20.109
Synthetic Biology Module
Lecture #3

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MIT

March 15, 2011
Commercial DNA Synthesis Foundries

Rob Carlson, University of Washington; Gerald Epstein and Anne Yu, CSIS

18 July 05. Method: Rough Google search. Thus not a thorough survey. No academic facilities.

Data Source: Rob Carlson, U of W, Seattle
www.synthesis.cc, rob@synthesis.cc
DNA synthesis & genetic circuits

DNA synthesis

![Graph showing the growth of DNA synthesis in base pairs from 1975 to 2005.]

- **Length in base pairs**
  - 1975: 207
  - 1985: 2,100
  - 1995: 2,700
  - 2005: 1,080,000

- **Year**
  - 1975
  - 1985
  - 1995
  - 2005

Synbio Pubs

![Bar graph showing the number of systems in publications from 2000 to 2008.]

- **Systems**
  - 2000: 5
  - 2001: 5
  - 2002: 5
  - 2003: 5
  - 2004: 10
  - 2005: 10
  - 2006: 5
  - 2007: 20
  - 2008: 25

*Sampling of systems in publications with experimental circuits*
DNA synthesis & genetic circuits

**DNA synthesis**

<table>
<thead>
<tr>
<th>Year</th>
<th>Length in base pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>207</td>
</tr>
<tr>
<td>1985</td>
<td>2,100</td>
</tr>
<tr>
<td>1995</td>
<td>2,700</td>
</tr>
<tr>
<td>2005</td>
<td>14,600</td>
</tr>
<tr>
<td>2005</td>
<td>1,080,000</td>
</tr>
<tr>
<td></td>
<td>583,000</td>
</tr>
<tr>
<td></td>
<td>32,000</td>
</tr>
<tr>
<td></td>
<td>7,500</td>
</tr>
</tbody>
</table>

**Circuit size**

- Max (18 months)
- Moving average (18 months)

*Sampling of systems in publications with experimental circuits*
A collection of reusable parts

SN74LS14

Schmitt Triggers
Dual Gate/Hex Inverter

The SN74LS14 comprises logic gates/inverters which accept standard TTL input signals and provide standard TTL output levels. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals. Additionally, they have greater noise margins than conventional inverters.

Each circuit contains a Schmitt trigger followed by a Darlington level shifter and a phase splitter driving a TTL type output. The Schmitt trigger uses positive feedback to effectively speed up slow input transitions, and provide different input threshold voltages for positive and negative-going transitions. This hysteresis between the positive-going and negative-going input thresholds (typically 800 mV) is determined internally by resistor ratios and is essentially insensitive to temperature and supply voltage variations.

LOGIC AND CONNECTION DIAGRAMS

GUARANTEED OPERATING RANGES

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vcc</td>
<td>Supply voltage</td>
<td>4.70</td>
<td>5.0</td>
<td>5.25</td>
<td>V</td>
</tr>
<tr>
<td>T</td>
<td>Operating Ambient Temperature Range</td>
<td>0</td>
<td>0.0</td>
<td>70</td>
<td>°C</td>
</tr>
<tr>
<td>Ioh</td>
<td>Output Current = High</td>
<td>&gt;0.8</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Iol</td>
<td>Output Current = Low</td>
<td>5.0</td>
<td>mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Package</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN74LS14</td>
<td>14 Pin DIP</td>
<td>2000 Units/Box</td>
</tr>
<tr>
<td>SN74LS14D</td>
<td>14 Pin</td>
<td>1000 Tape &amp; Reel</td>
</tr>
</tbody>
</table>

© Semiconductor Components Industries, LLC, 1999
December, 1999 – Rev. 0
Publication Order number: SN74LS14D
The Registry of Standard Biological Parts has moved from parts.mit.edu to partsregistry.org. References to the Registry at parts.mit.edu will be automatically redirected to the new site.

Registry News

- We are considering releasing the Registry's DNA Repository and Library system to the Registry labs and iGEM teams. This is the system we use to keep track of parts in our freezer boxes and plates. Please check it out and let us know what you think. - June 2, 2008
- A bug that kept Internet Explorer users from seeing the Part menu on Part pages has been fixed. Now, if you go to a part, you will see menu choices for hard information and physical location. - June 2, 2008
- The sequence and features for all parts are available through DAS, the Distributed Annotation System. Learn more here - May 26, 2008
- Changes to the Registry software are underway. Check it out!
- We have a new tutorial for starting teams in the Help section
- We are starting an editorial board for promoting well-defined and useful parts to BioBrick™ part status. To join this effort check the BioBrick™ Part Program
- There is a problem with using primers VR and VF2 to PCR parts containing B0015 or B0010.
- News archive...

Report any bugs here | Request new features here | See new features here | See old bugs, requests, and features here
Part Types

Browse parts by projects:

iGEM 2007 | iGEM 2006 | iGEM 2005 | Labs | Courses | Featured Parts

Or browse parts by part categories:

**Systems**
- Measurement
- Measurement (Under Development)
- Projects (empty)

**Devices**
- Reporters
- Inverters
- Signalling

**Chassis**
- E.coli Strains
- Cell-Free Systems

**Mammalian**

**Vectors**
- Plasmids

**Other**
- Yeast Parts

**A:B** Construction Intermediate

**Parts**
- Ribosome Binding Sites
- Protein Coding
- Regulatory
- Terminators
- RNA
- Conjugation
- DNA

- For more information on each part type, click the ? for help documentation next to the category name.
- To discuss how to measure the functions of these parts visit Characterization of Parts
System elements:
Lambda repressor (cI)
Bacteriophage $\lambda$
Lysis/Lysogeny
$P_R$ and $P_{RM}$ Promoters
The Promoters

Table 2.3. Lambda promoter sequences compared with the consensus promoter. The differences are shown in red.

<table>
<thead>
<tr>
<th></th>
<th>-35</th>
<th>-10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consensus</td>
<td>T T G A C A</td>
<td>- 17bp</td>
</tr>
<tr>
<td>$\lambda P_{RM}$</td>
<td>T A G A T A</td>
<td>- 17bp</td>
</tr>
<tr>
<td>$\lambda P_R$</td>
<td>T T G A C T</td>
<td>- 17bp</td>
</tr>
</tbody>
</table>
Repressor Positive and Negative Control
Cooperative Binding