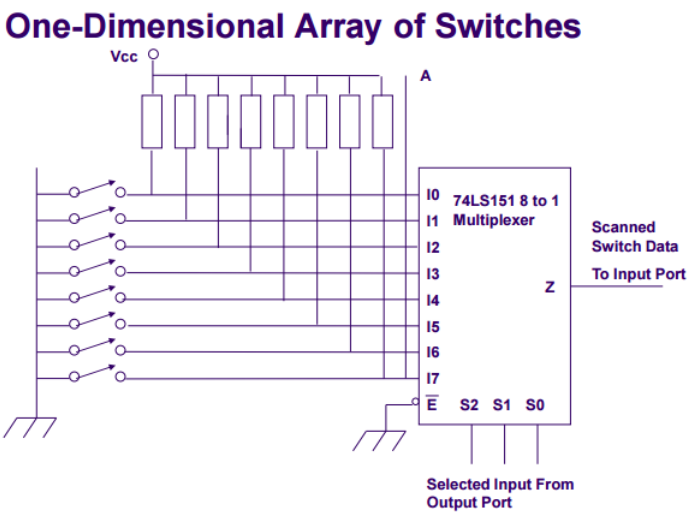
(b) Multiple pole switch.

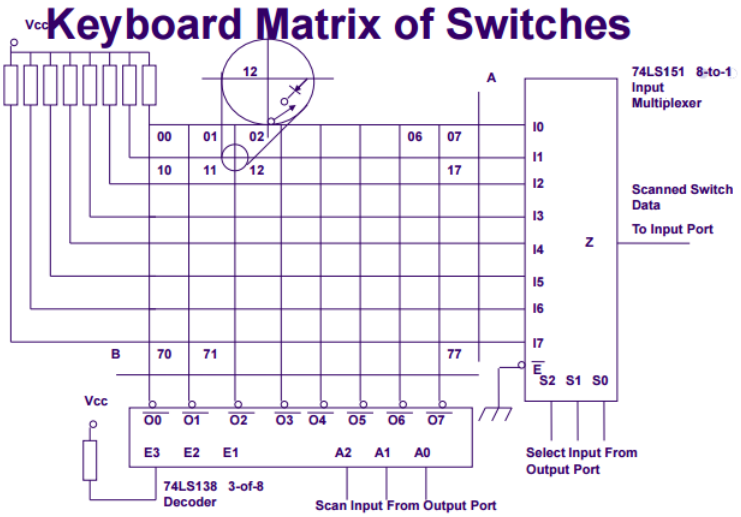
- **Switch bounce**: a **transient behaviour** causing erroneous counting in software
  - Switches bounce for 5-10ms, needs **debouncing**
- **Software debouncing**:
  - **"Wait and See"**: software waits for 20 to 100ms and tests if the switch is still low
  - **Counter-based**: Initialise a counter to 10, and at the detection of a logic low, poll the switch every 1ms and decrement if a low is polled, increment if a high is polled.
    - 0 = switch closed for at least 10ms
    - 20 = switch has been open for at least 10ms
- NAND Latch Debouncer



6.2 Arrays of Switches and the Keypad

- **<u>Linear/1D Array of Switches</u>**: software scans through the array and outputs a **3-bit sequence (S2,S1,S0)** from 000 to 111 **to select a switch**.
    - The selected switch input is scanned one bit at a time by the multiplexer
- **<u>Matrix/2D Array of Switches</u>**: (A2,A1,A0) selects a switch's A position, (S2,S1,S0) selects a switch's B position
    - i.e. **output (A2,A1,A0)** and then **scan (S2,S1,S0)**, repeat for all A's
    - Switches are connected **at each intersection of vertical/horizontal line**
    - Closing the switch **connects** the two lines





- Diode prevents **ghosting**, when several keys are pushed at once
    - Diodes in the switches eliminate ghosting by preventing current flow down a row

6.3 Dot Matrix LCD

- A **controller** is used for **communication between LCD and MPU**. It has its own internal character generator ROM, and display functions are controllable **using instructions**
- Connected to 14 pins:
    - **DB4-7**: high order data bus used bi-directionally, DB7 used as a busy flag
    - **DB0-3**: low order data bus
    - **E**: Enable bit, operation start signal for data read and write
    - **R/W**: Signal to select read (1) or write (0)
    - **RS**: Register select (write instruction register or write/read data register)
    - **Vee**: terminal for LCD drive power source, **Vcc**: +5V, **Vss**: 0V
- **Instruction register**: instruction codes like Cursor shift, as well as addresses in the Display Data RAM (DD RAM) or character generator RAM (CG RAM)
- **Data register**: Temporarily store data to be read/written to/from DD RAM
- LCD module may be busy (busy flag) with an internal operation. Also needs to be **initialised** in software before use.