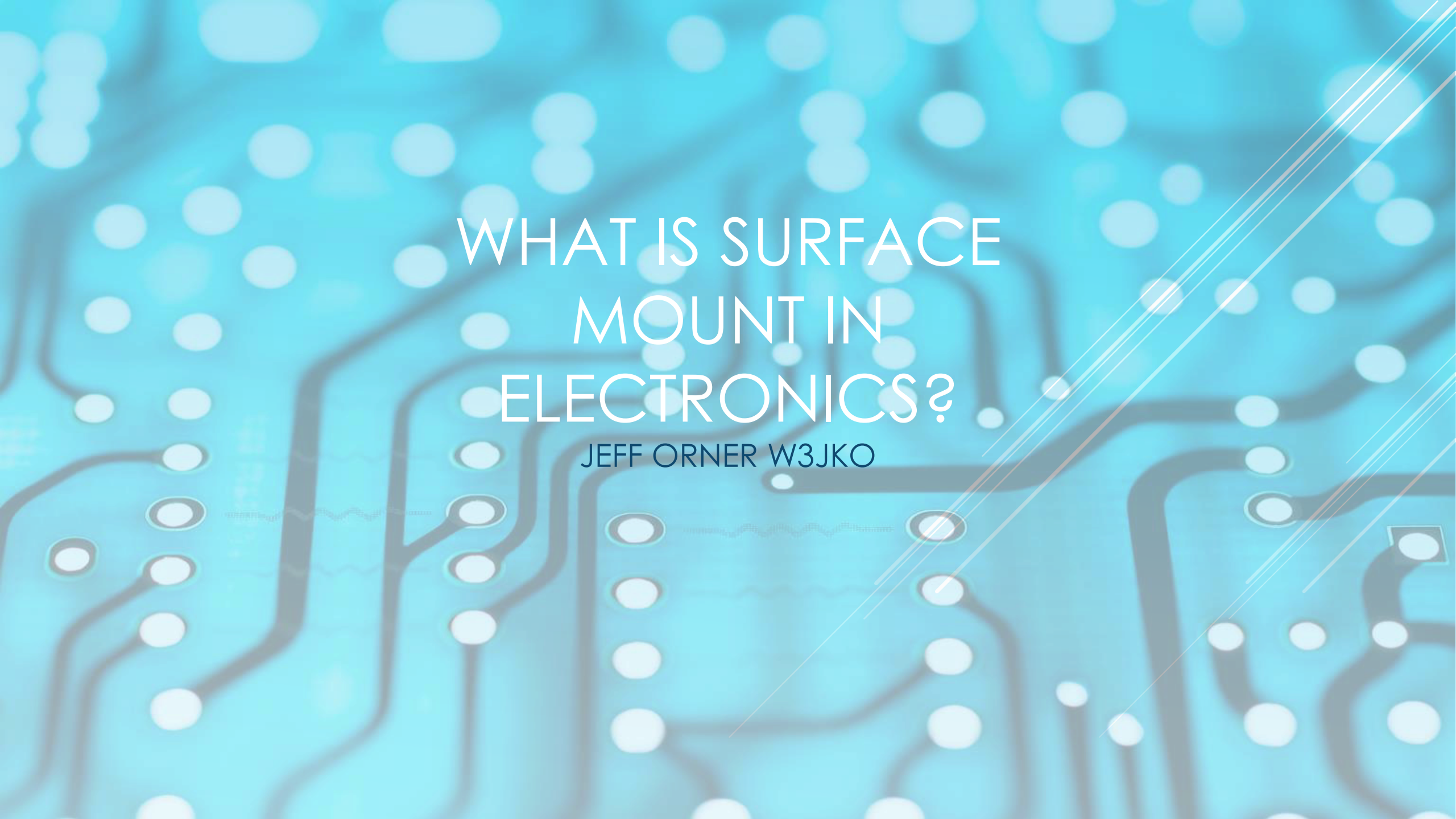


# Surface Mount Components

Jeff Orner – W3JKO

Open



# WHAT IS SURFACE MOUNT IN ELECTRONICS?

JEFF ORNER W3JKO





# AGENDA

- ▶ Some history on electronic circuits
- ▶ Show what surface mount parts are
- ▶ Review the steps manufacturers use to produce modern devices using surface mount
- ▶ Show the tools needed for SMD DIY
- ▶ Show the basic technique for SMD repair
- ▶ Discuss whether it makes sense to repair

# EVERYTHING IS GETTING SMALLER

- ▶ The size of everything keeps getting smaller.
- ▶ Devices have more features than ever before
- ▶ The smaller the components the smaller and more efficient the product can be





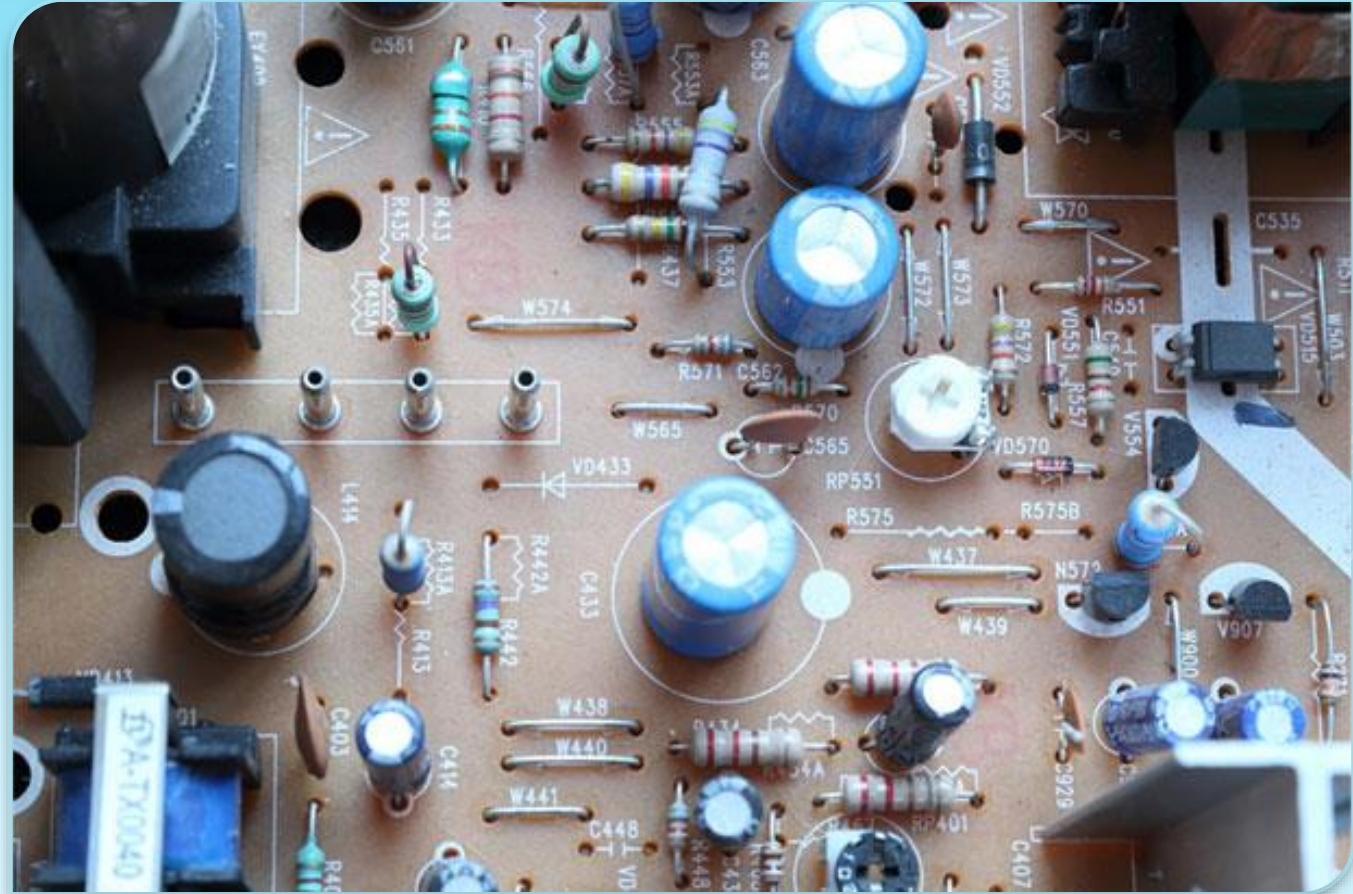
# THE EARLY YEARS: CHASSIS MOUNTING

- ▶ In the early days of electronics, major components were mounted atop a metal chassis
- ▶ All electrical connections were made using wire and components underneath
- ▶ This process required all manual labor to connect everything together



# MID 20<sup>TH</sup> CENTURY: PCB THROUGH HOLE

- ▶ In the 1960s the printed circuit board was developed
- ▶ Copper traces on the bottom of the board replaced hand wiring
- ▶ Components were placed into the board and soldered to make all connections
- ▶ This was a faster assembly but still required some operator intervention.



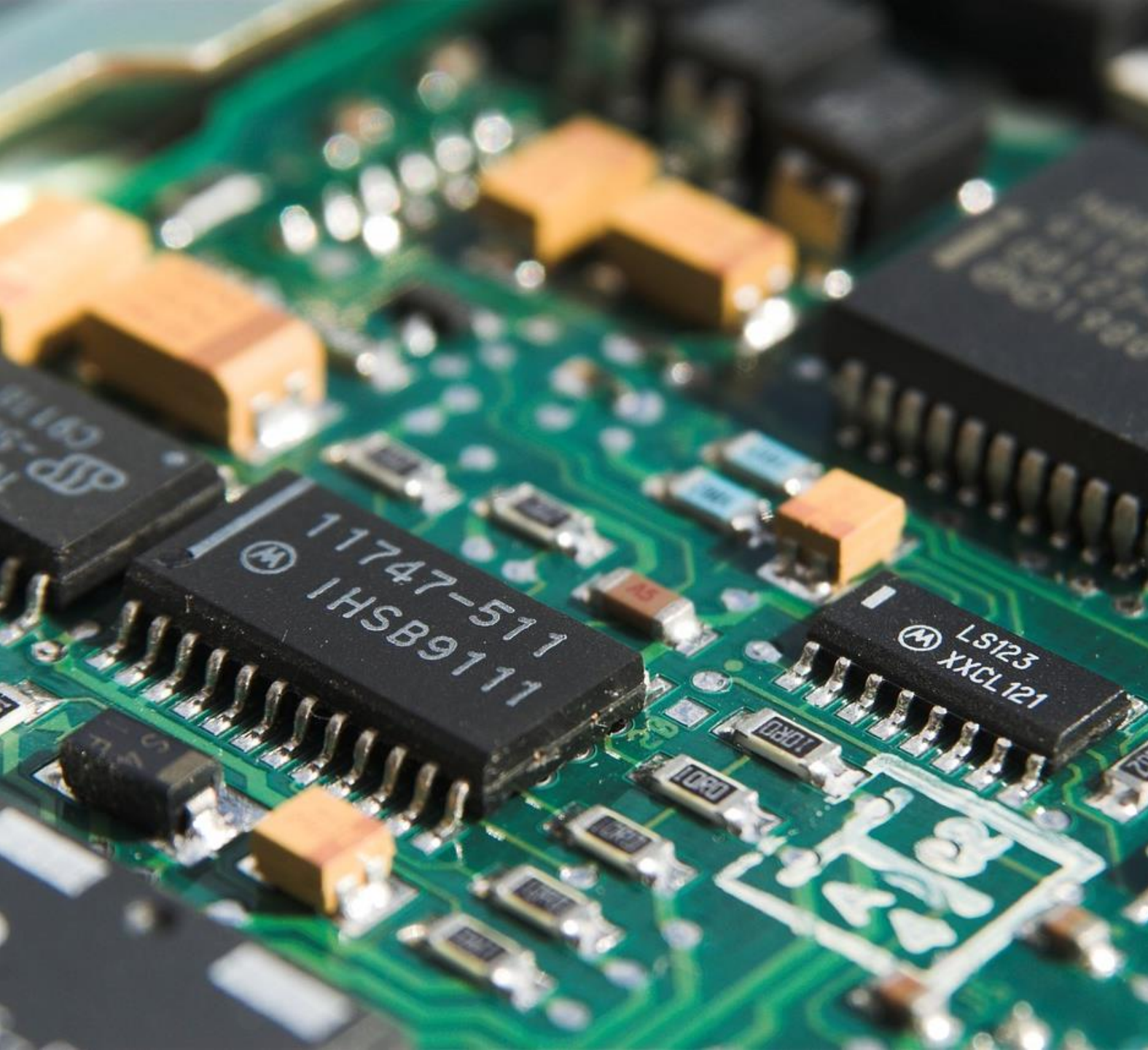


## 1980: SURFACE MOUNT WAS DEVELOPED

- ▶ Surface mounting of components on both sides of a PCB began use in the 1980s and took off in the 1990s with the proliferation of the PC market.
- ▶ Copper traces are still used top, bottom and inside the PCB
- ▶ Components are placed on the top and bottom of the board.
- ▶ This increased the component density and made assemblies smaller



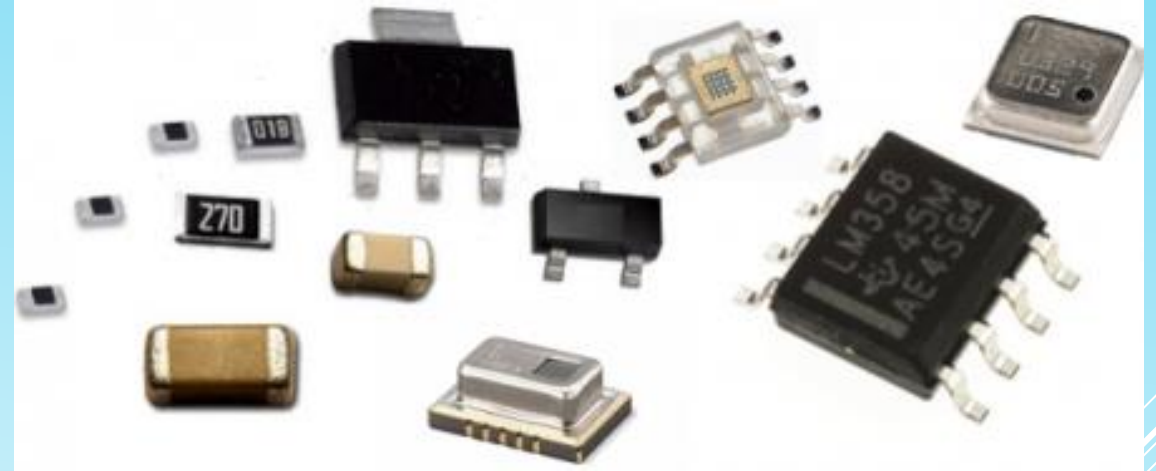




**WHAT IS SURFACE MOUNT?**

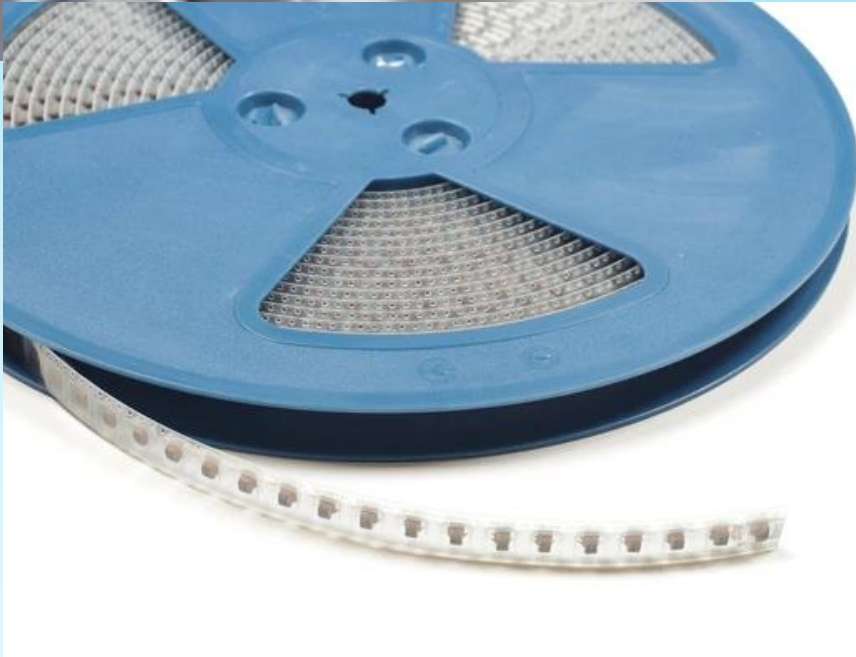
Surface Mount Technology is a method for assembling electronic components onto printed circuit boards (PCBs). Unlike traditional through-hole technology, where components have leads inserted through holes in the PCB, SMT involves mounting components directly onto the surface of the PCB. The SMT offers advantages such as smaller form factors and improved manufacturing efficiency and compatibility with the automated assembly processes

# SURFACE MOUNT COMPONENTS





# PART PACKAGING





# SOLDERING PARTS TO THE BOARD

- ▶ To solder parts to the PCB a paste of flux and small beads of solder is used.
- ▶ The tiny solder beads melt and form a continuous molten bead of solder which attaches the part to the board

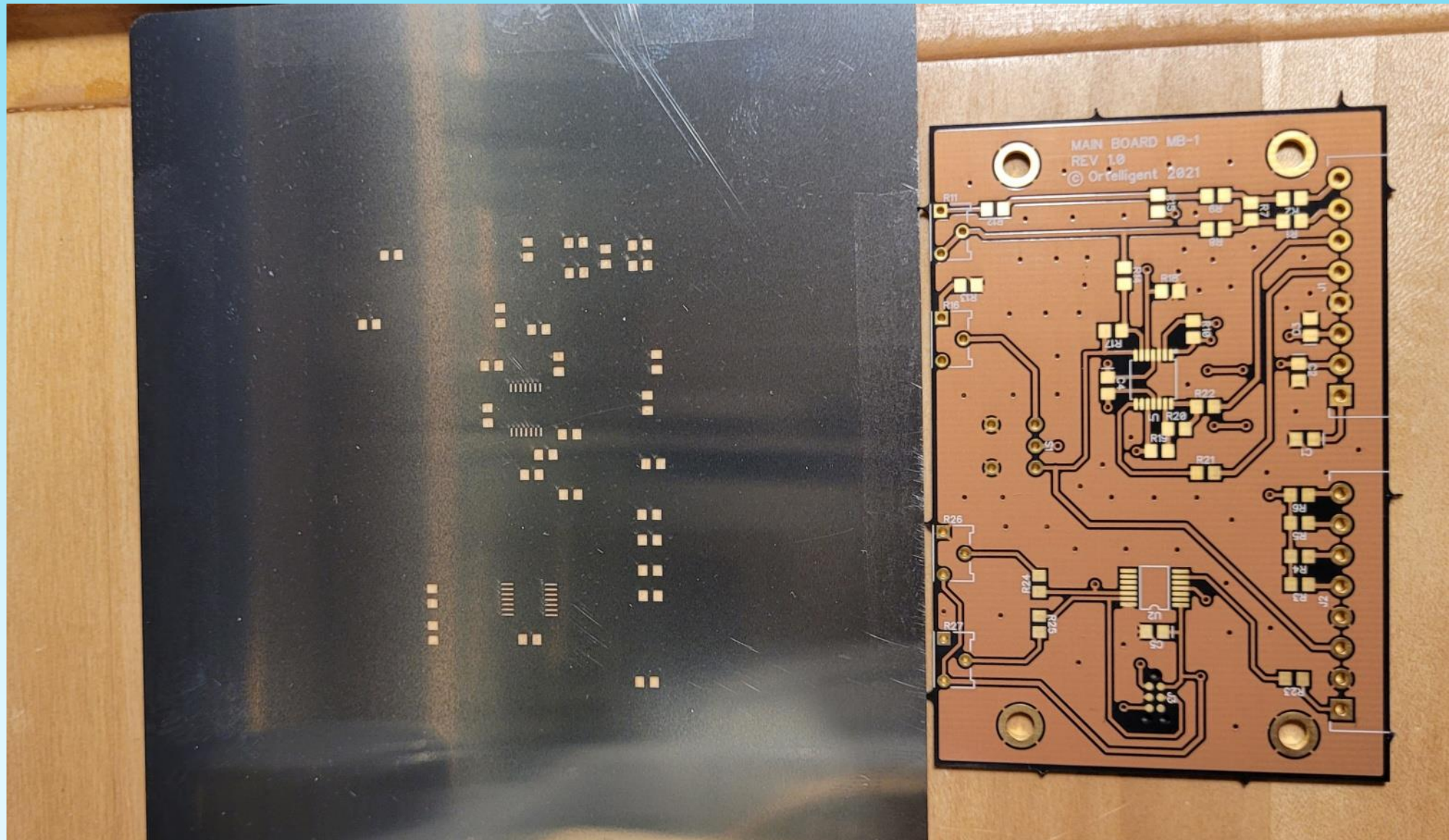




# SOLDERING PARTS TO THE BOARD

- ▶ A solder stencil is used to apply the paste to the pads on the PCB.
- ▶ This is done much like a silkscreen in making a t-shirt where the paste fills the openings in the stencil.
- ▶ This leaves lands of solder paste on each pad.







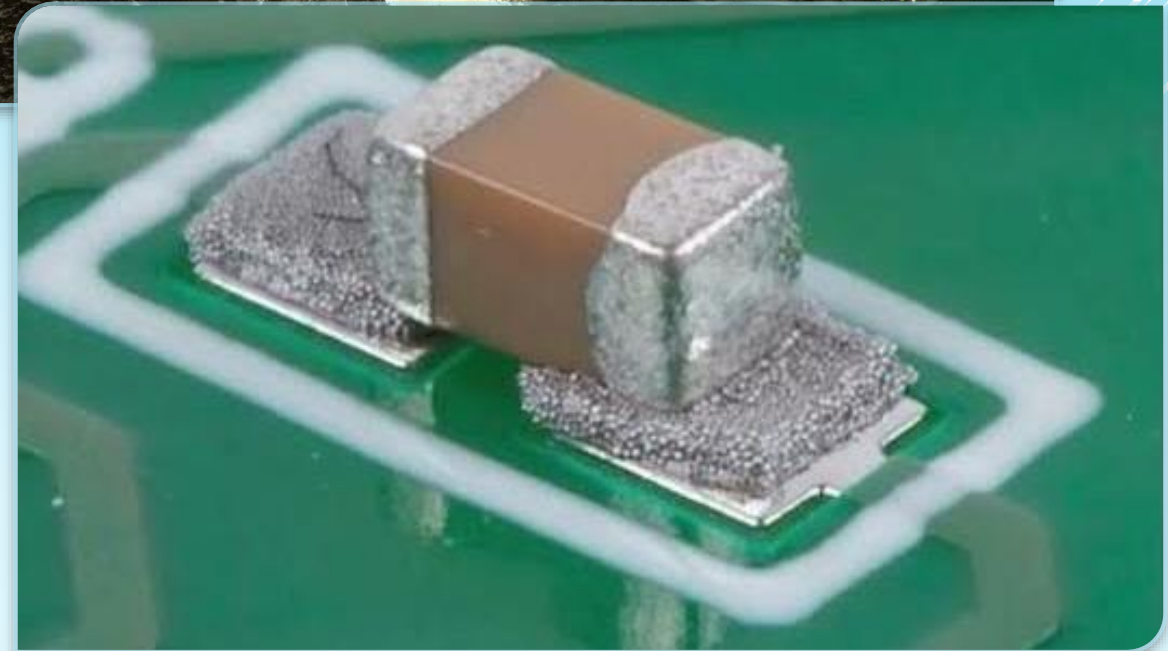






# SOLDERING PARTS TO THE BOARD

- ▶ The parts rest on top of the pads.
- ▶ Surface tension and the paste keeps the parts steady for the reflow process.
- ▶ The parts float on top of the paste and mis-aligned parts tend to right themselves and center on the pads.

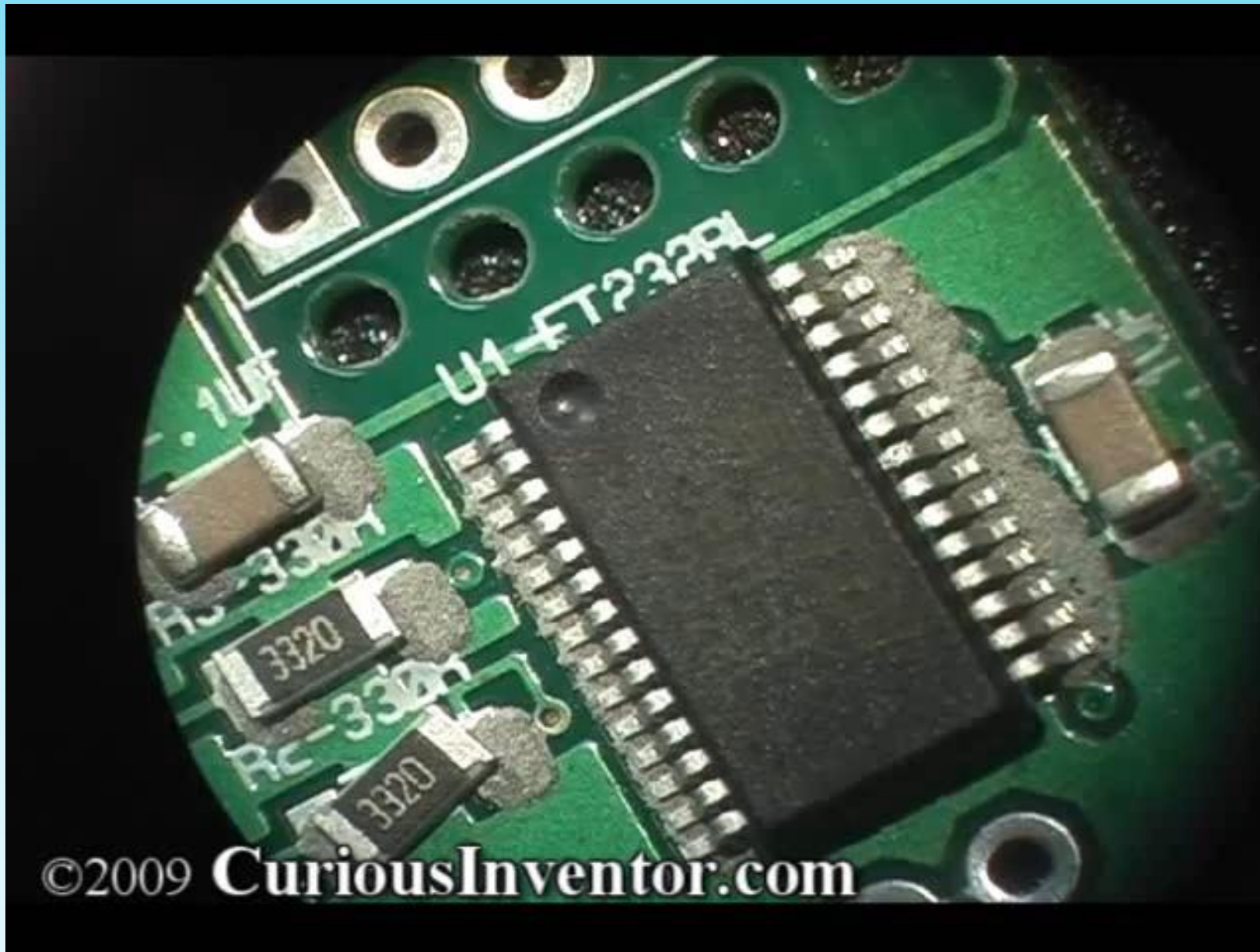


# MELTING THE SOLDER PASTE: REFLOW

- ▶ After the parts are placed on the PCB in the wet solder paste they go through a reflow process.
- ▶ This is an oven with a conveyor that slowly heats the boards to the melting point and cools them as they progress through the oven
- ▶ This is a controlled process to ensure no damage to the parts and proper melting of the solder paste



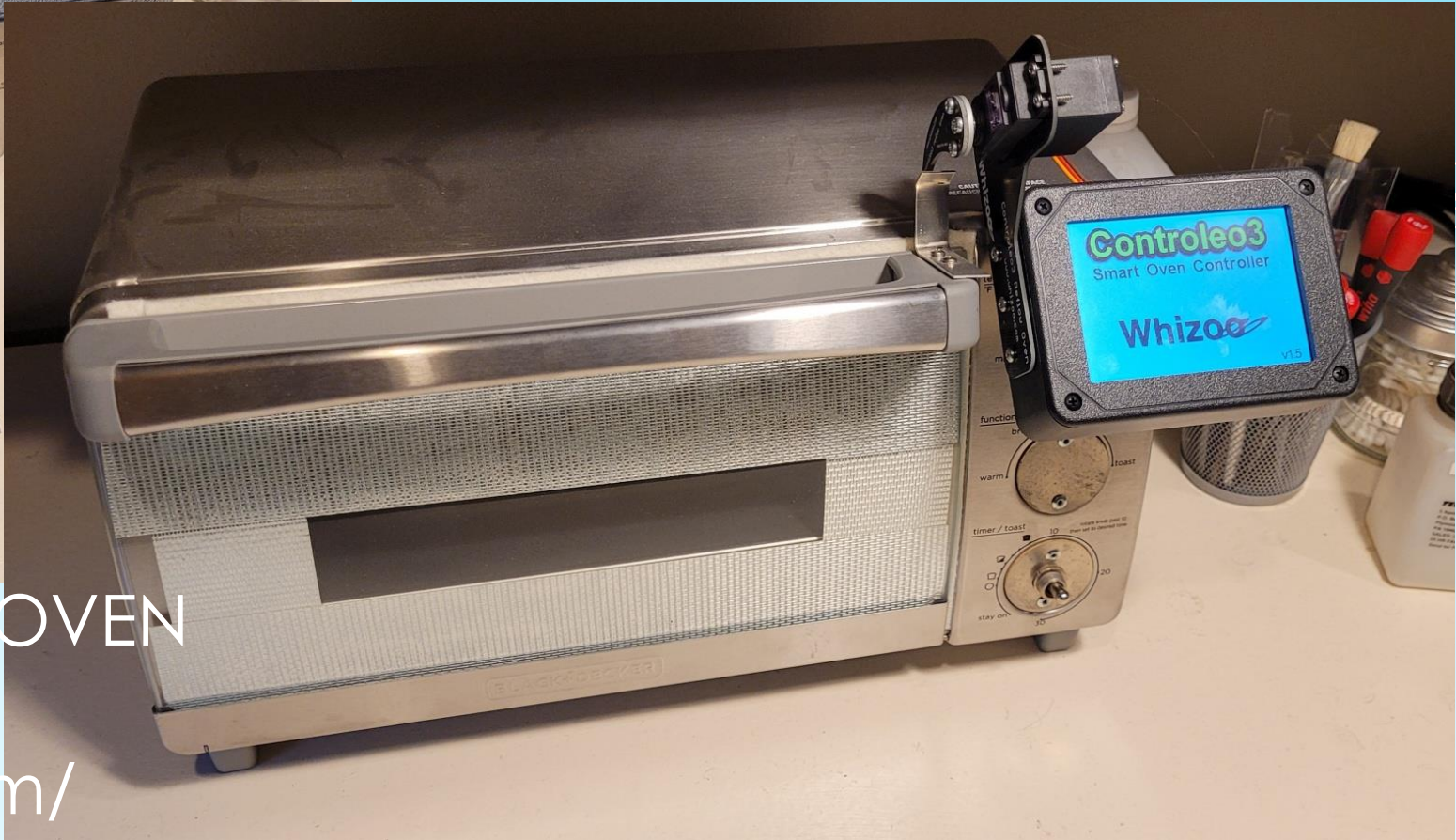




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REFLOW TOASTER OVEN  
CONTROLEO 3  
<https://whizoo.com/>





# REPAIRING AND REPLACING SMD PARTS

- ▶ Tools needed
- ▶ Techniques
- ▶ Does it make sense?



# REMOVING SMD PARTS

- ▶ A hot air tool is preferred for removing SMD components
- ▶ The tool uses an air pump to force a stream of hot air out a nozzle to concentrate the heat to the component to be removed.
- ▶ Available online as low as \$99
- ▶ Many come with a soldering iron
- ▶ Search “SMD hot air rework station”



# REMOVING SMD PARTS

- ▶ A good set of tweezers are needed
- ▶ Curved tweezers are good for tight spaces or awkward situations
- ▶ Needle nose pliers can be used for larger components that require a larger gripping area.







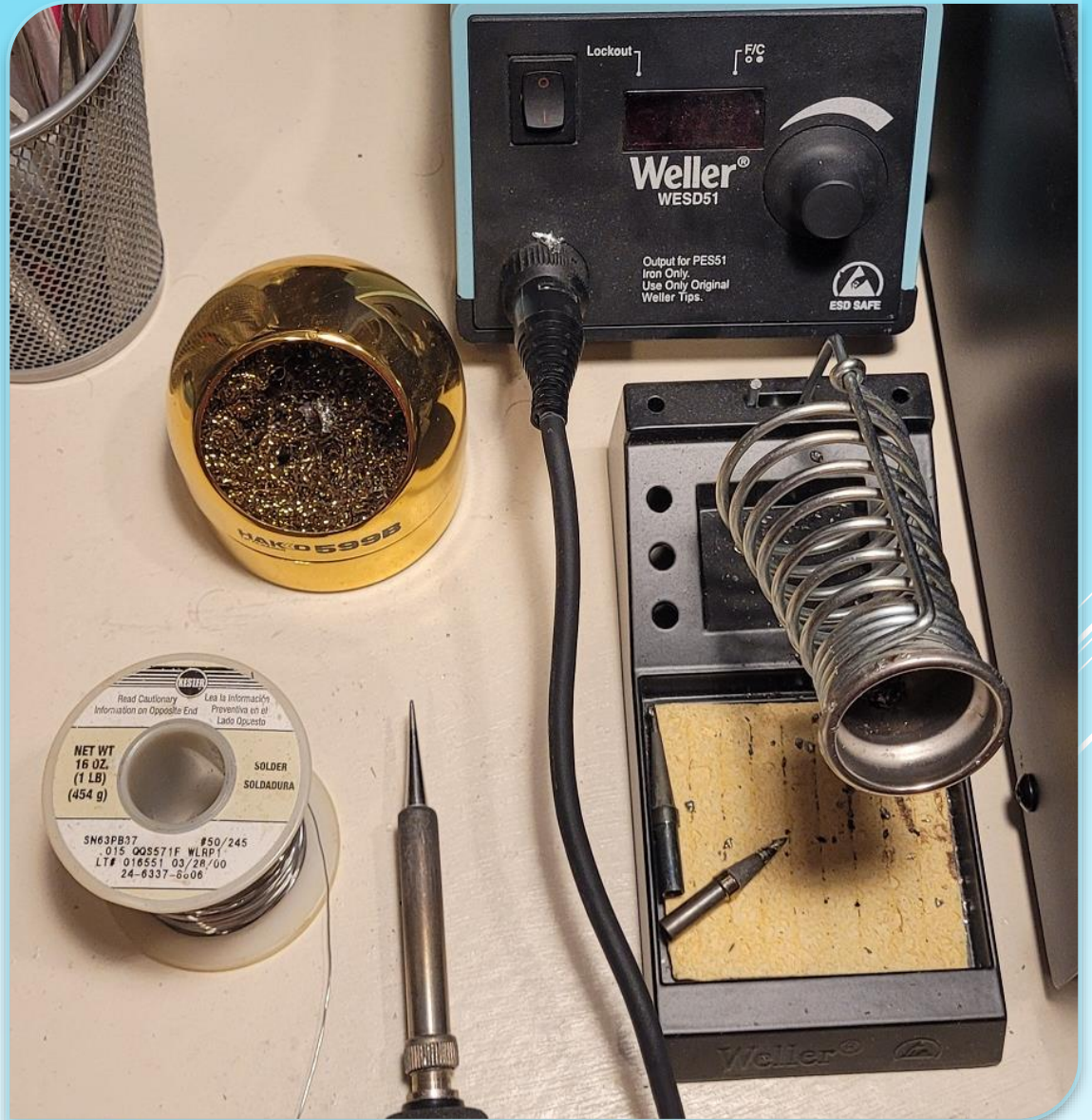
REMOVING SMD  
PARTS

- For very small parts a microscope may be needed



# REMOVING SMD PARTS

- ▶ A soldering iron with a very fine tip point can be used with solder wick
- ▶ An iron is best used for soldering the new parts to the board
- ▶ A fine gauge wire solder is needed to control the amount for each pad





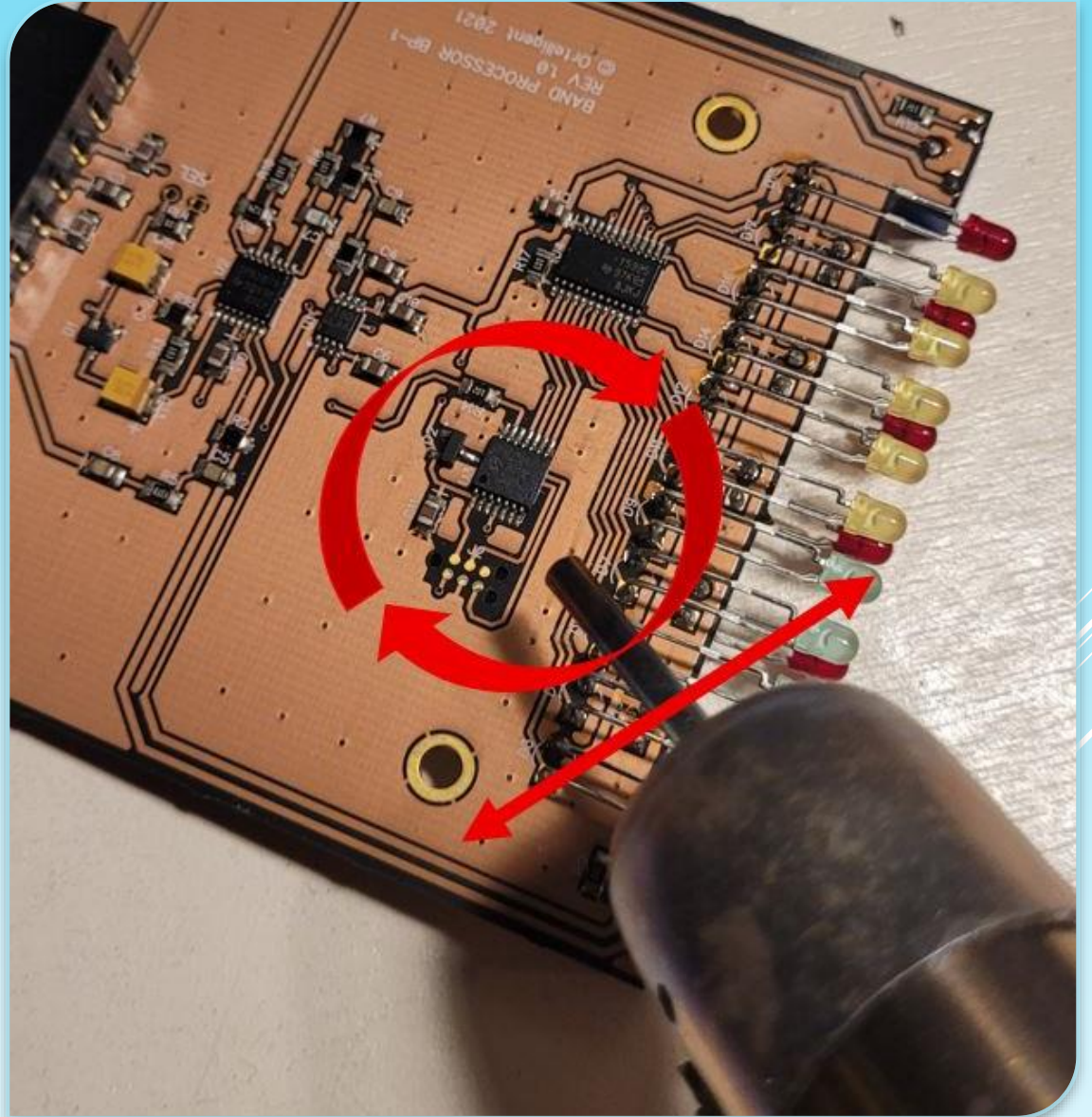


## REPAIRING AND REPLACING SMD PARTS

- ▶ Tools needed
- ▶ Techniques
- ▶ Does it make sense?

# REMOVING SMD PARTS

- ▶ When using a hot air tool DO NOT hold the tool in one spot
- ▶ For small rectangular parts move the tip back and forth across the part.
- ▶ For larger parts move the tool around the part in a circular motion
- ▶ Hold the part with tweezers and pull on it slightly.
- ▶ When the solder goes liquid the part will lift off the board
- ▶ Use solder wick to clean the pads before placing a new part

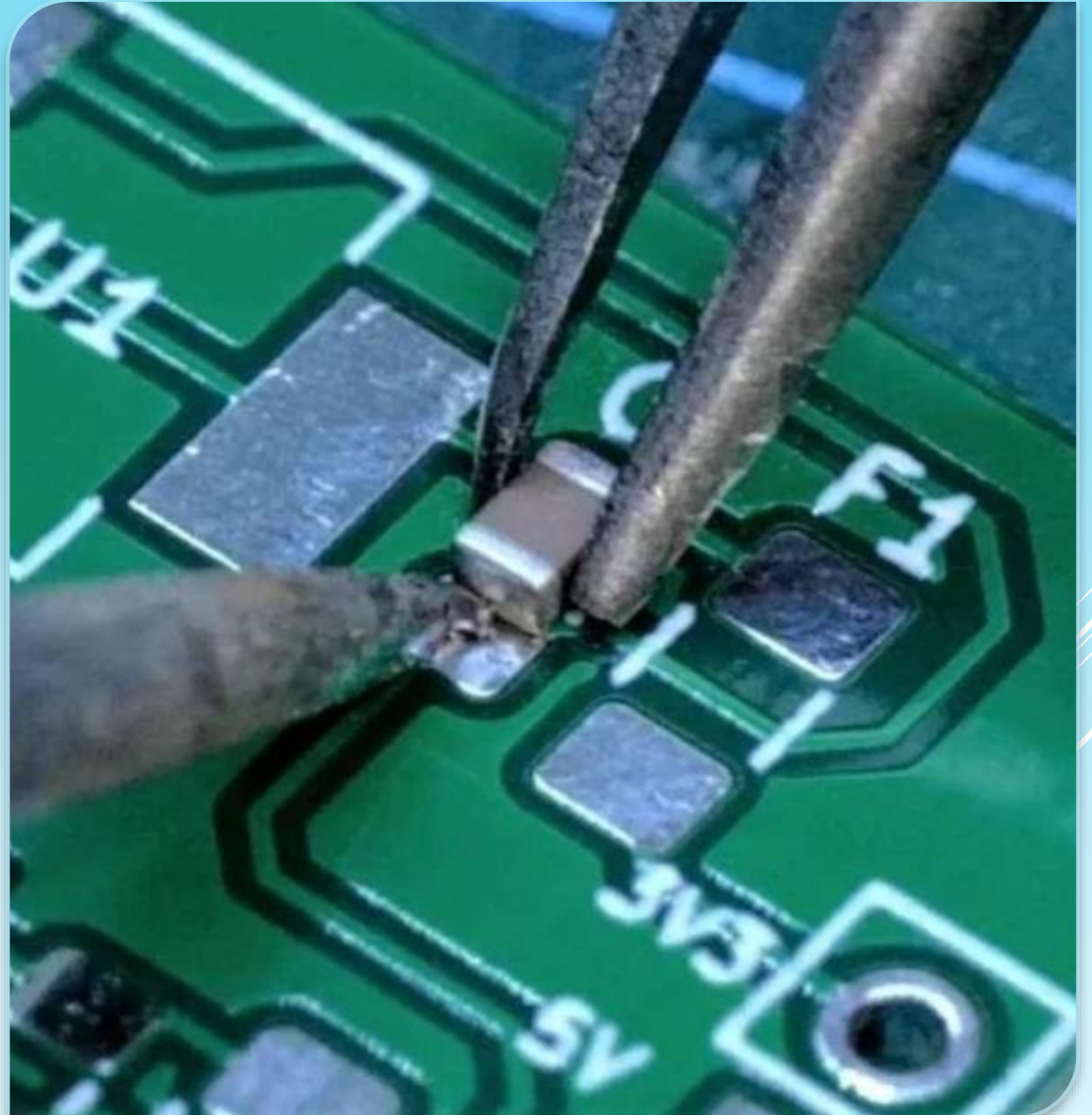




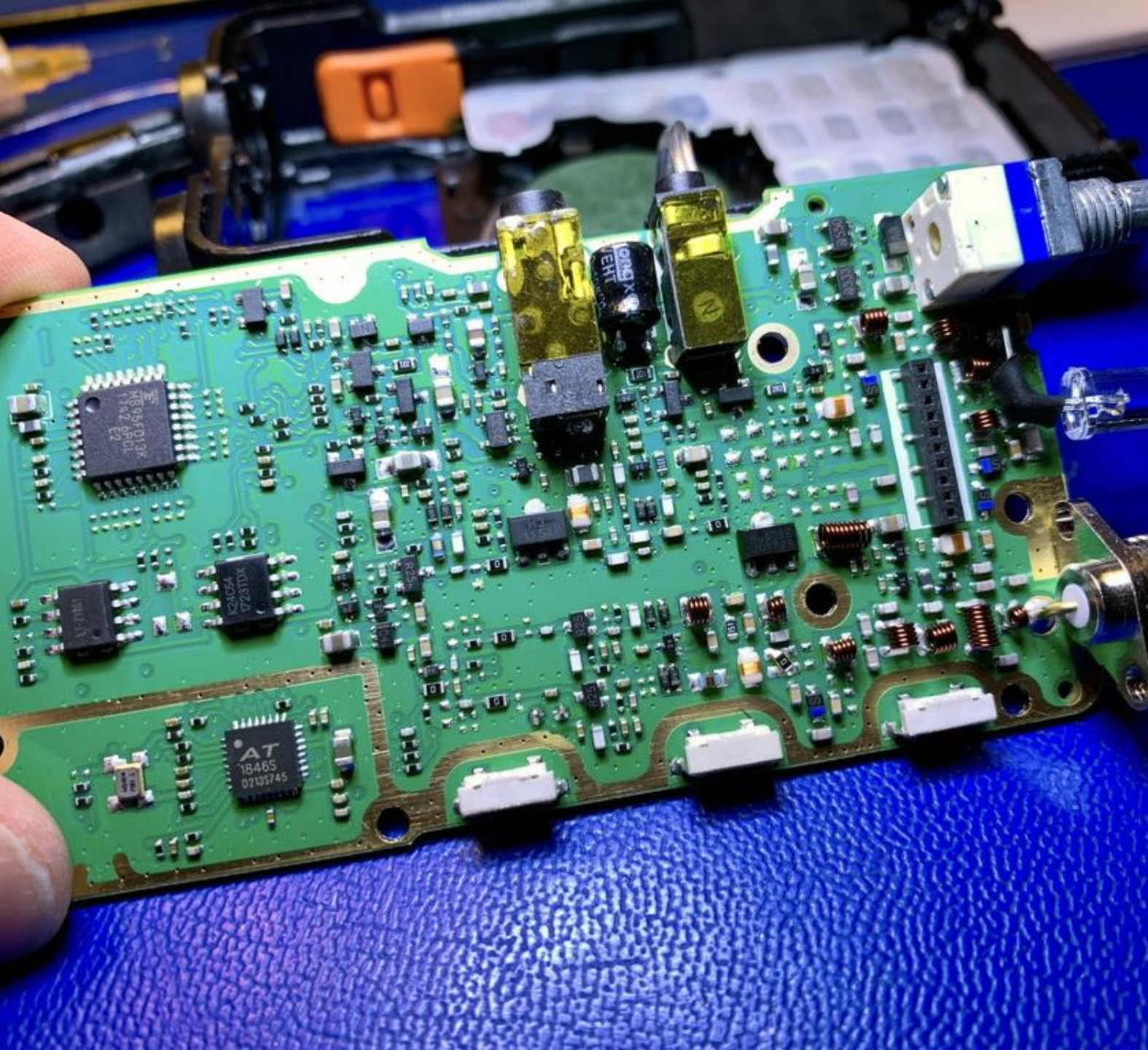
# PLACING SMD PARTS

Two methods:

1. Apply solder to the pads with an iron or using solder paste. Use the hot air tool to hold and drop the part in the molten solder
2. Apply solder to one pad. Use the soldering iron to melt the solder and apply the part to the pad. Solder each pin/pad individually.







## REPAIRING AND REPLACING SMD PARTS

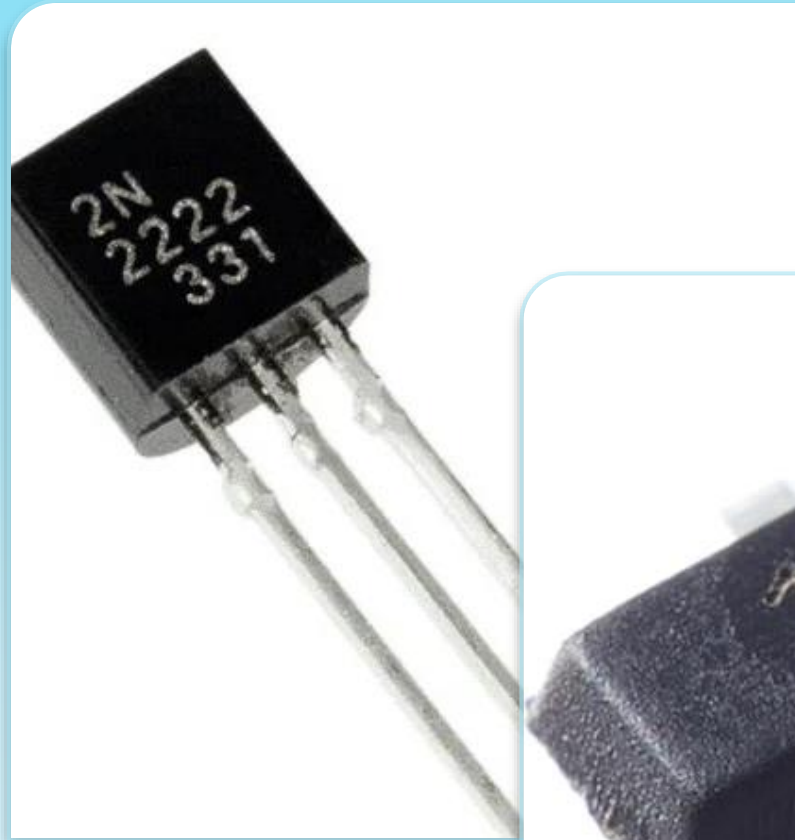
- ▶ Tools needed
- ▶ Techniques
- ▶ Does it make sense?



## “BACK IN MY DAY.....”

It's more difficult to troubleshoot SMD

- Is the schematic available?
- Is the board layout available?
- Has the problem been searched online to figure out a common problem?
- Can the parts themselves be identified based on the markings?



# PART MARKING VARIES BY MANUFACTURER

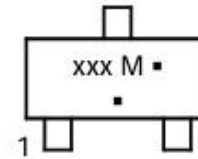


## General Purpose Transistors

NPN Silicon

**MMBT2222L, MMBT2222AL,  
SMMBT2222AL**

### MARKING DIAGRAM



xxx = 1P or M1B  
M = Date Code\*  
▪ = Pb-Free Package

NXP Semiconductors

Product data sheet

NPN switching transistor **MMBT2222A**

### MARKING

TYPE NUMBER	MARKING CODE <sup>(1)</sup>
MMBT2222A	7C*



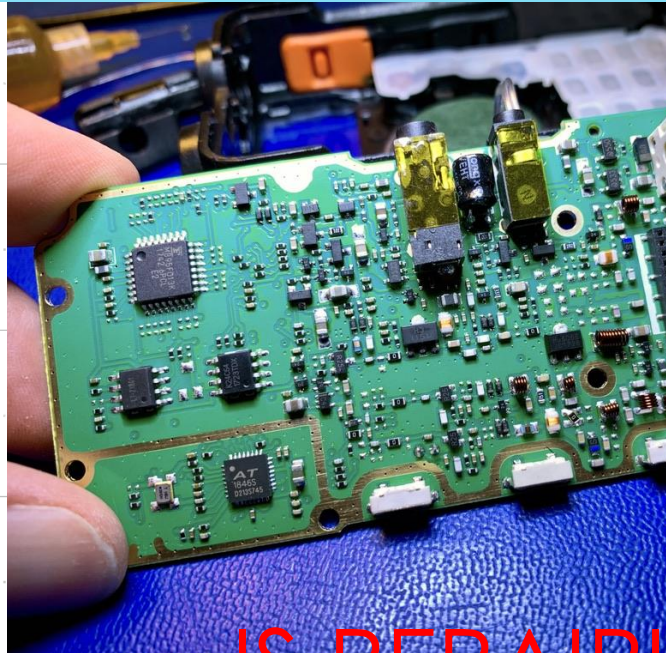
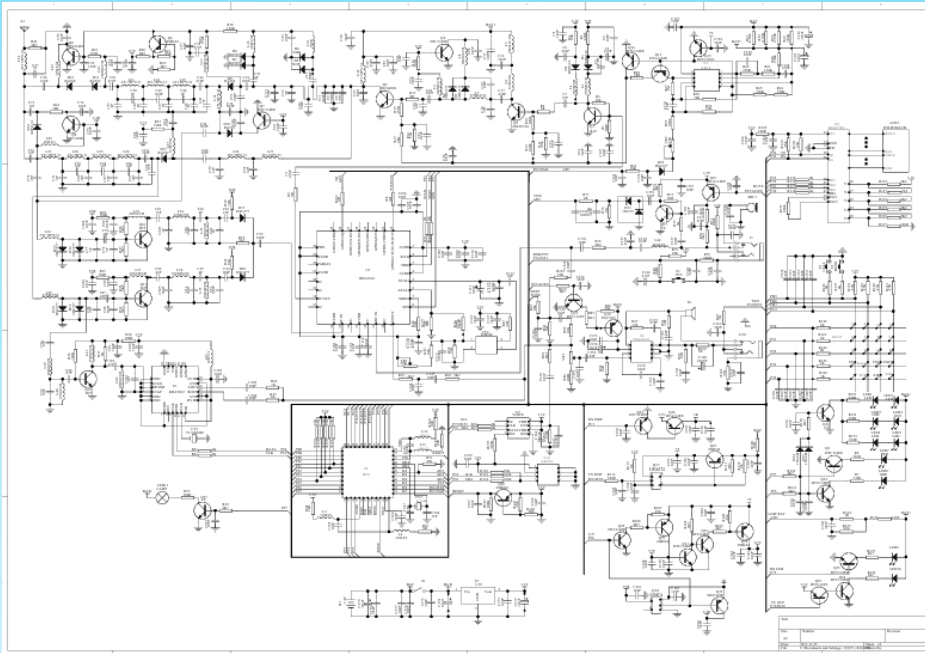
40V NPN SMALL-SIGNAL TRANSISTOR IN SOT23

**MMBT2222A**

Orderable Part Number	Package	Marking
MMBT2222A-7-F	SOT23	K1P
MMBT2222A-13-F	SOT23	K1P







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TP5

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uv5r-TP5-2PC

\$38.99

IS REPAIRING WORTH IT?

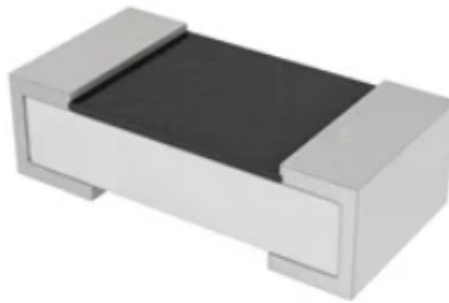


Image shown is a representation only. Exact specifications should be obtained from the product

### Cut Tape (CT) & Digi-Reel®

QUANTITY	UNIT PRICE	EXT PRICE
1	\$0.10000	\$0.10
10	\$0.01000	\$0.10
25	\$0.00640	\$0.16
50	\$0.00540	\$0.27

### Cart Summary

Subtotal \$0.27

Shipping \* \$6.99

**Total \* \$7.26**

\* Estimates

# IN SUMMARY

- ▶ The basic tools needed can be as simple as a soldering iron, magnifier and tweezers
- ▶ It makes little sense to repair a \$20 HT but may be justified on your out of warranty \$1000 HF rig.
- ▶ Lots of resources online and tutorials to repair the most common issues. Google and forums are your friend
- ▶ Best way to learn is to practice, practice, practice. Best of all, have fun learning!



