Review of Lab 0 & DE0–Nano Intro
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
- Pin counting is ALWAYS CCW
- Diagrams are ALWAYS top down views
74HC4040

- Q0 = clk/2^1
- Q1 = clk/2^2
- Q2 = clk/2^3
- Etc…
74HC14

- Inverting buffers with Schmitt trigger

**Table 3. Function table**

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>nA</td>
<td>nY</td>
</tr>
<tr>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>H</td>
<td>L</td>
</tr>
</tbody>
</table>

[1] H = HIGH voltage level; L = LOW voltage level.
**ENABLE TRUTH TABLE**

<table>
<thead>
<tr>
<th>PIN 1</th>
<th>PIN 5 or PIN 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logic '1'</td>
<td>Output</td>
</tr>
<tr>
<td>Open</td>
<td>Output</td>
</tr>
<tr>
<td>Logic '0'</td>
<td>High Imp.</td>
</tr>
</tbody>
</table>

**D.U.T. PIN ASSIGNMENTS**

<table>
<thead>
<tr>
<th>PIN</th>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>EOH</td>
<td>Enable Input or No Connect</td>
</tr>
<tr>
<td>7 or 4</td>
<td>GND</td>
<td>Circuit &amp; PackageGround</td>
</tr>
<tr>
<td>8 or 5</td>
<td>Output</td>
<td>RF Output</td>
</tr>
<tr>
<td>14 or 8</td>
<td>$V_{CC}$</td>
<td>Supply Voltage</td>
</tr>
</tbody>
</table>
LEDs

- Epoxy lens/case
- Wire bond
- Reflective cavity
- Semiconductor die
- Anvil Post
- Leadframe
- Flat spot
- Anode
- Cathode
Wiring Diagram:
Ground:
Pin 3 – LED and Slow Output:

CP/ $2^{10}$

Where is the clock?
Clock:
Dividers:

- **Blue**: $Q_3 = 2^4$
- **Lime**: $Q_4 = 2^5$
- **Yellow**: $Q_5 = 2^6$
- **Red**: $Q_6 = 2^7$
- **Brown**: $Q_7 = 2^8$
- **Purple**: $Q_8 = 2^9$
- **Pink**: $Q_{11} = 2^{12}$

![Diagram showing the dividers and associated components]
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

- FPGA Serial Configuration Device (EPCS)
- 32 MB SDRAM
- 40-pin GPIO Header
- 8 Green LEDs
- 2 Push-buttons
- Altera Cyclone IV EP4CE22F17C6N FPGA
- 26-pin Header
- A/D Converter
- 40-pin GPIO Header
- 2-pin External Power Header
- Digital Accelerometer
- 50MHz Clock Oscillator
- USB Type mini-AB Port
- 2Kb I2C EEPROM
- 4 Dip Switches
Figure 3-3  Connections between the push-buttons and Cyclone IV FPGA

Figure 3-4  Pushbuttons debouncing
DE0–Nano

![Image of DE0–Nano with LED connections]