



# Hands-On SMT Soldering

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*Kim Concillado*

# Hi

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*Aaron Bonnell-Kangas*

- ECE grad student
- Z750
- MetaFilter
- Giant Eagle frozen pierogies
  - Name brand way too expensive



*Kim Concillado*

- ECE undergrad student
- Ninja 250
- Tumblr
- Ravioli



# Buckeye Current

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- We're a student project team at the Center for Automotive Research
- We design, build, and race electric motorcycles

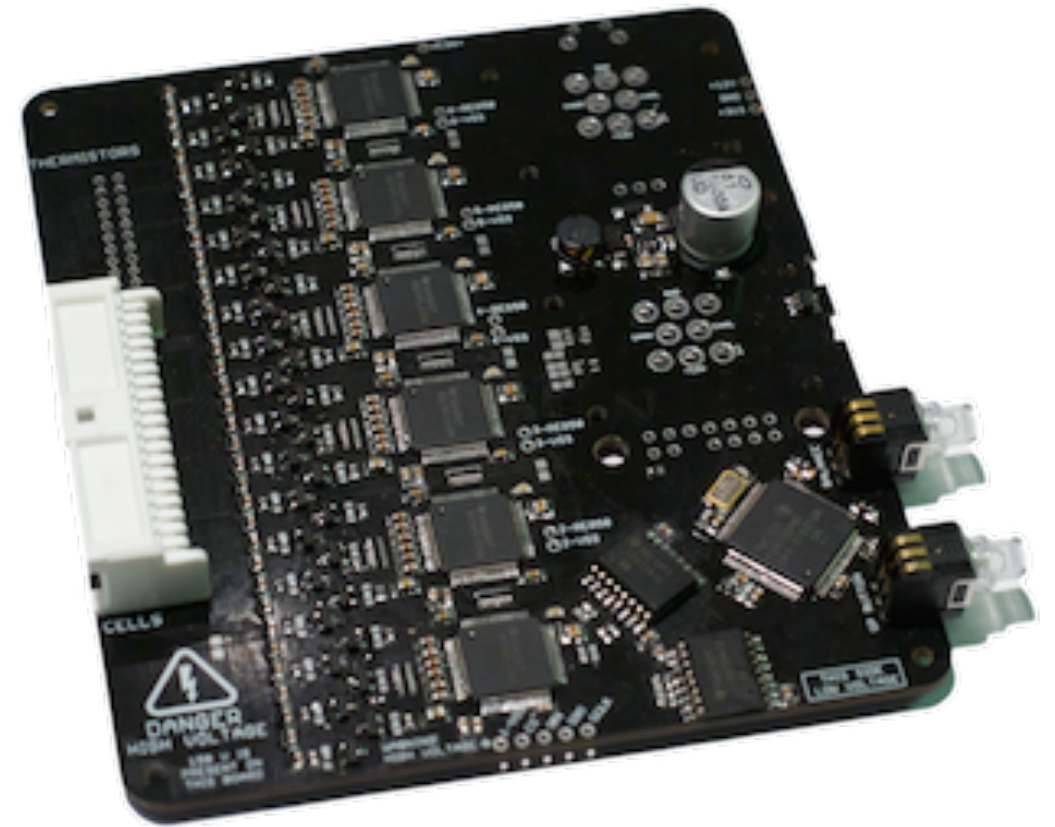




# Buckeye Current

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- We do a lot of electronic hardware design
- For the past 2-3 years we've been working on low-cost, practical methods to assemble complex PCBs
- It's going okay



# Agenda

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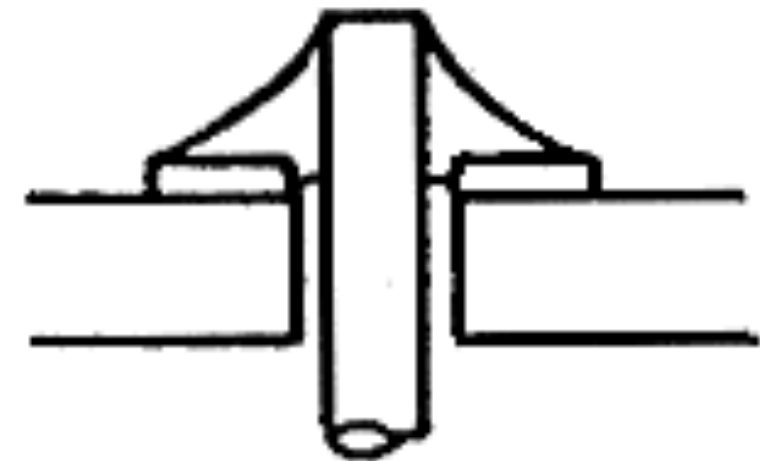
- A little bit of background
- A little bit of technique
- A little bit about the project
- Make it!



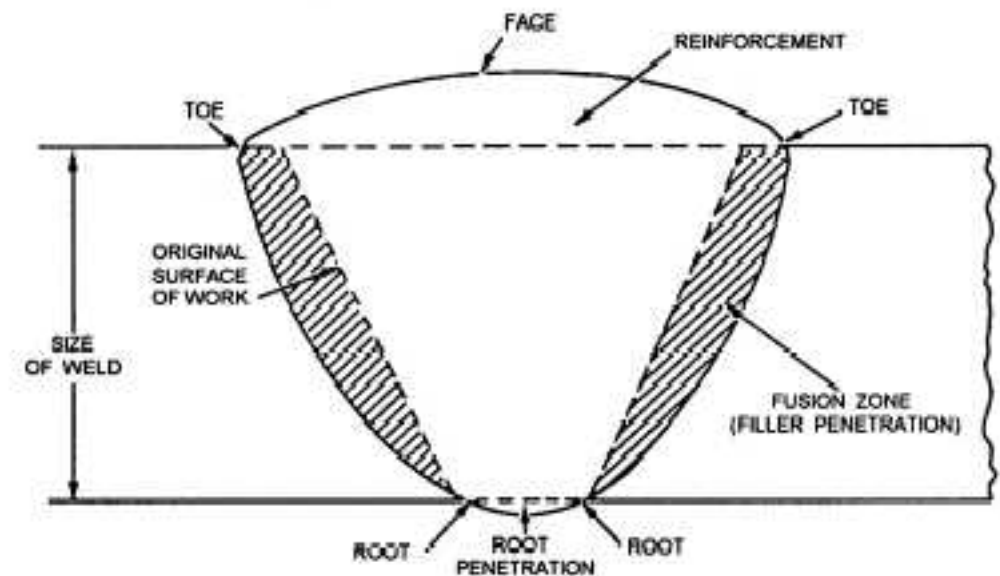
# What is soldering?

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- A soldered joint is made by joining two materials together with a filler metal
- Compare to *welding*: joining two materials together by melting them and fusing them
- A good solder joint provides mechanical and electrical connections



*Soldered joint*



*Welded joint*

# What is solder?

- An alloy with a convenient melting point

- Commonly used solders:

- Lead-based

- “63/37”: 63% lead, 37% tin (eutectic)
- “60/40”: 60% lead, 40% tin

- Lead-free formulations

- Tin-silver-copper (SAC)
- Tin-copper (SnCu)

- We’re working with lead-based solder

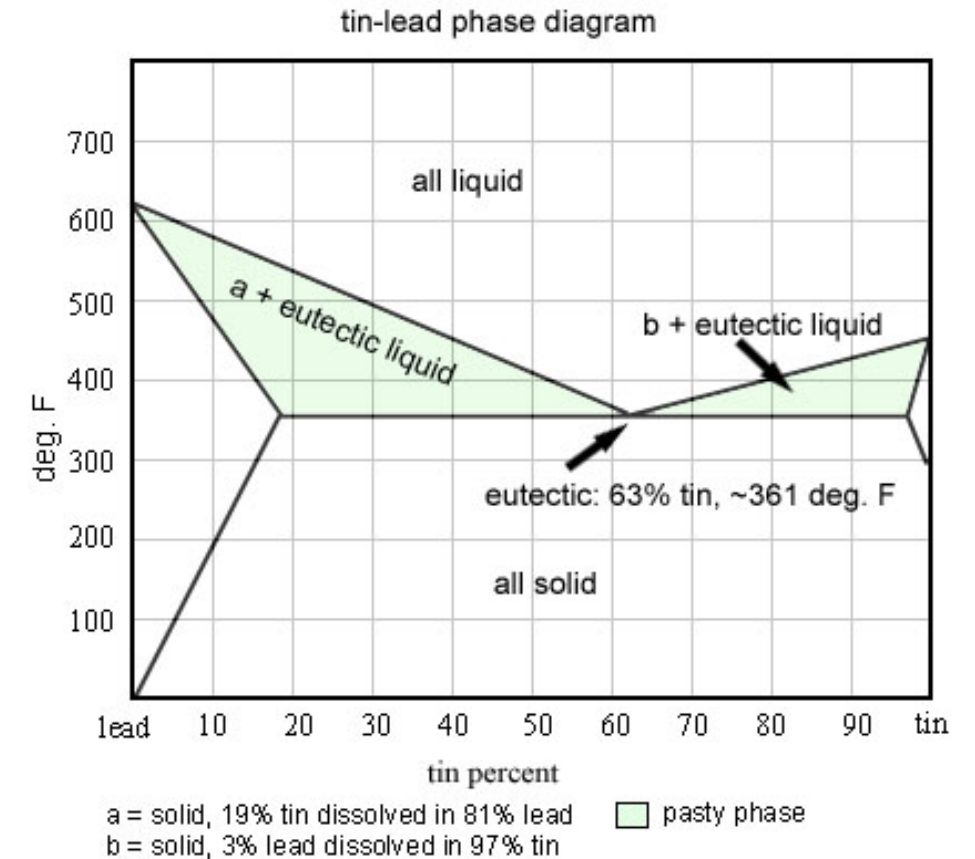
- Better wetting characteristics

- Lower melting point

- 182°C (63/37 Sn/Pb) vs. 217°C (SnAg3Cu.5)

- Lead is not absorbed through the skin, but if it is present on your hands after soldering, it can be accidentally ingested

- Wash your hands after soldering!



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# Flux

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- Everything you are soldering is dirty!
  - Pads and parts on your PCB have thin oxide layers
  - Your solder has an oxide layer
  - These oxides inhibit solder wetting and bond formation
- Flux is a mild acid that attacks these oxide layers while you're soldering
  - Also protects joint from oxygen (in the air) until soldering is done
- Available in many varieties and forms:
  - Rosin flux: generally made from tree resins
  - Water-soluble flux: proprietary formulations that dissolve in water for cleaning
  - “No-clean” flux: mild enough not to require removal
- Formats
  - Flux-core solder
  - Liquid/paste flux
  - Flux pens



*Flux-core solder*



*Paste flux*



*Flux pen*



# Surface-mount devices

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- Why SMT?
  - Size reduction and PCB layout
  - Many components are now only available in SMD



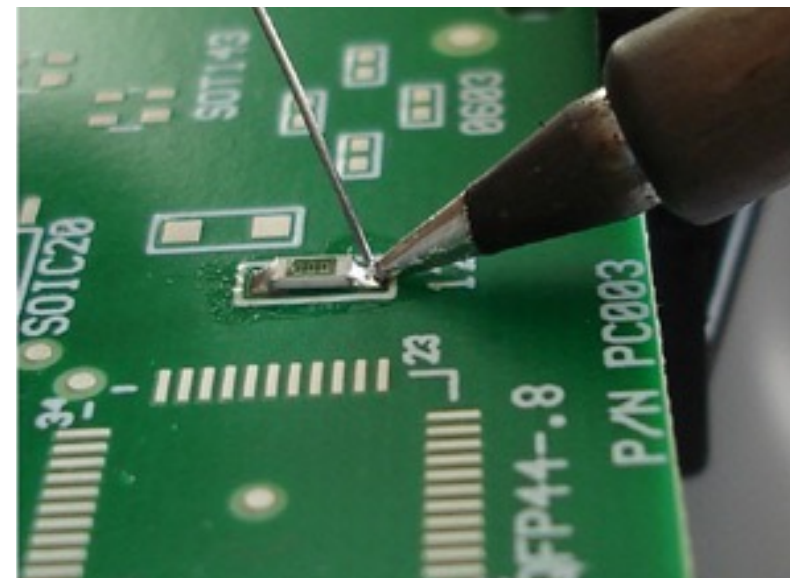
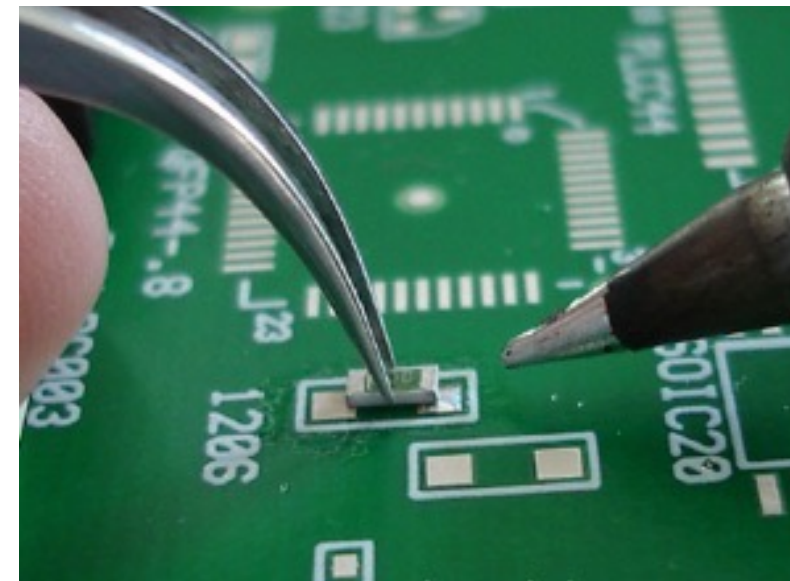
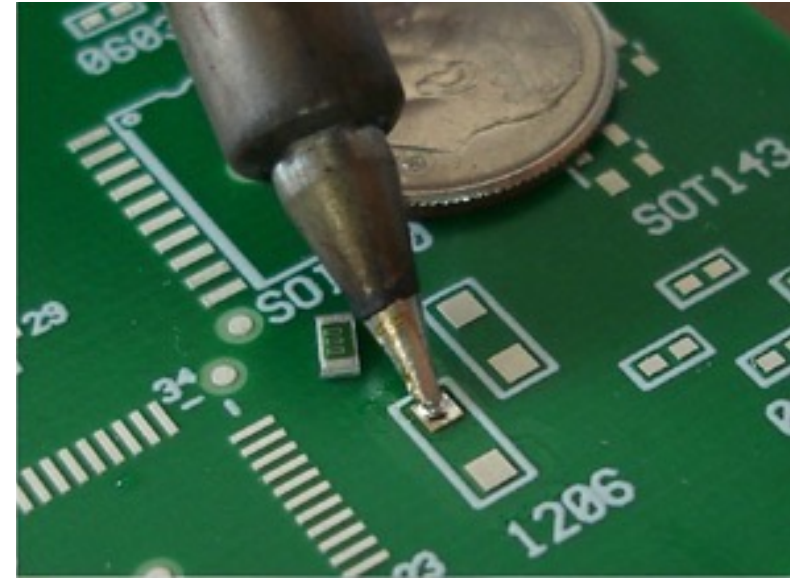
# Soldering 1-2-3

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1. Tin

2. Tack

3. Solder





# Soldering 1-2-3

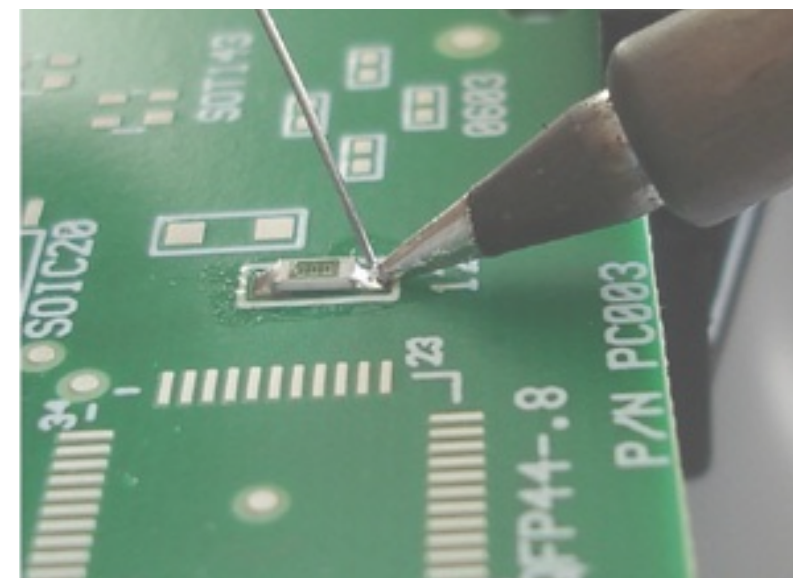
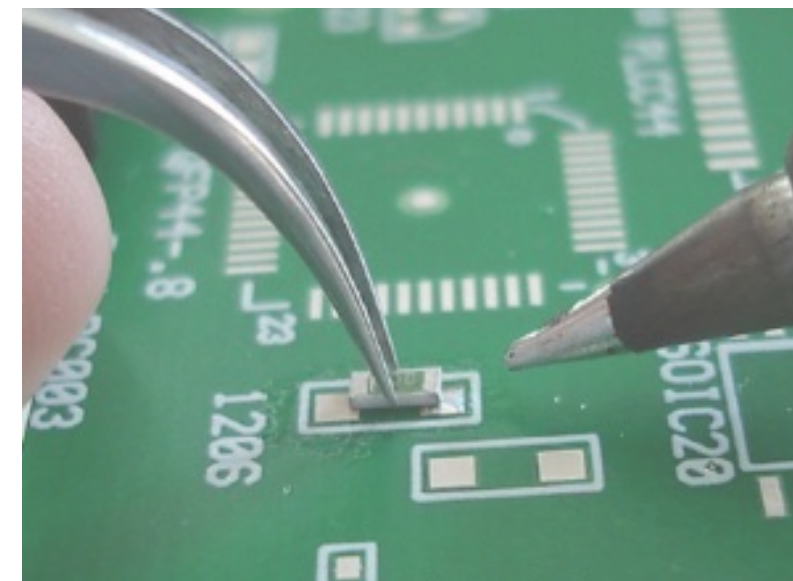
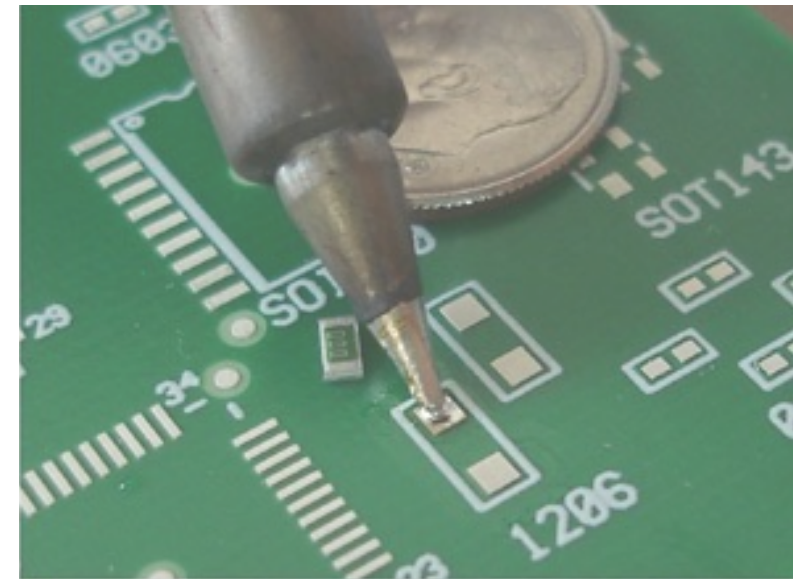
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## 1. Tin

- Add solder to one pad on the PCB.

## 2. Tack

## 3. Solder





# Soldering 1-2-3

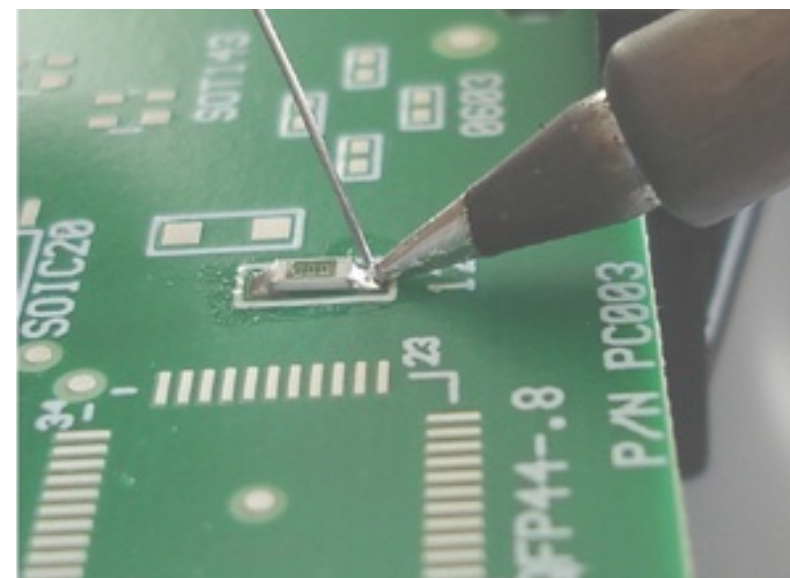
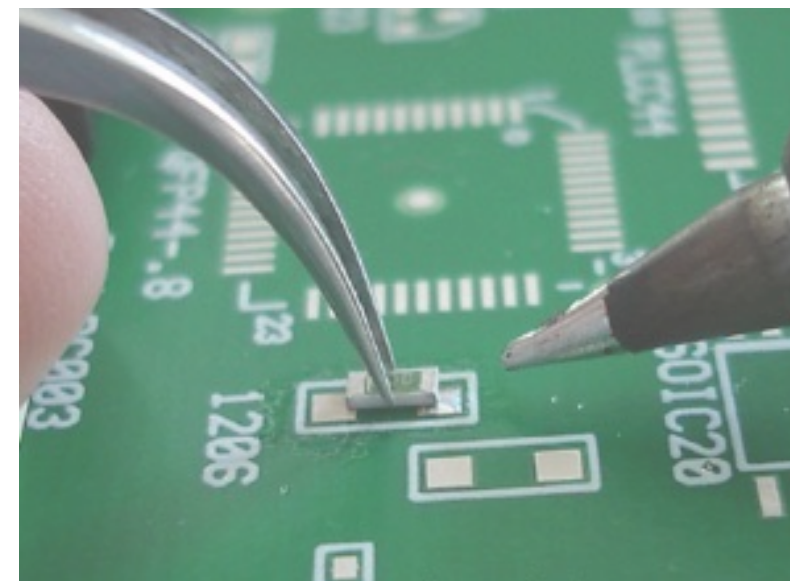
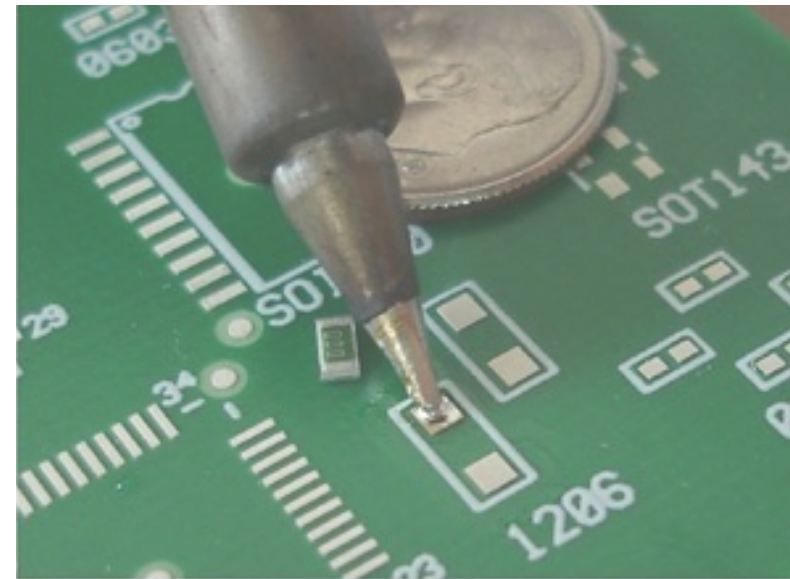
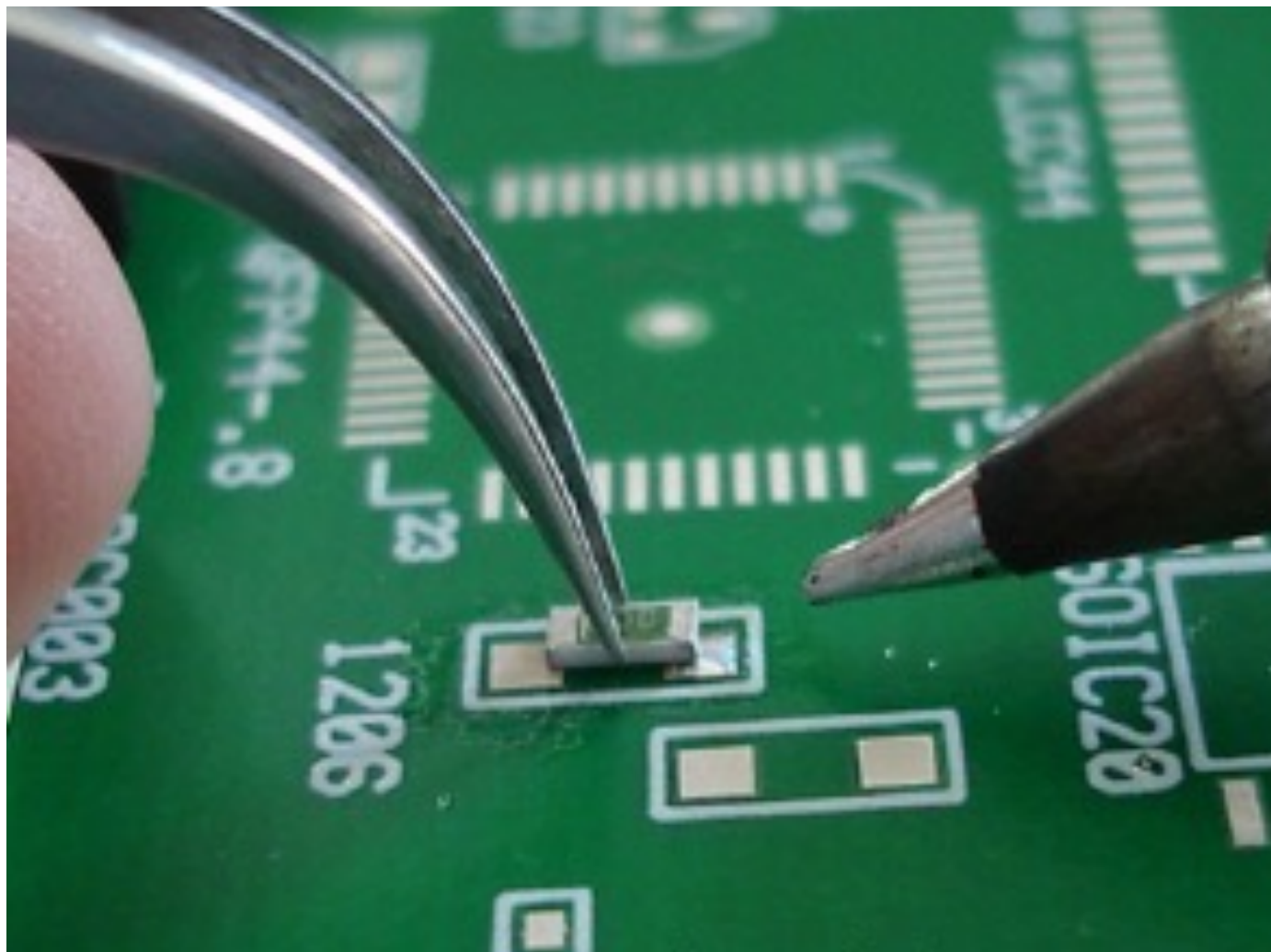
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1. Tin

## 2. Tack

- Hold the component with tweezers and melt the solder you applied.

3. Solder

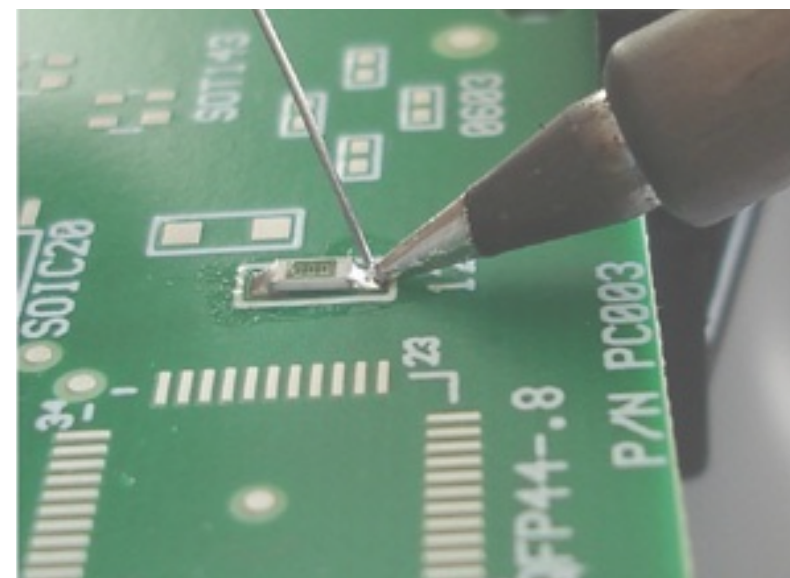
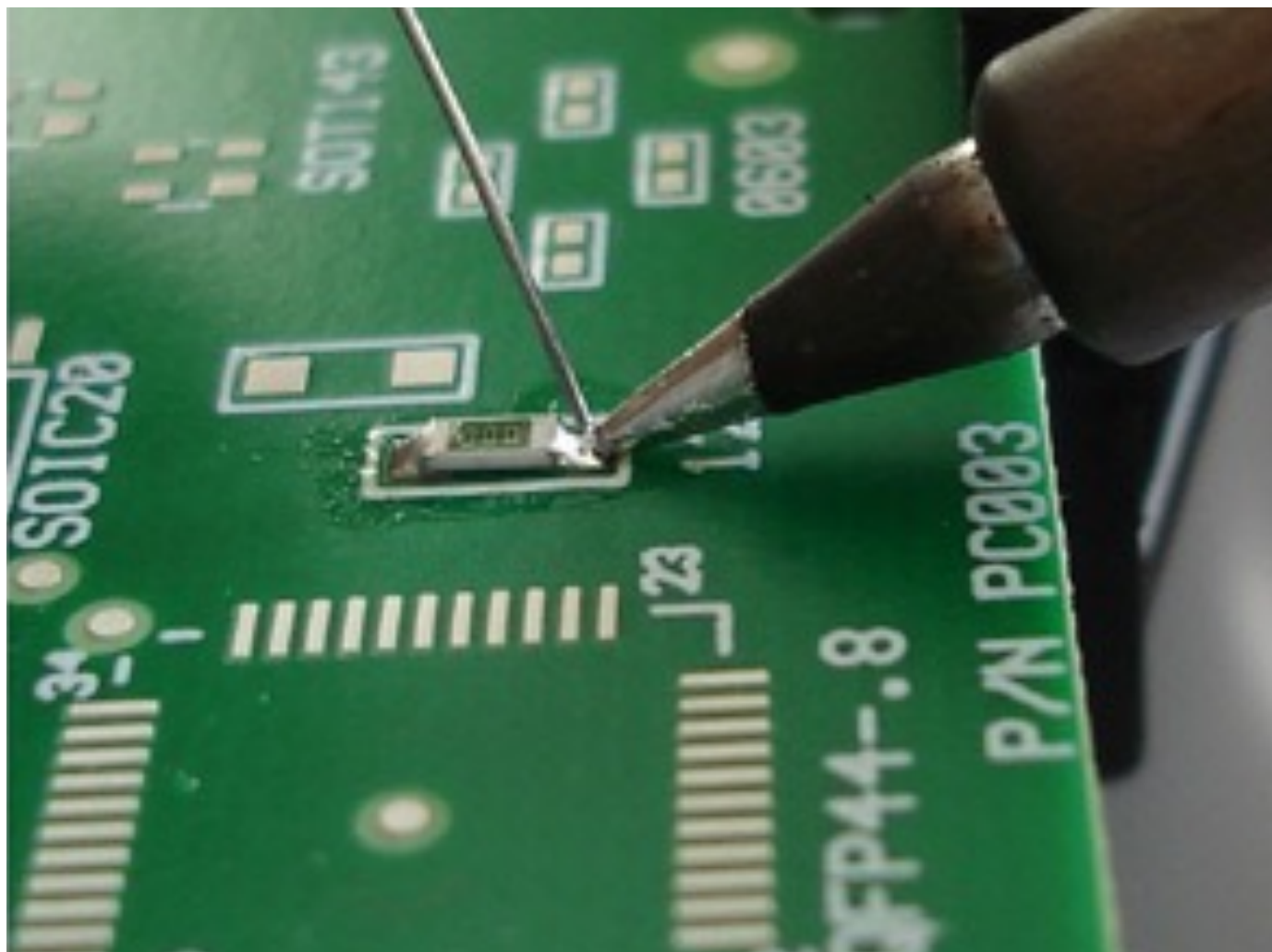
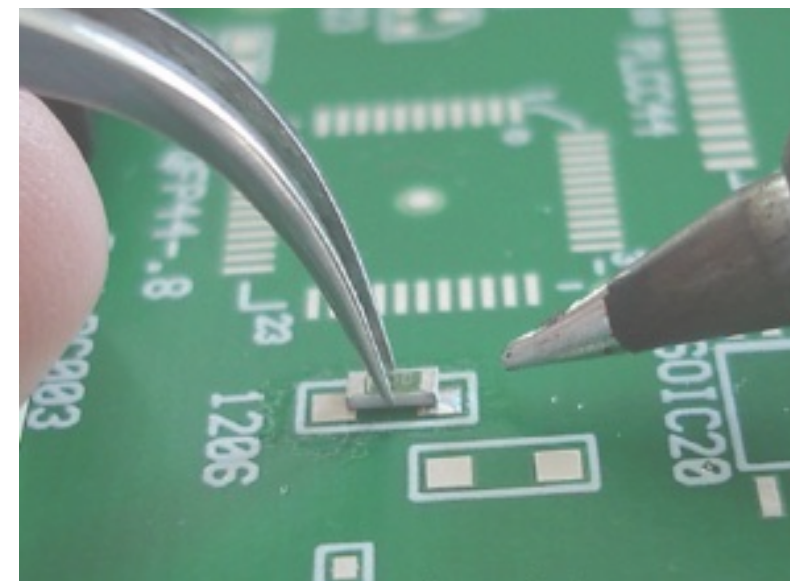
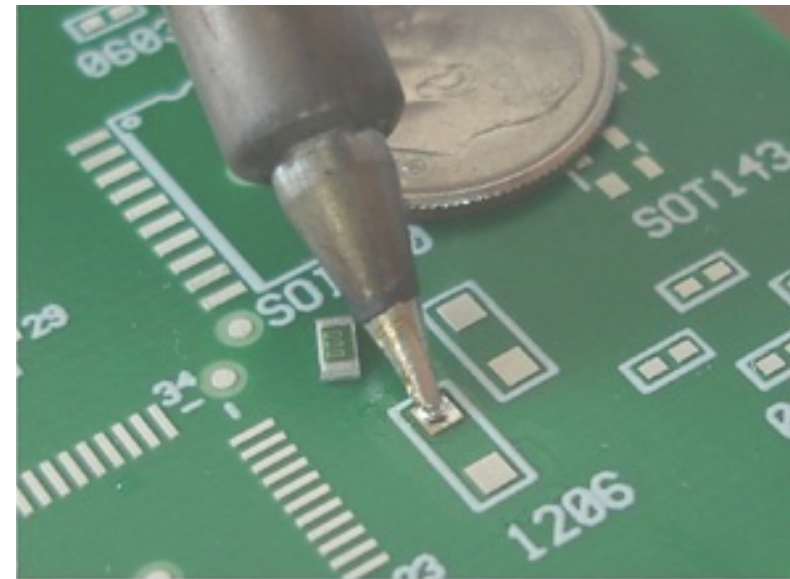




# Soldering 1-2-3

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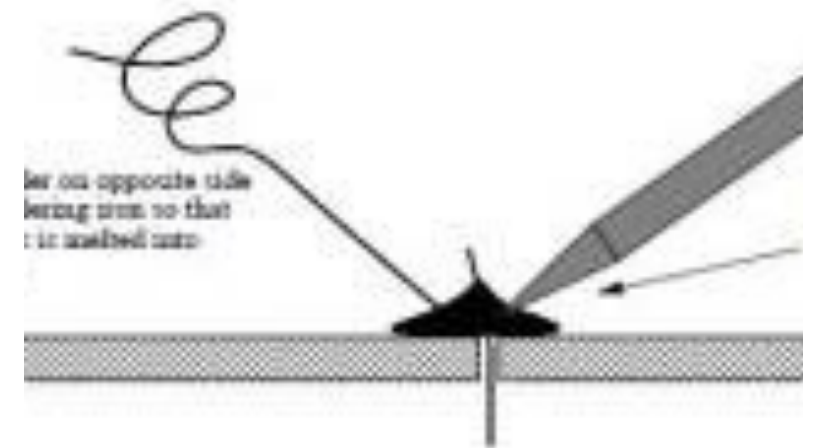
1. Tin
2. Tack
- 3. Solder**
  - Solder the other pins of the component.



# Heat and iron technique

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- Heat is the enemy!
  - Unfortunately it is also the tool
  - Overheating components (especially sensitive components like ICs) can cause them to fail
  - High iron temperature and long soldering times increase the heat delivered to the component
  - Solder at the lowest practical iron temperature, for the shortest practical time
    - Try 300-315 °C (575 - 600 °F) to start
- Iron technique
  - Your iron doesn't melt the solder - your joint does
  - Hold the iron on the component for a moment
  - Then feed in solder





# Station setup

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- Soldering iron
- Tweezers
- Helping hands
- Parts bag
- Solder
- Flux

