IEEE’s Hands on Practical Electronics (HOPE)

Final Project
Question
This Week

• Final Project
  – Review of diodes
  – Zener Diodes
  – What can they be used for?
Review - PN Junctions

- A PN Junction is also called a diode.
Review - Diode Usage

• Diodes are used to
  – prevent current from flowing in the wrong direction
  – prevent too much current from flowing in a direction
  – indicate if there is current flowing (LEDs)
Zener Diode

The I-V characteristic of a zener diode

- Anode
- Cathode

Diode is "off"
- Slope \( \frac{1}{R} = 0 \)
- \( R = \infty \)

Forward conduction diode is "on"
- Slope \( \frac{1}{R} = \infty \)
- \( R = 0 \)

Reverse conduction diode is "on"
- Slope \( \frac{1}{R} = \infty \)
- \( R = 0 \)
Zener Diode as Voltage Clamp

This will always stay at 5V if Vcc is large enough.
The Problem

• Many Devices Charge via USB
• Computers are not always portable

We want to create a portable charger
# The Solution

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Cable colour</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>VCC</td>
<td>Red</td>
<td>+5V</td>
</tr>
<tr>
<td>2</td>
<td>D−</td>
<td>White</td>
<td>Data −</td>
</tr>
<tr>
<td>3</td>
<td>D+</td>
<td>Green</td>
<td>Data +</td>
</tr>
<tr>
<td>4</td>
<td>GND</td>
<td>Black</td>
<td>Ground</td>
</tr>
</tbody>
</table>

## Male USB Port

![Male USB Port Diagram]
The Solution

We need a circuit that will give us 5 Volts across pins 1 and 4
THE CONSTRAINTS

1. Your circuit must fit inside a portable enclosure

2. The charger must be able to switch “on” and “off”

3. You should be able to see if your charger is “on”

4. You have the following materials: resistors, LEDs, wire, USB port, 9V battery cell, switches

5. Feel free to expand form and functionality
HINTS AND SUGGESTIONS

• Use the Voltage Clamp you learned about today to maintain 5V across pins 1 and 4 of the USB port

• Too much current through the LED will burn it out. How do we limit the current flowing through the LED?

• Every resistor and LED in the circuit will have a voltage drop across it. Make sure this does not compromise your circuit.

• The Altoids enclosure is a conductor. What happens if your circuit touches the tin?