



New Mexico Institute of Mining and Technology

# Review of Lab 0 & DE0–Nano Intro

EE 231L

# KEY CONCEPTS

- ▶ If you are unsure of something:
  - Datasheet
  - TA/Instructor
  - Lab Attendant
- ▶ Purpose of these labs:
  - Lab 0
    - Build a clock source
    - Gain experience with wire wrapping
  - Lab 1
    - Utilize the clock source
    - Recognize gate delays & implications thereto

# Lab 0

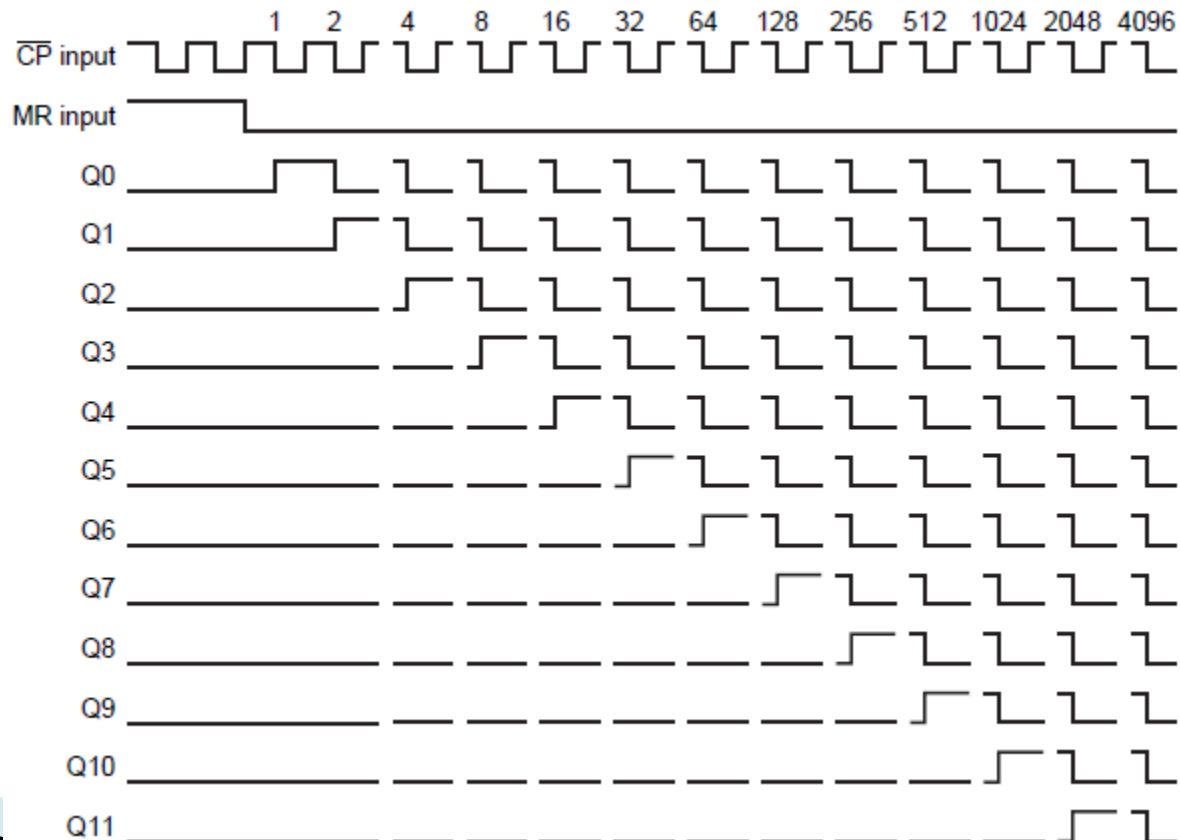
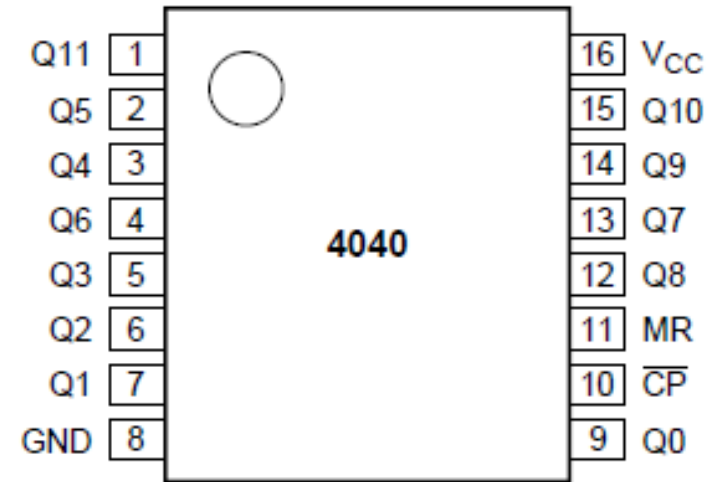
- ▶ Utilizes 4 basic components:
  - 74HC4040
  - 74HC14
  - Oscillator
  - LED & resistor
- ▶ Key realizations
  - COLOR CODE EVERYTHING
  - Position parts properly
  - Proper wire wrapping skills
  - How to use documentation

# IC Basics

- ▶ There is ALWAYS an indicator for Pin 1
  - Dot
  - Notch
  - Edge
  - Stripe
  - <http://www.evilmadscientist.com/2010/basics-finding-pin-1/>
- ▶ Pin counting is ALWAYS CCW
- ▶ Diagrams are ALWAYS top down views

# 74HC4040

- ▶  $Q0 = \text{clk}/2^1$
- ▶  $Q1 = \text{clk}/2^2$
- ▶  $Q2 = \text{clk}/2^3$
- ▶ Etc...



# 74HC14

- ▶ Inverting buffers with Schmitt trigger

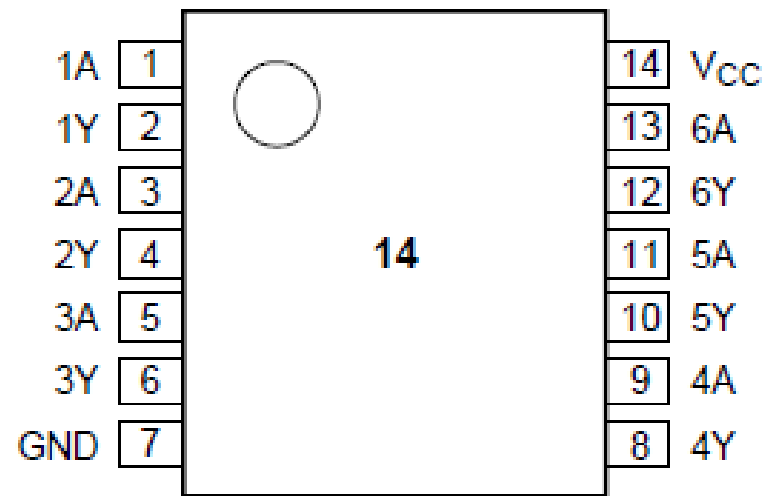
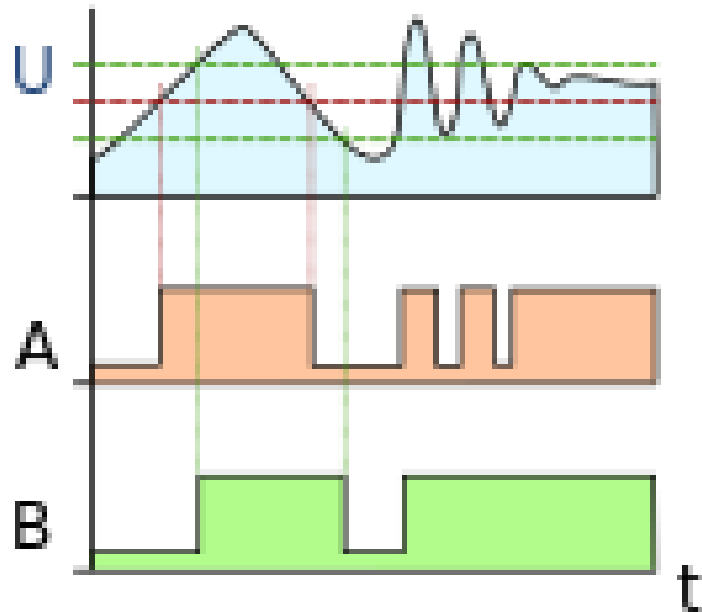
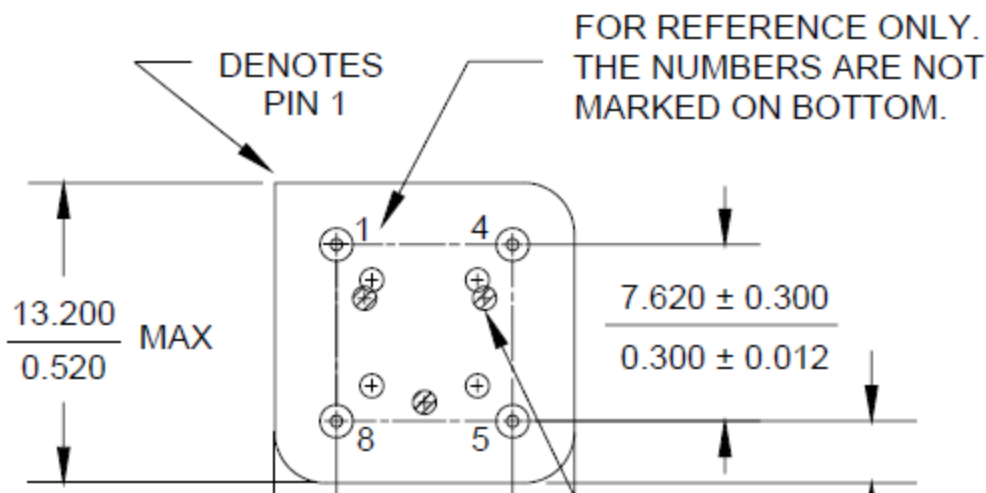


Table 3. Function table<sup>[1]</sup>

| Input | Output |
|-------|--------|
| nA    | nY     |
| L     | H      |
| H     | L      |

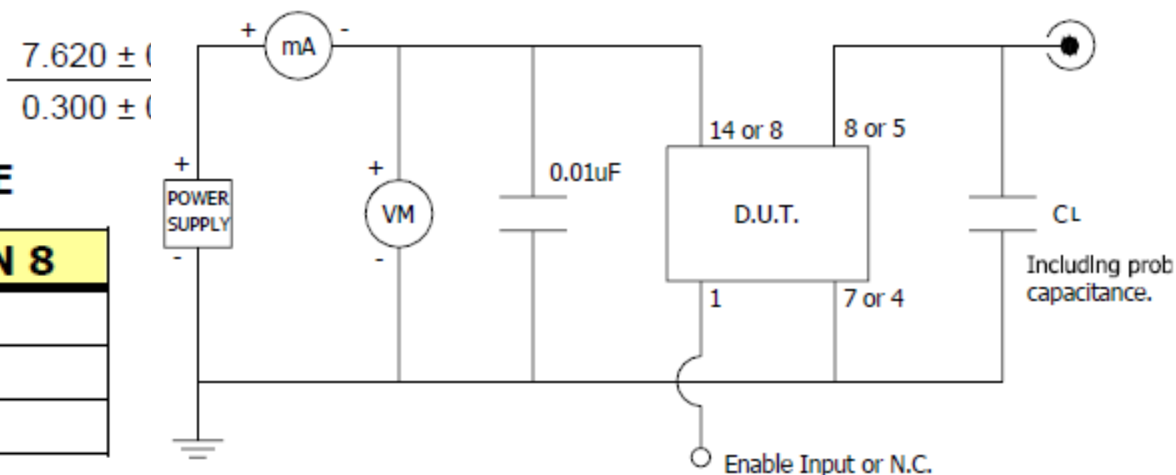
- [1] H = HIGH voltage level;  
L = LOW voltage level.

# MXO45HS



## ENABLE TRUTH TABLE

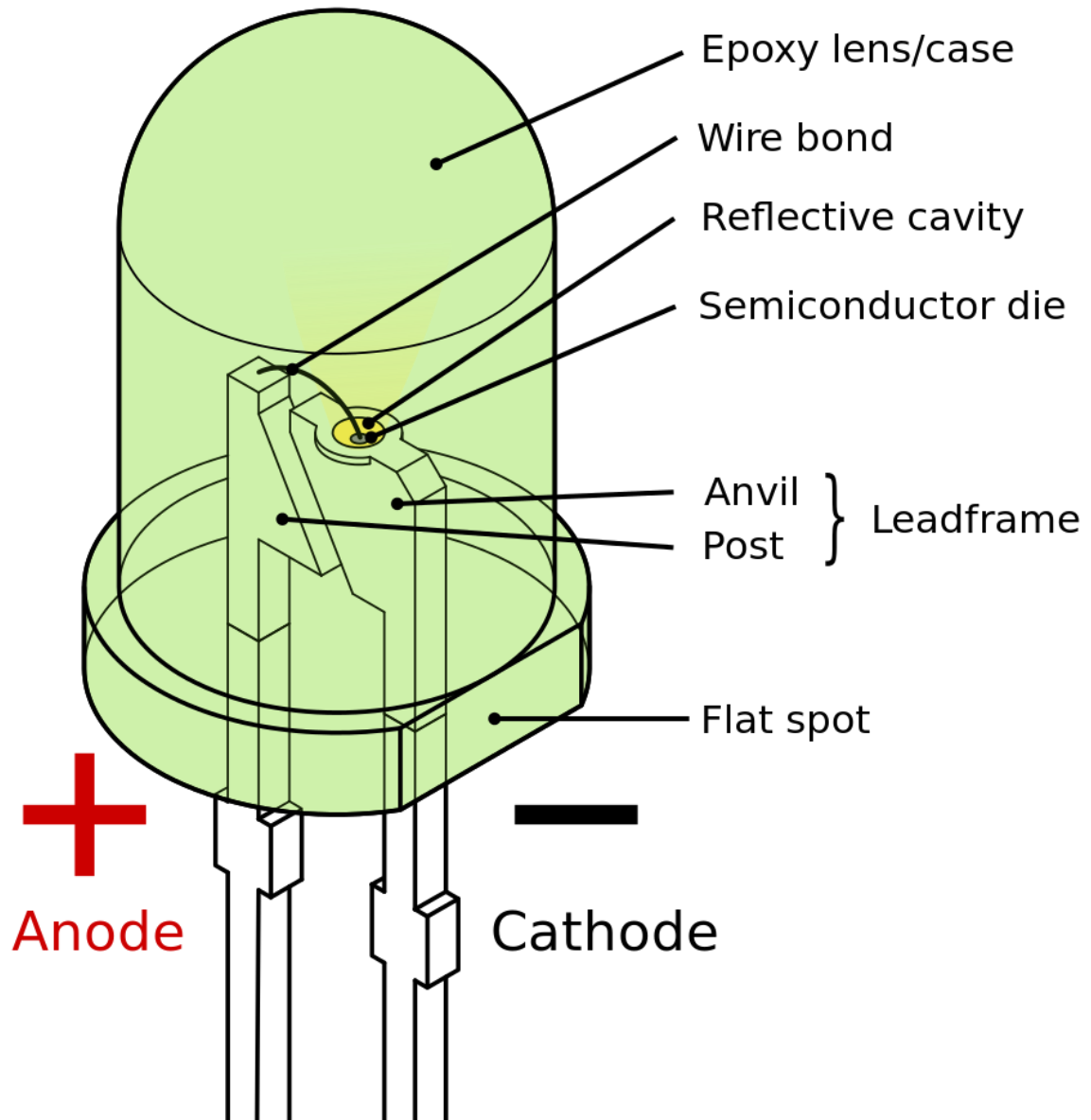
| PIN 1     | PIN 5 or PIN 8 |
|-----------|----------------|
| Logic '1' | Output         |
| Open      | Output         |
| Logic '0' | High Imp.      |



## D.U.T. PIN ASSIGNMENTS

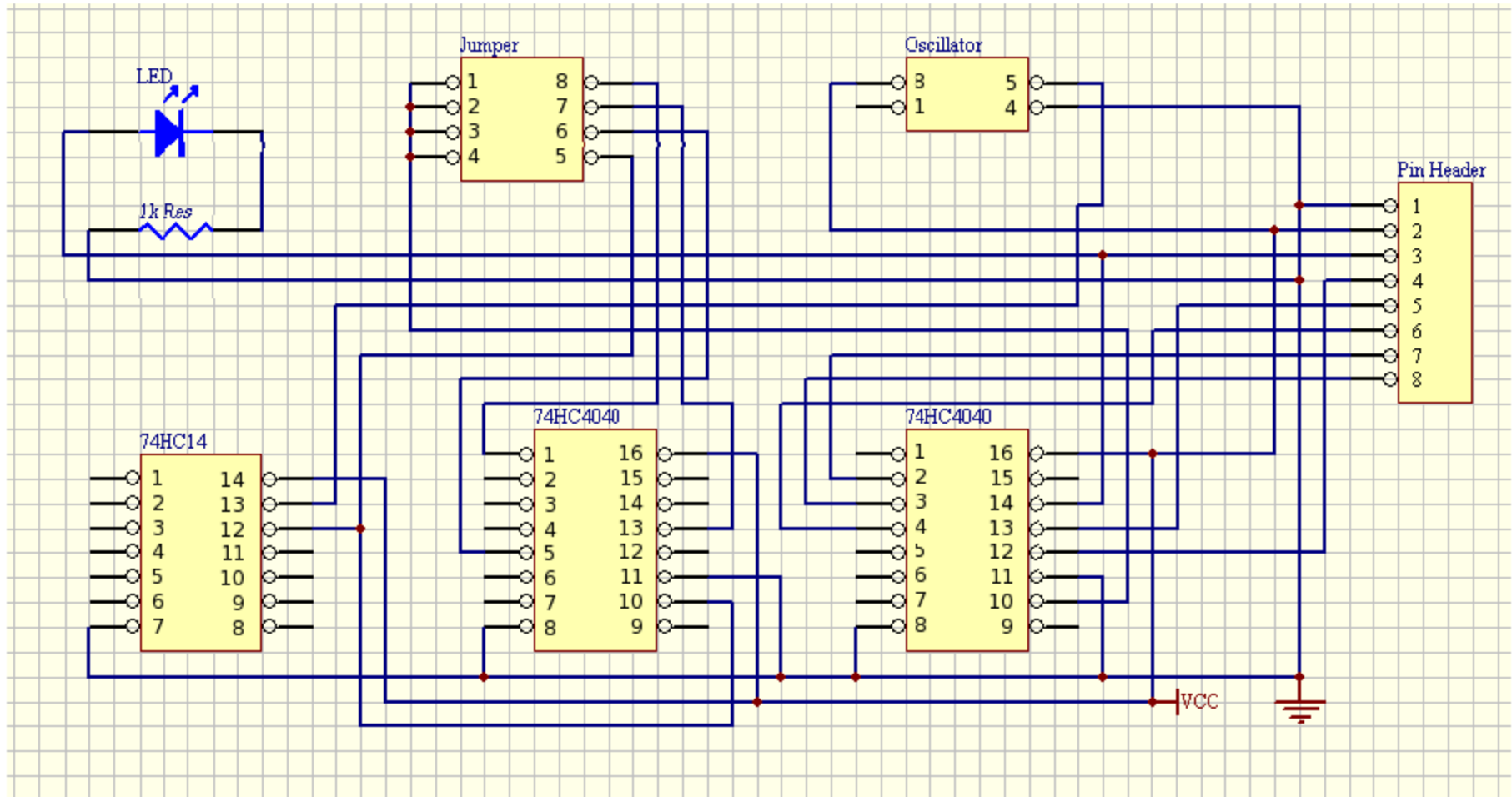
| PIN     | SYMBOL          | DESCRIPTION                |
|---------|-----------------|----------------------------|
| 1       | EOH             | Enable Input or No Connect |
| 7 or 4  | GND             | Circuit & Package Ground   |
| 8 or 5  | Output          | RF Output                  |
| 14 or 8 | V <sub>cc</sub> | Supply Voltage             |

# LEDs

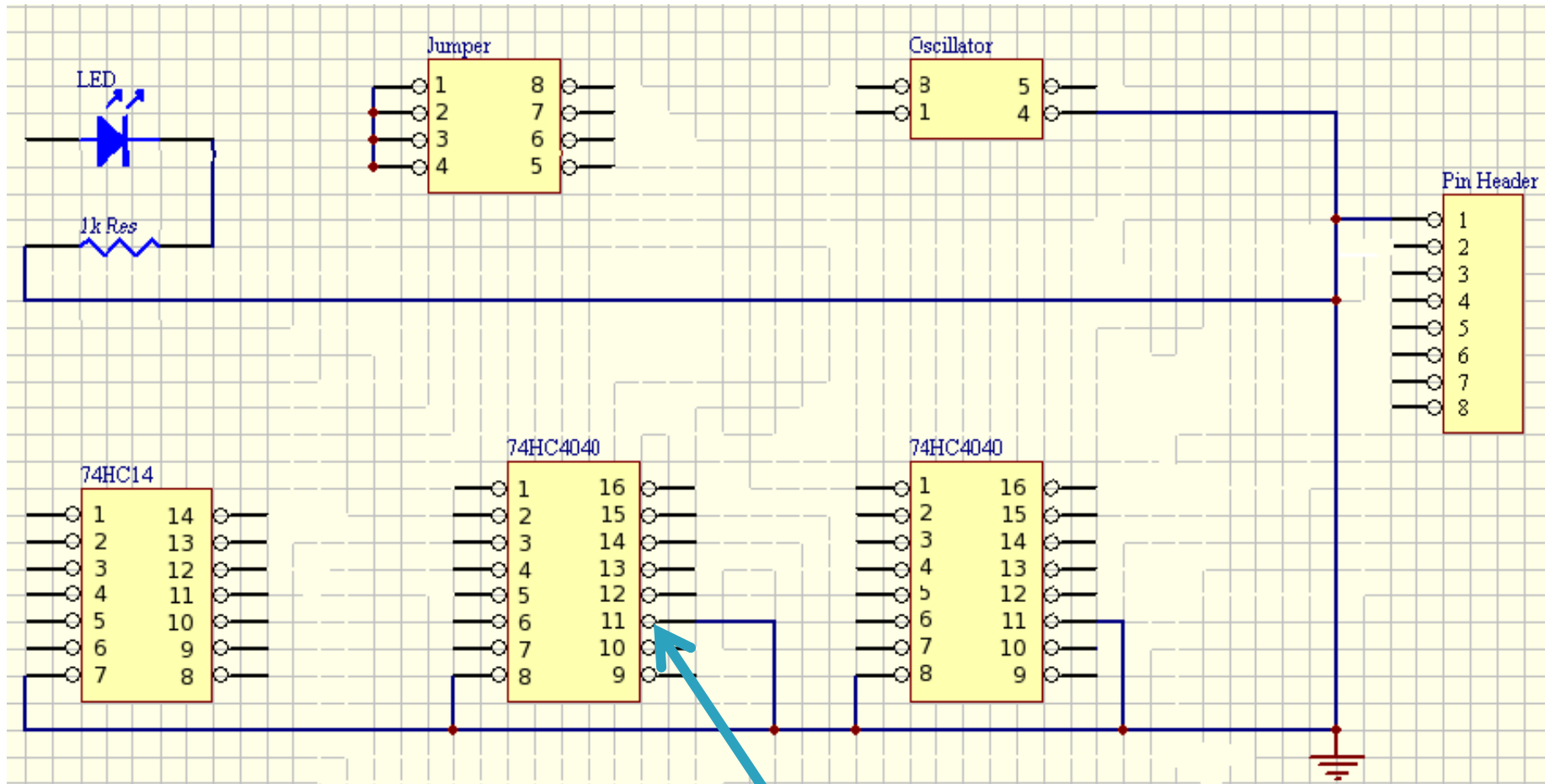




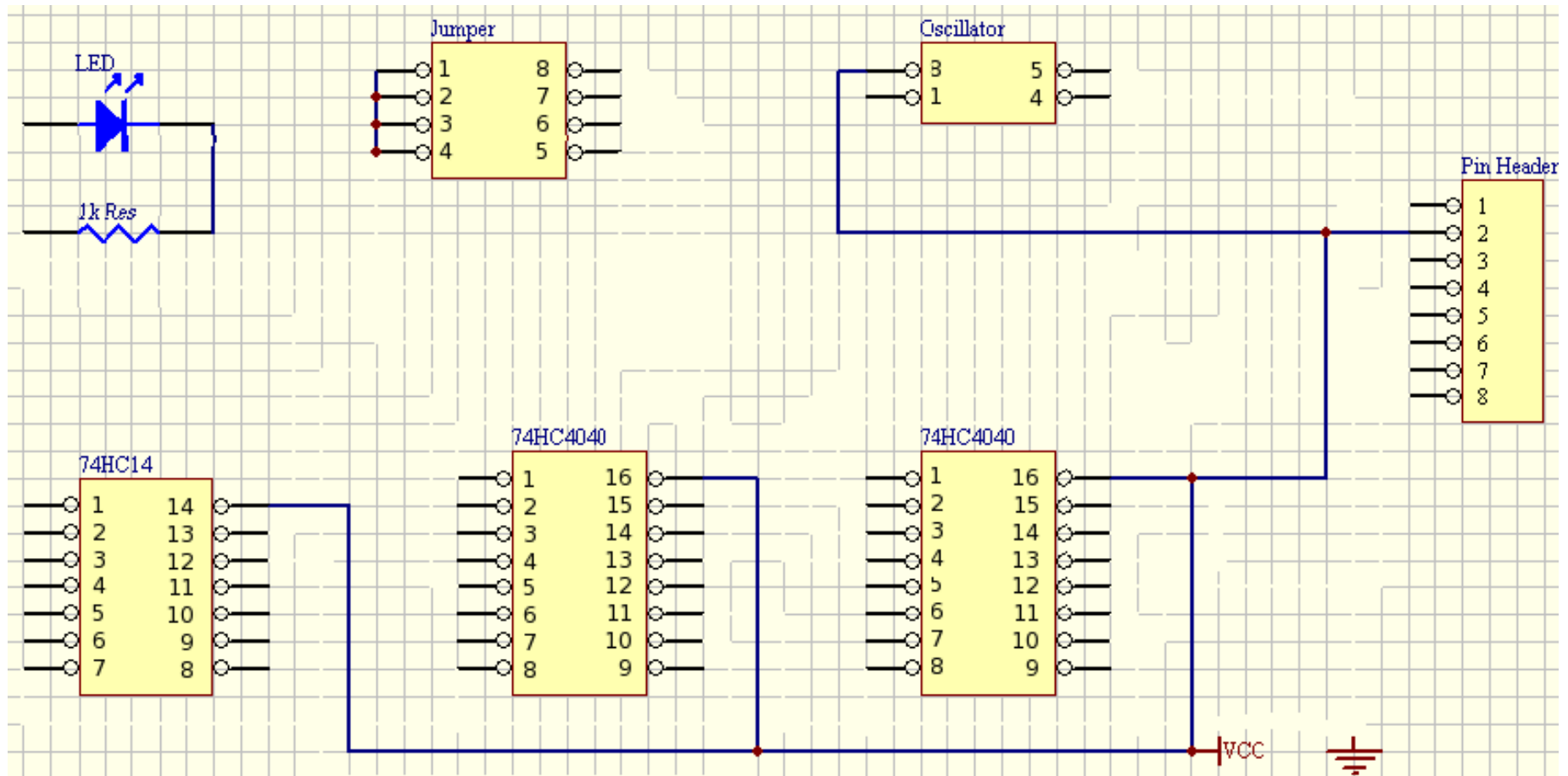
# Wiring Diagram:



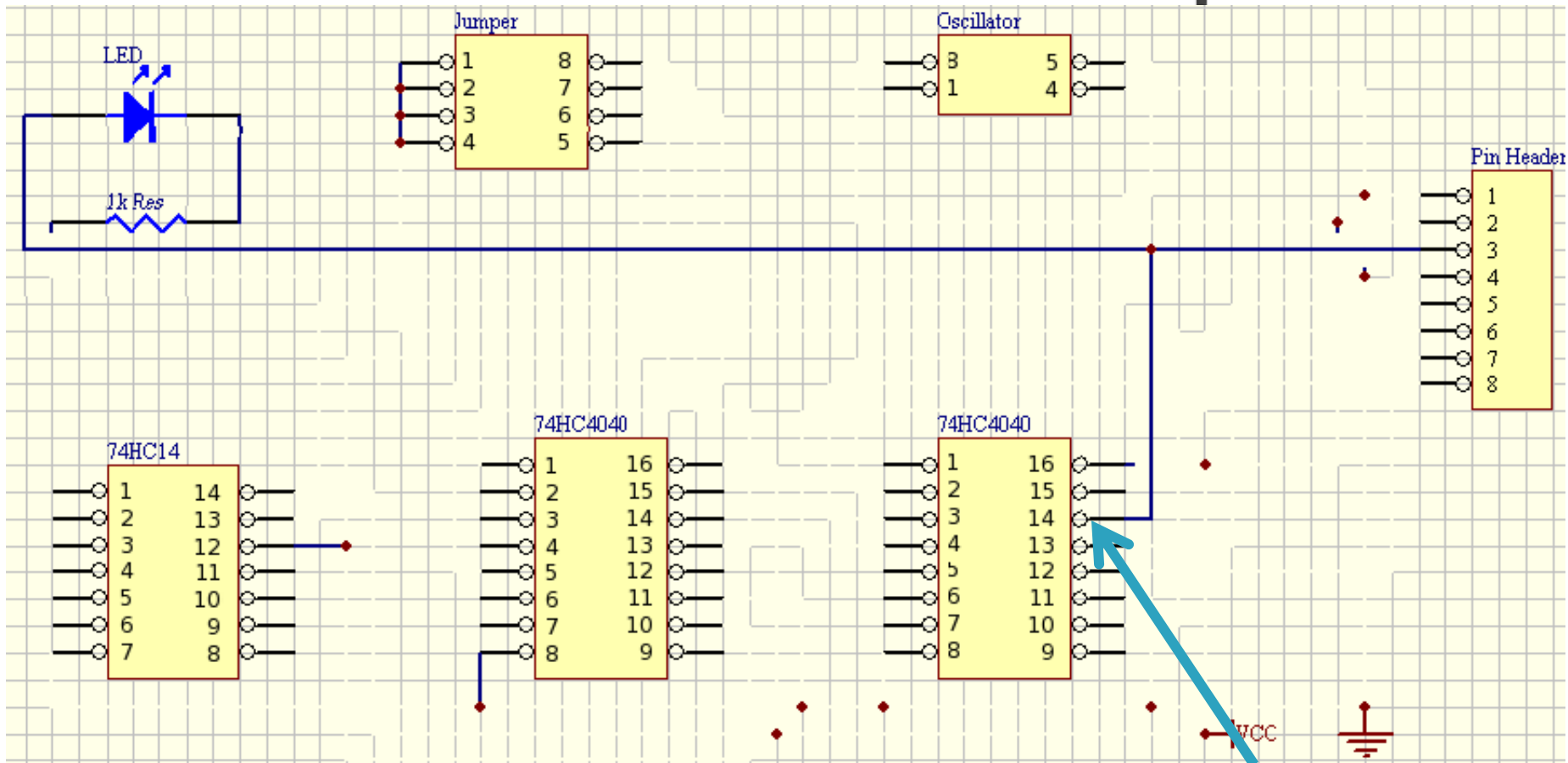
# Ground:



# VCC:



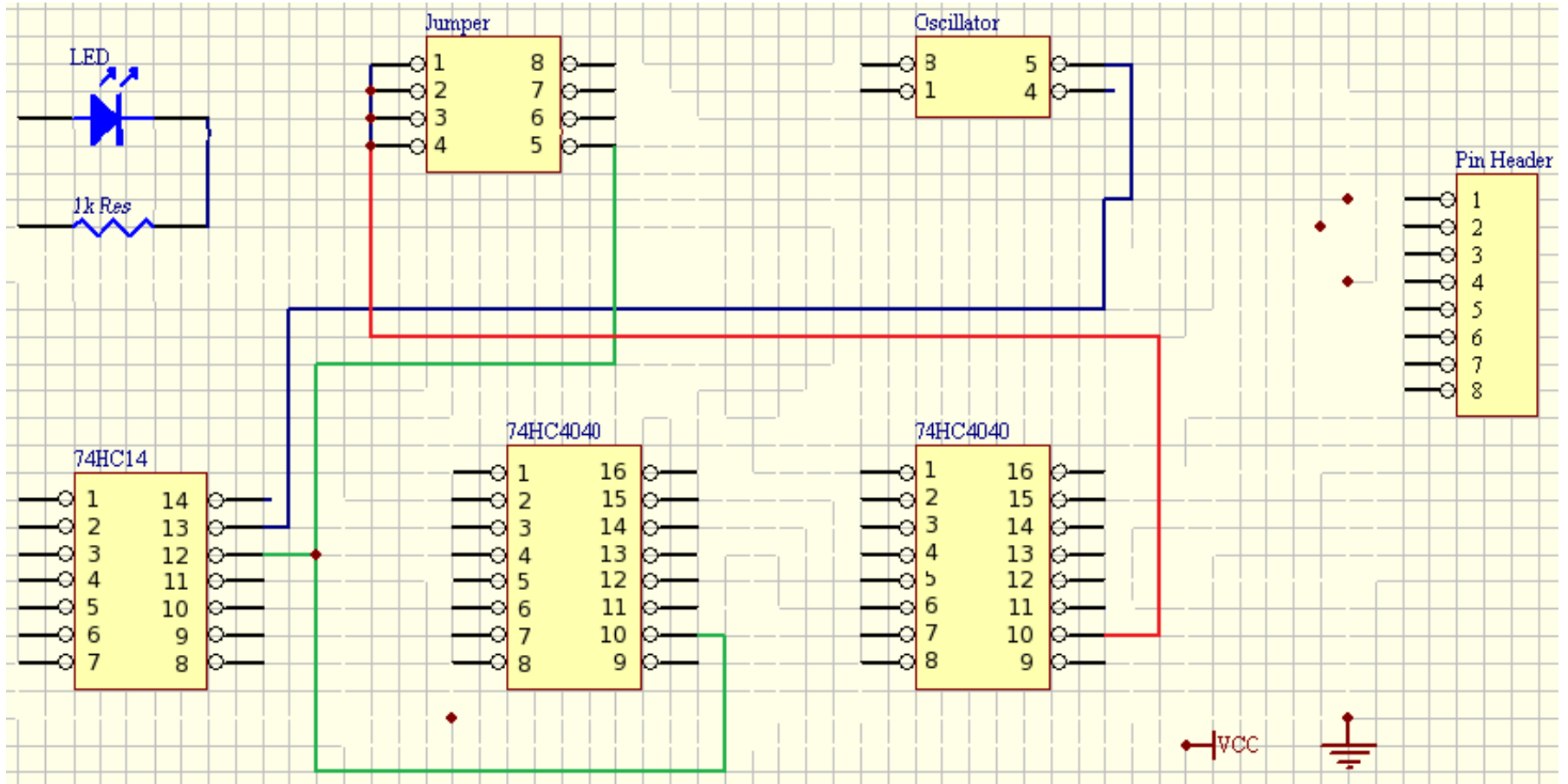
# Pin 3 - LED and Slow Output:



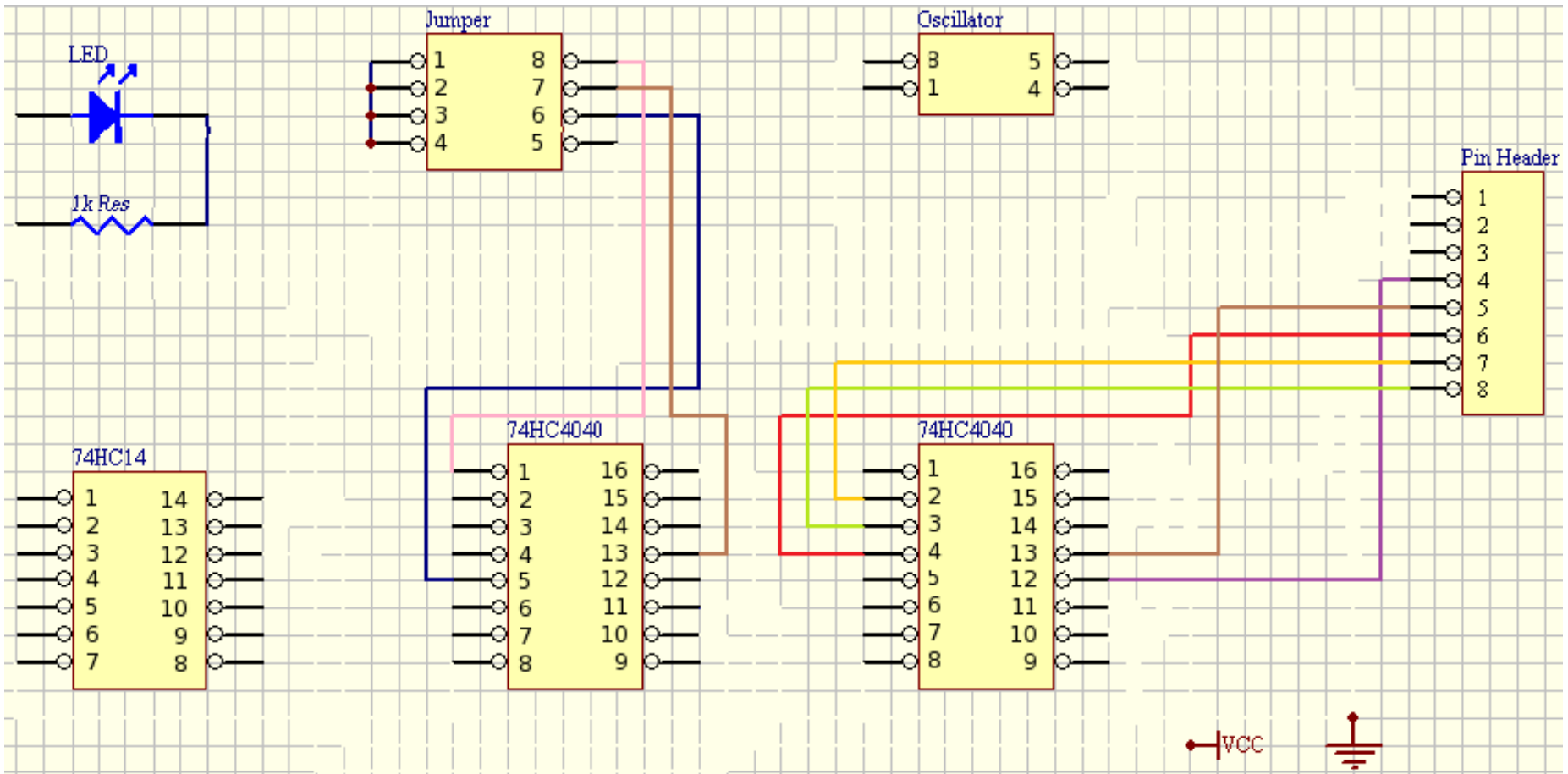
$CP / 2^{10}$

Where is the clock?

# Clock:



# Dividers:



- Blue - Q3 =  $2^4$
- Lime - Q4 =  $2^5$
- Yellow - Q5 =  $2^6$
- Red - Q6 =  $2^7$
- Brown - Q7 =  $2^8$
- Purple - Q8 =  $2^9$
- Pink - Q11 =  $2^{12}$

# Clock Rates:

- ▶ 4 jumper selected rates:
  - $2^0$  – Jumper 4–5
  - $2^4$  – Jumper 3–6
  - $2^8$  – Jumper 2–7
  - $2^{12}$  – Jumper 1–8
- ▶ 5 additional division rates per jumper:
  - $2^5$  – Pin 8
  - $2^6$  – Pin 7
  - $2^7$  – Pin 6
  - $2^8$  – Pin 5
  - $2^9$  – Pin 4
  - $2^{10}$  – Pin 3
- ▶ 20 total clock rates

# DE0-Nano

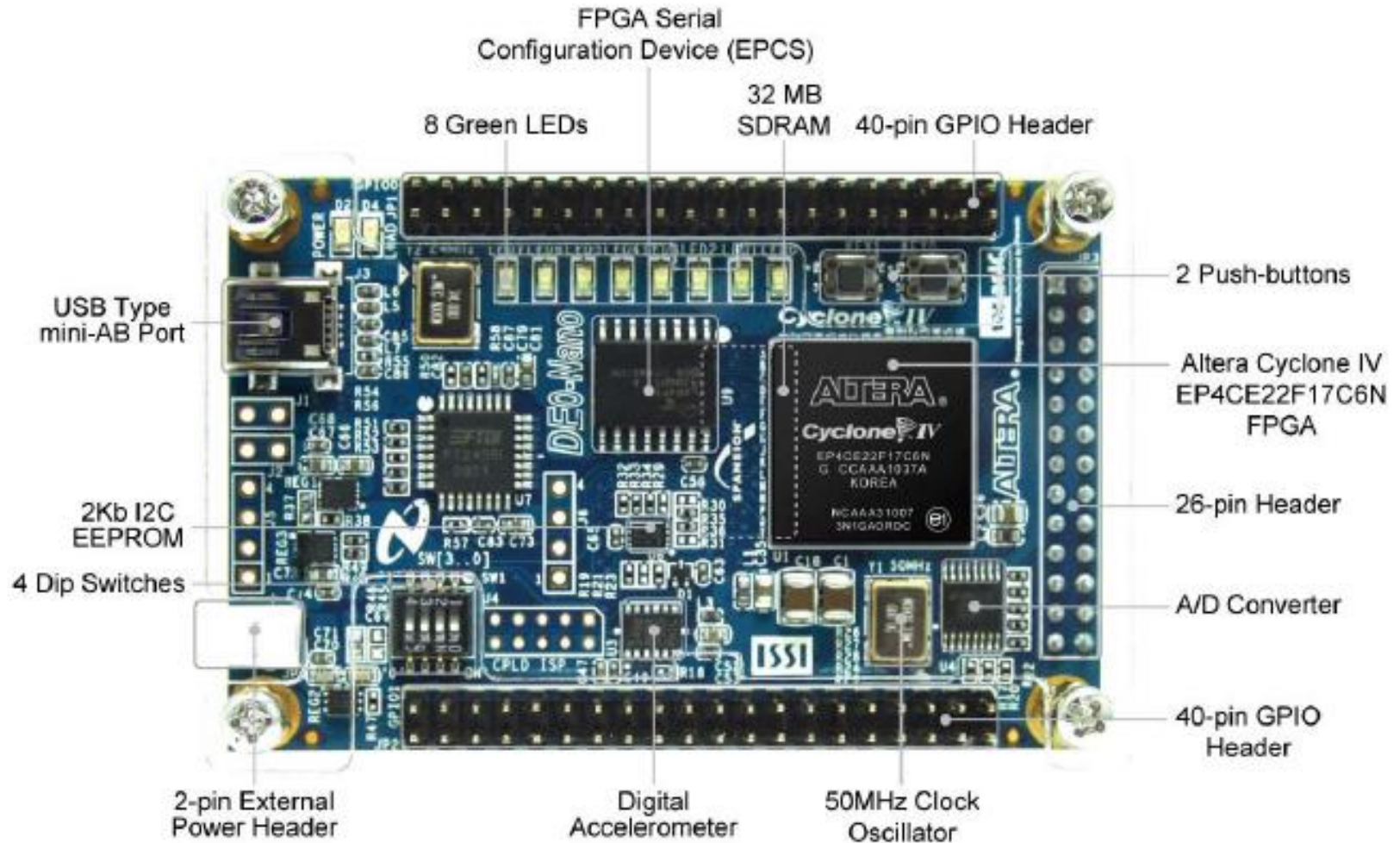
- ▶ Cyclone IV FPGA
- ▶ SDRAM
- ▶ 8 channel A/D
- ▶ 3 axis Accelerometer



Figure 1-1 The DE0-Nano Board



# DE0-Nano



# DE0-Nano

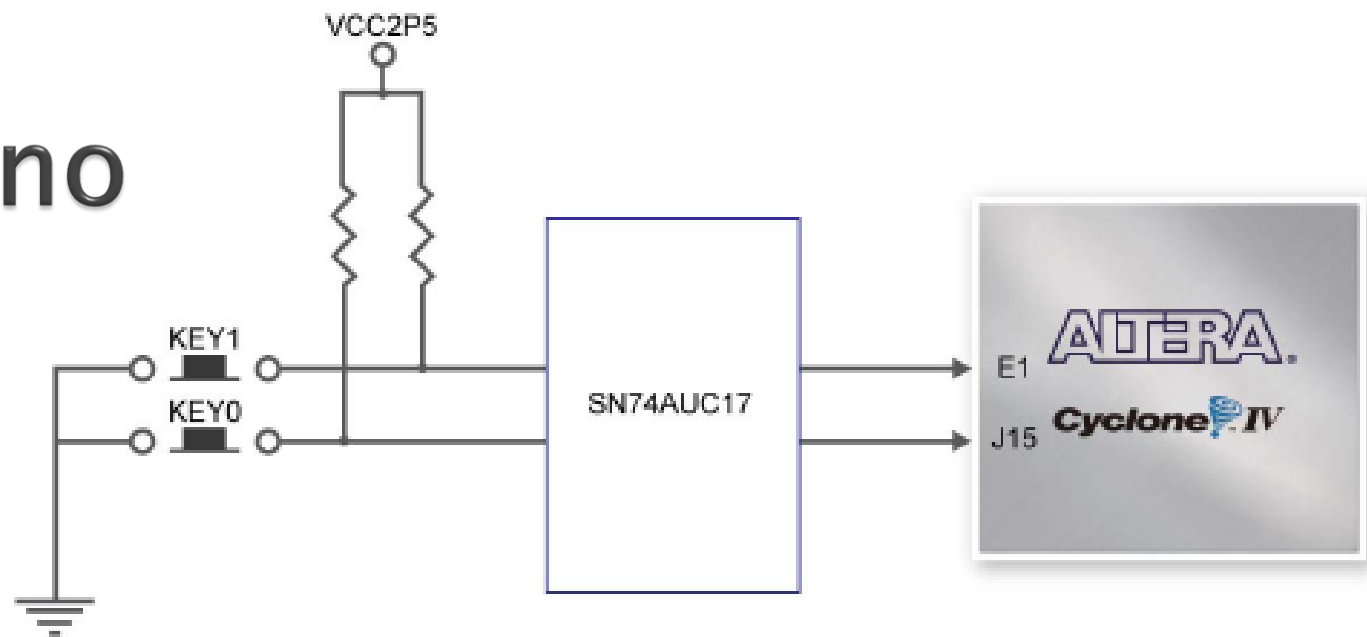


Figure 3-3 Connections between the push-buttons and Cyclone IV FPGA

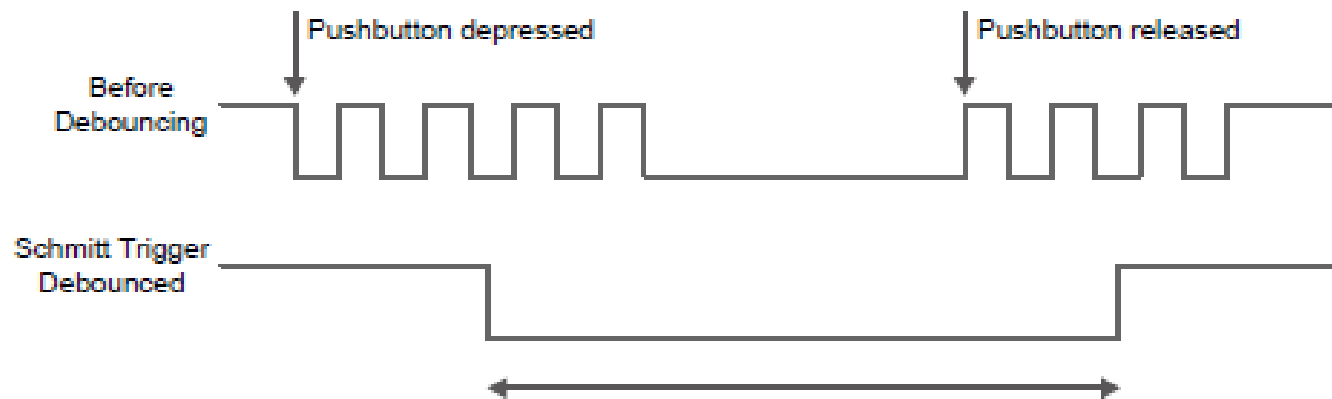


Figure 3-4 Pushbuttons debouncing

# DE0-Nano

