Welcome

Soldering Training 2021

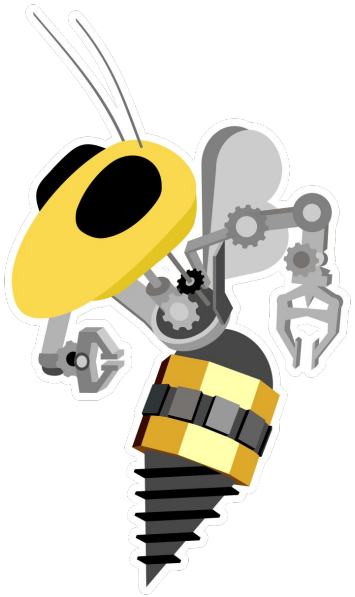
RoboJackets

Competitive Robotics at Georgia Tech

www.robojackets.org

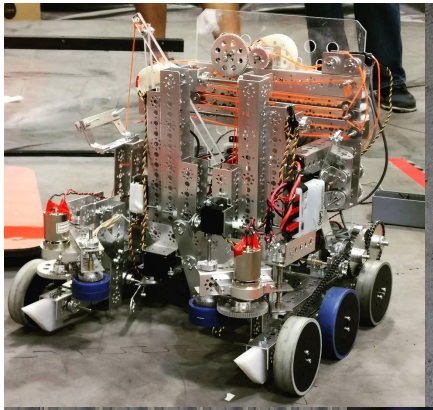
Agenda

- Introduction
- Board overview - what are we soldering?
- How to Solder
  - Basics
  - Tools
  - Component Types
- Soldering Instructions
- Debugging



Introduction

What is RoboJackets?

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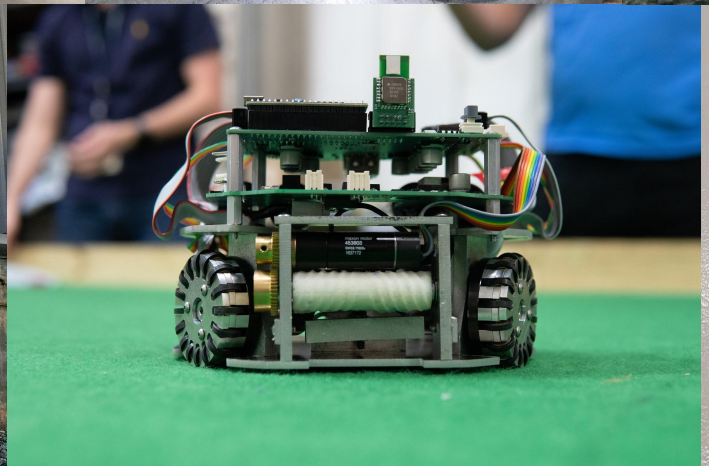


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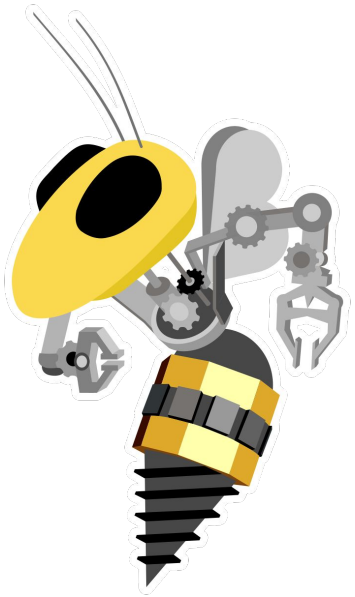
RoboJackets Electrical

- Embedded System Design
  - Printed Circuit Board design
    - Analog and Digital Circuitry
  - Microcontroller firmware programming
  - Control systems
- A bunch of other cool stuff!



Training Board Overview

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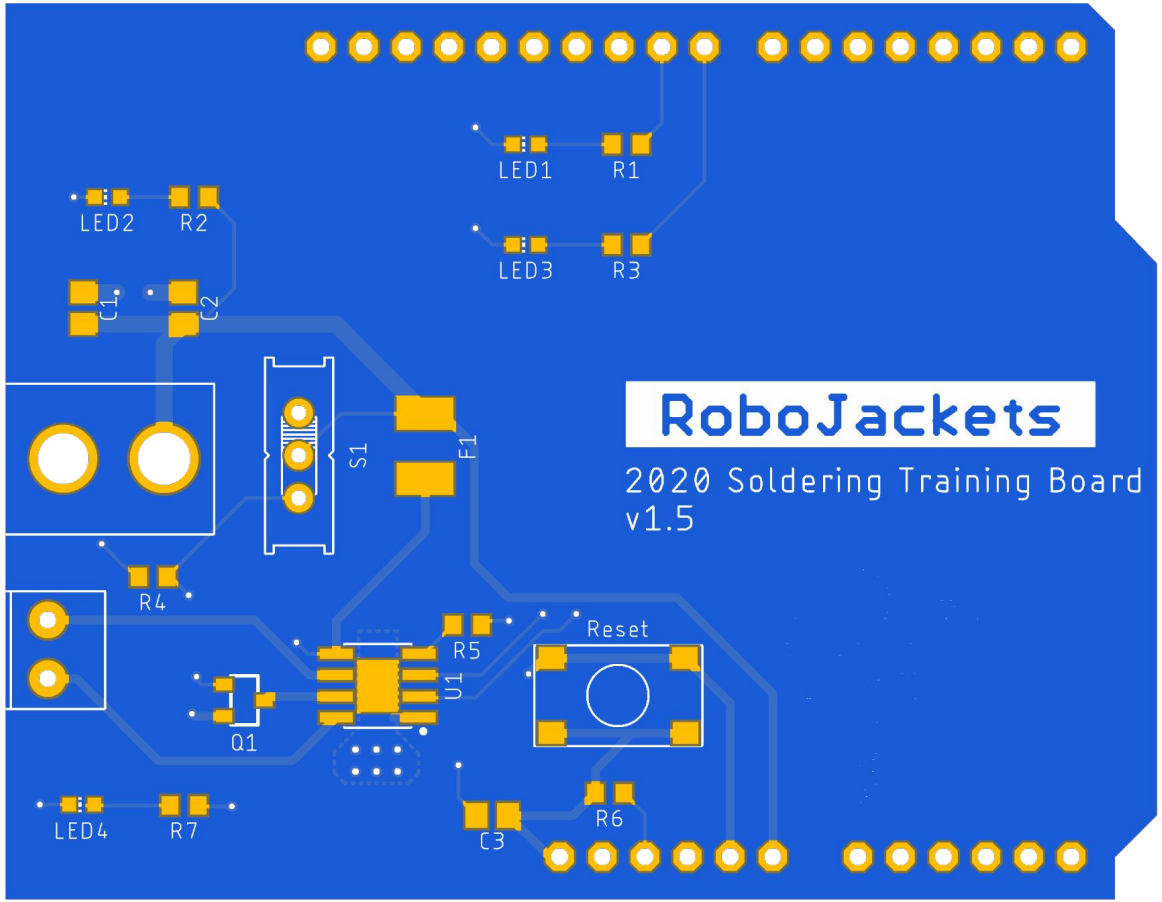
The Board

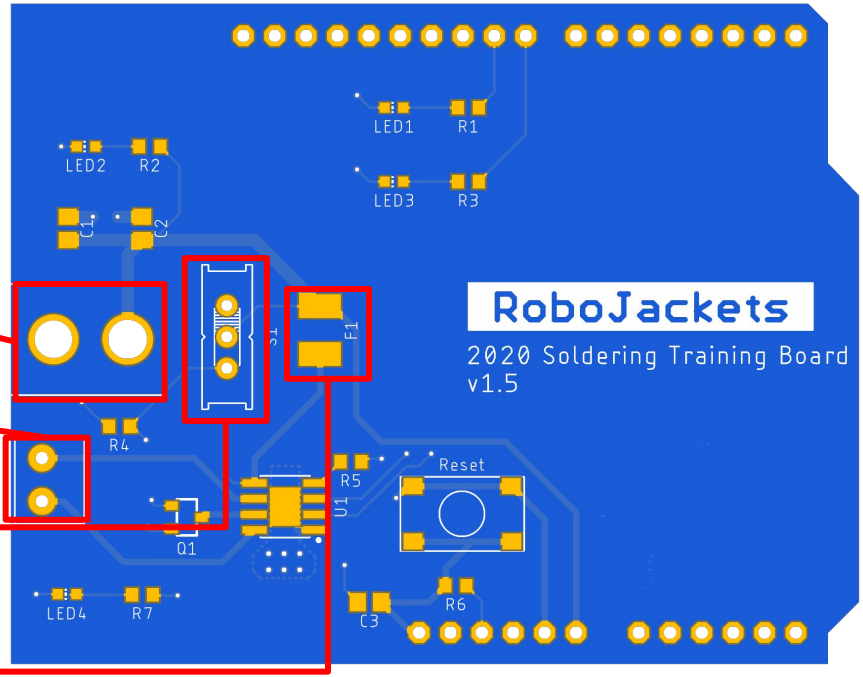


Purpose

- Control a brushed DC motors using an Arduino Uno
  - Motor Driver chips controlled with logic/PWM signals from Arduino
- Source power from 12V DC Barrel Jack

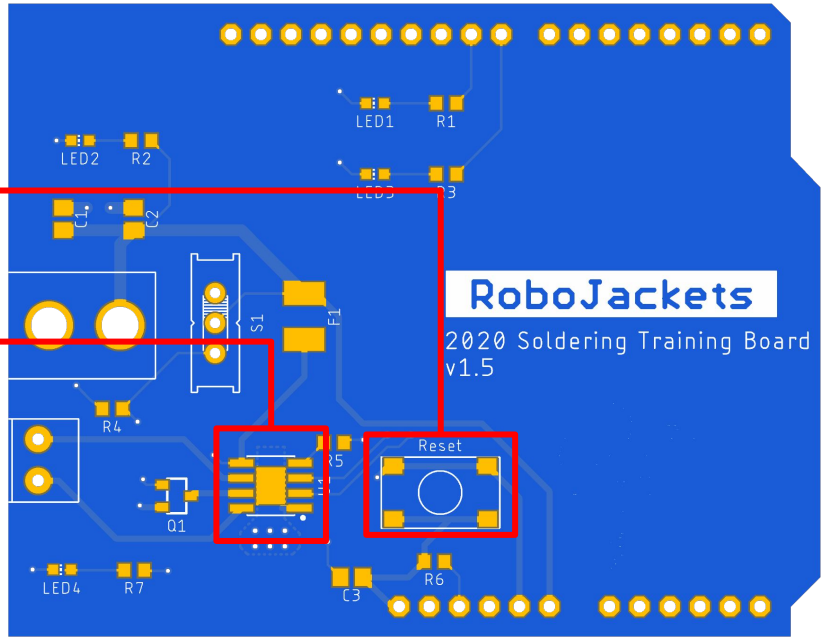
Components

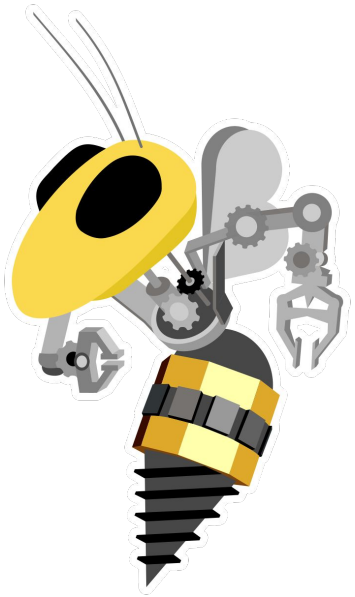
- DC Barrel Jack
  - Source power
- Screw Terminal
  - To attach motor wires
- Power Switch
  - Turn motor on or off
- Fuse
  - Overcurrent protection



Components

- Reset Button
  - Reboots Microcontroller
- Motor Driver
  - Converts logic signals to motor power
- Indication LEDs
  - Visually indicate power, fuse, and status of system





Soldering

I suppose this is what you actually came here for...

Safety

- Hold like a pencil from plastic grip area
- Entire metal gets hot (not just the tip!)
- Make sure iron is in holder when not in use

Supplies

Solder

Metal that is melted to form joints

Sponge

For cleaning iron tip

Flux

Helps solder to flow more easily

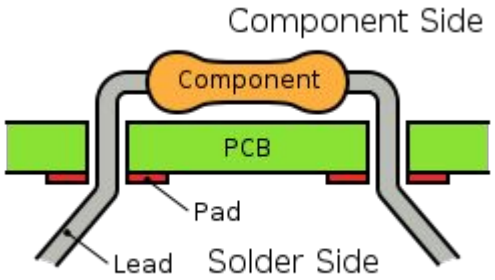
Supplies

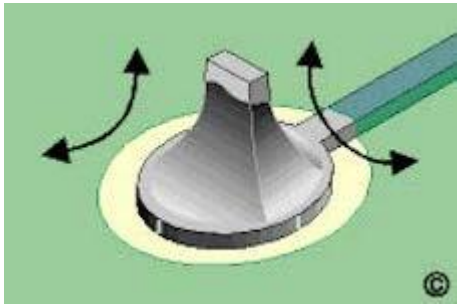
Iron Tips - Choose based on desired precision and heat transfer capability

Supplies

- Exhaust Fan
  - Keep solder fumes out of your lungs
- Desoldering Wick
  - Copper mesh to remove solder
- Desoldering Pump
  - Sucks out undesired solder

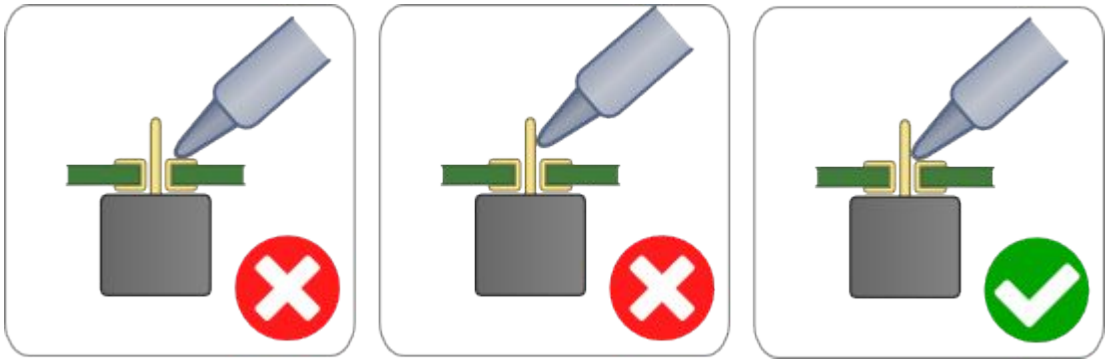
Through-Hole Soldering





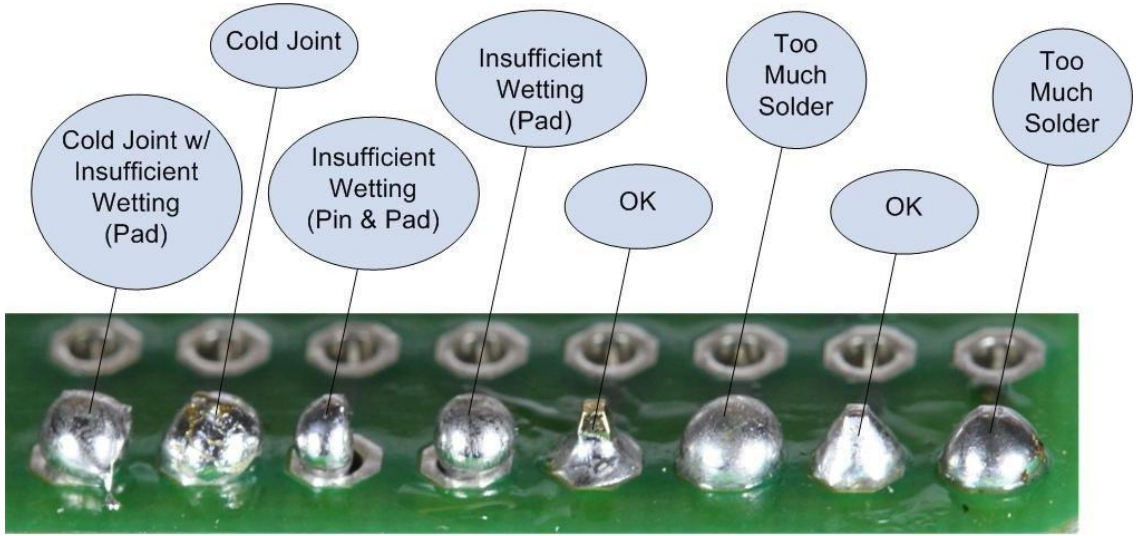
- Place pins in hole
- Touch iron to both pin and pad simultaneously
- Apply solder to pad at opposite side of iron
- Remove solder, then iron, then clip excess

Heating Technique



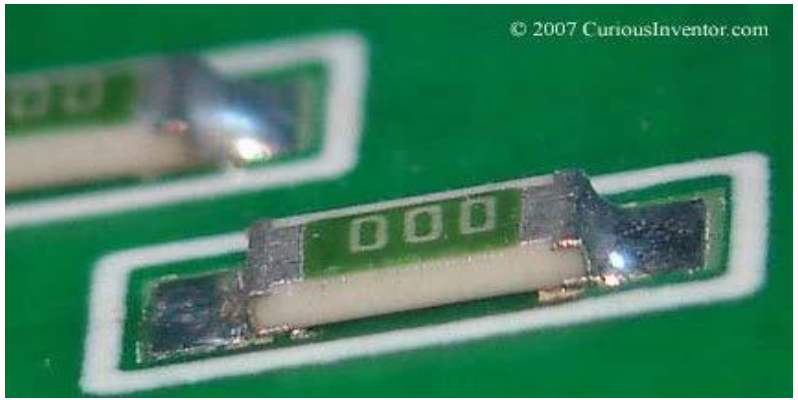
- Touch both the component and the pad at the **same time**
- Make sure to apply solder to the pad, not the iron
  - Remove solder before removing iron

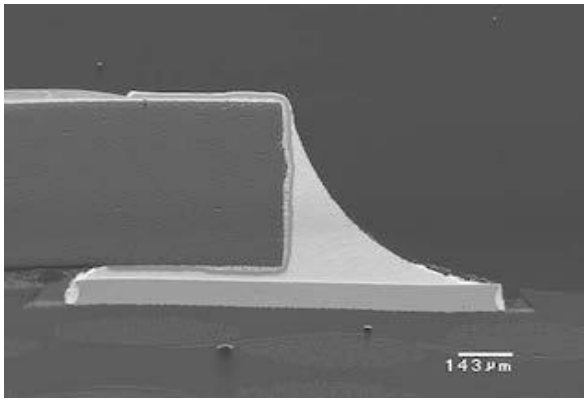
How much Solder?



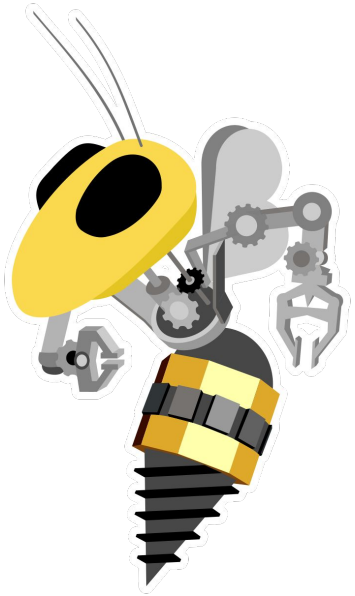
- Fully cover the pad, but don’t form a bubble

Surface Mount Components





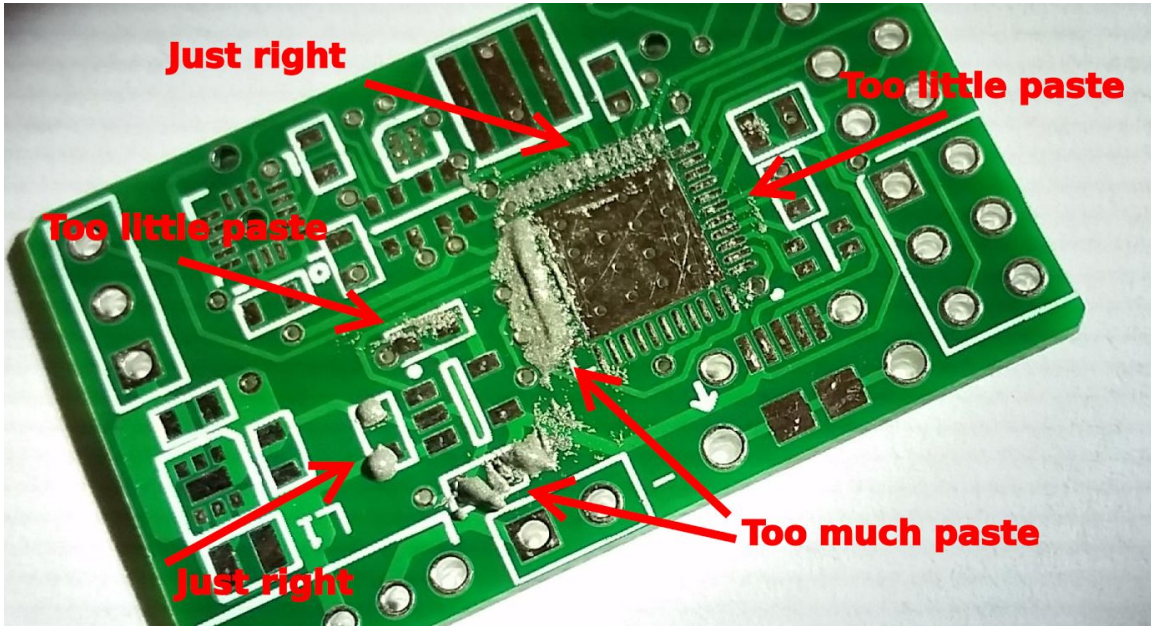
- Wet one pad with Solder
- Place component on pad and remove iron
- Solder remaining pads before reflowing first pad



Other Soldering Techniques/Tips

Hot Air Gun

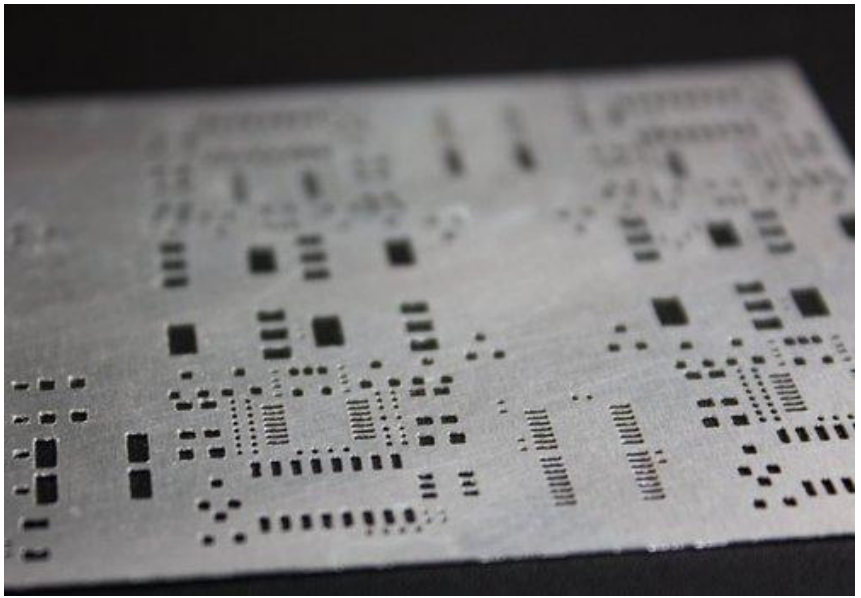
Solder Paste



Reflow Oven

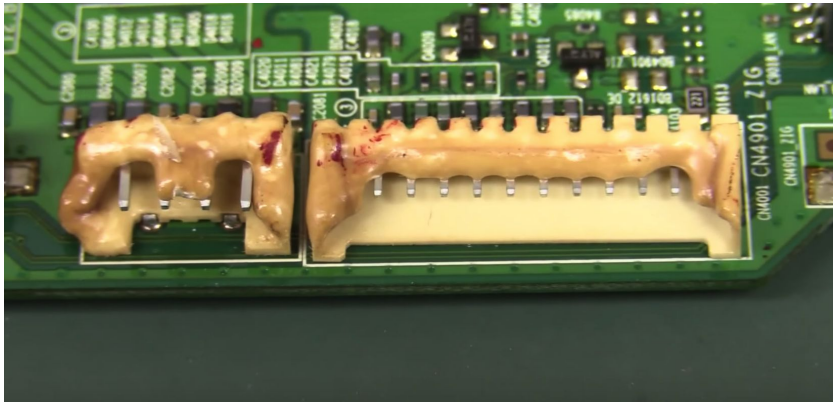
Soldering Stencil

- Apply paste using stencil
- Remove stencil and place all components
- Place circuit board in reflow oven



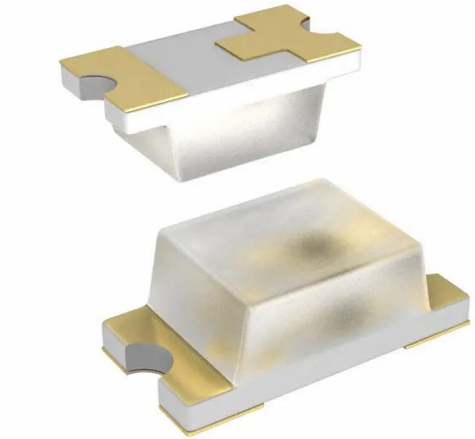
Tips

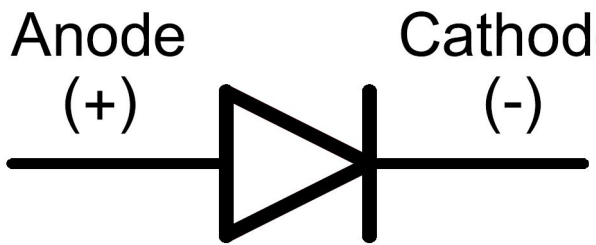
- Previously mentioned techniques heat up entire circuit board
- Some components cannot stand the heat
  - Make sure your components (especially connectors) can take the heat



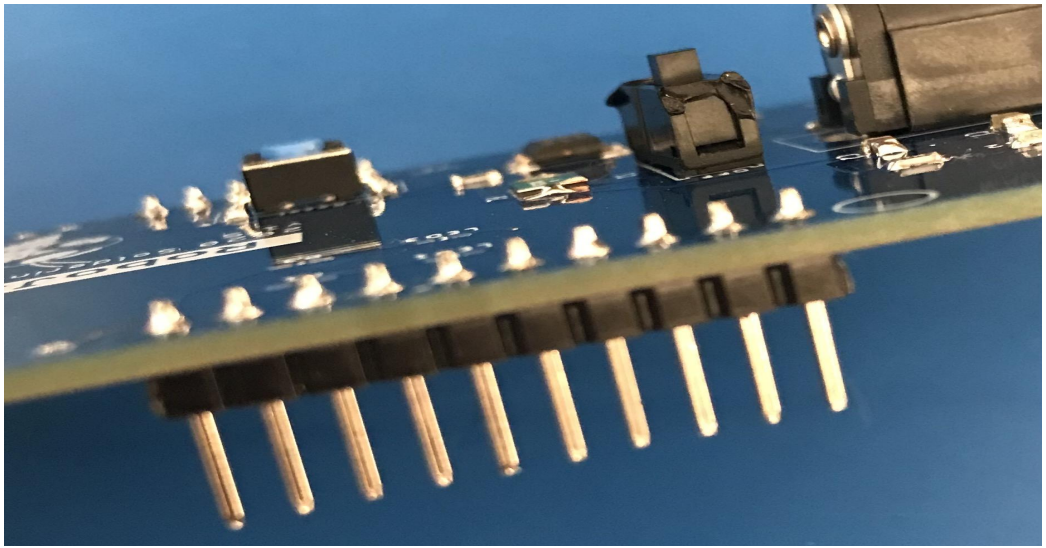
LED Direction

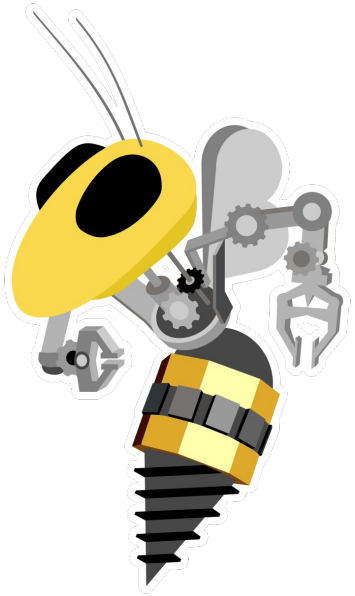
- “Arrow points towards the house”
- The “house” side is the cathode side which should be on the same side as the marking on the solder mask





Pin Direction

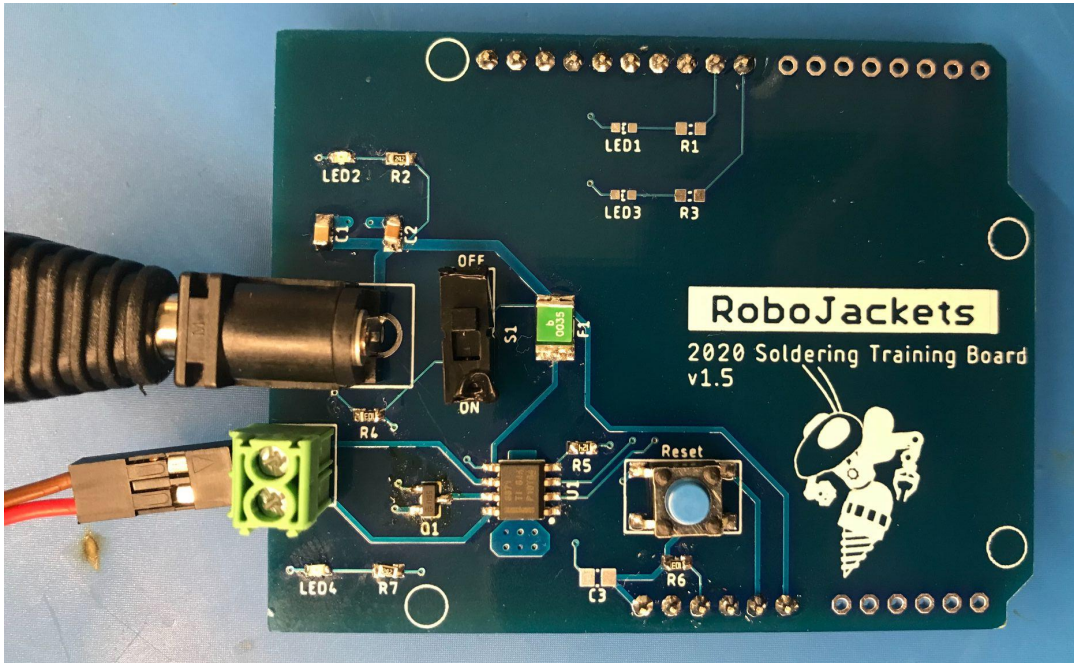


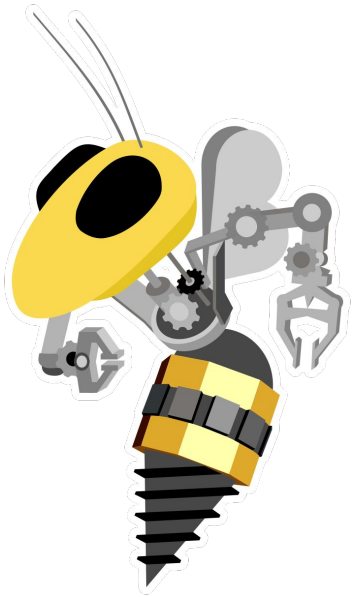


Soldering Activity!

Solder the training board

Sample Board



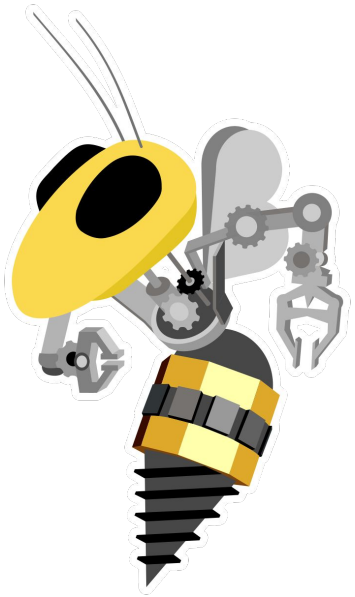


Debugging

Complex boards rarely work first time

Questions to Ask

- What is the expected behavior?
- What is the current behavior?



Getting Started

Top-Down Methodology

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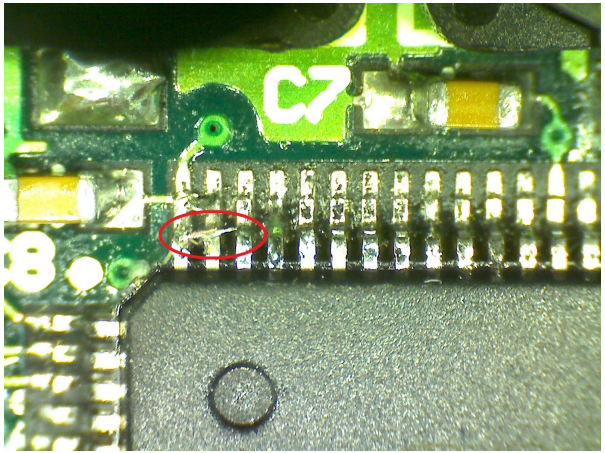
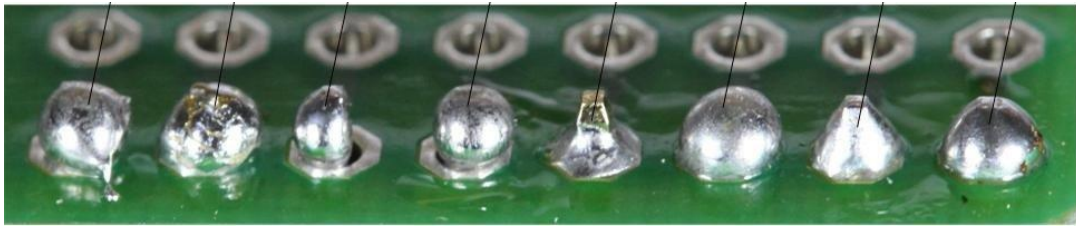
Done Soldering?

Always check for shorts!



Is there an oopsie?

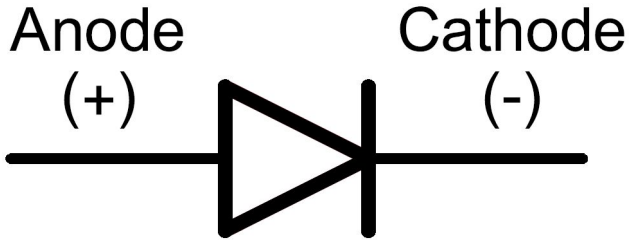


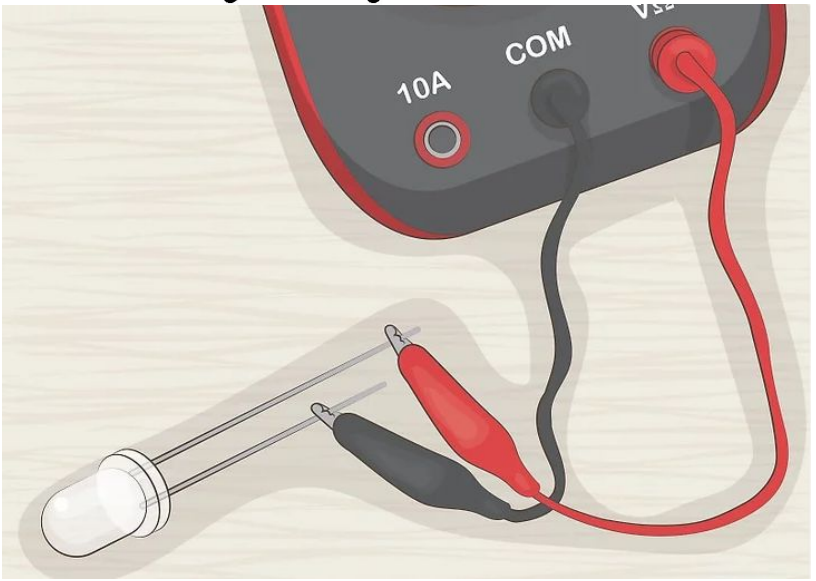
Is the power bus active?

Power LEDs can save tons of time here

But were they soldered correctly?

Continuity/Diode Mode





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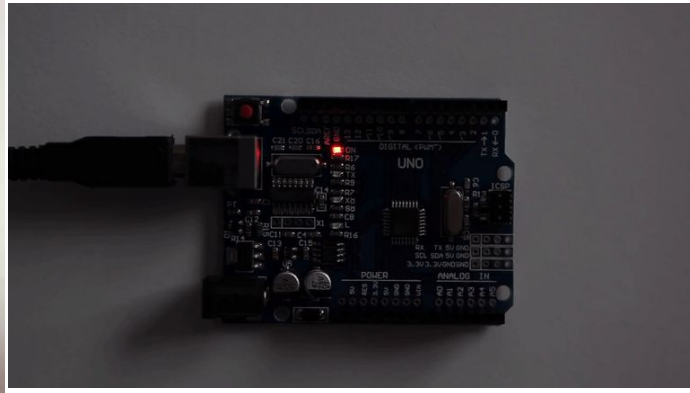
“Hello World”

Test basic code first




```
sketch_hello_world

void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);     // open the serial port at 9600 bps:

}

void loop() {
  // put your main code here, to run repeatedly:
  Serial.print("Hello World\n");       // prints a label

}
```

COM7 (Arduino/Genuino Uno)

Send

```
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hello World
Hell
```

Autoscroll Show timestamp Newline 9600 baud Clear output

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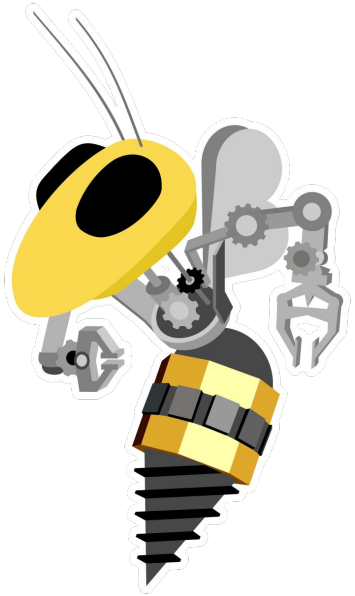
Every Circuit is Different

Always start general to not waste time

A few more pointers:

- Data not being sent correctly?
  - Continuity between end points
  - Continuity to adjacent lines
  - Is firmware using the correct pins?
  - Could try reflowing the data lines or associated devices

- Useful debugging tools
  - Multimeter
    - Voltage check
    - Continuity check
  - Oscilloscope
    - Can see waveforms over time
      - Useful to analyze noise issues
    - Many have decoding features
      - Isolate problems to transmitter or receiver ends



Debugging Activity

Sorry not sorry