Lecture 9
Pulse Generation

- **Pulsout**
  - Software version of pulse generation
  - Pulsout pin, Period
    - Pin: specified I/O pin from 0 to 15
    - Period: $2\mu\text{sec}$ per each unit

- **555 Timer**
  - Hardware version of pulse generation
  - BS2 can do other works
  - Microcontroller is not necessary
555 Timer

- Highly stable devices for generating accurate time delay or oscillation
- Not programmable
- Controlled by resistors and capacitors
- Applications
  - Pulse generation
  - PWM
  - Time delay generation
555 Timer Block Diagram
Connection Diagram

Identifier
555 Timer without BS2

Connect to P1
555 Timer with BS2
Astable Operation 1
Calculation of Duty Cycle

\[ t_{low} = 0.693 \ R_2 C \]
\[ t_{high} = 0.693 \ (R_1 + R_2) C \]

Duty cycle \[=\frac{t_{high}}{t_{high} + t_{low}}\]

\[ f = \frac{1}{t_{high} + t_{low}} \]
Calculation of Duty Cycle

\[ t_{low} = 0.693(20K)(680nF) = 9.6ms \]
\[ t_{high} = 0.693(10K + 20K)(680nF) = 14.1ms \]

\[
\text{Duty cycle} = \frac{14.1ms}{14.1ms + 9.6ms} = 0.6
\]

\[
f = \frac{1}{14.1ms + 9.6ms} = 42Hz
\]
Astable Operation 2

Frequency vs. $C$, $R_1$, and $R_2$

- $1k\Omega$ 
- $10k\Omega$ 
- $100k\Omega$ 
- $1M\Omega$

- $1k\Omega$ 
- $10k\Omega$ 
- $100k\Omega$ 
- $1M\Omega$
Applications 1

- It will sound an alarm if it gets too dark all over sudden
- The LDR enables the alarm when light falls below a certain level

![Dark Detector Circuit Diagram](image)
Applications 2

- This circuit can be used as a audible 'Power-out Alarm'
- When the line voltage fails, the tone will be heard in the speaker
Applications 3

- Actually really a alarm circuit, it shows how to use a 555 timer and a small glass-encapsulated mercury switch to indicate 'tilt'.
Applications 4

- A Metronome is a device used in the music industry.
- It indicates the rhythm by a 'tic-toc' sound which speed can be adjusted with the 250K potentiometer.
# 555 Timer Experiments

<table>
<thead>
<tr>
<th>Experiments</th>
<th>Chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>What’s micro controller</td>
<td>5</td>
</tr>
<tr>
<td>Basic A and D</td>
<td>6</td>
</tr>
<tr>
<td>Earth measurements</td>
<td></td>
</tr>
<tr>
<td>Robotics</td>
<td></td>
</tr>
<tr>
<td>StampWorks</td>
<td>17 and 18</td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>
DS1620

- Digital thermometer
  - Provides 9-bit temperature readings
  - Temperature range from -55°C to 125°C
  - Acts as a thermostat
## Detail Description

<table>
<thead>
<tr>
<th>PIN</th>
<th>SYMBOL</th>
<th>DESCRIPTION</th>
</tr>
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<tr>
<td>1</td>
<td><strong>DQ</strong></td>
<td><strong>Data Input/Output pin</strong> for 3-wire communication port.</td>
</tr>
<tr>
<td>2</td>
<td><strong>CLK/CONV</strong></td>
<td><strong>Clock input pin</strong> for 3-wire communication port. When the DS1620 is used in a stand-alone application with no 3–wire port, this pin can be used as a convert pin. Temperature conversion will begin on the falling edge of <strong>CONV</strong>.</td>
</tr>
<tr>
<td>3</td>
<td><strong>RST</strong></td>
<td><strong>Reset input pin</strong> for 3-wire communication port.</td>
</tr>
<tr>
<td>4</td>
<td><strong>GND</strong></td>
<td>Ground pin.</td>
</tr>
<tr>
<td>5</td>
<td><strong>T&lt;sub&gt;COM&lt;/sub&gt;</strong></td>
<td><strong>High/Low Combination Trigger.</strong> Goes high when temperature exceeds TH; will reset to low when temperature falls below TL.</td>
</tr>
<tr>
<td>6</td>
<td><strong>T&lt;sub&gt;LOW&lt;/sub&gt;</strong></td>
<td><strong>Low Temperature Trigger.</strong> Goes high when temperature falls below TL.</td>
</tr>
<tr>
<td>7</td>
<td><strong>T&lt;sub&gt;HIGH&lt;/sub&gt;</strong></td>
<td><strong>High Temperature Trigger.</strong> Goes high when temperature exceeds TH.</td>
</tr>
<tr>
<td>8</td>
<td><strong>V&lt;sub&gt;DD&lt;/sub&gt;</strong></td>
<td><strong>Supply Voltage.</strong> 2.7V – 5.5V input power pin.</td>
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DS1620 with BS2
Programming for DS1620

- Low 13 ✠ Waiting state of DS1620
- High 13 ✠ Ready to start
- Shiftout 15,14,lsbfirst,[12,2]
- Low 13
- End ✠ Two bytes from BS2 to DS1620
- Least significant bit is sent first
- Clock
- Sending the data bytes to P15
Programming for DS1620 2

high 13 ← – – – – – – – – – Ready to start
Shiftout 15,14,lsbfirst,[238] ← – – – Start conversion
low 13

Temploop:
high 13
shiftout 15,14,lsbfirst,[170] ← – – Send “get data” command
shiftin 15,14,lsbpre,[x] ← – – – Get the data
low 13
degC=x/2
Goto Temploop
AD592

- Analog temperature sensor
  - Provides an output current proportional to absolute temperature
  - Temperature range from -25°C to 105°C
  - Acts as a thermostat
  - Extended out away from the recording instruments
Temperature Probe with AD592

- The part needs to be protected before being inserted into liquid
How to Make Temperature Probe 1

1. Identify the AD 592’s (-), NC, and (+) pins from this picture as viewed from the bottom
2. Slip the solder sleeve over the black wire and pin 3 (-)
3. Slip another solder sleeve over the red wire and pin 1 (+)
4. Heat up the connections until the wires are joined
How to Make Temperature Probe 2

5. Slip the heat shrink tubing over the entire package

6. Fasten the package with a heat gun, and while it’s still hot clamp the top portion to ensure that it stays shut
AD592 with BS2
Caution!!

- Be careful when you put your finger on it
- Specially for a big finger
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*Use 2 wires for Simple Resistance Detector with proper resistor and capacitor*