Introduction to Electronics

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6-9 PM
Who are we?
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From Metrix Create:Space
Today we'll be covering:

- Voltage
- Current
- Simple electrical components
- Circuit diagrams
- Simple circuits and designs
- Useful applications
Atoms and Electrons

- All matter is made up of charged particles
- When these particles interact, crazy things happen
- Positive particles (protons) are stationary
- Negative particles (electrons) can sometimes move
Electricity: Voltage and Current
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>

### 4-Band-Code
- 2%, 5%, 10%
- 560kΩ ± 5%

### 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
Placing Components

Series

Parallel
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
Fade in and fade out
Series Components

\[ Rt = R_1 + R_2 \]

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

$$R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

$$C_t = C_1 + C_2$$
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

[Diagram of an electronic circuit using an NE555 IC, with connections to ground (GND) and power (+) and a resistor (R3)]
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED
Blinking an LED

![Circuit Diagram](image)
Blinking an LED
Blinking an LED (it works!)
Where do I go next?

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