

Isolated Breadboard Bipolar Power Supply Assembly

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Introduction

We are making a bipolar power supply that plugs into a breadboard.

- 5V USB, 500 mA max. input.
- +/- 5V, 200 mA max. output.

- Mark each step as you complete it.
- Turn on the HEPA filter.
- Wear safety glasses.
- Gather tools.
- Adjust your work area.
- Ask your instructor for assistance.
- Avoid developing bad habits.

Set the temperature.

- Insert key.
- Hold down *(star) button until left digit flashes.
- Press Up or Down button.
- Press *(star) to advance to next digit.
- Press *(star) to exit.

Tin the tip.

- Remove handle from sleep cradle.
- Feed SAC305 solder into hot tip over metal trashcan.
 - ✓ Solder should melt easily.
 - ✓ If tip is dark, it will take several applications of solder and flux to reduce the oxidation.
- Flick excess solder into metal trashcan.
- Repeat until tip is shiny.
- Put handle into sleep cradle.

Soldering Iron Best Practice

1. **Clean (GENTLY push tip into brass sponge once).**
2. **Solder (this action naturally applies a protective coating of solder).**
3. **Put handle into sleep cradle (cools tip in sleep mode for less rust).**

Warning

- If you clean the tip before putting handle into cradle, you will ruin a \$15 tip in an afternoon (and have a lot of difficulty soldering).

Errors

- A dark tip indicates a poor habit of cleaning the tip before putting it into cradle.
- A brass sponge full of solder indicates a poor habit of feeding a lot of solder into the tip and plunging the tip into the sponge.

SMT or SMD?

- Surface Mount Technology or Surface Mount Device
- https://en.wikipedia.org/wiki/Surface-mount_technology

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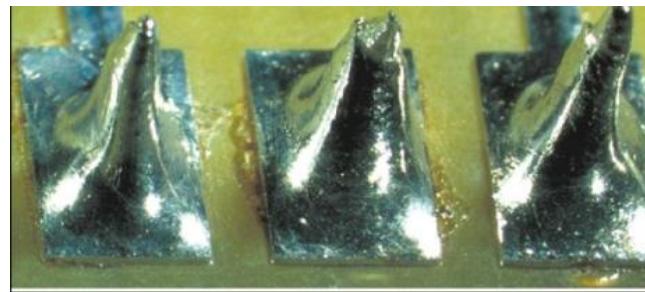
Hakko FX-951 Reference

- <https://www.youtube.com/watch?v=wPcwOc7XnFM>



USB Connector Pins (SMT)

- Set soldering tip temperature to 700°F. (Tiny pads may come off board if >700).
- Tin the PCB pads for the USB connector. (Ask your instructor).
- We are using lead-free solder with no-clean flux (SAC305).
- No-clean flux evaporates in about 3 seconds. It smells like hot chili peppers.
- The HEPA filter intake hose should be within one meter of your work.

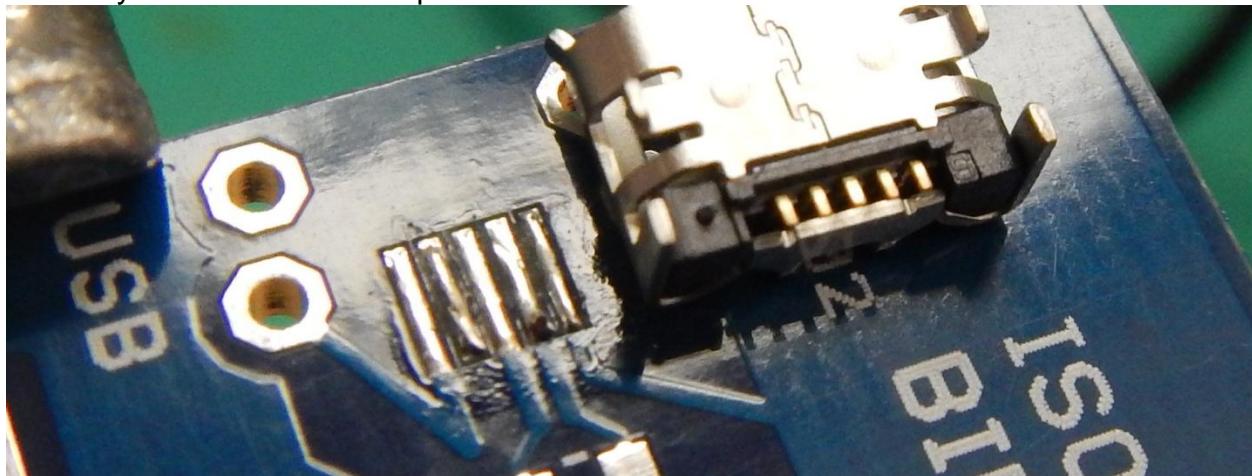


UNACCEPTABLE SOLDER PEAKS, ICICLES, SHARP EDGES

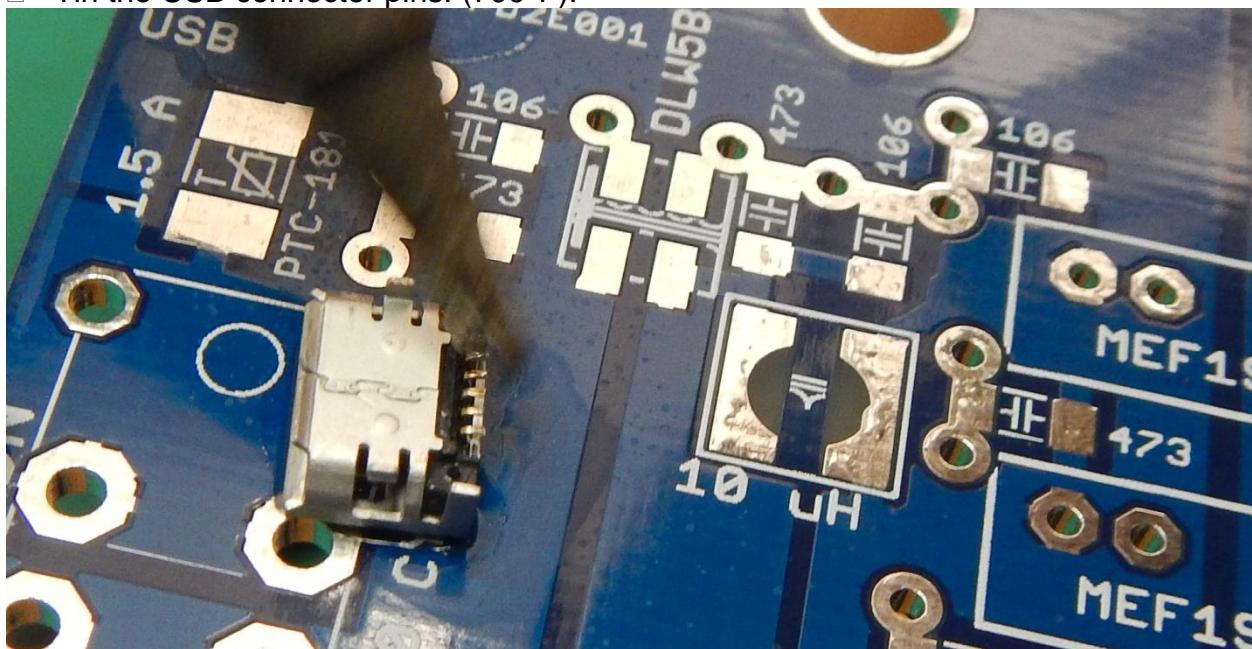
Solder peaks, icicles, and/or sharp edges are an indicator of an improper process parameter and are a reliability and short-circuit concern.

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- You may need to use liquid flux (Kester 951 pen) and a dry tip to smooth the solder.
- Ask your instructor for help.

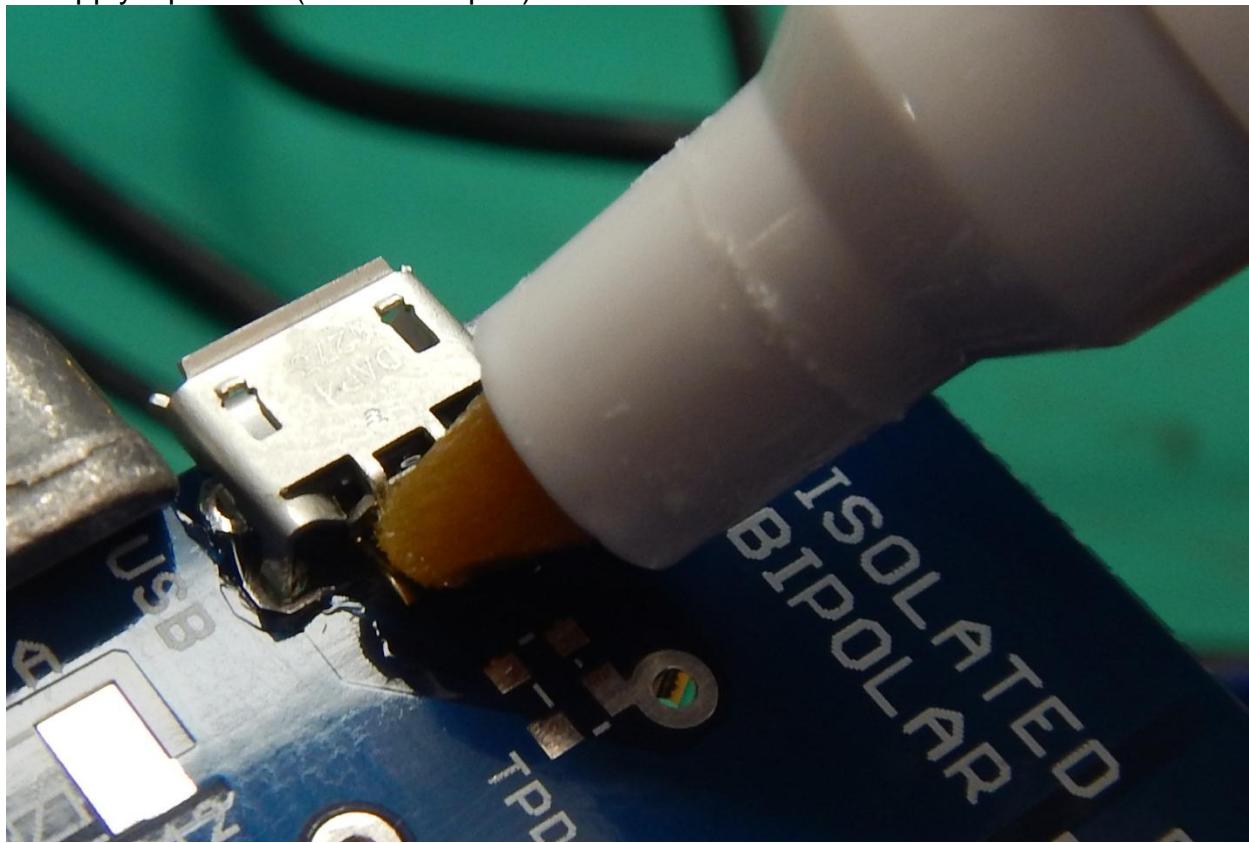


- Tin the USB connector pins. (700°F).

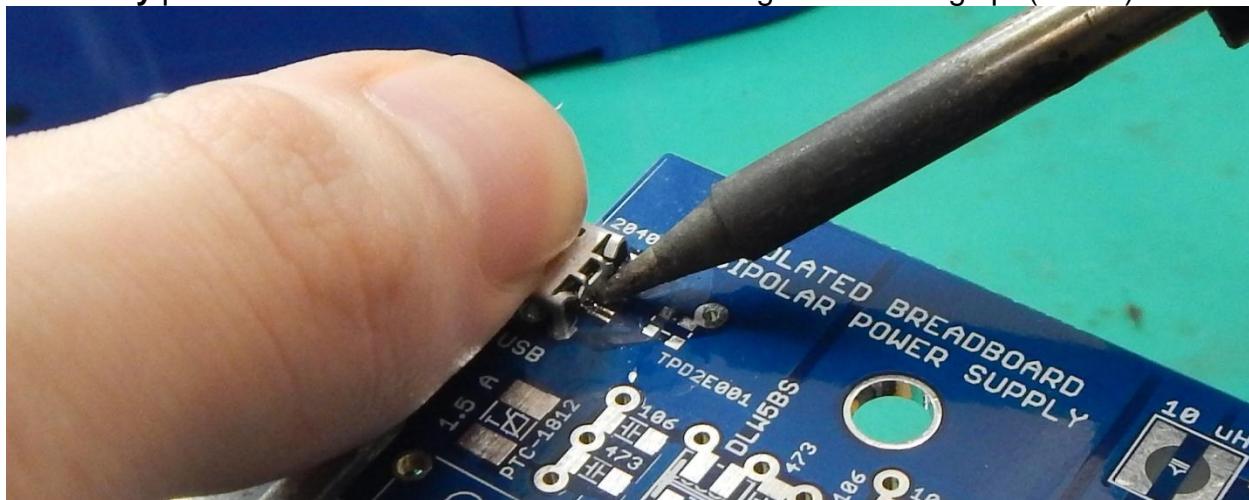


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- Place the USB connector on the PC board.
- Apply liquid flux. (Kester 951 pen).

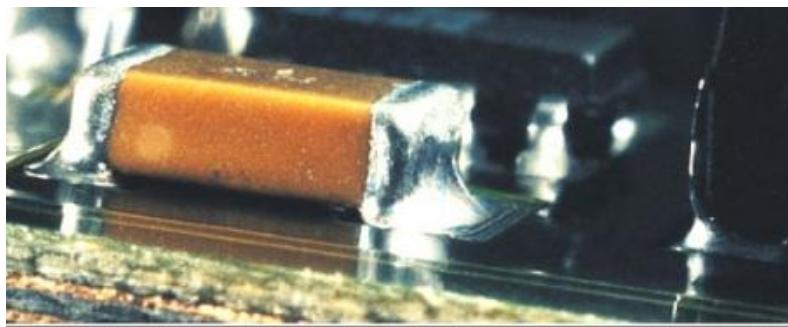
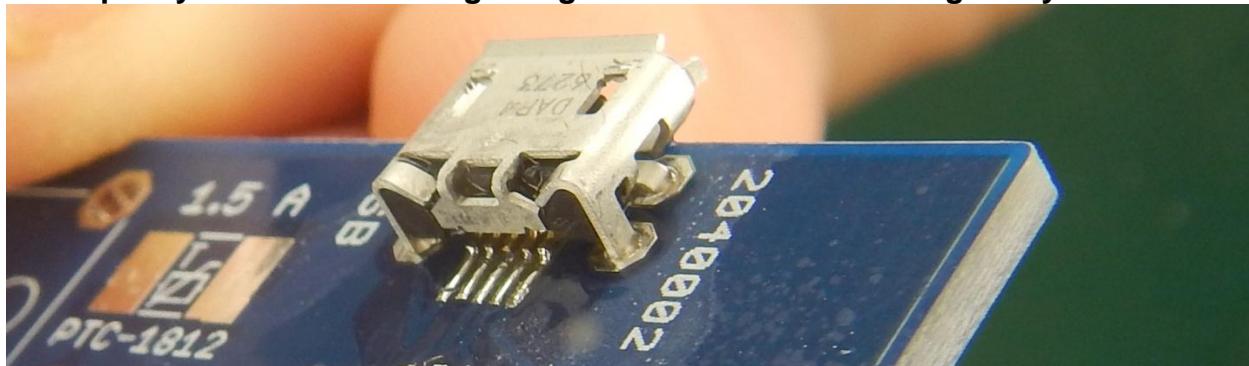


- While the liquid flux is wet (**important**).
- Gently** press the USB connector down.
- Gently** push the solder toward the connector using the soldering tip. (700°F).



Isolated Breadboard Bipolar Power Supply Assembly

- Use magnification to ensure that you have created a smooth fillet of solder between the pads and the connector pins.
- Inspect your work under high magnification before showing it to your instructor.**



PREFERRED

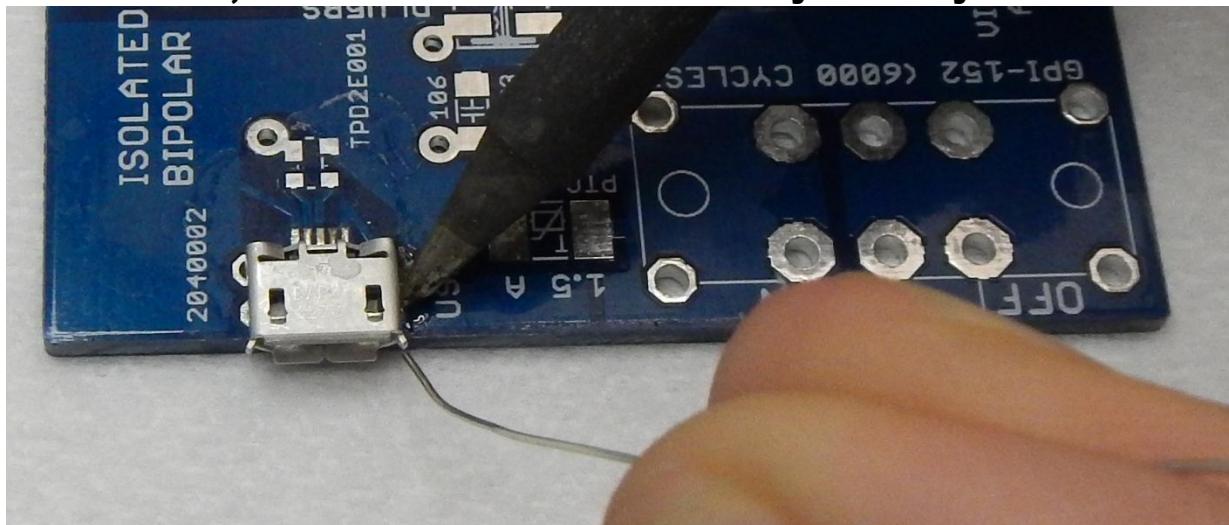
The solder joint surface is smooth, nonporous, undisturbed, with a finish varying from satin to bright. The fillet completely wets all elements to the periphery of the connection and is concave.

USB Connector Shell (through-hole)

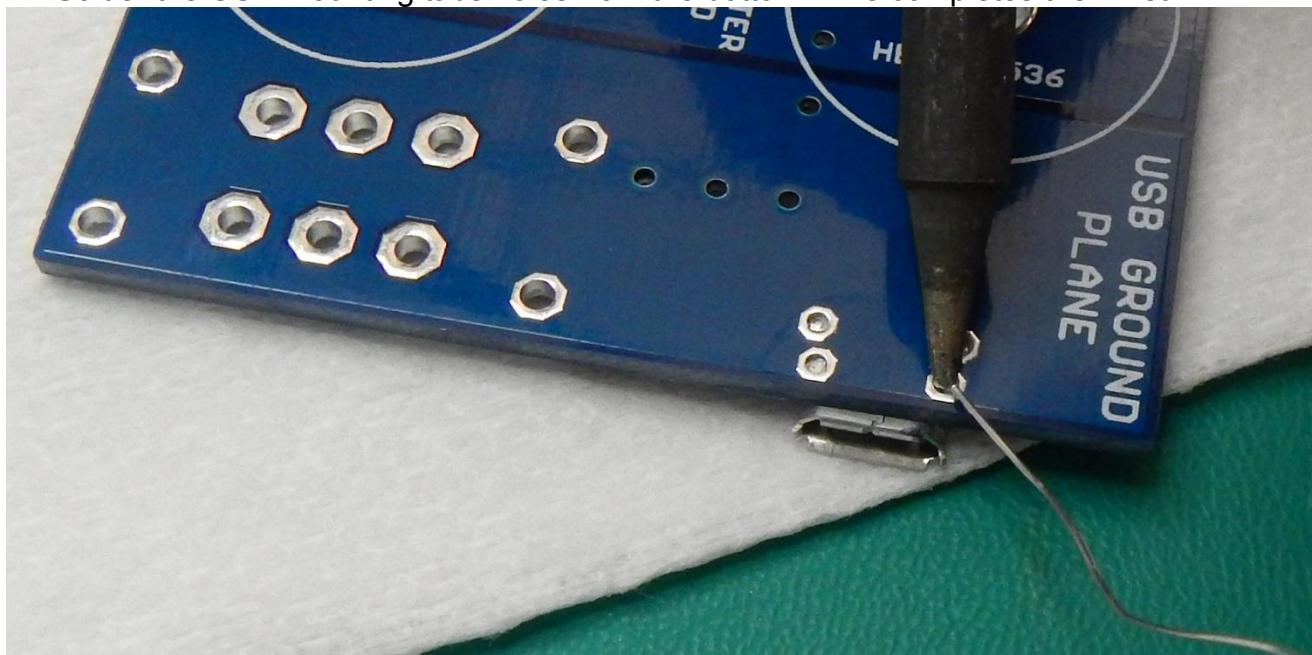
- Raise the soldering tip temperature to 800°F.
 - ✓ This is necessary to solder large pins, large pads, and ground planes.
- More heat; less solder. Your instructor may remind you often.**

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- Solder the 4 USB mounting tabs from the top.
- More heat; less solder. Your instructor may remind you often.**



- Solder the USB mounting tabs holes from the bottom. This completes the “rivet”.

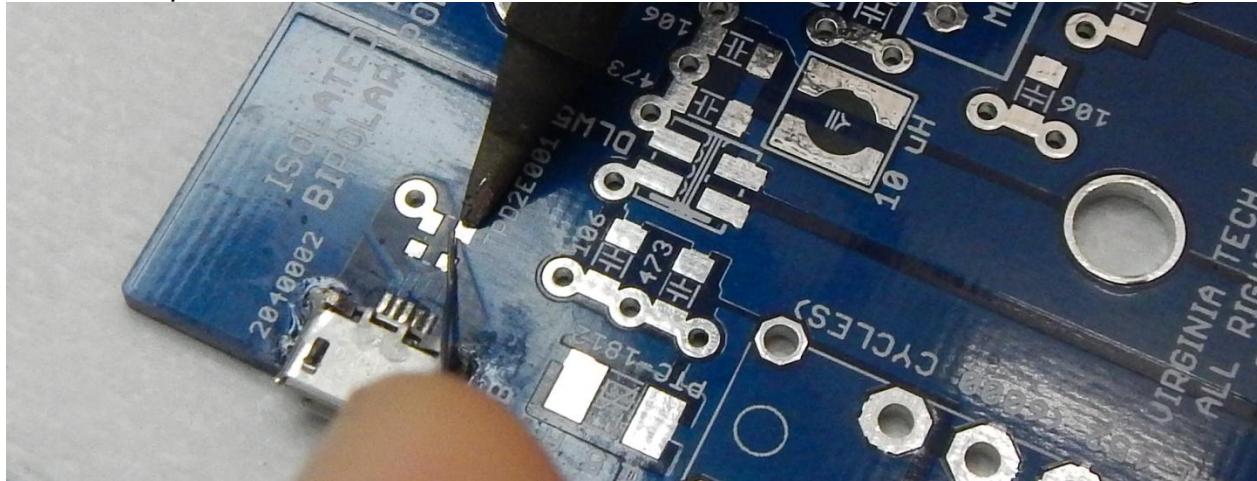


- NOTE: We start with the most fragile components.**
- NOTE: If you mess up now, you can start over with a new board and not lose a lot of work.**
- NOTE: We all mess up sometimes.**

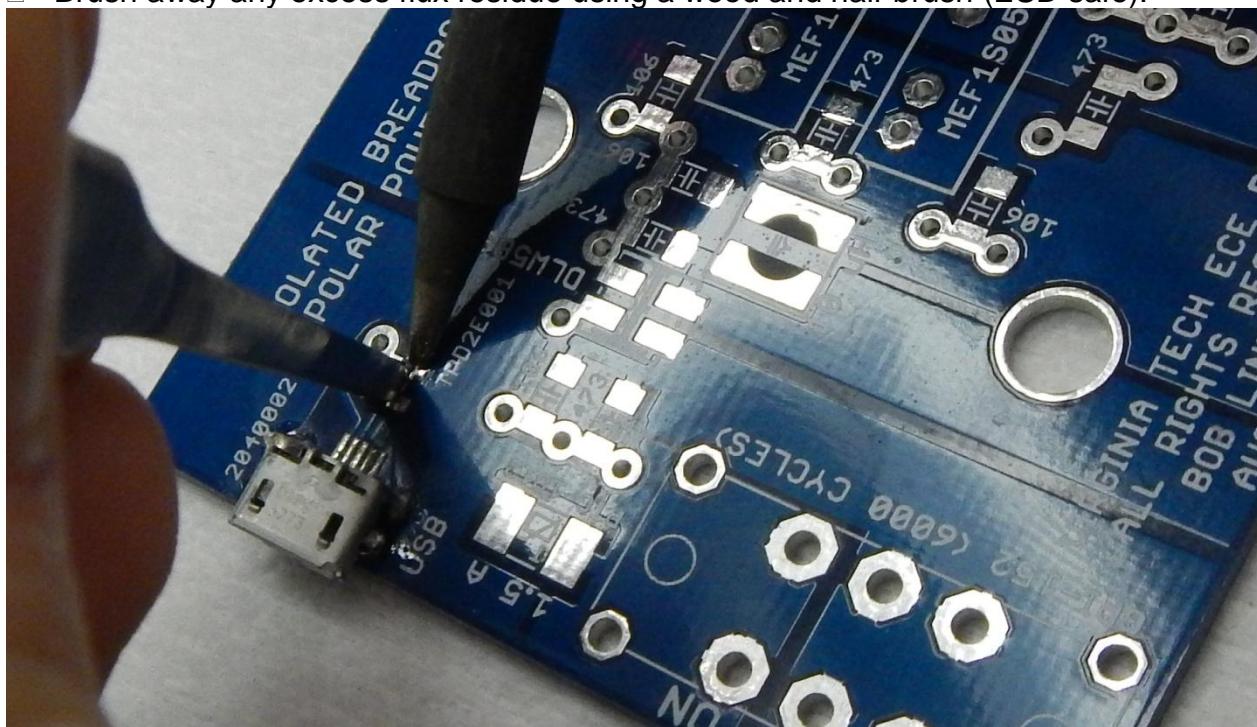
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TPD2E001 ESD Protection (SMT)

- Lower the soldering tip temperature to 700°F.
- Tin one pad of the TPD2E001. ONE PAD ONLY.

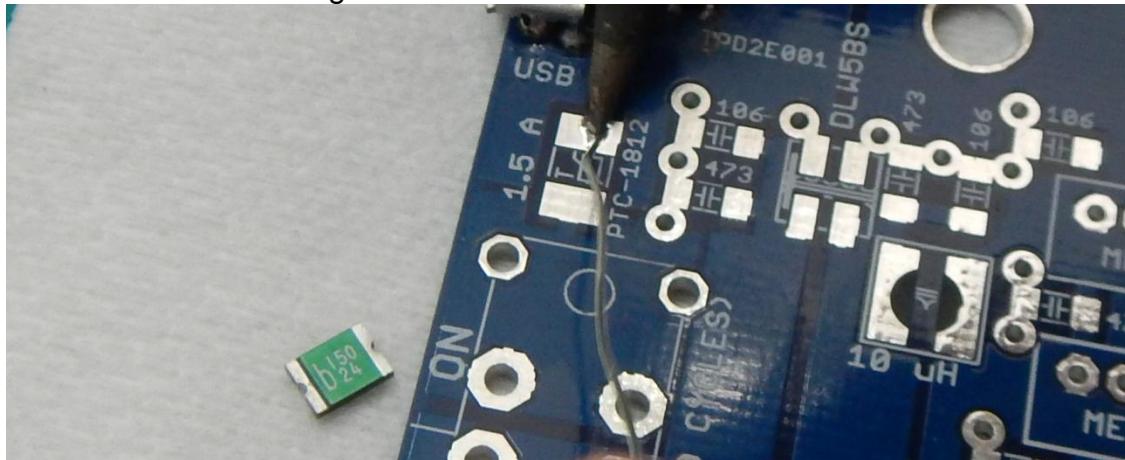


- Place the TPD2E001 using SMT tweezers.
- The chip pins are very fragile.
- Heat the solder on the tinned pad and pin.
- If needed, reheat the one pad and one pin and correct the chip alignment.
- Solder the rest of the pads and pins. (700°F).
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).

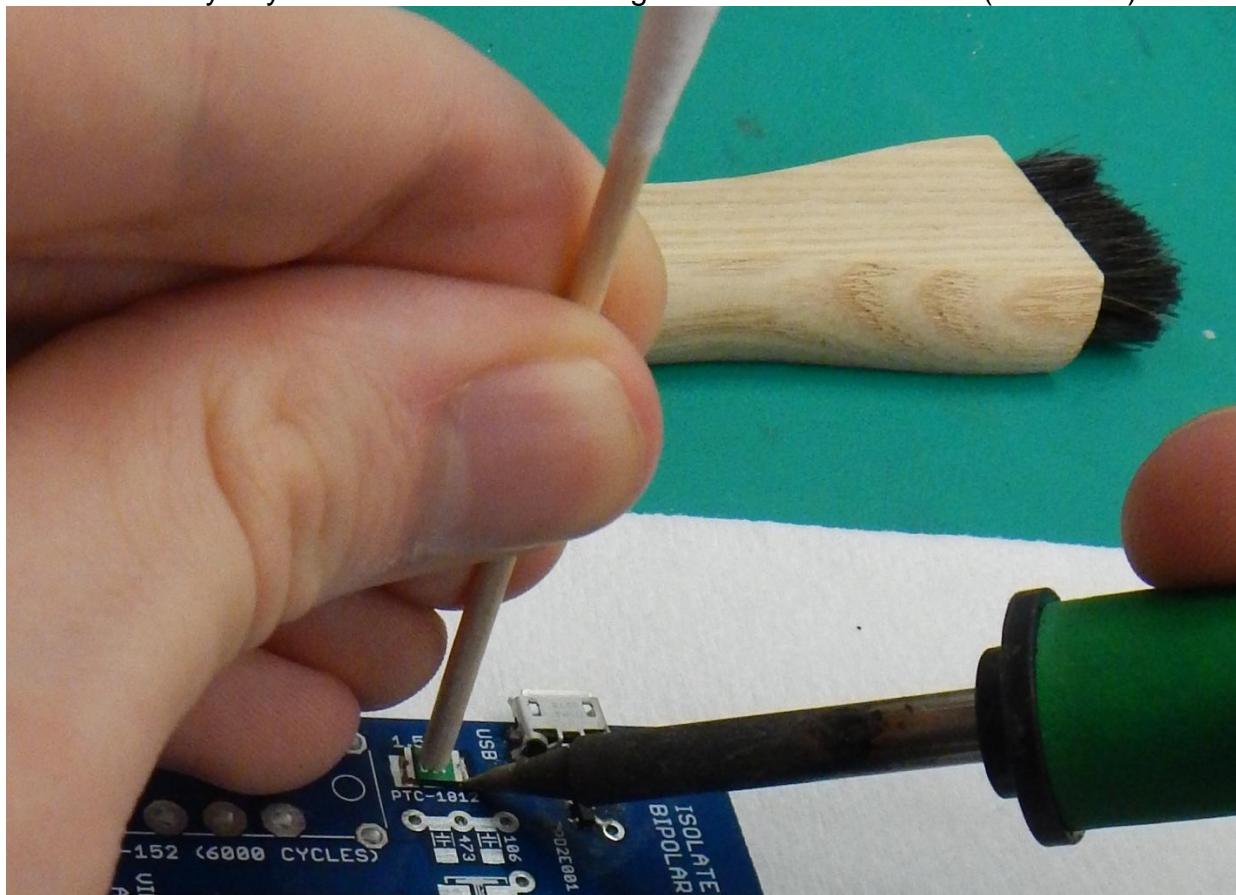


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Positive Temperature Coefficient (PTC) Thermistor (resettable fuse)(SMT)

- Tin one pad of the PTC. (700°F).
- Place the PTC using SMT tweezers.



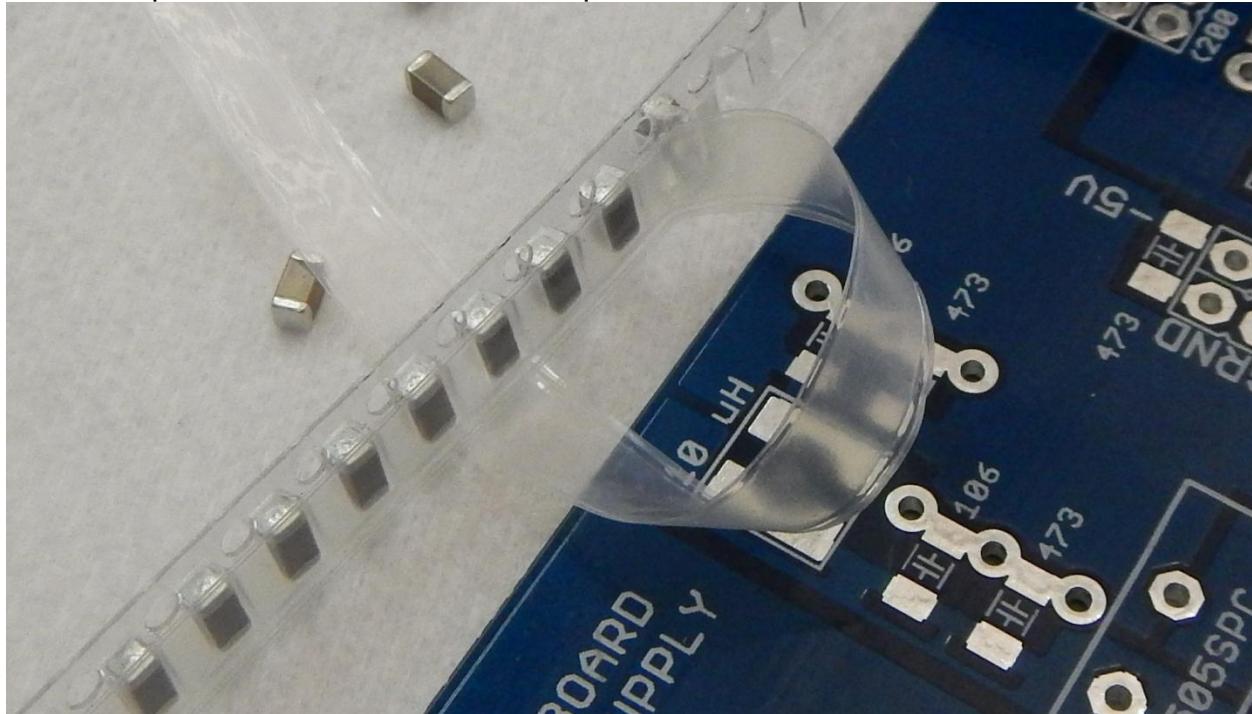
- Using a bamboo swab, **gently** press straight down on the PTC and heat the tinned pad. (700°F).
 - ✓ The tweezers tend to slip on top of SMD components (metal on ceramic).
- The PTC is sensitive to overheating.
- Solder the other side of the PTC. (700°F).
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).



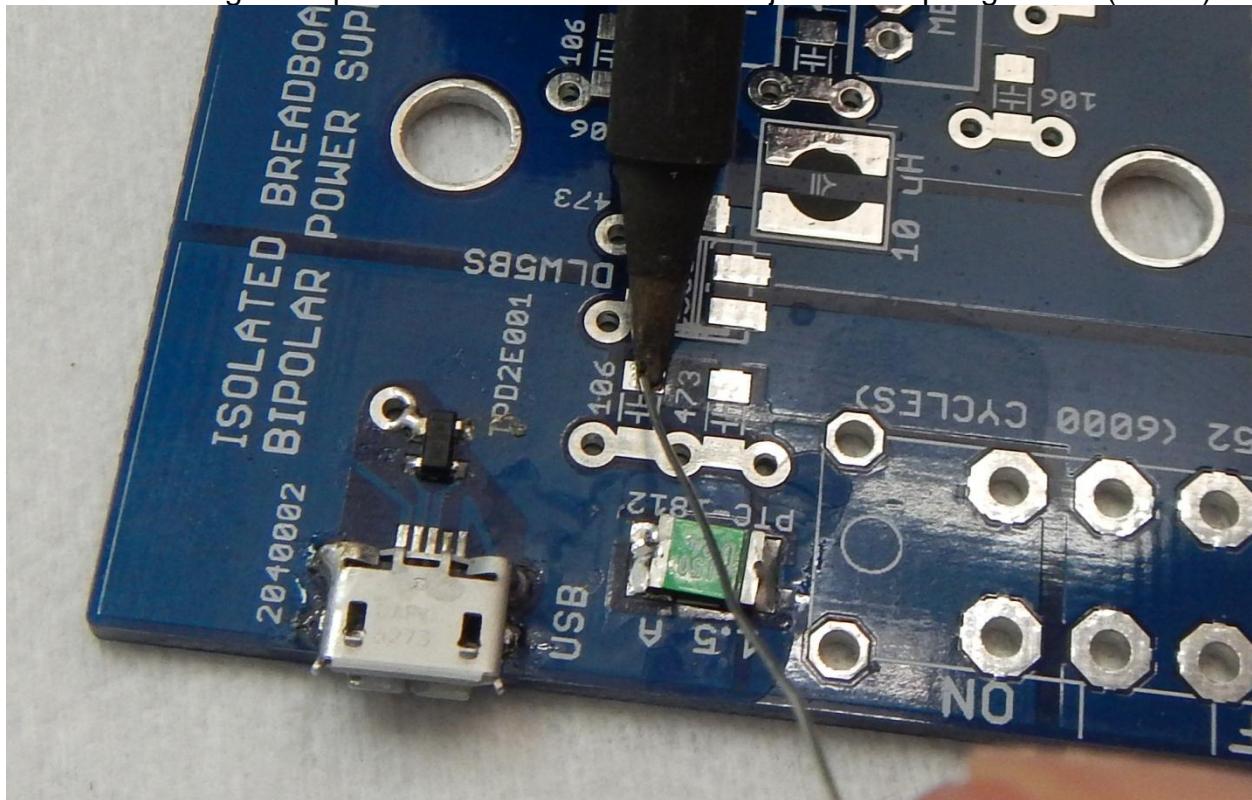
Isolated Breadboard Bipolar Power Supply Assembly

10 µF SMD Capacitors (SMT)

- SMD capacitors don't have any markings on them.
- Solder all of one value before beginning another value.
- Put capacitors back in their marked bag after you solder one value.
- The capacitors, below, are 106 or 10 µF.

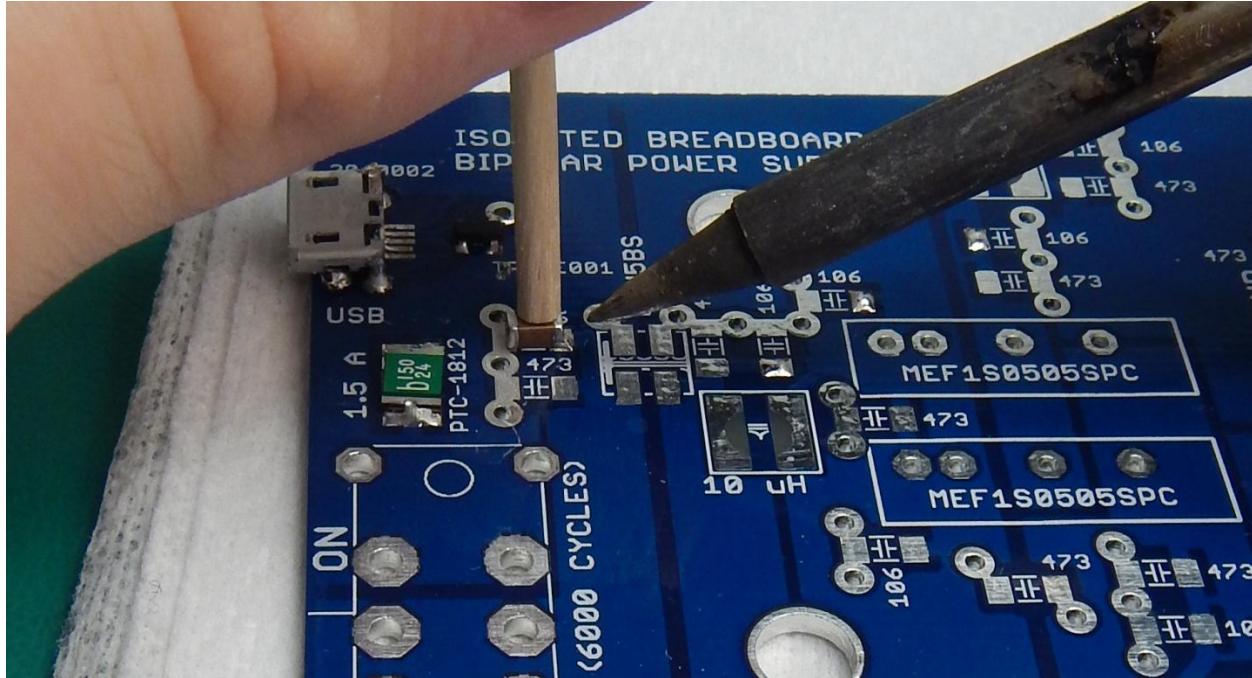


- Tin the non-ground pad. This makes it easier to adjust the chip alignment. (700°F).



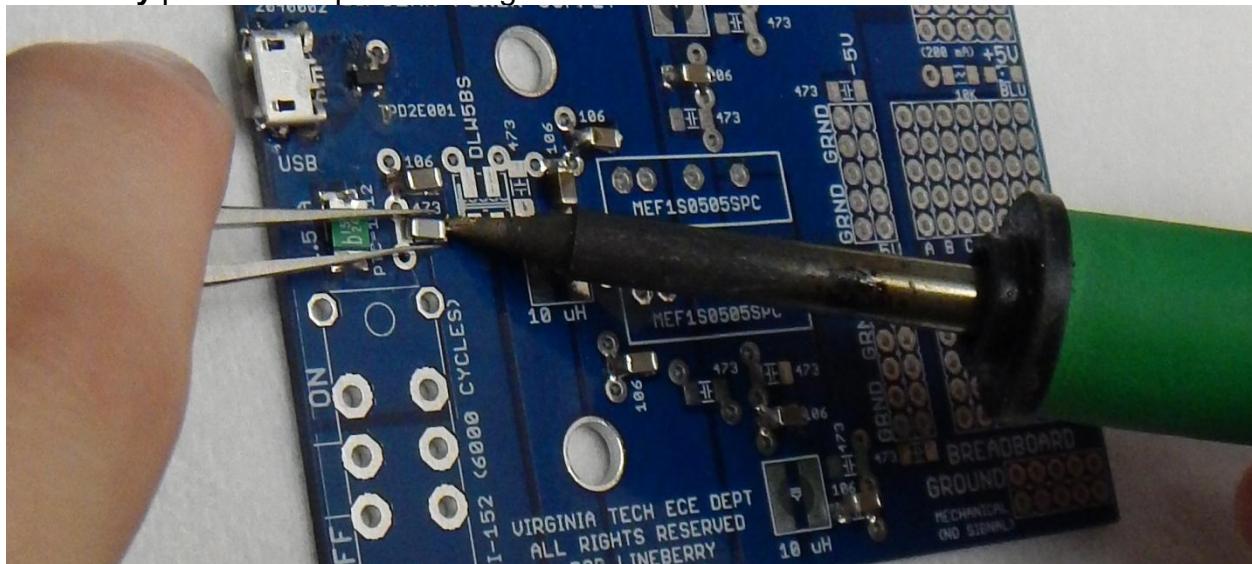
Isolated Breadboard Bipolar Power Supply Assembly

- Gently** place the capacitor using SMT tweezers.
- Using a bamboo swab, **gently** press straight down on the capacitor.
 - The tweezers tend to slip on top of SMD components (metal on ceramic).
- Reheat the tinned pad to secure the capacitor. Make sure the capacitor is flat on the board and aligned correctly.
- Solder the ground pad side. (700°F).
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).



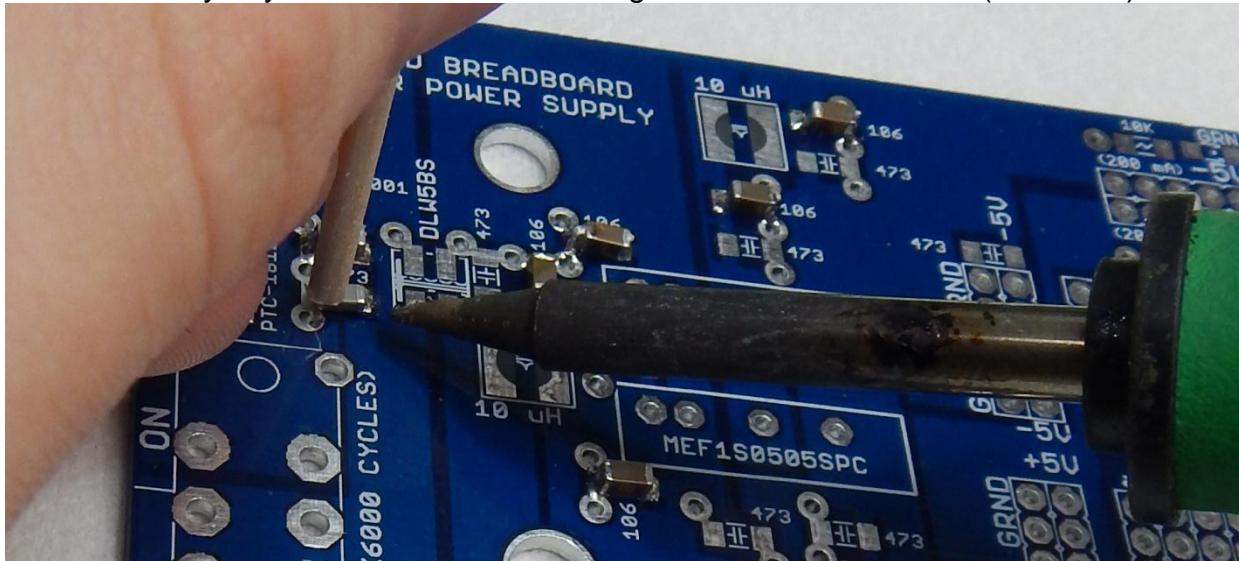
0.047 µF SMD Capacitors (SMT)

- Populate the 473 capacitors (0.047 µF).
- Tin the non-ground pad. (700°F).
- Gently** place the capacitor using SMT tweezers.



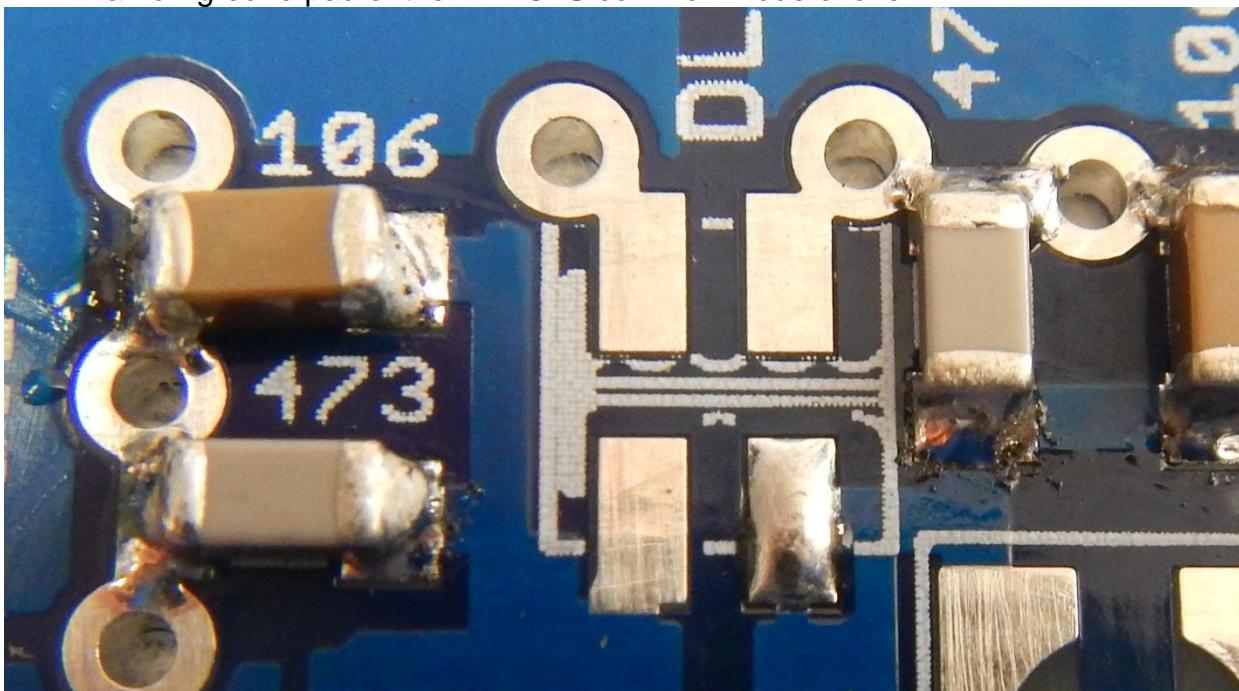
Isolated Breadboard Bipolar Power Supply Assembly

- Using a bamboo swab, **gently** press straight down on the capacitor.
 - ✓ The tweezers tend to slip on top of SMD components (metal on ceramic).
 - Reheat the tinned pad to secure the capacitor. Make sure the capacitor is flat on the board and aligned correctly.
 - Solder the ground pad side. (700°F).
 - Add liquid flux and reheat to fix any ugly solder joints.
 - Brush away any excess flux residue using a wood and hair brush (ESD safe).



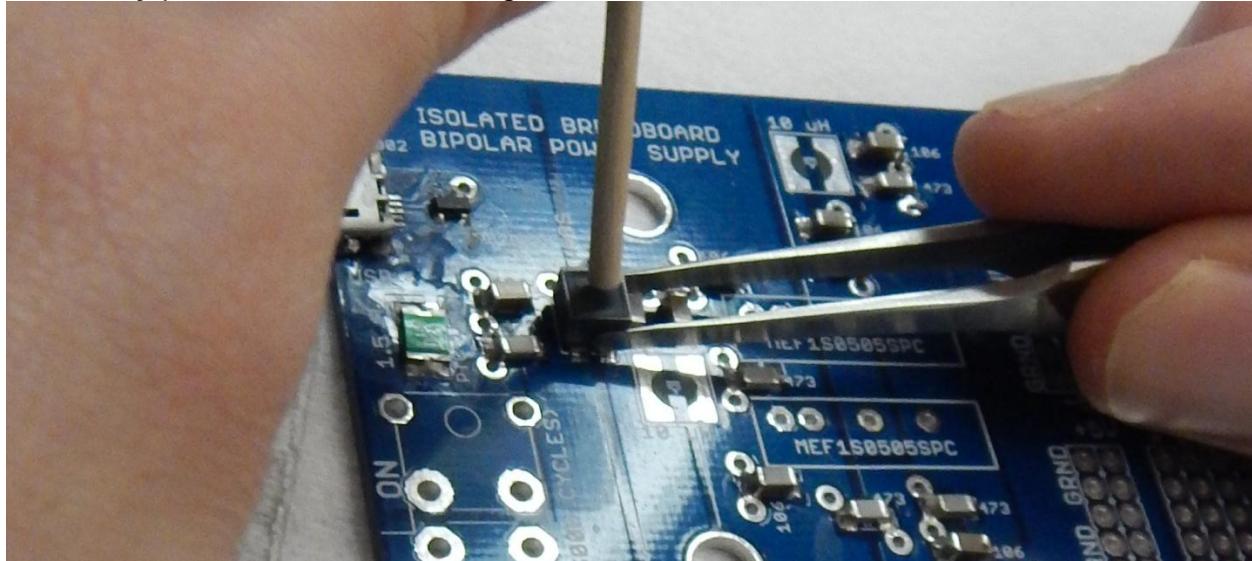
DLW5BS Common Mode Choke (inductor) (SMT)

- Tin a non-ground pad of the DLW5BS common mode choke.

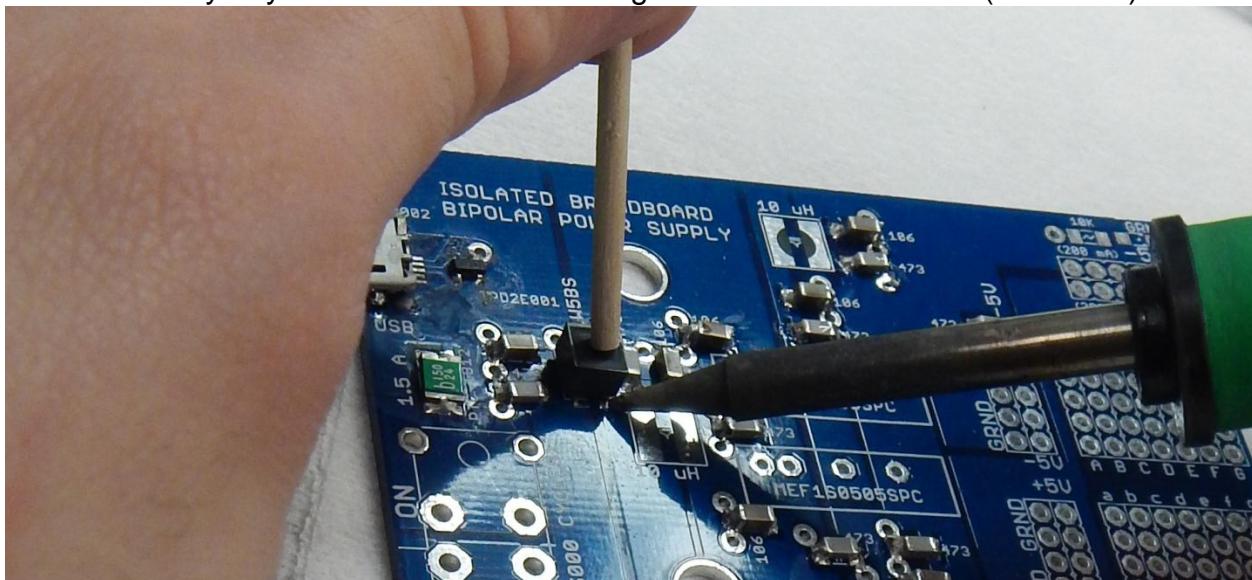


Isolated Breadboard Bipolar Power Supply Assembly

- Carefully inspect the bottom of the DLW5BS. The long pads on the PC board should match the long pads of the DLW5BS.
- Gently** place the DLW5BS using SMT tweezers.



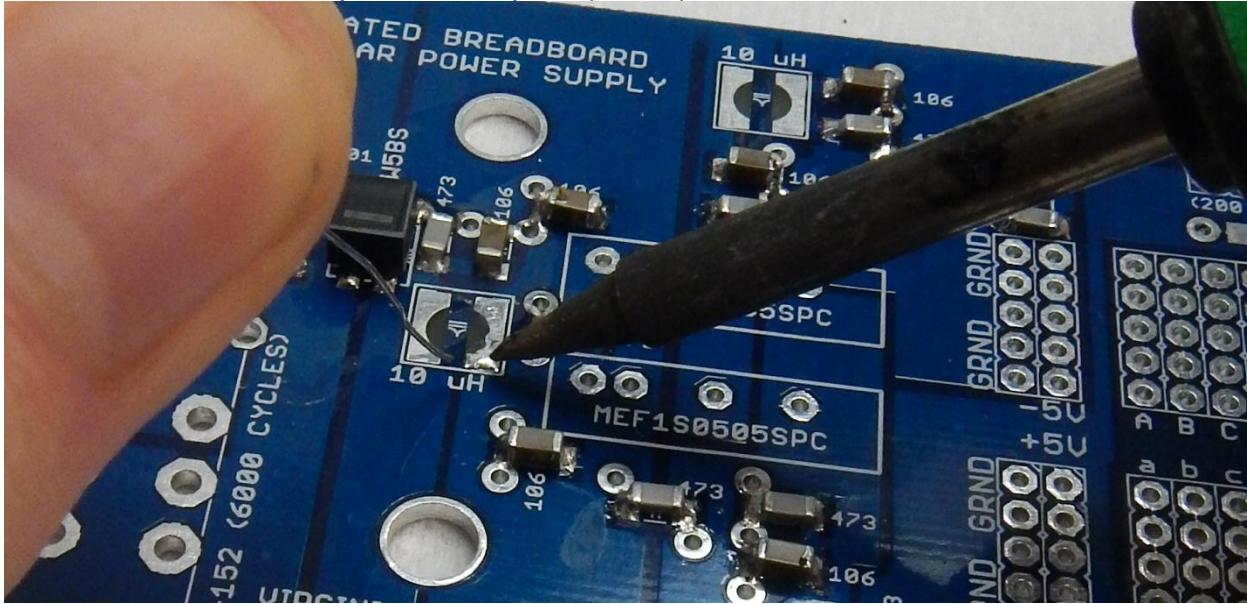
- Using a bamboo swab, **gently** press straight down on the DLW5BS.
 - ✓ The tweezers tend to slip on top of SMD components (metal on ceramic).
- Reheat the tinned pad to secure the DLW5BS. (700°F).
- Carefully inspect the bottom of the DLW5BS using high magnification.
 - Is it flat on the board?
 - Are the PCB pads aligned with the DLW5BS pads?
 - This is your last chance to correct the alignment.
- Raise the soldering tip temperature to 800°F.
- Finish soldering the other pads of the DLW5BS. (800°F)
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).



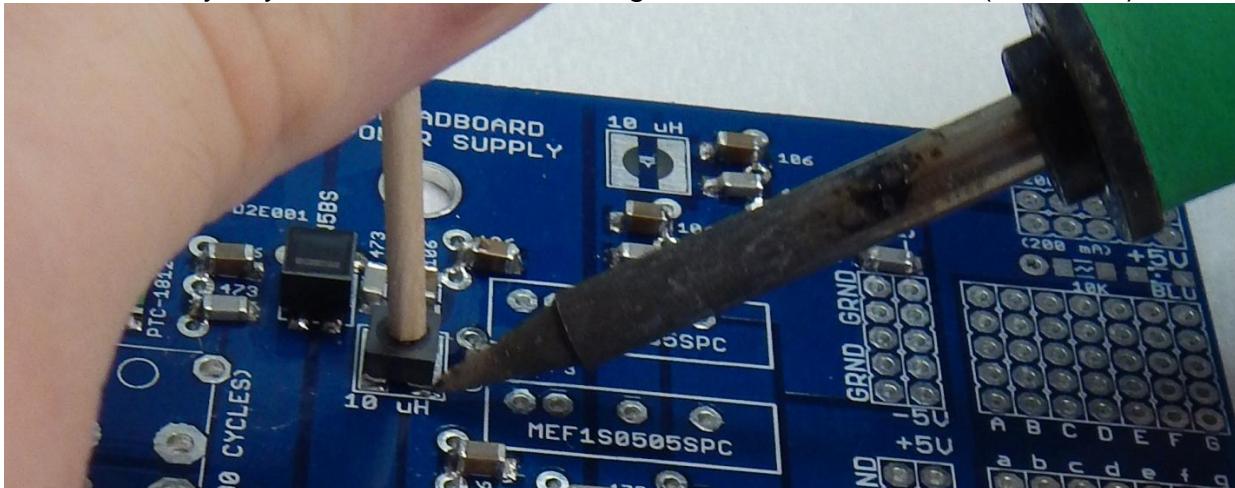
Isolated Breadboard Bipolar Power Supply Assembly

10 μ H Inductors (SMT)

- Tin a corner of a 10 μ H inductor pad. (800°F).

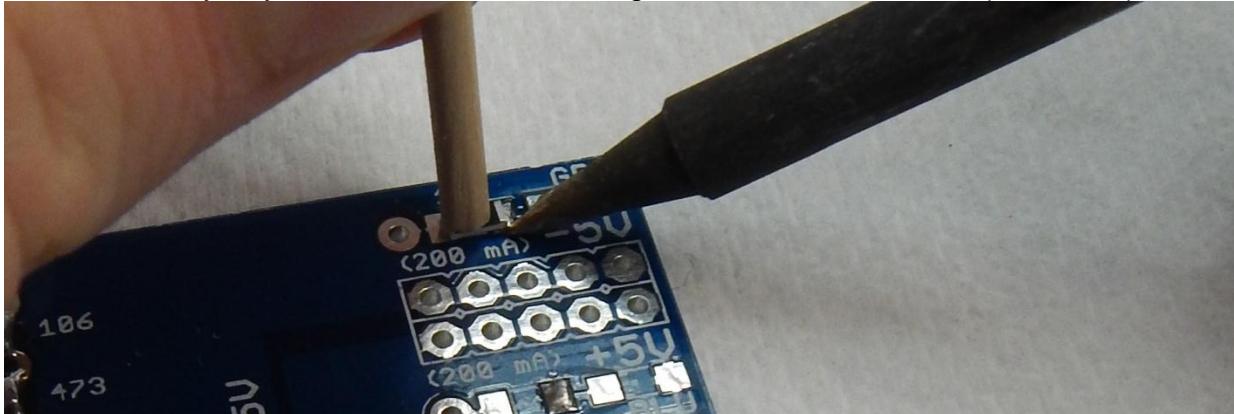


- Carefully inspect the bottom of the 10 μ H inductor. The long pads on the PC board should match the long pads of the 10 μ H inductor.
- Gently** place the 10 μ H inductor using SMT tweezers.
- Using a bamboo swab, **gently** press straight down on the 10 μ H inductor.
 - ✓ The tweezers tend to slip on top of SMD components (metal on ceramic).
- Reheat the tinned pad to secure the inductor. (800°F).
- Carefully inspect the bottom of the 10 μ H inductor using high magnification.
 - Is it flat on the board?
 - Are the PCB pads aligned with the 10 μ H inductor pads?
 - This is your last chance to correct the alignment.
- Solder the other pad of the 10 μ H inductor. (800°F).
- Completely fill the pad. Move the tip along the joint to distribute heat.
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).



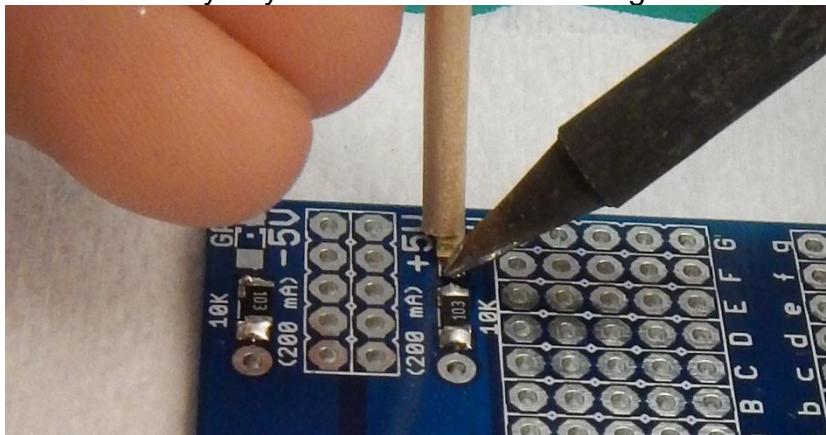
10K Resistors (SMT)

- Lower the soldering tip temperature to 700°F.
- Populate the 10K resistors (marked 103).
- Tin the non-ground pad. (700°F).
- Gently** place the resistor using SMT tweezers.
- Using a bamboo swab, **gently** press straight down on the resistor.
- Reheat the tinned pad to secure the resistor. (700°F) Make sure it is flat and aligned.
- Solder the ground pad side. (700°F).
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).



Light Emitting Diodes (LEDs) (SMT)

- Populate the LEDs. They are polarized.
- Make sure you match the dots on the board with the dots on the LED.
- Tin either pad. (700°F)
 - ✓ **IMPORTANT:** never connect an LED to a ground plane.
- Gently** place the LED using SMT tweezers.
 - ✓ The tweezers tend to slip on top of SMD components (metal on ceramic).
- Using a bamboo swab, **gently** press straight down on the LED.
- Reheat the tinned pad to secure the LED. (700°F) Make sure it is flat and aligned.
 - ✓ **IMPORTANT:** LEDs melt easily.
- Solder the other side of the LED. (700°F)
- Add liquid flux and reheat to fix any ugly solder joints.
- Brush away any excess flux residue using a wood and hair brush (ESD safe).



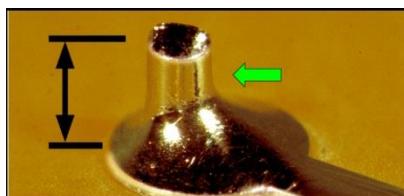
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Through-hole Soldering Sequence:

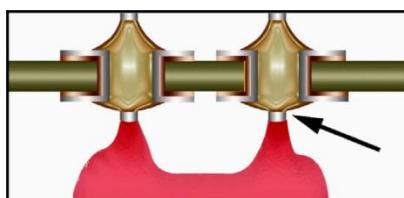
1. Make sure solder melts quickly on your tip. If not, "tin" the tip. (See page 2).
2. Touch the hot tip to both the pad and the lead. (700°F).
3. Melt a tiny amount of solder on the tip to make a better thermal contact among the tip, the lead, and the pad. This increases the heat flow.
4. Melt a tiny amount of solder at the junction of the lead and pad on the side opposite the tip. (700°F).
5. If the solder melts quickly, the joint is hot enough. Otherwise, test again.
6. When the joint is hot enough, push the solder "down the hole" in small increments.
7. You want to get some solder and fresh flux to the other side of the board before the flux evaporates (3 seconds).
8. Remove the solder wire.
9. Allow the flux to evaporate (3 seconds).
10. Remove the soldering tip.

DC-DC converters (MEF1S0505SPC)(through-hole)

- Through-hole soldering is a little different than SMT soldering.
- The DC-DC converters (MEF1S0505SPC) are upside down in the next photo.
- The chip pins are exposed on the ground plane (bottom) side of the board.
- There are traces (signals) on the component (top) side of the board that must be connected both mechanically and electrically. (See picture, at bottom of this page)
- The through-hole pads have large holes (drill size) to help beginners achieve a good solder joint using lead-free solder with no-clean flux (SAC305). (700°F).
- Solder one pin. Check that the DC-DC converter is still flat on the top of the board.
- Reheat and realign converters before soldering more than one pin.
- Pads that are connected to the ground plane require extra heat (extra time).**

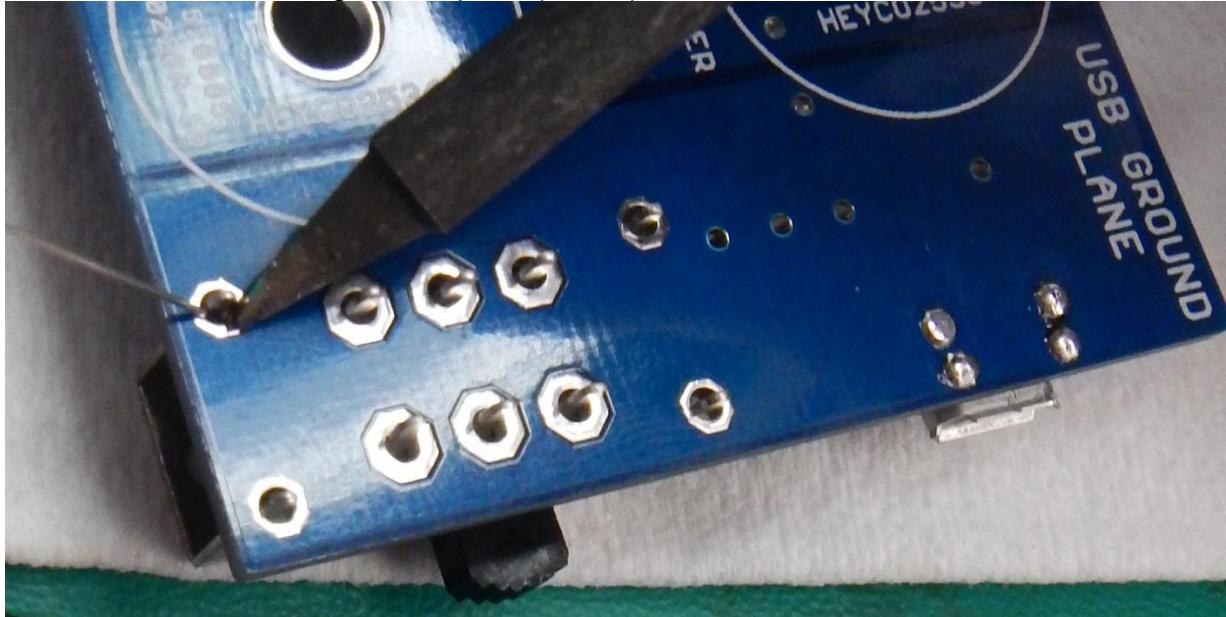


Trim the excess leads, but not too short.

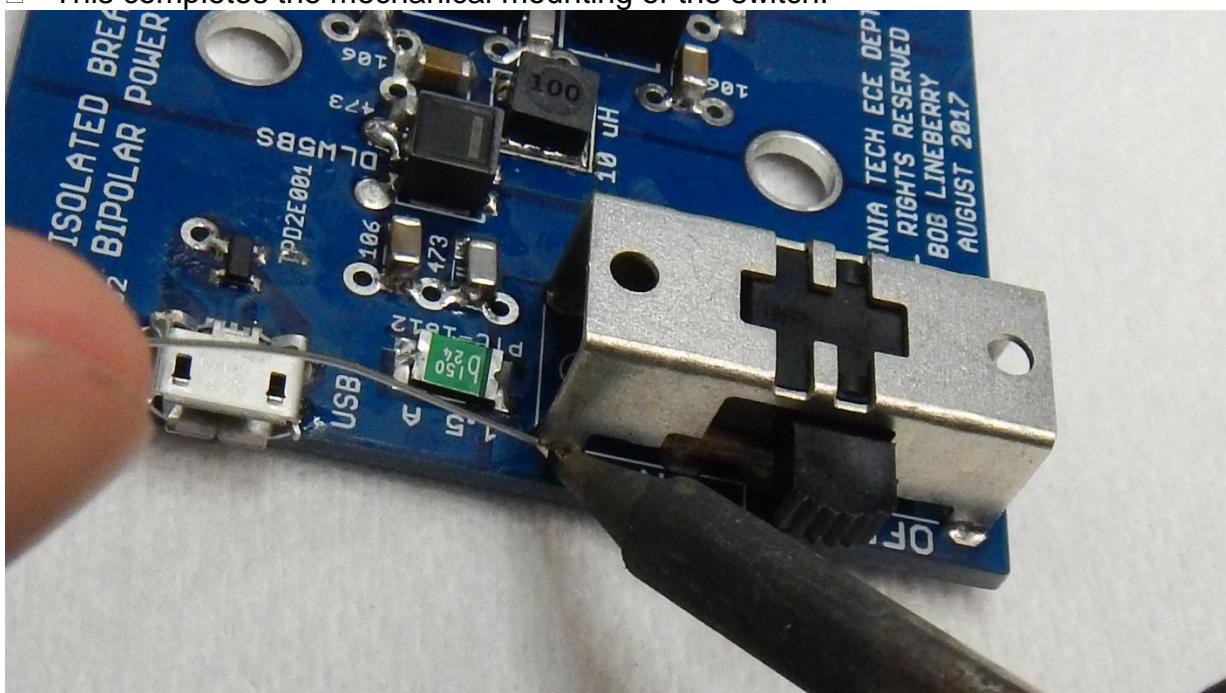


Isolated Breadboard Bipolar Power Supply Assembly
On-Off switch (GPI-152)(through-hole)

- Raise the soldering tip temperature to 800°F.
- Insert the On-Off switch (GPI-152).
- From the ground plane side, solder one corner pin. (800°F).
- Make sure the switch is still flat on the component side of the board.
- Solder the remaining corner pins. (800°F).

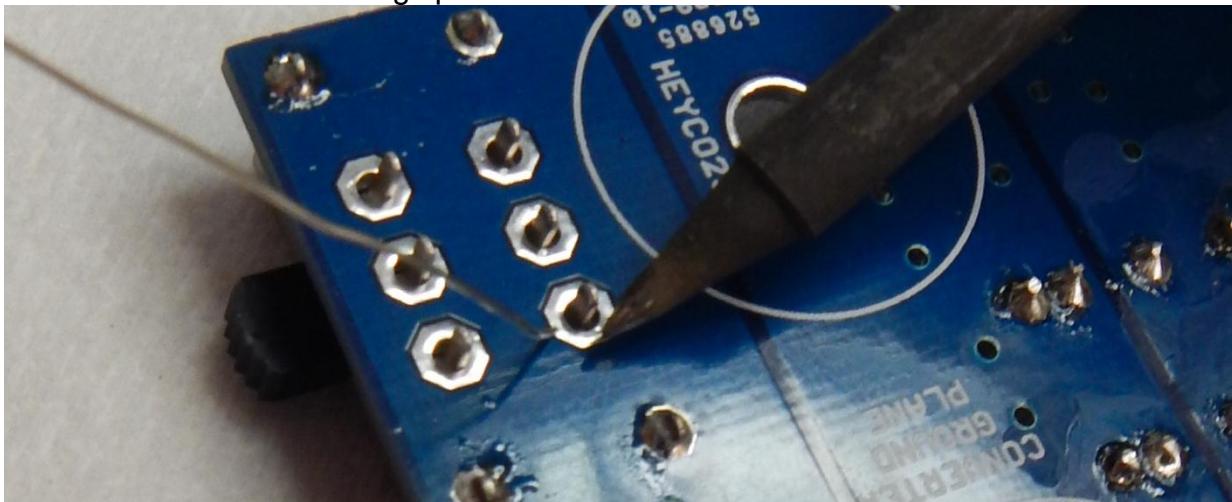


- From the component side of the board, solder the 4 corners. (800°F).
- This completes the mechanical mounting of the switch.



Isolated Breadboard Bipolar Power Supply Assembly

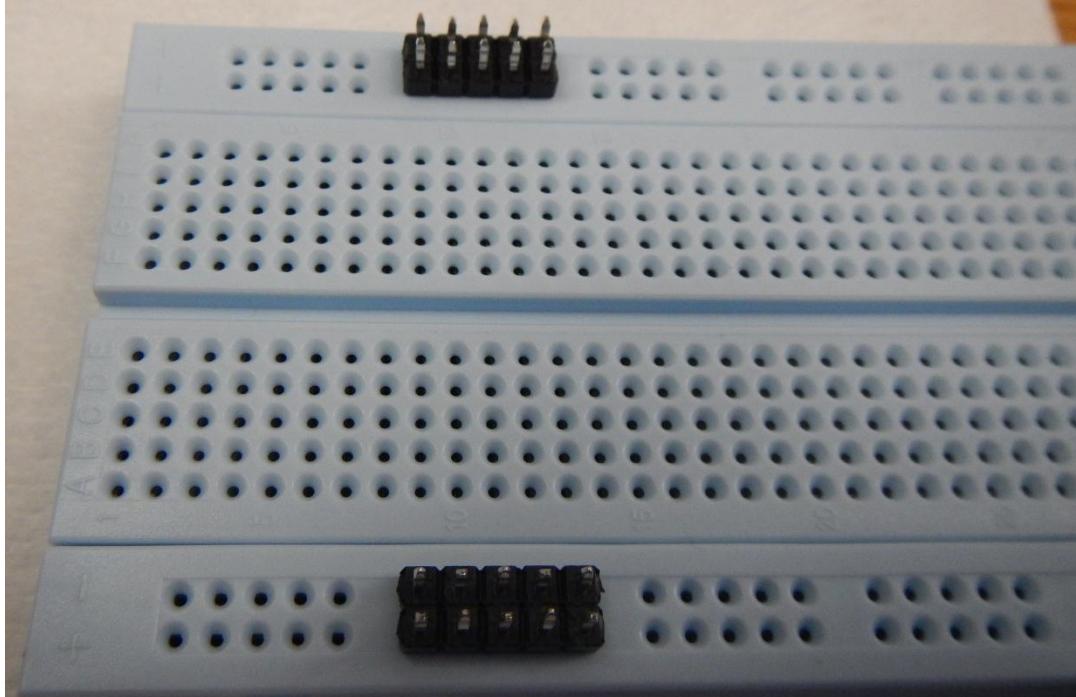
- There are traces (signals) on the other (component) side of the board that must be connected both mechanically and electrically.
- The through-hole pads have large holes (drill size) to help beginners achieve a good solder joint using lead-free solder with no-clean flux (SAC305). (800°F).
- Recurring Sequence:
 1. Make sure solder melts quickly on your tip. If not, "tin" the tip. (See page 1).
 2. Touch the hot tip to both the pad and the lead. (800°F).
 3. Melt a tiny amount of solder on the tip to make a better thermal contact among the tip, the lead, and the pad. This increases the heat flow.
 4. Melt a tiny amount of solder at the junction of the lead and pad on the side opposite the tip. (800°F).
 5. If the solder melts quickly, the joint is hot enough. Otherwise, test again.
 6. When the joint is hot enough, push the solder "down the hole" in small increments.
 7. You want to get some solder and fresh flux to the other side of the board before the flux evaporates (3 seconds).
 8. Remove the solder wire.
 9. Allow the flux to evaporate (3 seconds).
 10. Remove the soldering tip.



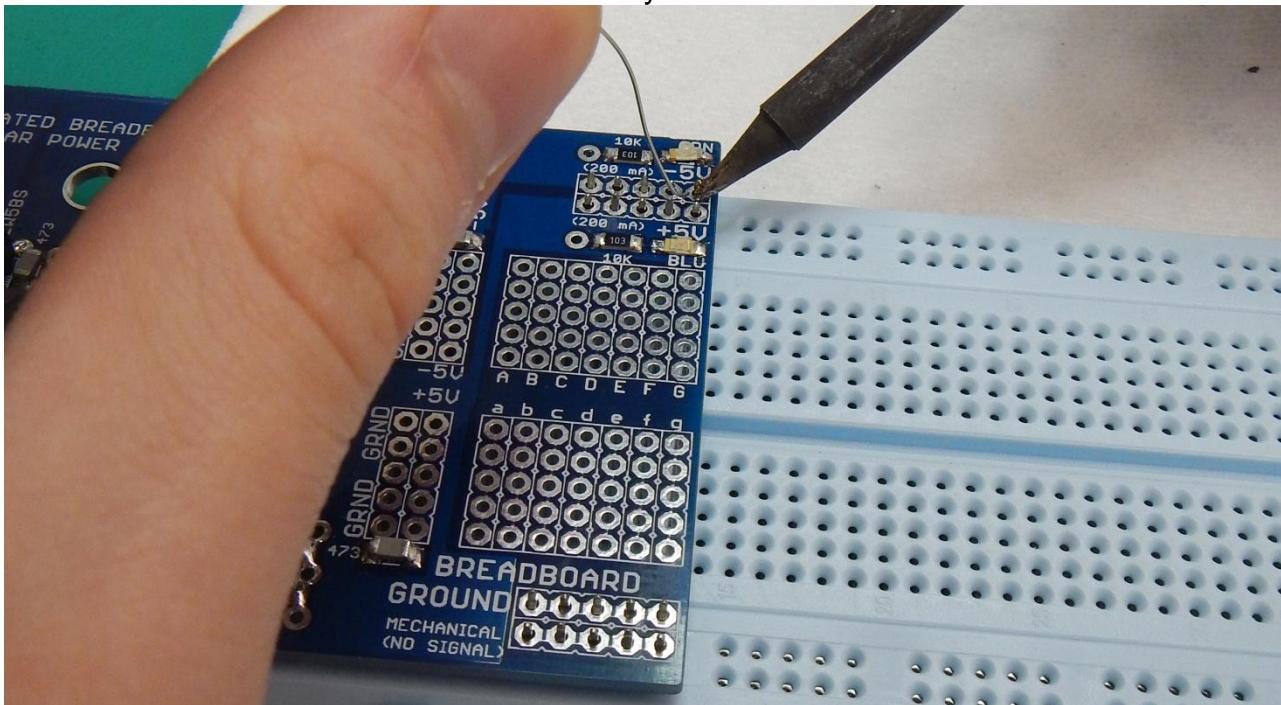
Isolated Breadboard Bipolar Power Supply Assembly

Breadboard Headers (through-hole)

- Insert the four 5-pin header assemblies into the high-temperature (light blue) breadboard.
- Long pins go into the breadboard.
- Use a blunt tool if necessary. The pins can be sharp.

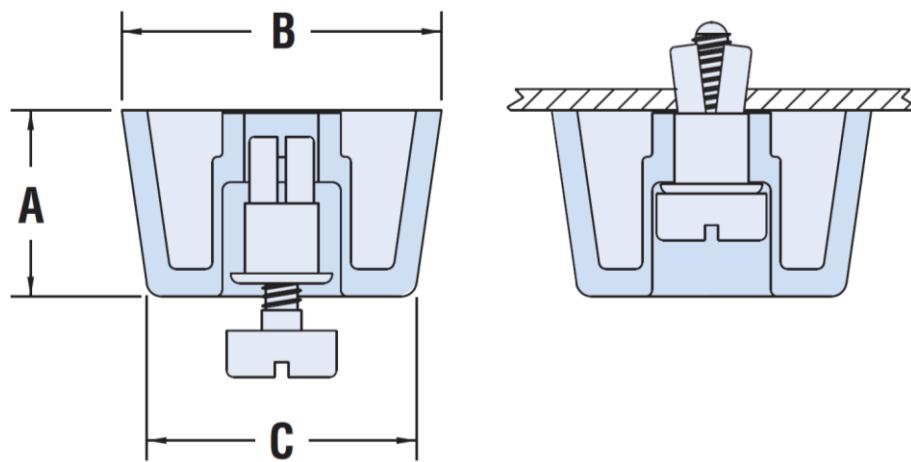
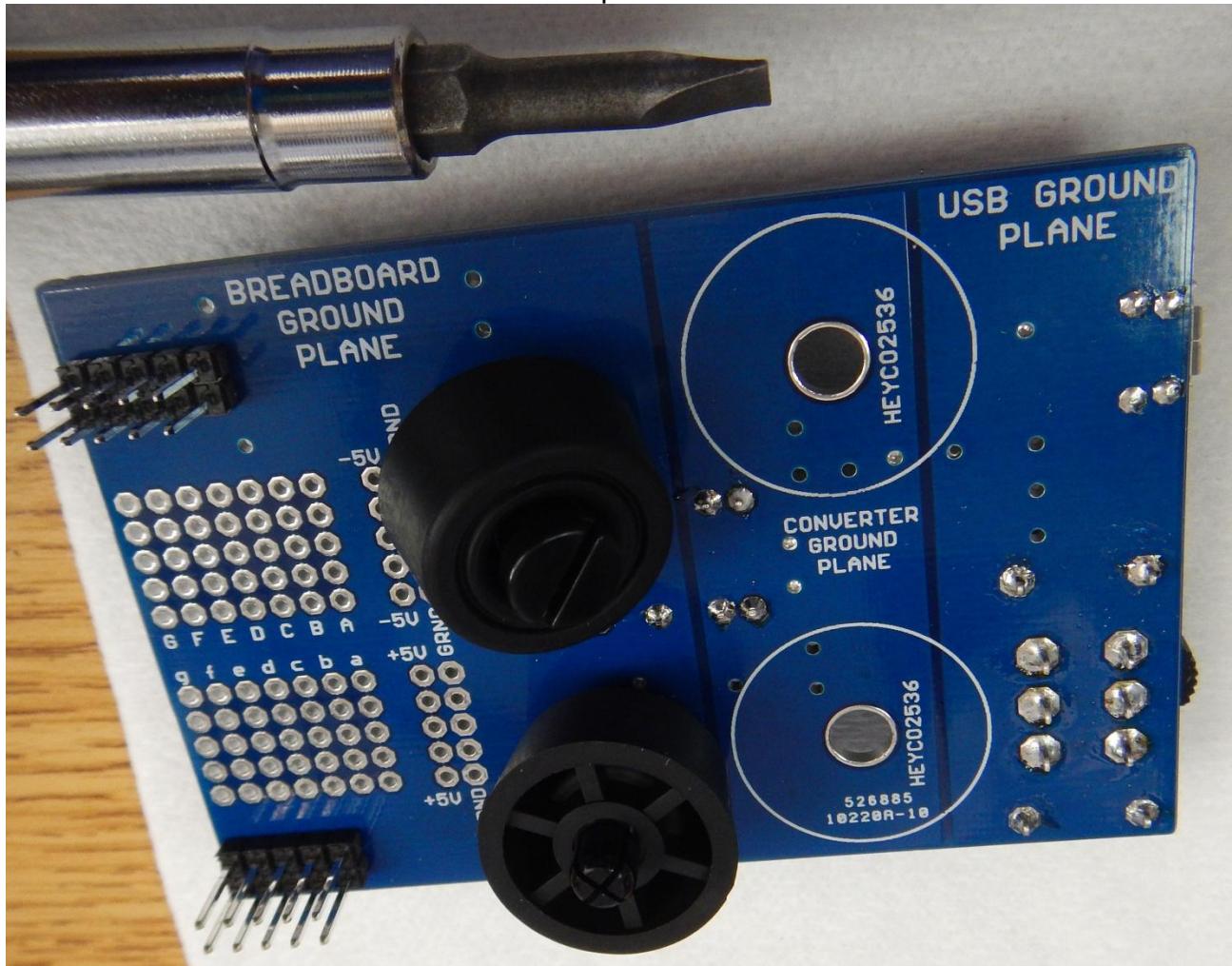


- Place the PCB assembly over the pins.
- Solder one row at a time to conserve heat. (800°F).
- Pins in each row are connected together.
- The fourth row is not connected electrically to the board.



Isolated Breadboard Bipolar Power Supply Assembly
Heyco 2536 Feet (mechanical)

- Insert the Heyco 2536 feet one at a time.
- Use the screwdriver and a little force to spread the crown.



Isolated Breadboard Bipolar Power Supply Assembly

Final Steps

- Your power supply board is now fully populated.
- Insert powered USB cable.
- Turn on switch.
- Lighted Blue and Green LEDs indicate +/- 5V output.
- Clean up your work area.
- Ask your instructor for final instructions.

