Introduction to Electronics

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6:30-9 PM
Today we'll be covering:

• Voltage
• Current
• Simple electrical components
• Circuit diagrams
• Simple circuits and designs
• Useful applications
Electricity: Voltage and Current

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Voltage Sources

- Supply a constant voltage
- Current may vary
- Output has units of Volts
Resistors

- Has a voltage drop proportional to the current across it
- Used to control current and voltage
- Has units of Ohms
- Ohm's law: $V = I \times R$
## Resistor Values

<table>
<thead>
<tr>
<th>COLOR</th>
<th>1st BAND</th>
<th>2nd BAND</th>
<th>3rd BAND</th>
<th>MULTIPLIER</th>
<th>TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1Ω</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>10Ω</td>
<td>± 1% (F)</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>100Ω</td>
<td>± 2% (G)</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1KΩ</td>
<td></td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>10KΩ</td>
<td></td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>100KΩ</td>
<td>±0.5% (D)</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>1MΩ</td>
<td>±0.25% (C)</td>
</tr>
<tr>
<td>Violet</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>10MΩ</td>
<td>±0.10% (B)</td>
</tr>
<tr>
<td>Grey</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td></td>
<td>±0.05%</td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gold</td>
<td></td>
<td></td>
<td></td>
<td>0.1</td>
<td>± 5% (J)</td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
<td>± 10% (K)</td>
</tr>
</tbody>
</table>

### 5-Band Code
- 0.1%, 0.25%, 0.5%, 1%
- 237Ω ± 1%
LEDS

- Light Emitting Diodes
- Have a constant voltage drop
- Light is proportional to current
- Damaged by too much current
What is GND?

Voltage is always measured with respect to some zero. GND defines where zero is in the circuit.
Breadboards
Our first circuit: light an LED
Kirchhoff and his laws

The Voltage Law:

- The sum of the voltage drops around a loop is always zero

The Current Law:

- Current into a wire node is equal to the current out of the node
Your friend, the multimeter

- Voltage: place probes in parallel
- Current: place probes in series
Potentiometers

- Constant Resistance between outer leads
- Variable resistance between center lead and either outer lead.
Change the brightness
Buttons and Switches

- Single Pole/Double Throw
- These are exactly what you think they are
Capacitors

- Store voltage
- Has units of Farads
- Higher capacitance means more power can be stored
- 63% charge time is $R \times C$
Charging and Discharging

Capacitors charge and discharge asymptotically.
Fading the brightness

Diagram with circuit components labeled.
Fade in and fade out
Series Components

\[ R_t = R_1 + R_2 \]

\[ C_t = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}} \]
Parallel Components

\[ Rt = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} \]

\[ Ct = C_1 + C_2 \]
Integrated Circuits (the 555 timer)

- Adjustable oscillator
- Controlled by connecting resistors and capacitors to input pins
- Choose DIP for breadboard use
Datasheets

- Almost all components have a datasheet
- Will tell you how to use a component
- Example circuits can let you cheat
- Be sure to check:
  - Pinouts
  - Max values
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED (it works!)
Where do I go next?

- Take apart your toys
- Forrest M. Mims III
- Make magazine
- SPICE
- Make your own things:
  - Analog electronics
  - Digital logic
  - Whatever you can imagine