Announcements:
- Prelab 4A → No 4B
- Midterm Qs → 15 marks/Q

Today:
- Monostable Cts
- 555 timer
- Lab 4B

Condition $V_o$

$V_i > 0, V_+ > V_- \rightarrow +10V$
$V_i < 0, V_+ < V_- \rightarrow -10V$

Amplifiers
$V_{CC} = 10\,V, V_{EE} = -10\,V$

Non-inv amp
$G_T = 1 + \frac{9}{1} = 10$

Schmitt trigger

Condition $V_o$

$V_+ \geq V_i \rightarrow 10\,V$
$V_+ < V_i \rightarrow -10\,V$

$V_+ = \frac{1k}{9k+1k} V_i = 0.1V_o$

$V_+ = \frac{1}{2}(10) = 1V,\ V_+ > V_i$
$V_+ = \frac{1}{2}(-10) = -1V,\ V_+ < V_i$
**Amp:**

max limit b/c
opamp max is $V_o = V_{cc}$

**Schmidt Trig:**

initially $V_i = -2$

$V_t = +1$ or $-1$

but $V_i < V_t \Rightarrow V_o = +10$

if $V_o = +10 \Rightarrow V_t = +1$

at 4 $V_i > V_t$, so $V_o = +10$

$\Rightarrow V_t = 1$

- Schmidt trigger solves multiple transition if
range $V_i <$ range $V_t$.

**LPF** - linear cct

- super position

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Short delay

LPF output
Filters

1-pole filter \( v_i \quad \frac{\text{passive}}{\tau} \quad v_o \)

2-pole filter \( v_i \quad \tau \quad v_o \)

So, we approx. \( N^{th} \) order filter (has \( \tau_N = \frac{\tau}{N} \))

Monostable Circuits

Def. Circuit active for time \( T \) after triggered

555 Timer:

<table>
<thead>
<tr>
<th>GND</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>Vcc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trigger</td>
<td>Ground</td>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>Discharge</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Threshold</td>
</tr>
<tr>
<td>Reset</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Control</td>
</tr>
</tbody>
</table>

Set to HI (inactive)
Bar means active low

If not reset circuit Pin4 = high
SR flip-flop → Single-bit memory

Input

<table>
<thead>
<tr>
<th>Set</th>
<th>Reset</th>
<th>Q</th>
<th>Q̅</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>retain prev. state (memory)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**Internals:**

- Trigger
- Threshold

Waveforms:
- Trigger
- S
- R
\[ V_{\infty} - V_f = (V_{\infty} - V_i) e^{-t/\tau} \]

\[ 3 - 2 = (3-o) e^{-t/\tau} \]

\[ \frac{1}{3} = e^{-t/\tau} \]

\[ t = -\tau \ln \left( \frac{1}{3} \right) \]

\[ = 1.1 \tau \]

\[ = 1.1 \text{ RC} \]

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**Lab**

\[ V_{\text{thresh}} \]

Comparator

\[ V_i \]

\[ V_{CC} \]

555

Trigger

\[ \text{trigger for 555} \]

\[ V_{CC} \]

\[ \text{use Diode} \]

\[ \text{HPF} \]

How to set threshold:

\[ \text{Potentiometer} \]