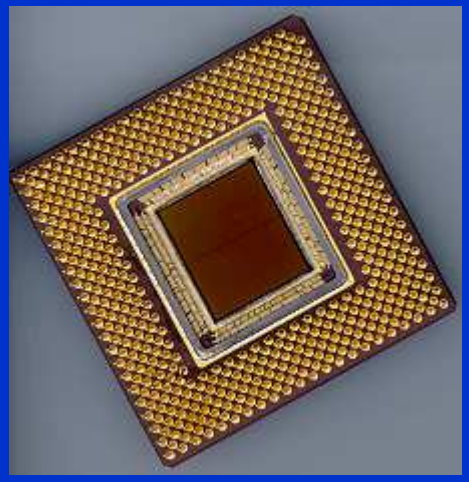


# ECE 477 Digital Systems Senior Design Project

## Module 9

## Board Assembly and Soldering Techniques

# Outline

- “I’ve got my board, now what?”
- “Which end of this thing gets hot?”
- “Flux is your friend.”
- “Static is your enemy.”
- “Do unto your iron, as you would have it do unto you.”
- “Everything is awesome, everything is cool when we’re part of a team.”

# "I've got my board, now what?" - 1

- Visually inspect board against printout of top/bottom copper
  - Confirm footprint and drill size of all parts
    - Minimum trace: 0.0049"
    - Minimum space: 0.0045"
    - Minimum finished hole size: 0.010"
  - If necessary, use drill press in lab to drill out any holes that need to be enlarged (e.g., headers)
    - Problem: your vias will already be plated!
  - Look for shorted traces and traces that got etched away (will be limited need to do this)
    - Using a sharp hobby knife, carefully scrape away copper that did not get etched between traces
    - "Fly wire" any traces that got etched away
    - If "major" problems – contact fab house for replacement

# "I've got my board, now what?" - 2

- "Ohm out" traces, especially those with vias
  - probably not essential if you used traces > 8mil
- Install power supply components (diodes, voltage regulators, filter capacitors, etc.)
  - never **ever** attempt to solder a "live circuit"
  - test and "burn in" your power supply
  - measure all supply voltages and look at them on an oscilloscope to determine how "quiet" they are
  - make sure correct supply voltage appears at correct pins of each IC and that, *under load* (a resistor), are within tolerance
  - note that some SMPS circuits will not function without a load – use an appropriately sized resistor

# "I've got my board, now what?" - 3

- Install all bulk and bypass capacitors and test all supply rails *again* to make sure nothing got "shorted" in the process
- Install microcontroller, reset circuit, crystal (or oscillator) circuit, flash programming header, and any other test points/headers
  - power up the board and "smoke test" (hint: if the microcontroller starts to get warm real fast, something is wrong!)
  - load a simple "heartbeat" program that toggles a port pin – verify basic functionality

# “I’ve got my board, now what?” - 4

- Install  RS232 level translator chip (where applicable) and associated components (9-pin D connector, capacitors, etc.)
  - power up and “smoke test”
  - load a simple program that “echoes” data to/from a virtual terminal – verify basic functionality “HELLO WORLD”
- Add each interface circuit to your board block-by-block and “smoke test” each one as well as test/verify functionality

# "I've got my board, now what?" - 5

**It is very important that each interface circuit be constructed and tested block-by-block!**

**Don't add "new" circuitry until all the "existing" circuitry is fully functional!!**

**NOTE: If you need to "fly wire" any signal traces, use 30 gauge "wire-wrap" wire (use thicker wire, e.g., solid 24 gauge, for power and ground connections)**

# "Which end of this thing gets hot?" - 1

- Heat transfer: solder will flow from the colder region to the warmer region *if it can*
- Secret
  - choose the right iron tip (and temperature) so the warm region will be effective
  - position the iron correctly so the solder flows in a path that makes sense
  - provide an environment for the solder to flow – need *flux* and clean, smooth metal surface
  - never **ever** attempt to solder a "live circuit"

# "Which end of this thing gets hot?" - 2

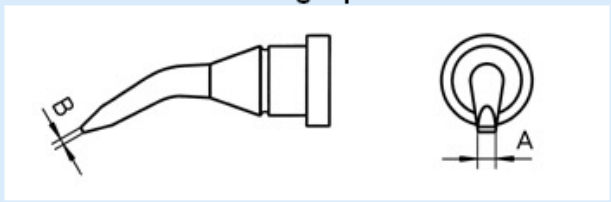
- Tip selection
  - different types: point, blade, chisel
  - bottom line: want to "match" geometry of surface area warmed by tip with geometry of surface area to be soldered
    - conical (point) tip $\rightarrow$ circular area
    - screwdriver (blade) tip $\rightarrow$ rectangular area
    - chisel tip $\rightarrow$ triangular region
  - if the tip is *too small*, it is difficult to get enough heat transfer for the solder to flow
  - if the tip is *too large*, the flow of solder cannot be contained in a small area

# Name That Tip

Chisel Soldering Tip .125" 700°F, Alternate for Weller PTC7


chisel (bevel)

LT Series Bent Chisel Soldering Tip .032 x .063" for WSP80 Iron




bent chisel

Screwdriver Soldering Tip .031" 600°F, Alternate for Weller PTH6


screwdriver (blade)

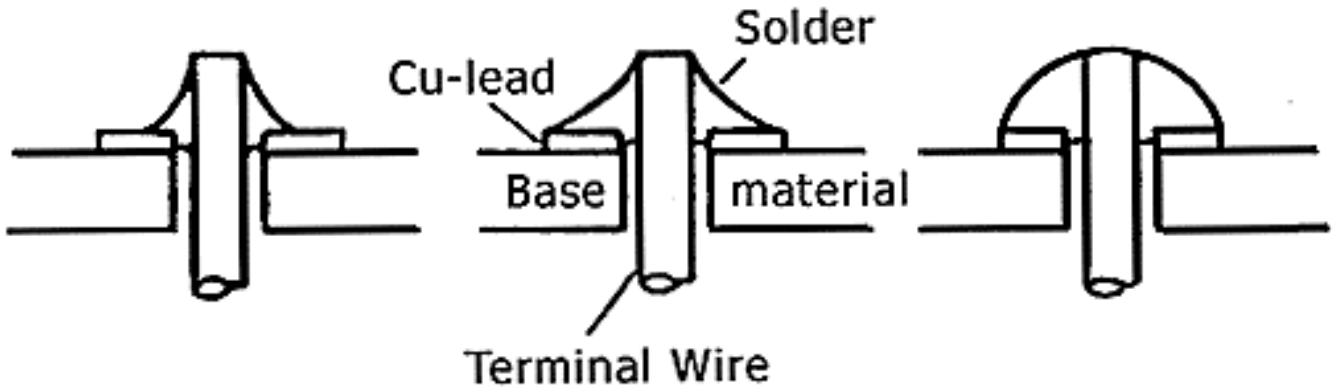
Conical Soldering Tip .031" 700°F, Alternate for Weller PTP7


conical (point)

# "Which end of this thing gets hot?" - 3

- Tip selection
  - note that chisel (bevel) and screwdriver tips can be very useful for:
    - soldering groups of pins "at once" on surface-mount devices
    - removing "solder bridges" among several pins at once
- Basic soldering technique
  - if needed, apply flux with pen/brush (e.g., for fine-pitch surface-mount components)
  - heat area with iron tip (2-3 seconds)
  - apply solder and allow to flow
  - remove heat and allow to cool

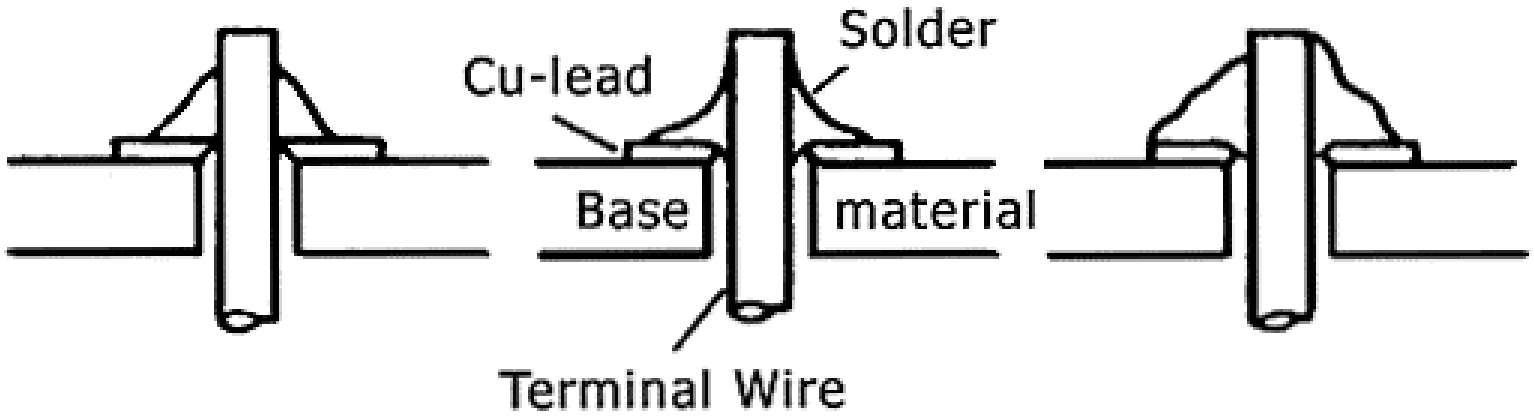
# Using the Right Amount of Solder




a) Minimal  b) Optimal  c) Excessive

see http://www.elexp.com/t_solder.htm

# What's Wrong With These Pictures?

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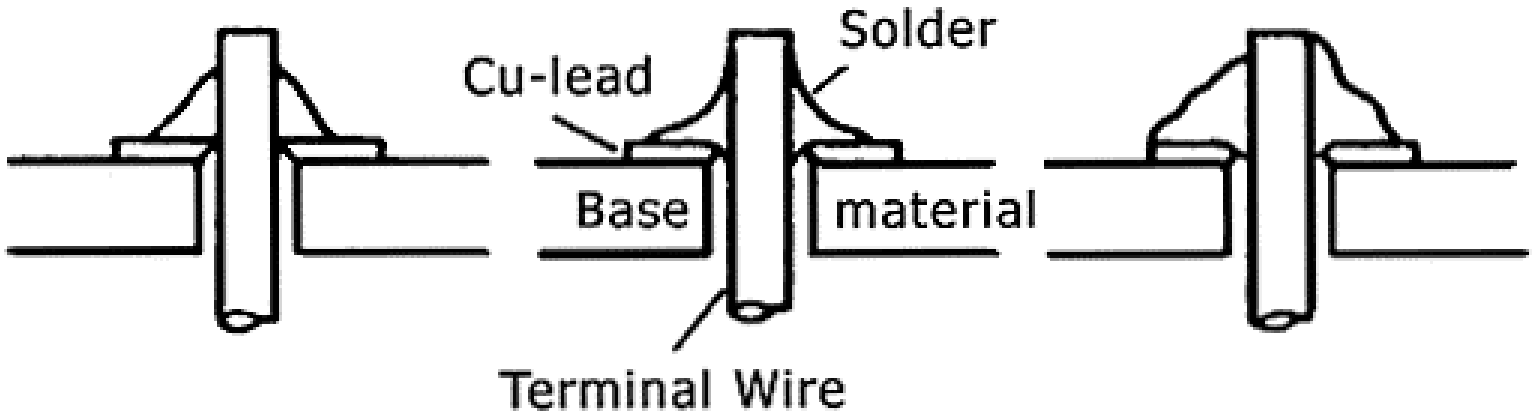


Bad soldering of terminal wire

see http://www.elexp.com/t_solder.htm

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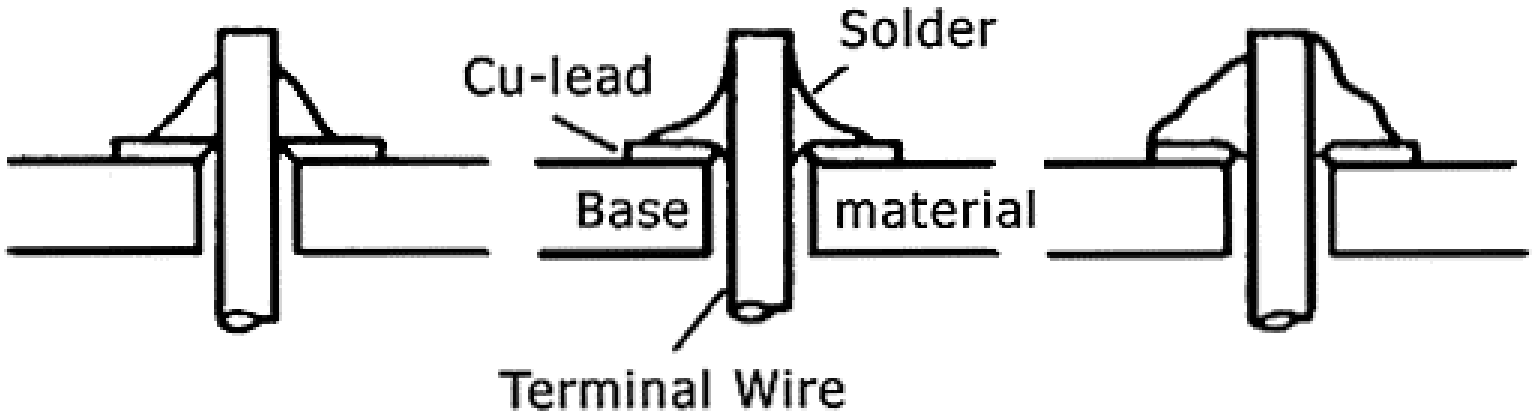
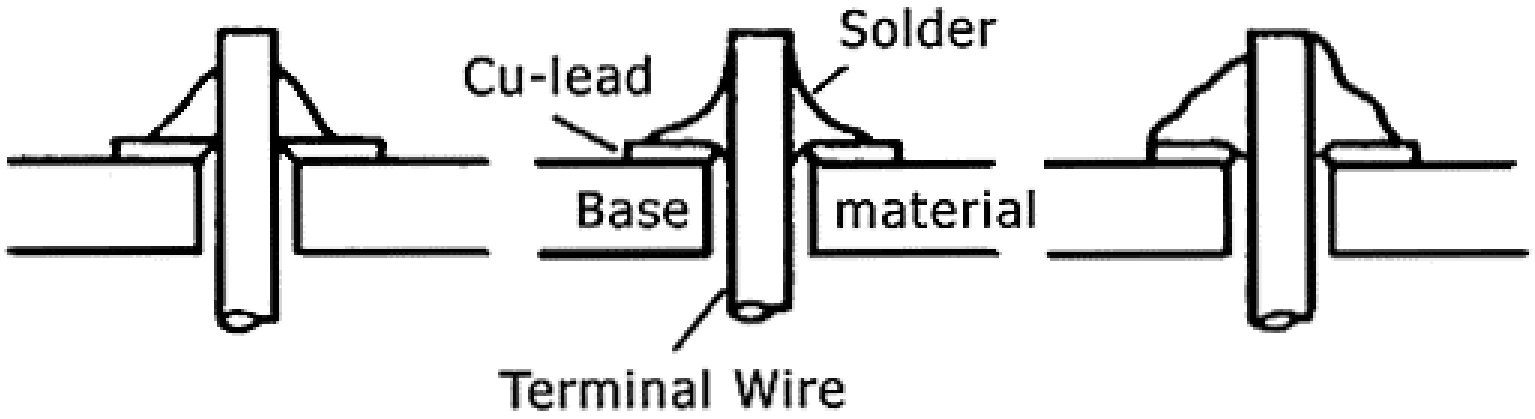



Bad soldering of terminal wire

Bad soldering of PCB pad

see http://www.elexp.com/t_solder.htm

# What's Wrong With These Pictures?




Bad soldering of terminal wire

Bad soldering of PCB pad

Bad soldering of both (solder did not flow properly)

see http://www.elexp.com/t_solder.htm

# "Which end of this thing gets hot?" - 4

- Solder removal (de-soldering)
  - apply flux (if necessary)
  - heat area to be de-soldered (surface-mount parts require a special heat gun to do this)
  - use solder wick (copper braid) or "solder sucker" to remove solder
- Cautions
  - "cold" solder joints (solder did not flow)
  - too much heat (components will be damaged and/or traces will peel off board)
  - access (be careful about assembly order!)
  - examine solder joints of surface mount components using microscope

# "Flux is your friend."

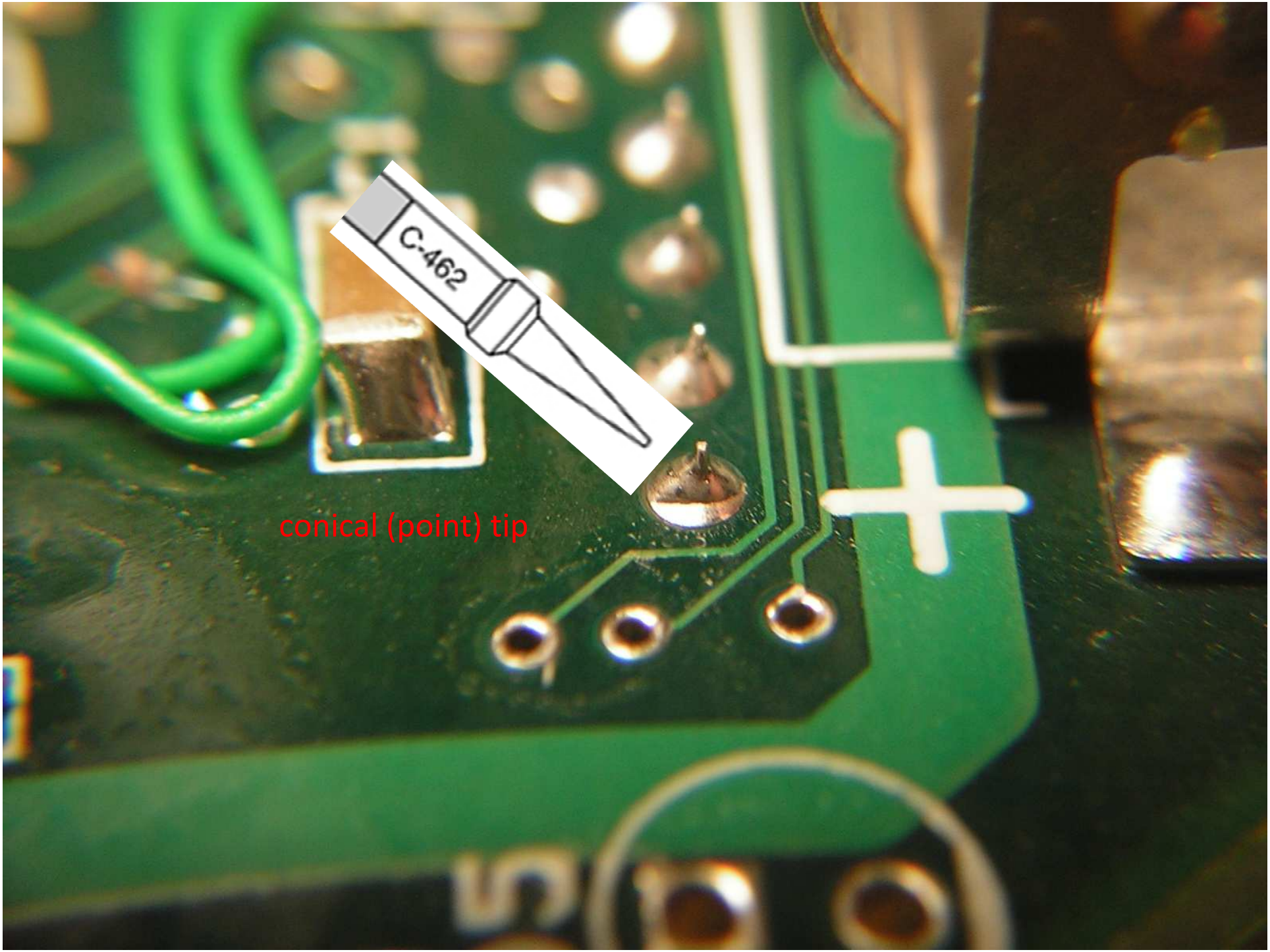
- Flux is a liquid in which solder can flow
- Most "electronic" solder contains some flux
- Without flux, solder will be pasty and sticky (refuse to flow)
- *The secret to soldering is using flux to make solder flow, and then controlling the heat so it flows under control*

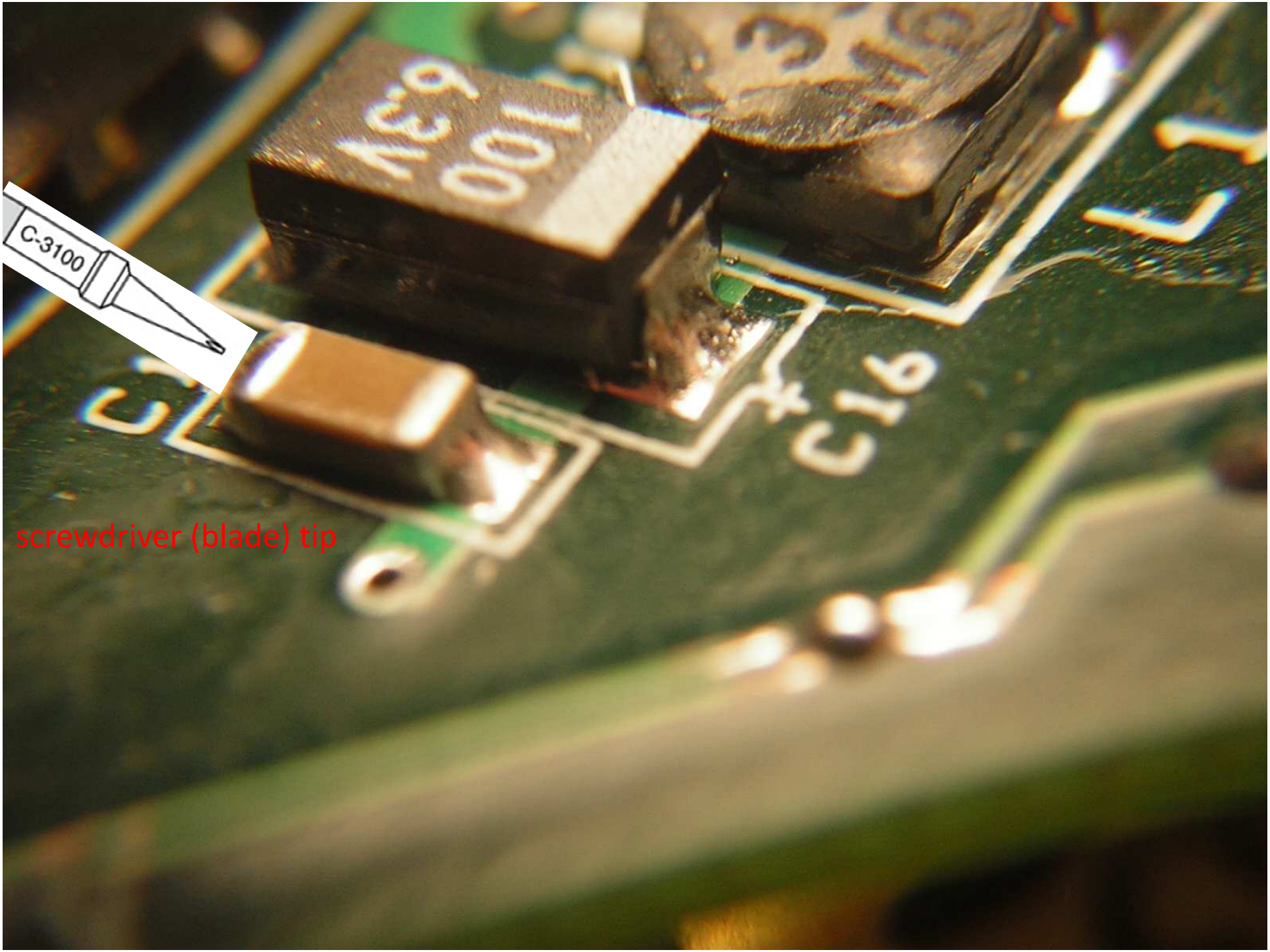
# "Static is your enemy."

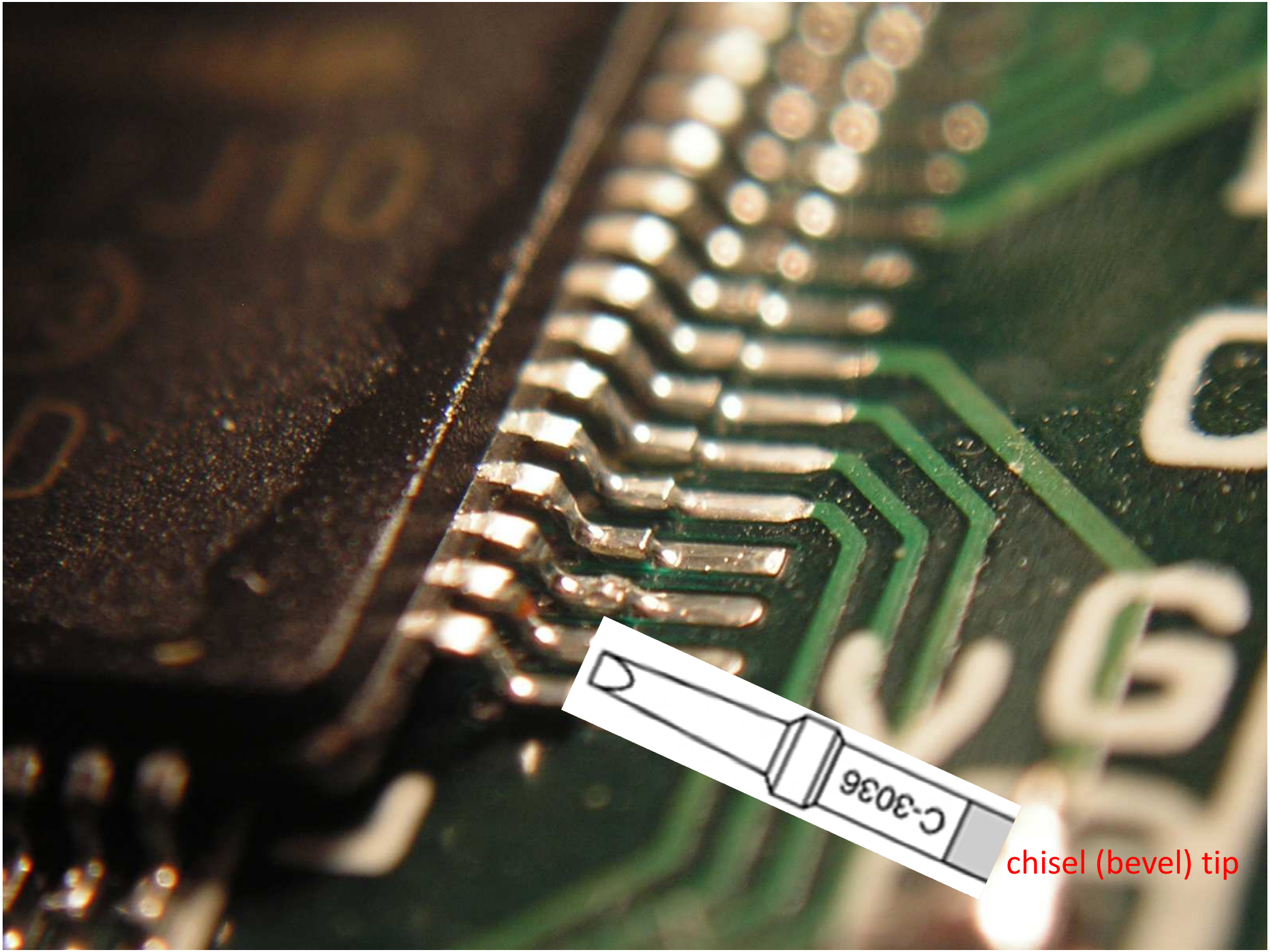
- Many of the parts you will be using are *static sensitive* (can be damaged by ESD)
- *To avoid damaging your components, do all of your board construction on the anti-static (gray or blue) mats in lab*
- *When soldering, use an anti-static wrist band and make sure it is connected to ground*

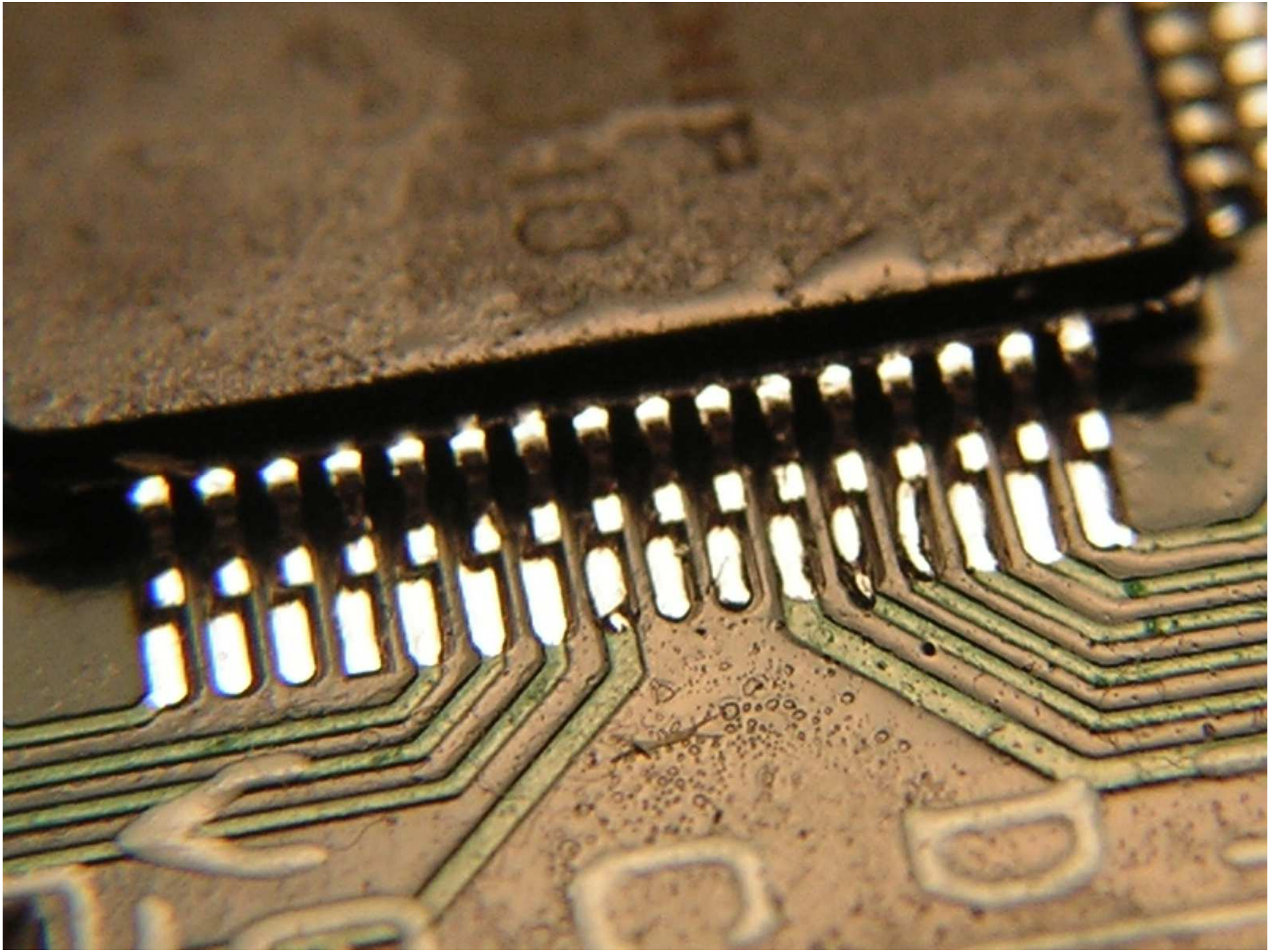
# "Do unto your iron, as you would have it do unto you."

- Wet the sponge with distilled water ***before*** you begin
- Choose the iron with the appropriate tip for the job and set the temperature accordingly (bent chisel is a good place to start)
- Tin and clean the tip *before* starting
- Clean the tip *frequently* during use
- Tin the tip when you are finished and **TURN OFF** the iron
- Use soldering irons only for soldering!


C-462
conical (point) tip


C-3100
C16
screwdriver (blade) tip


C-3036
chisel (bevel) tip



"Everything is awesome, everything is cool when we're part of a team."

- Professional SMT Soldering Demo
- Fine Pitch Drag Soldering
- Leaded vs. Lead-Free Solder
- Circuit Board Manufacturing
- SMD Removal Using a Chip Quik Kit
- Everything is Awesome!