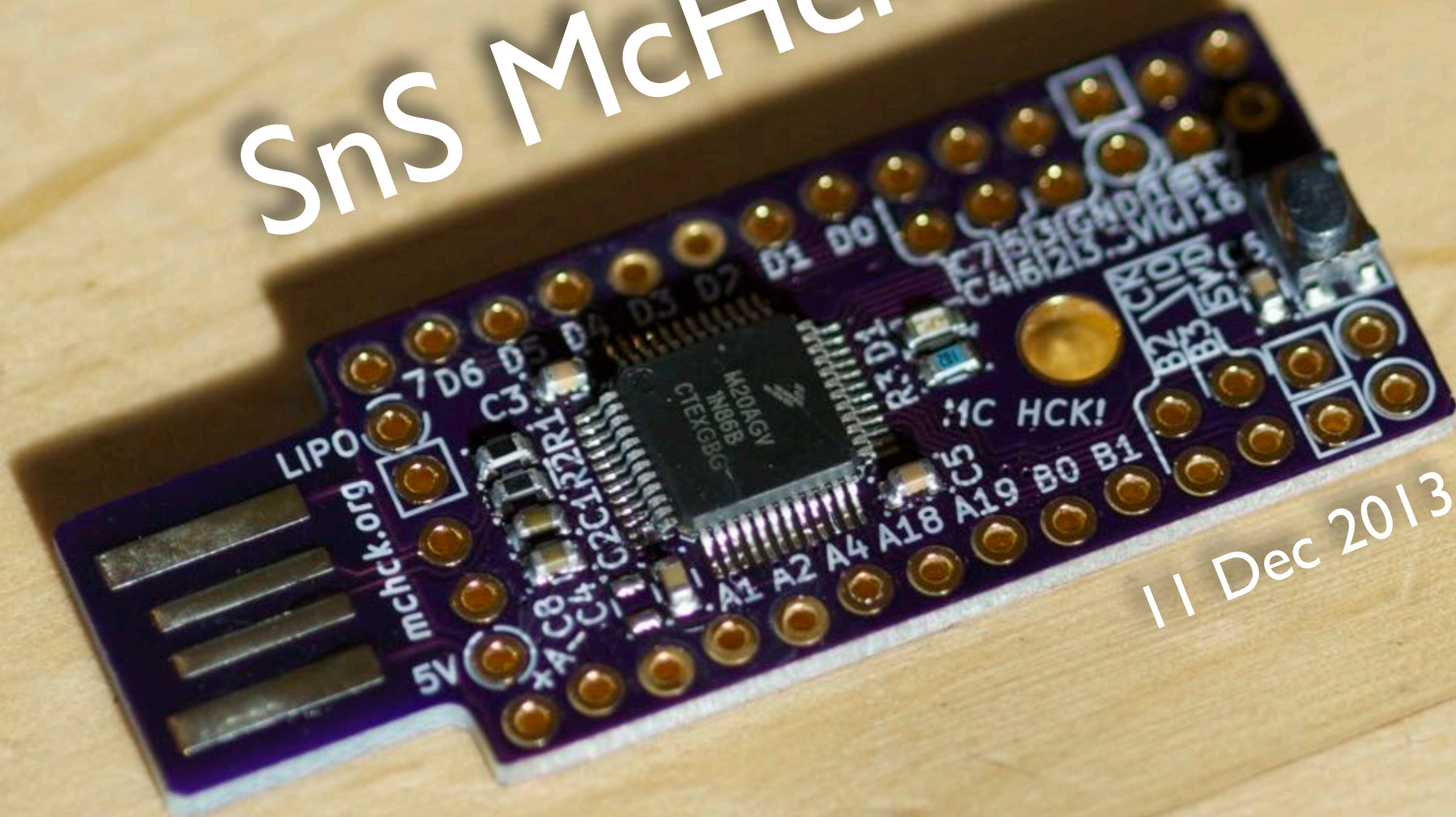




SnS McHck

11 Dec 2013

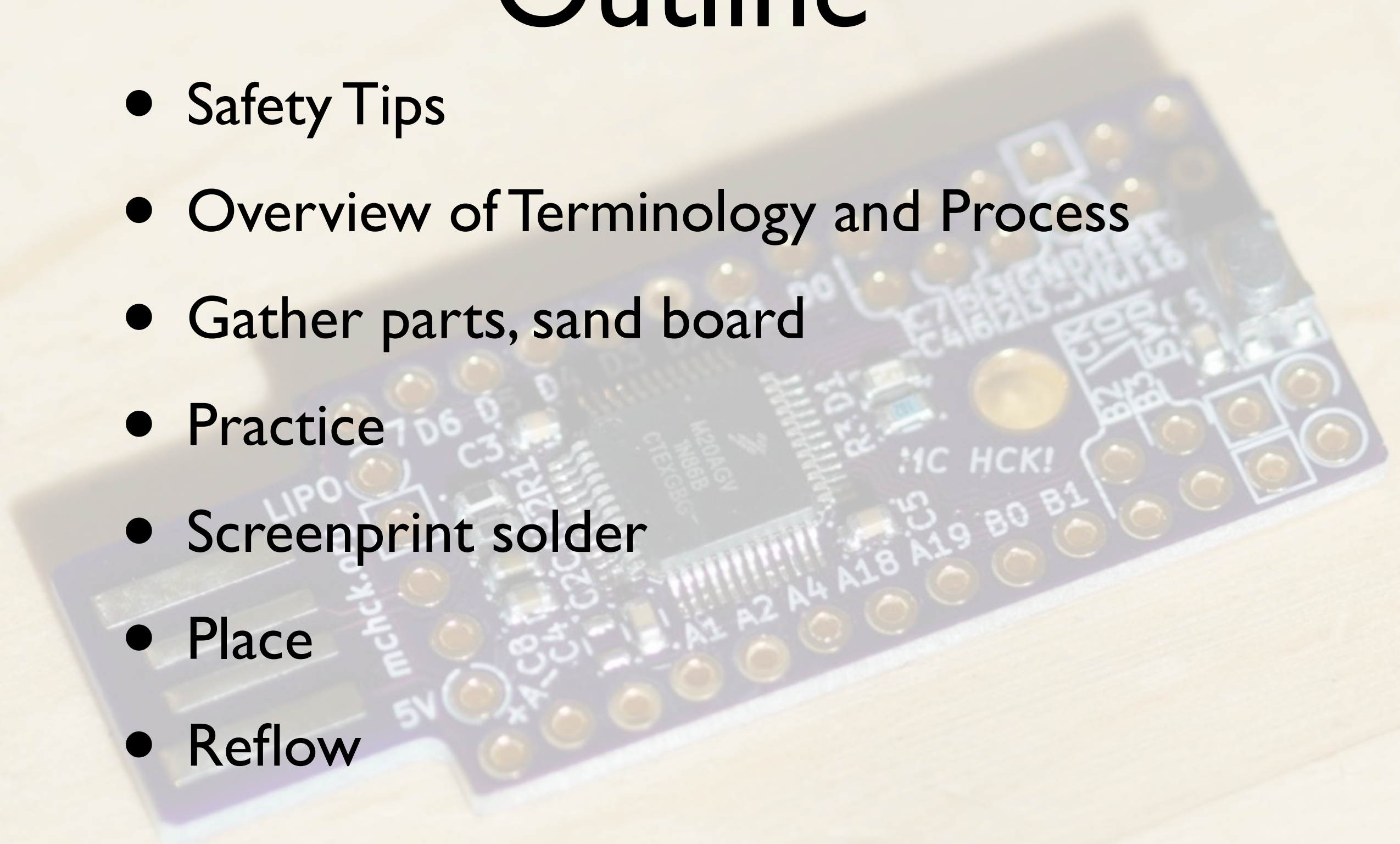


Show of Hands



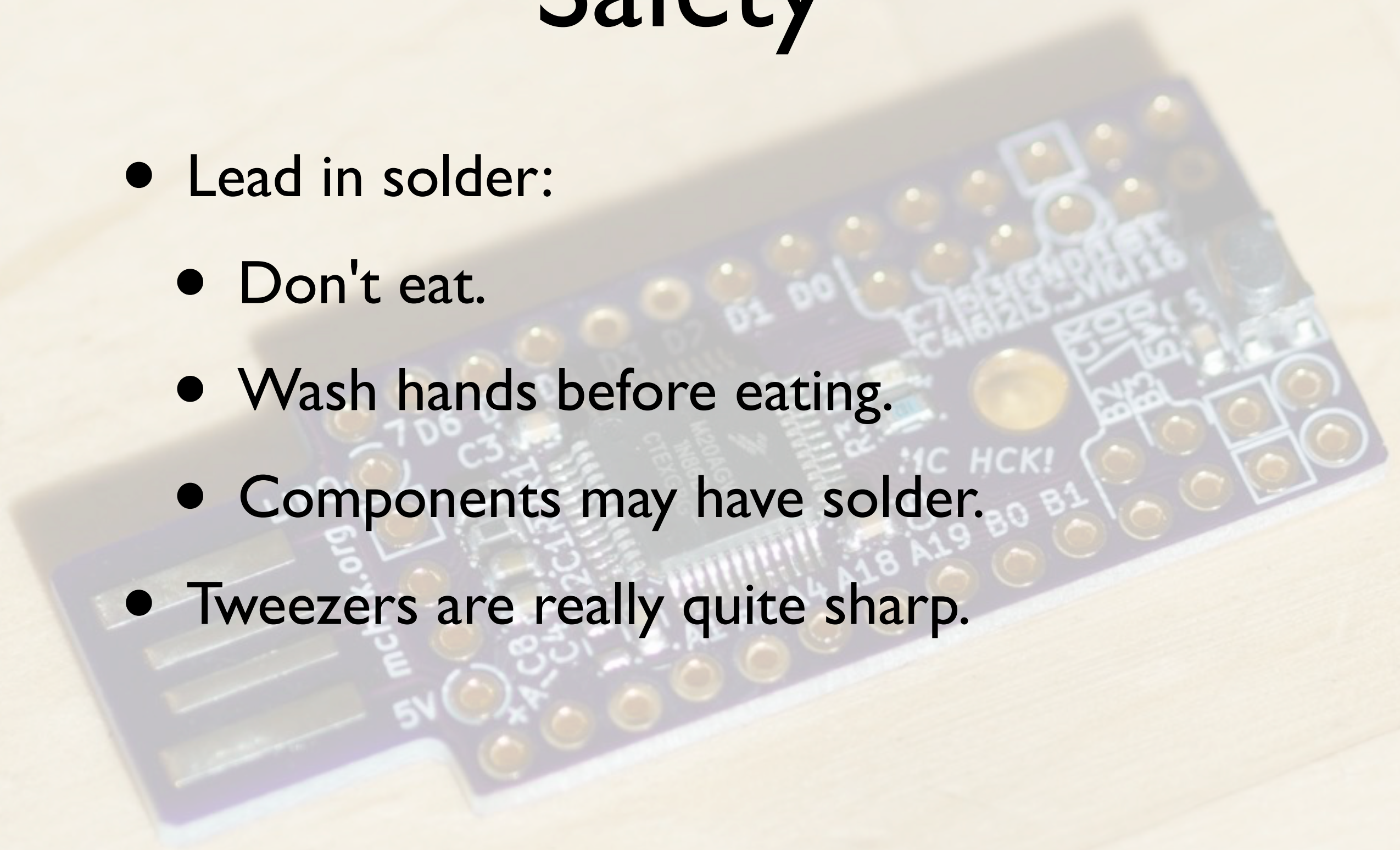
Outline

- Safety Tips
- Overview of Terminology and Process
- Gather parts, sand board
- Practice
- Screenprint solder
- Place
- Reflow



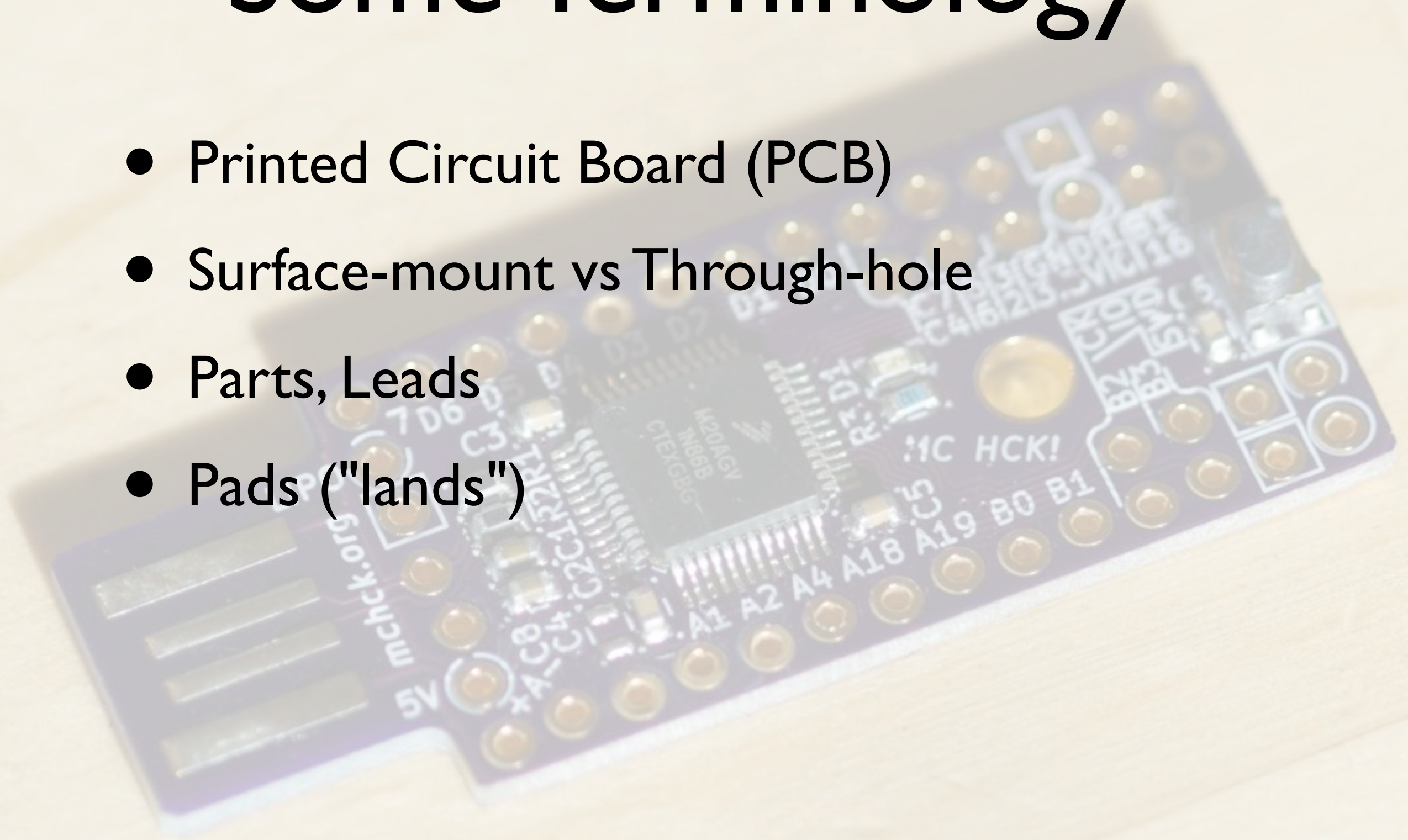
Safety

- Lead in solder:
 - Don't eat.
 - Wash hands before eating.
 - Components may have solder.
- Tweezers are really quite sharp.

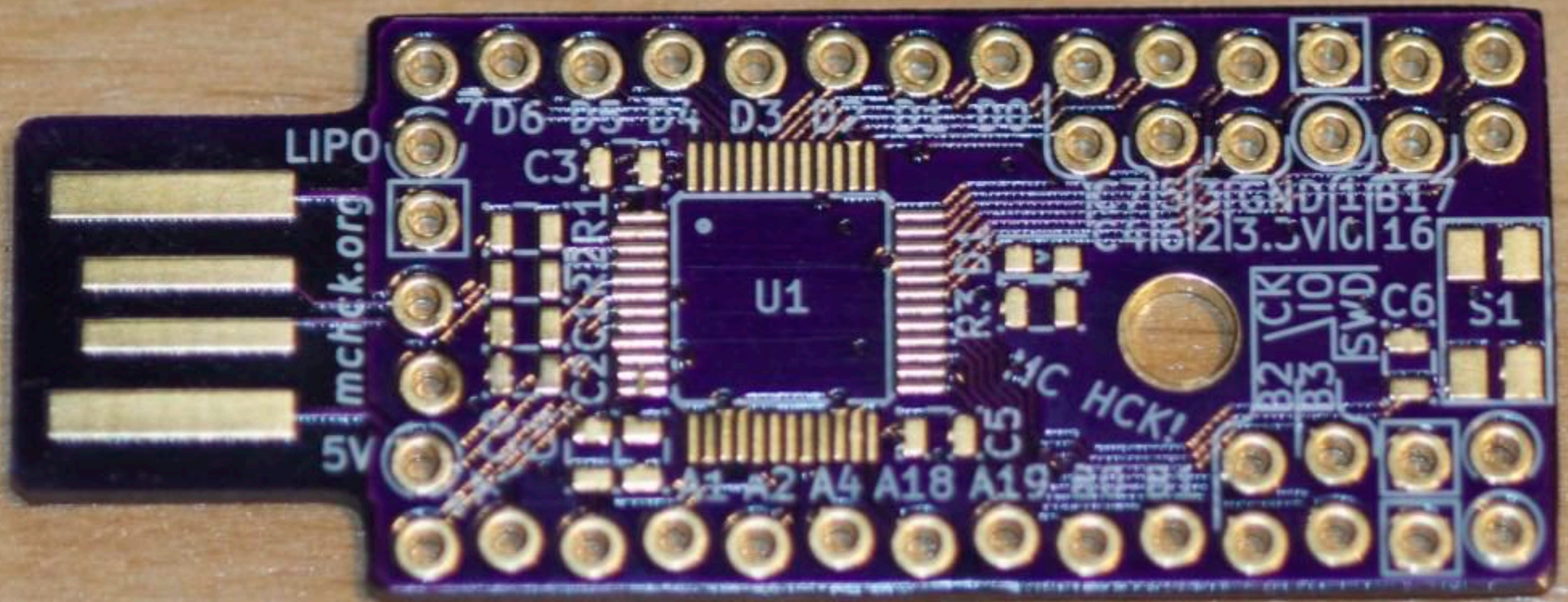


Some Terminology

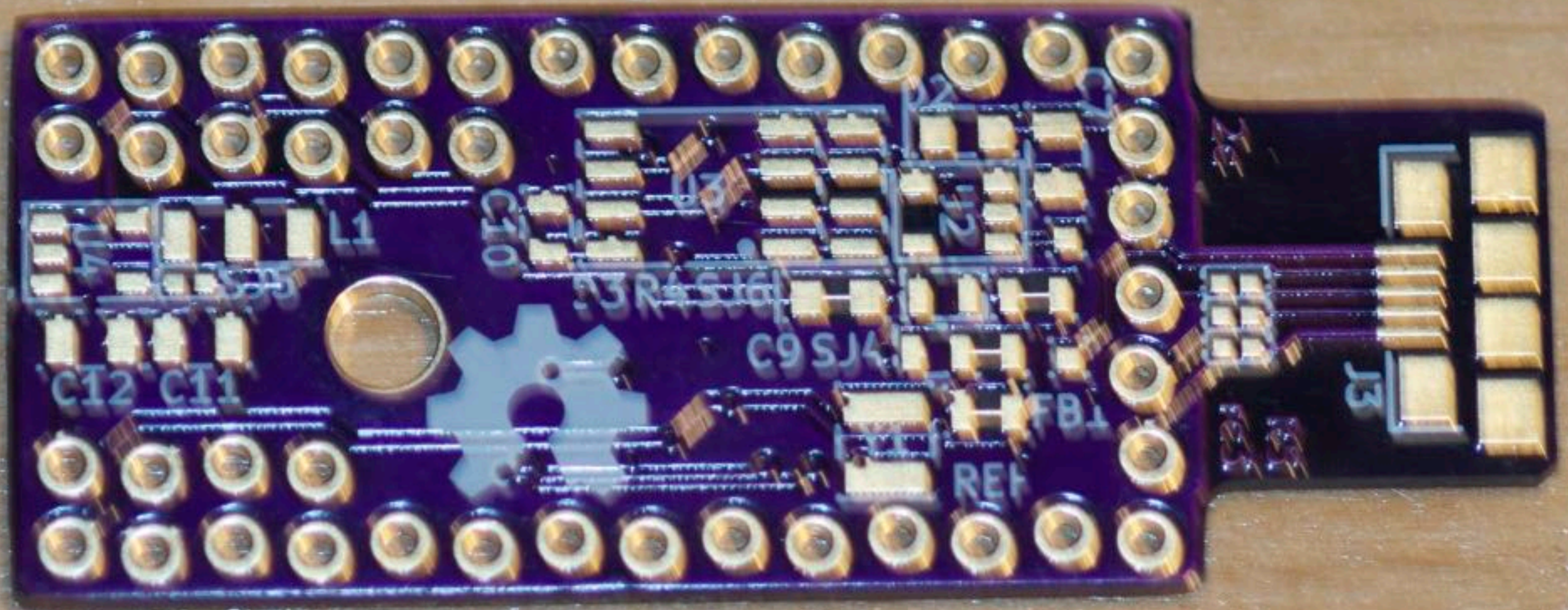
- Printed Circuit Board (PCB)
- Surface-mount vs Through-hole
- Parts, Leads
- Pads ("lands")



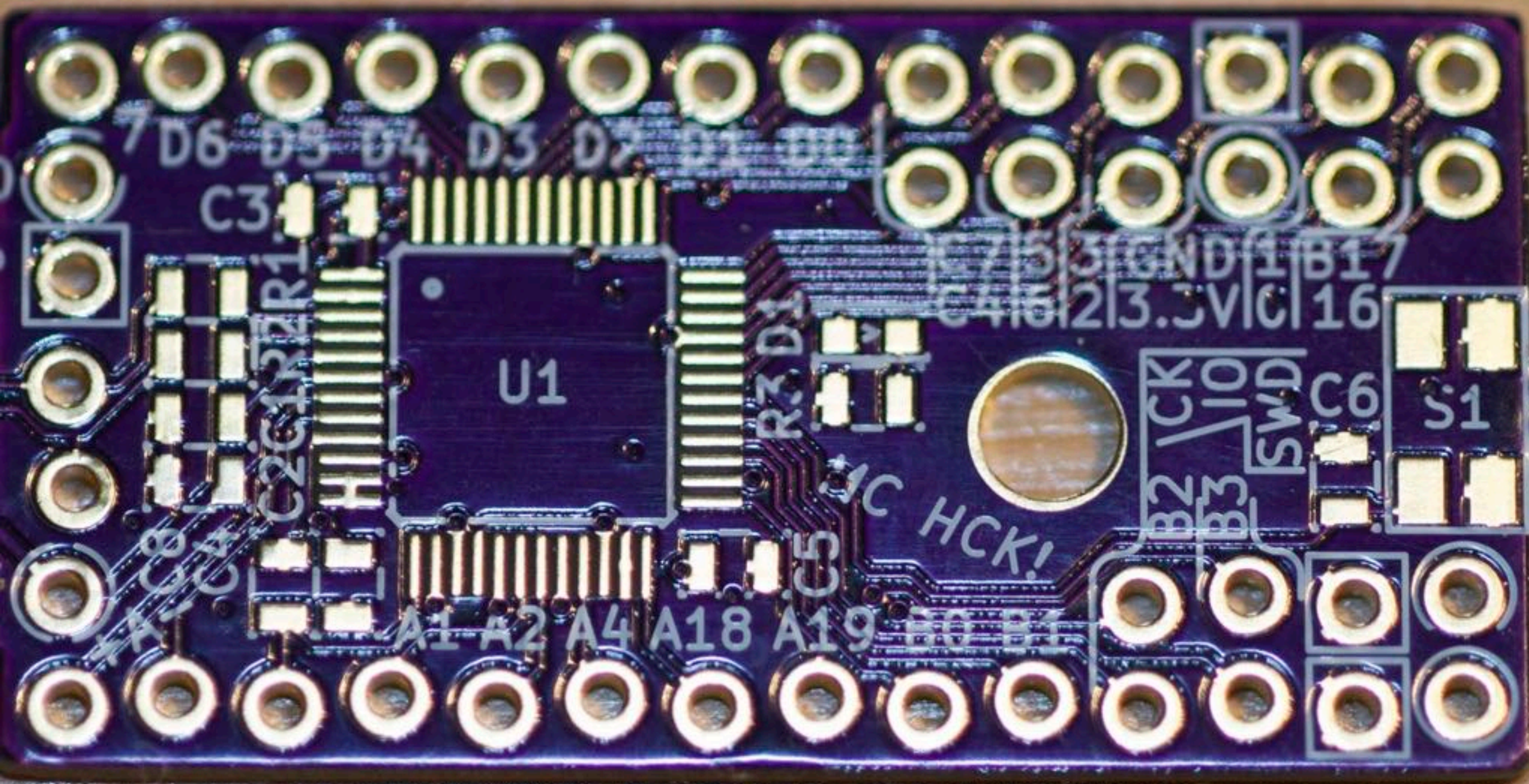
Board Front

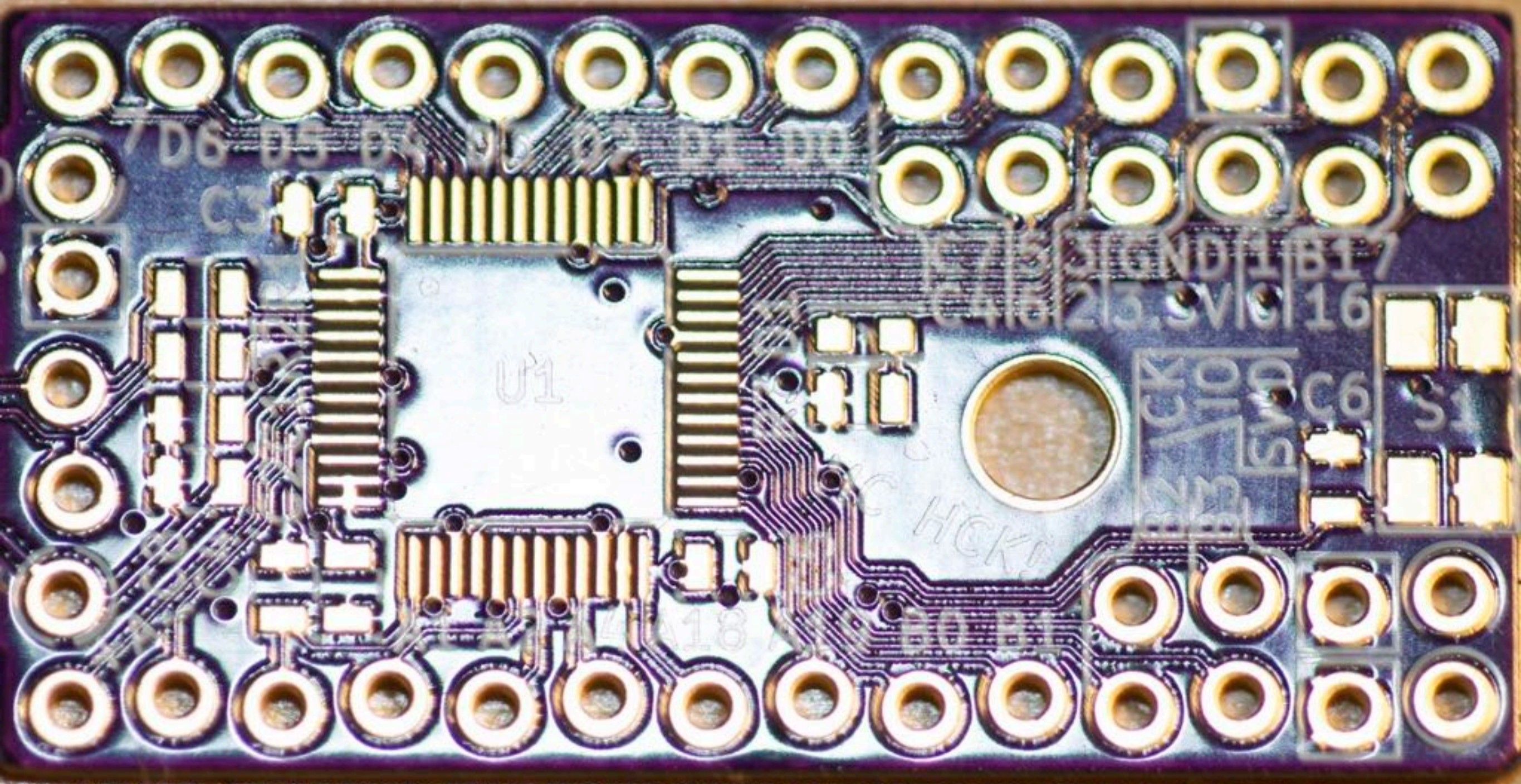


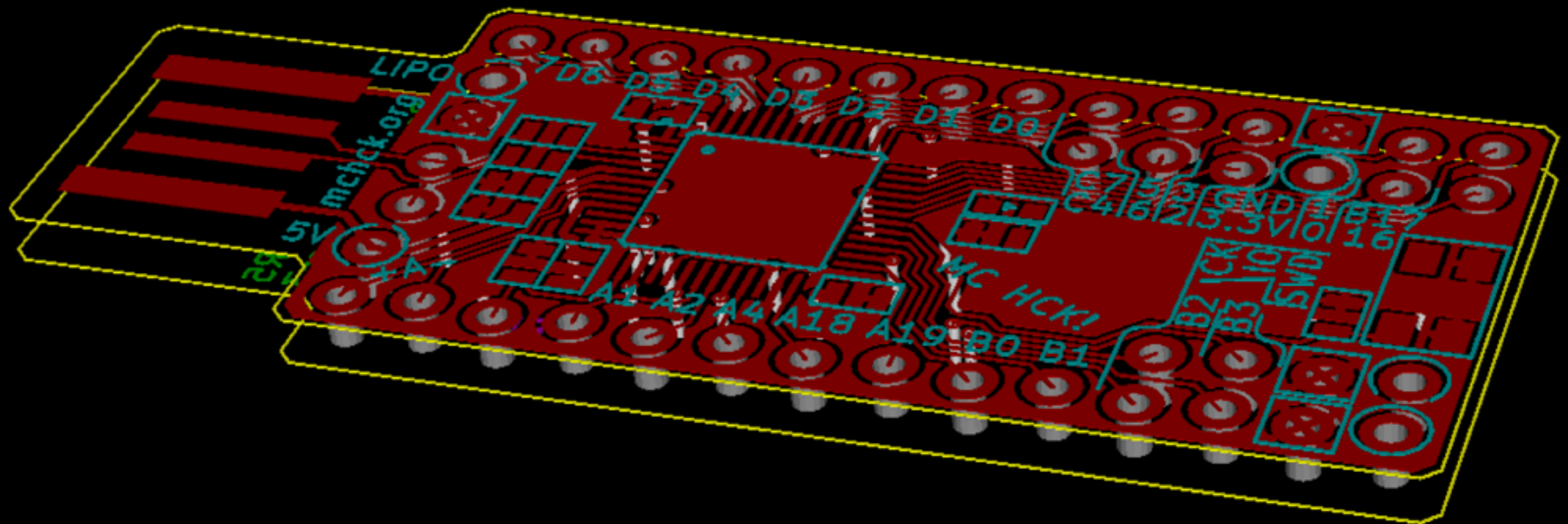
Board Back

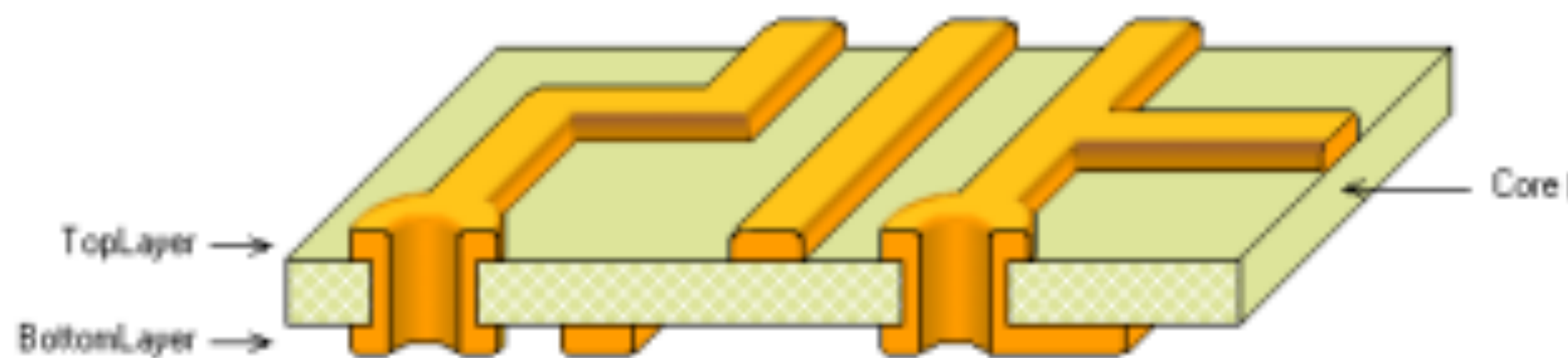


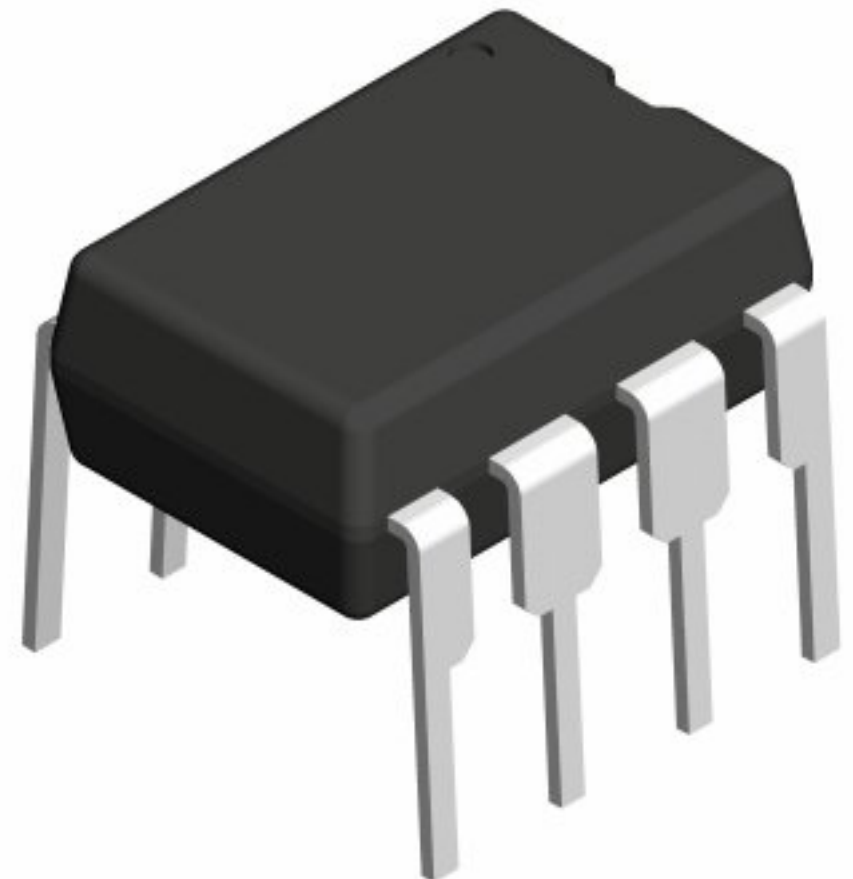
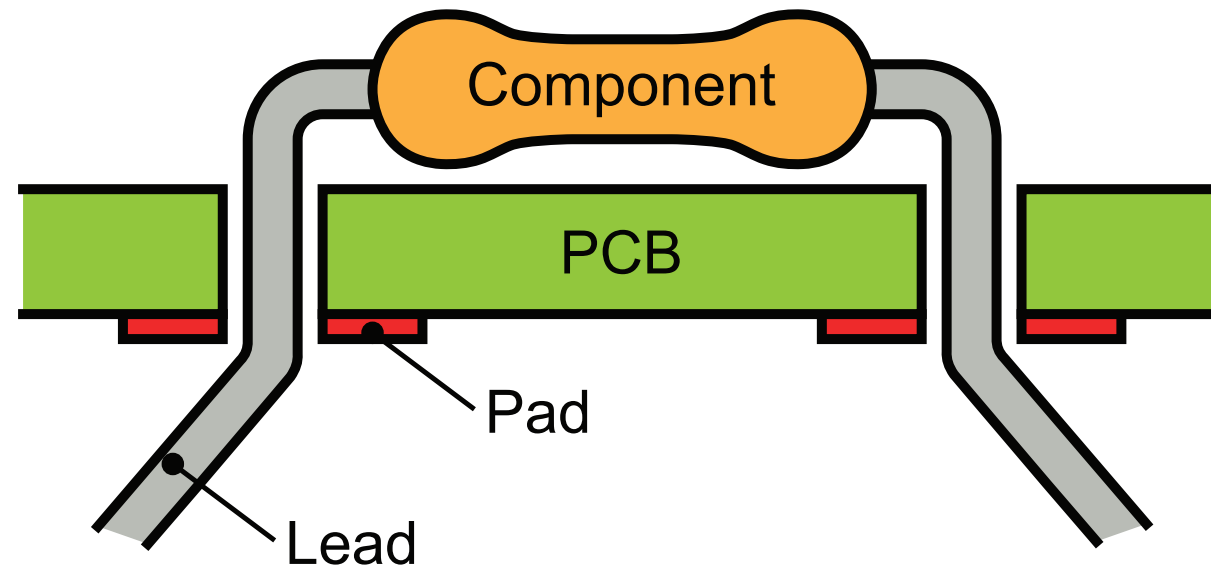
(not this side :)



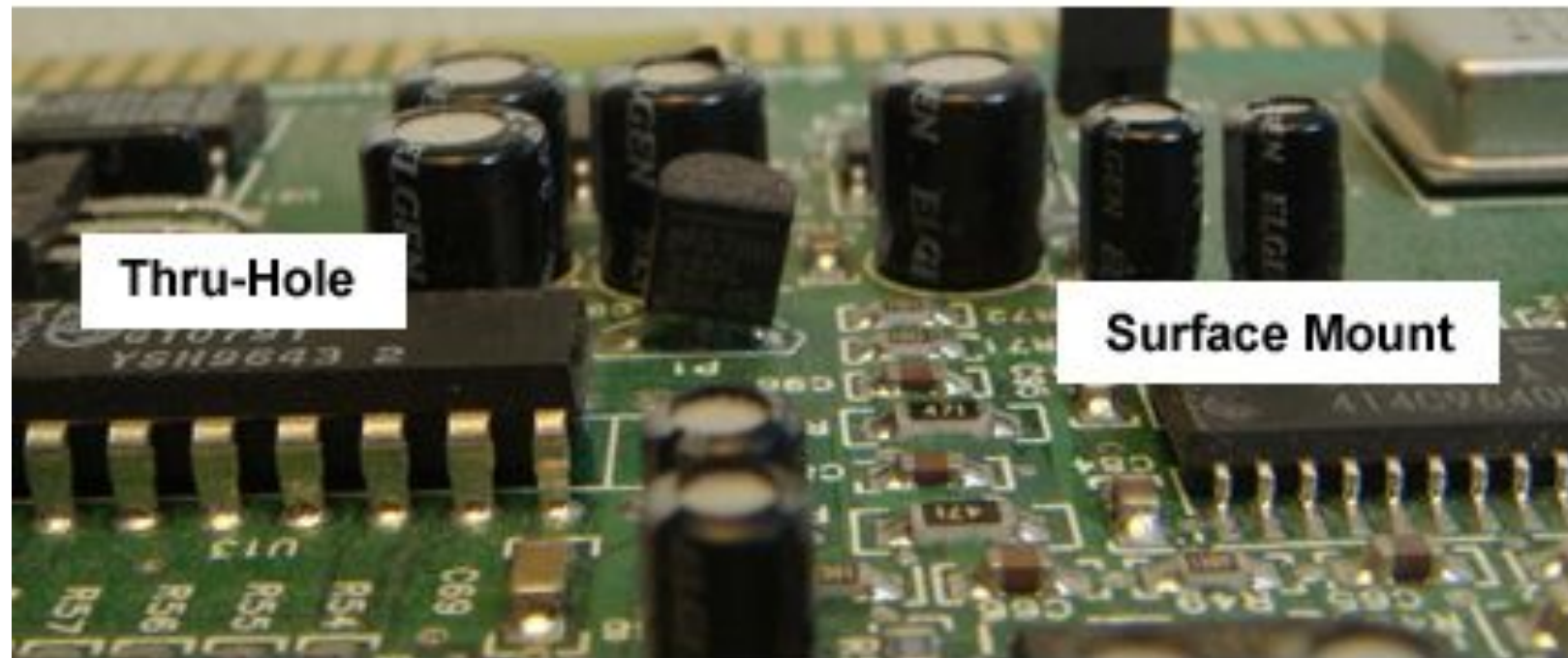






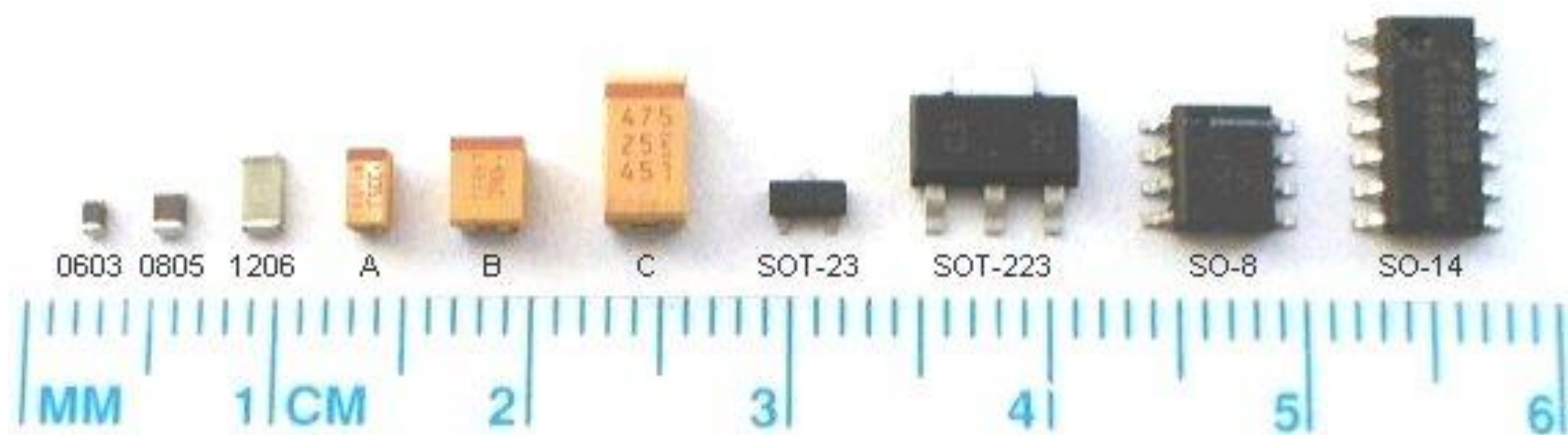


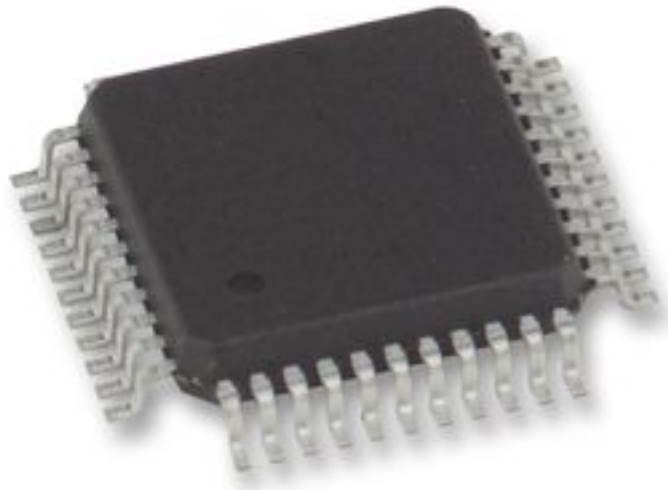
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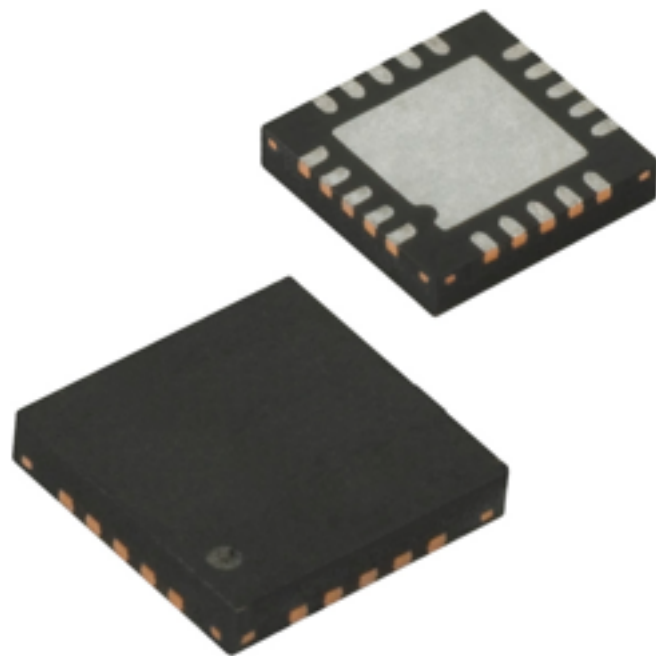
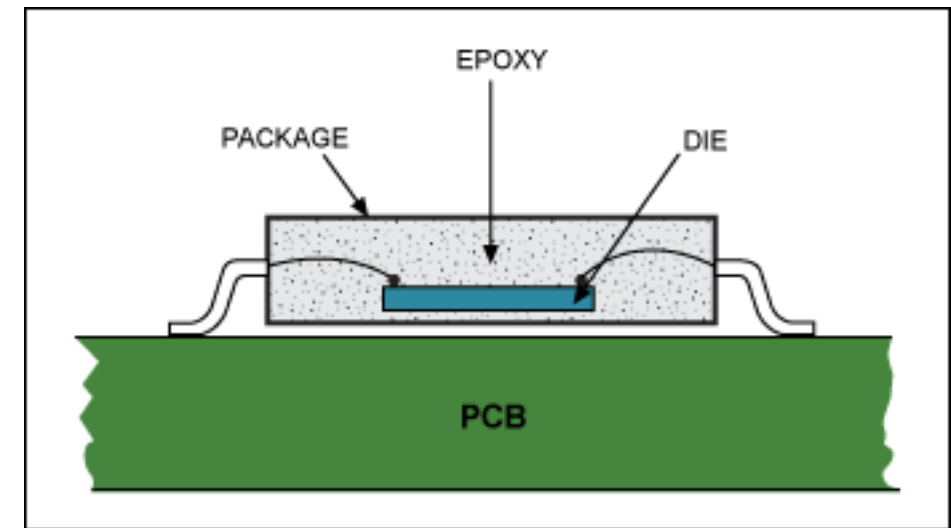
Bottom of the Board



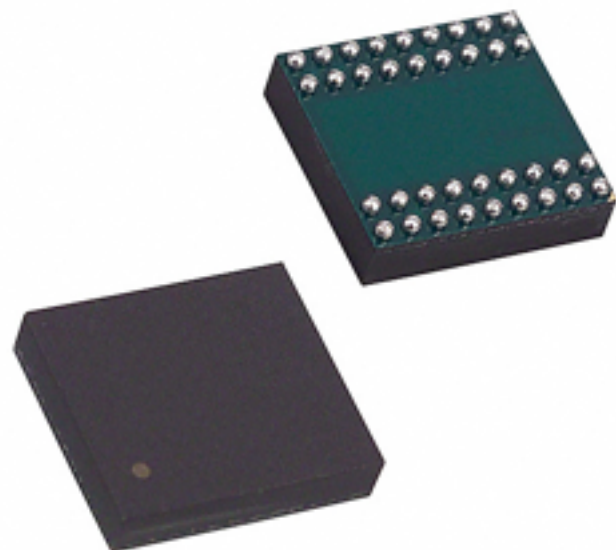
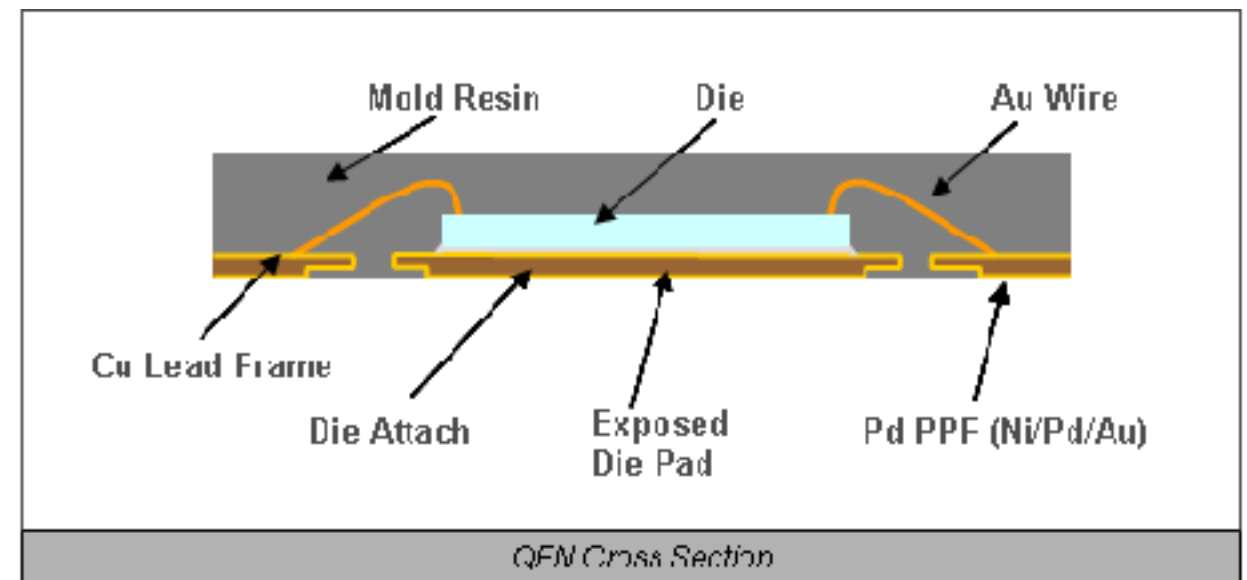




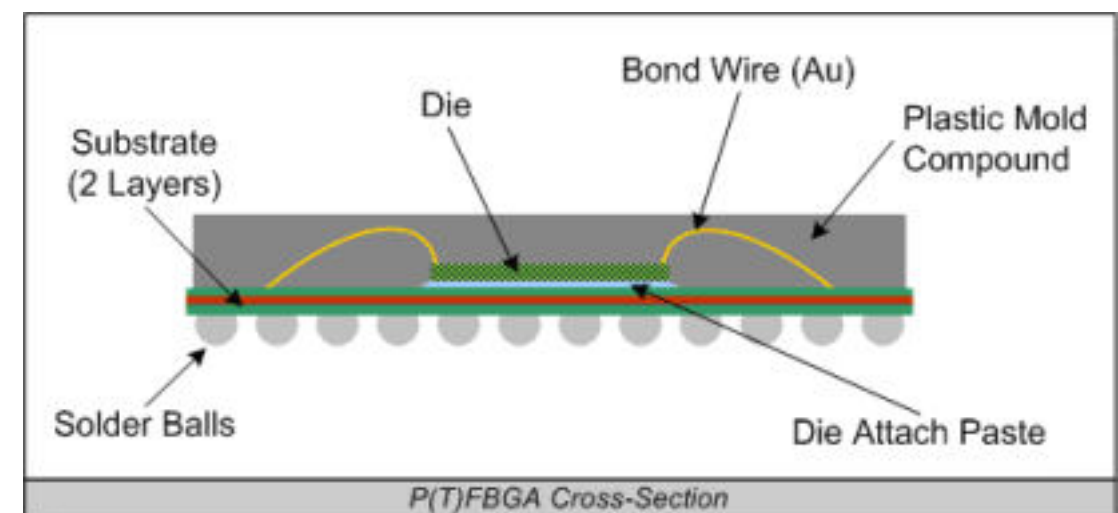
(L)QFP

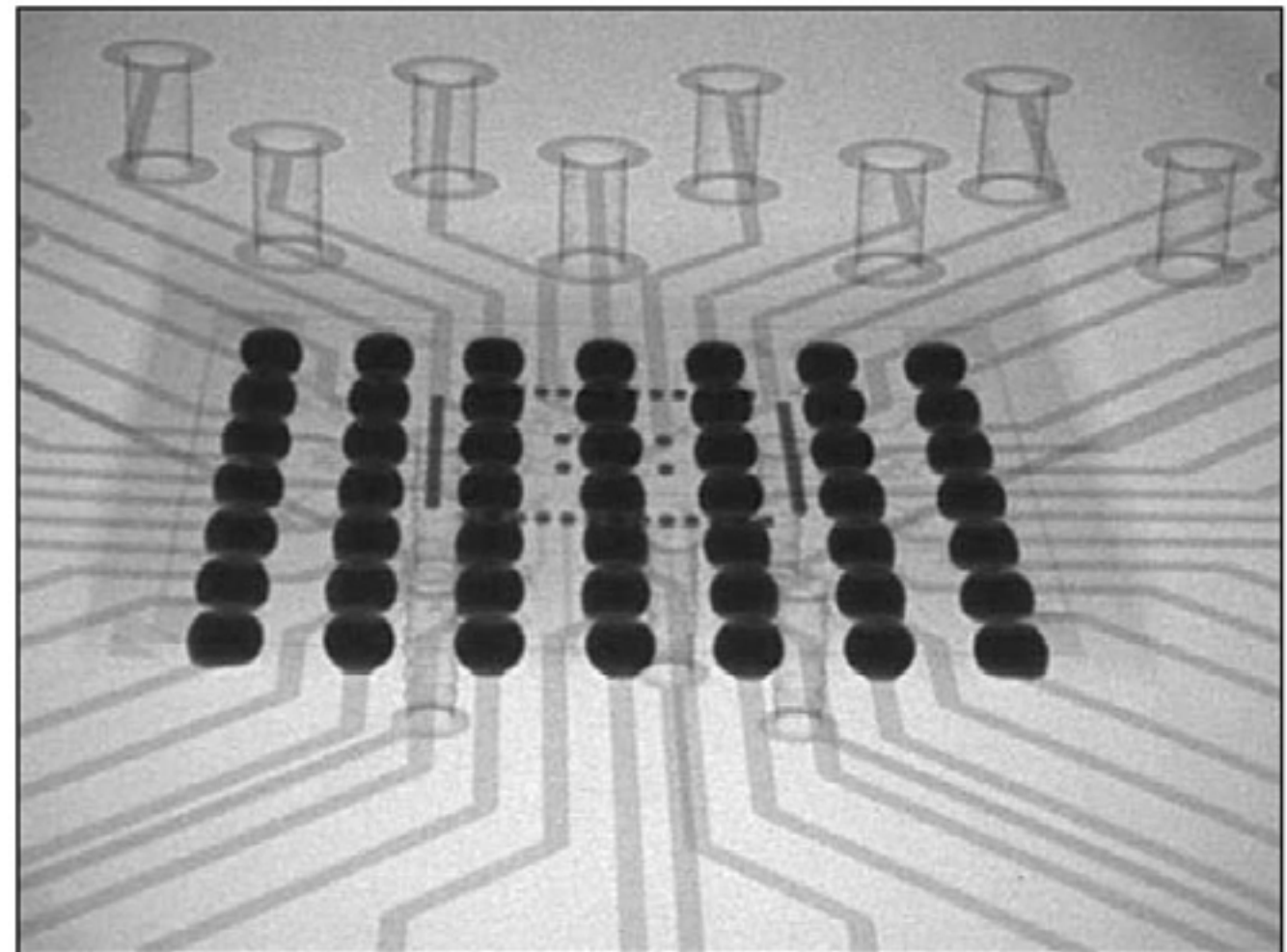
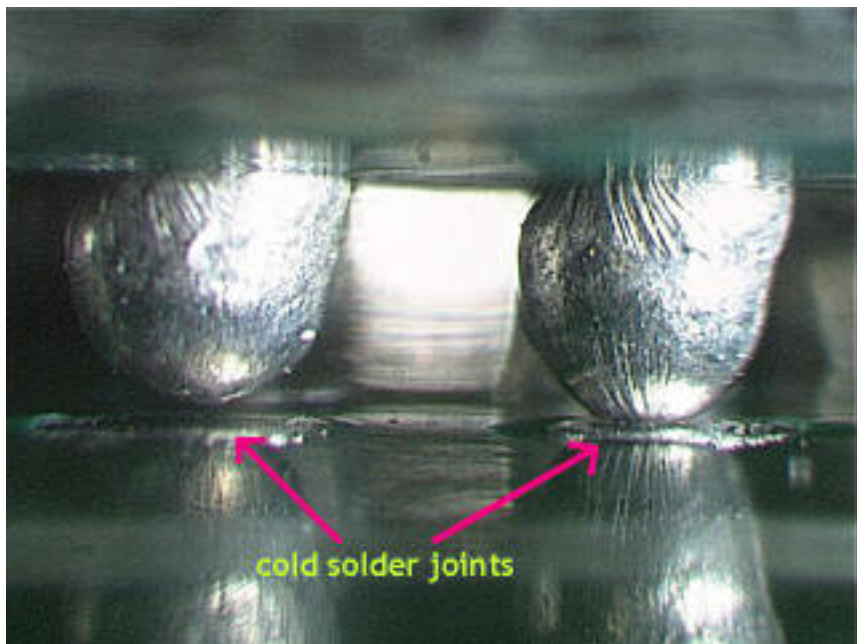
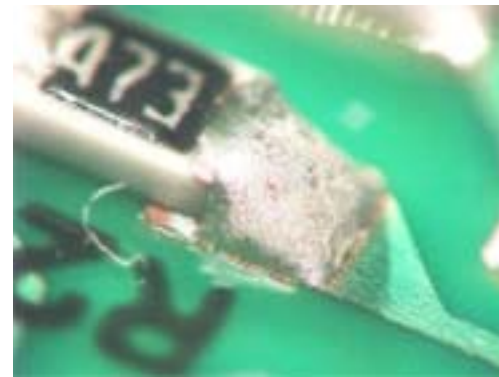


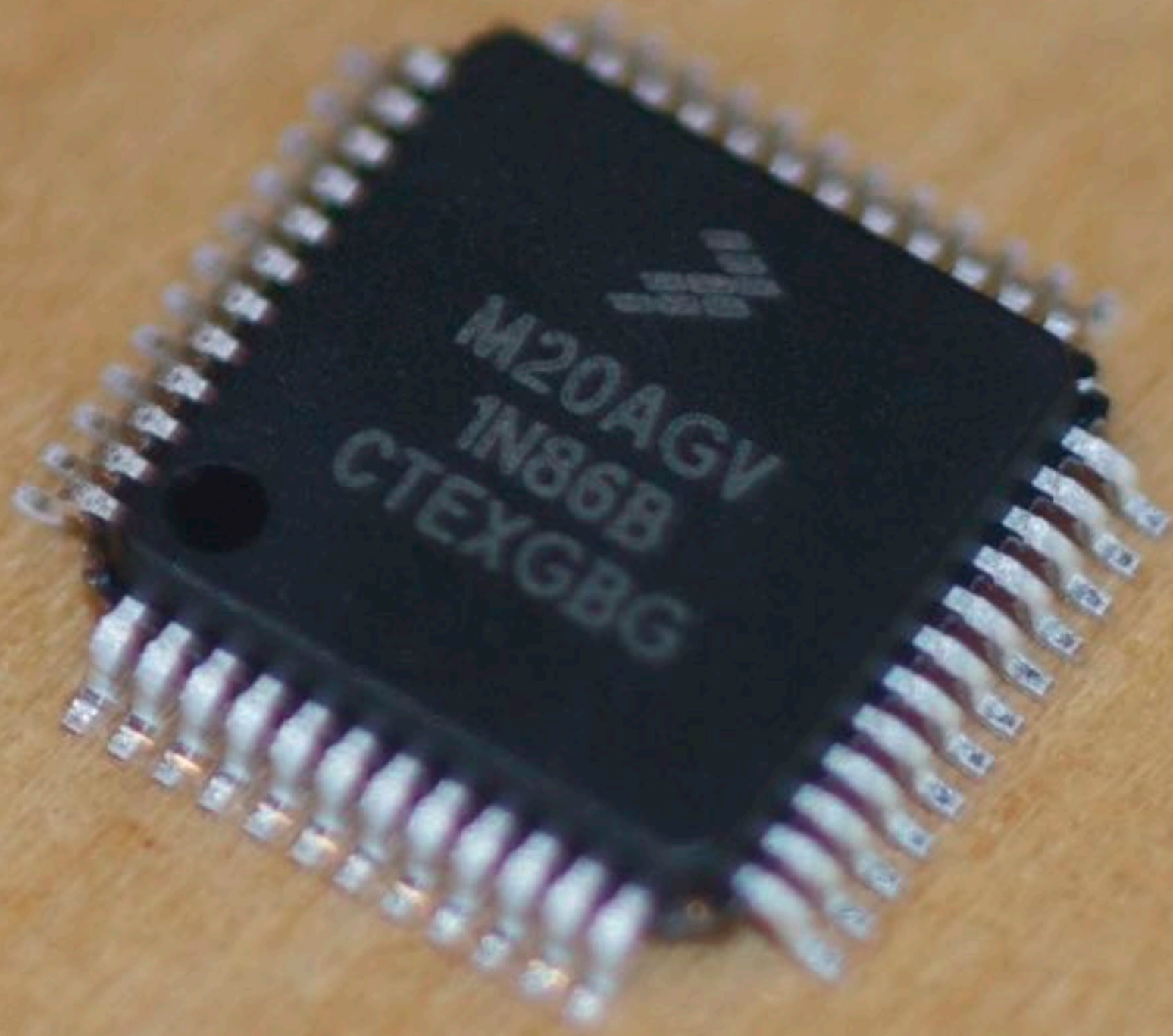
QFN

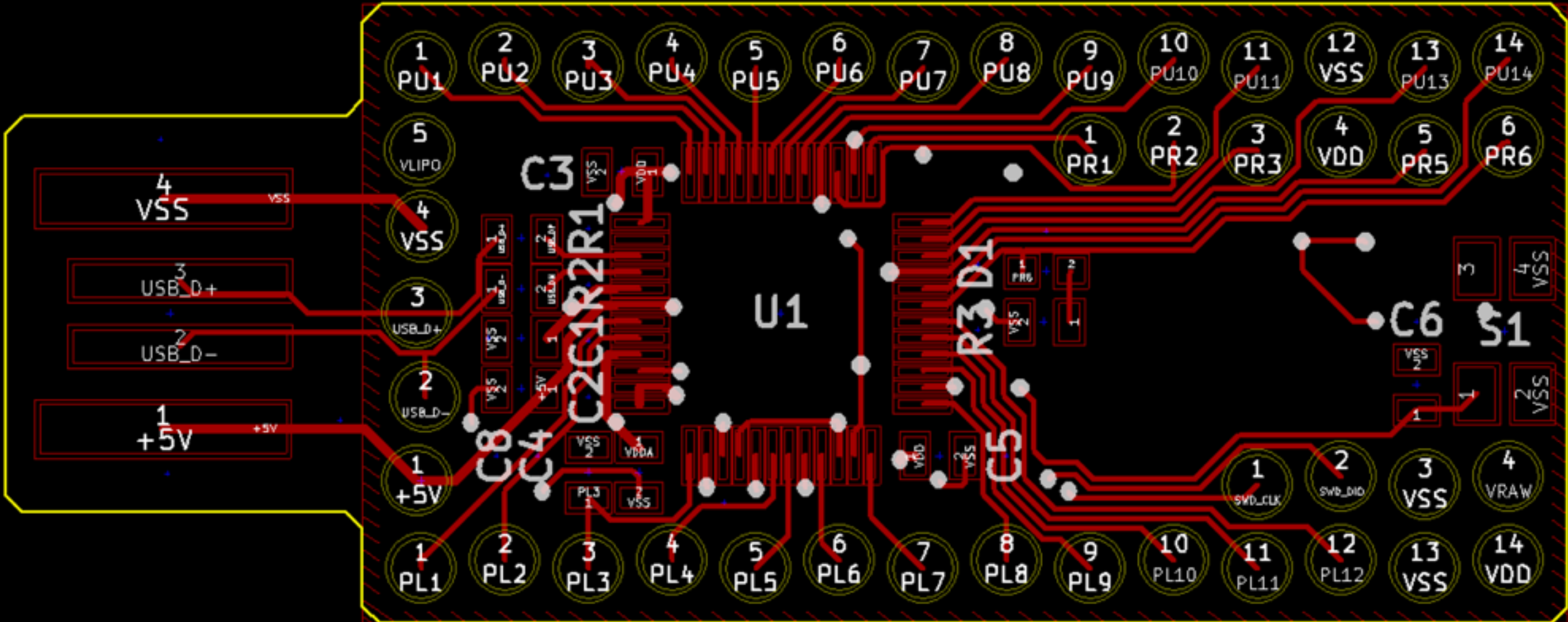


BGA









OSH Park

An electric ecosystem



Welcome to OSH Park!

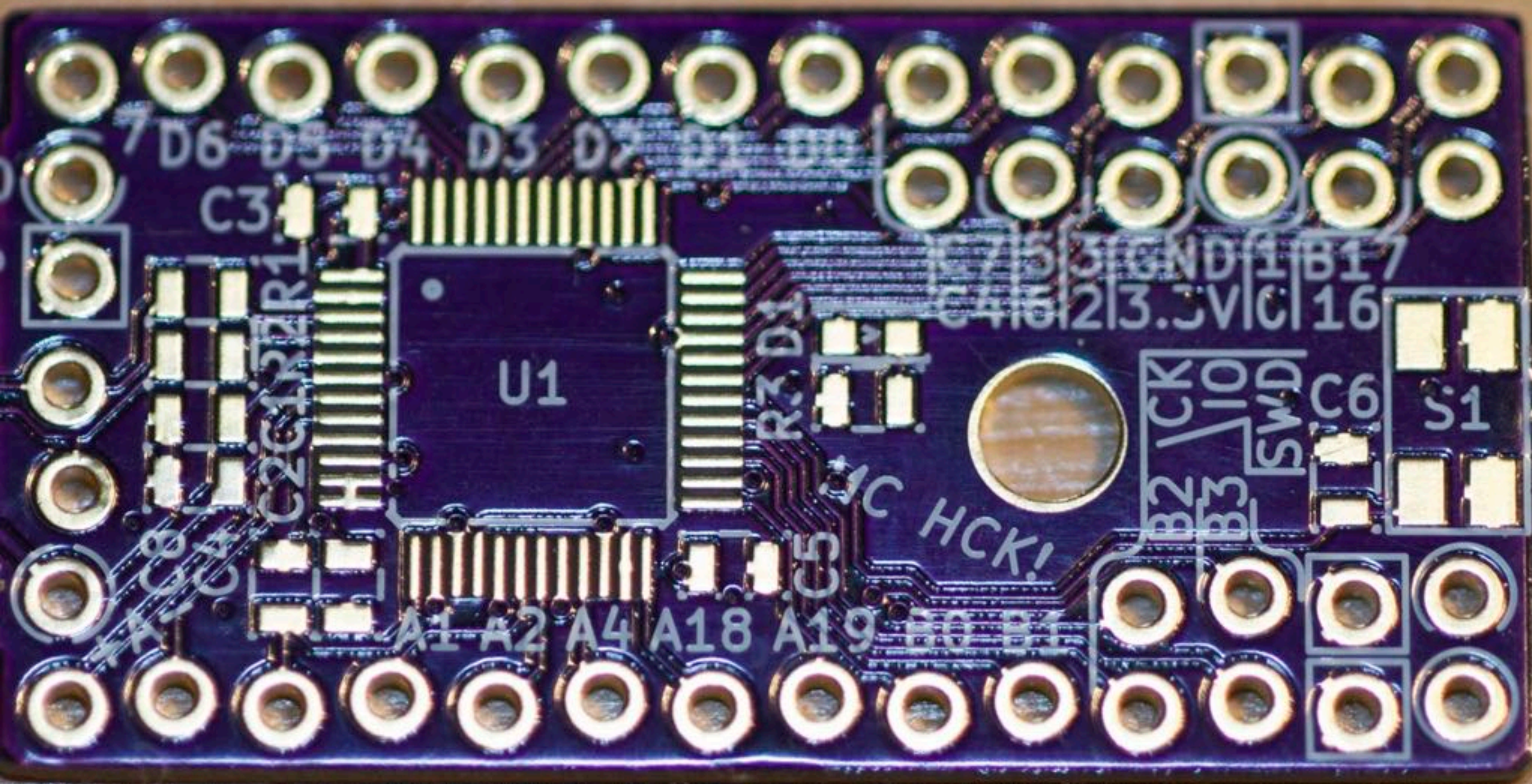
OSH Park is a community printed circuit board (PCB) order.

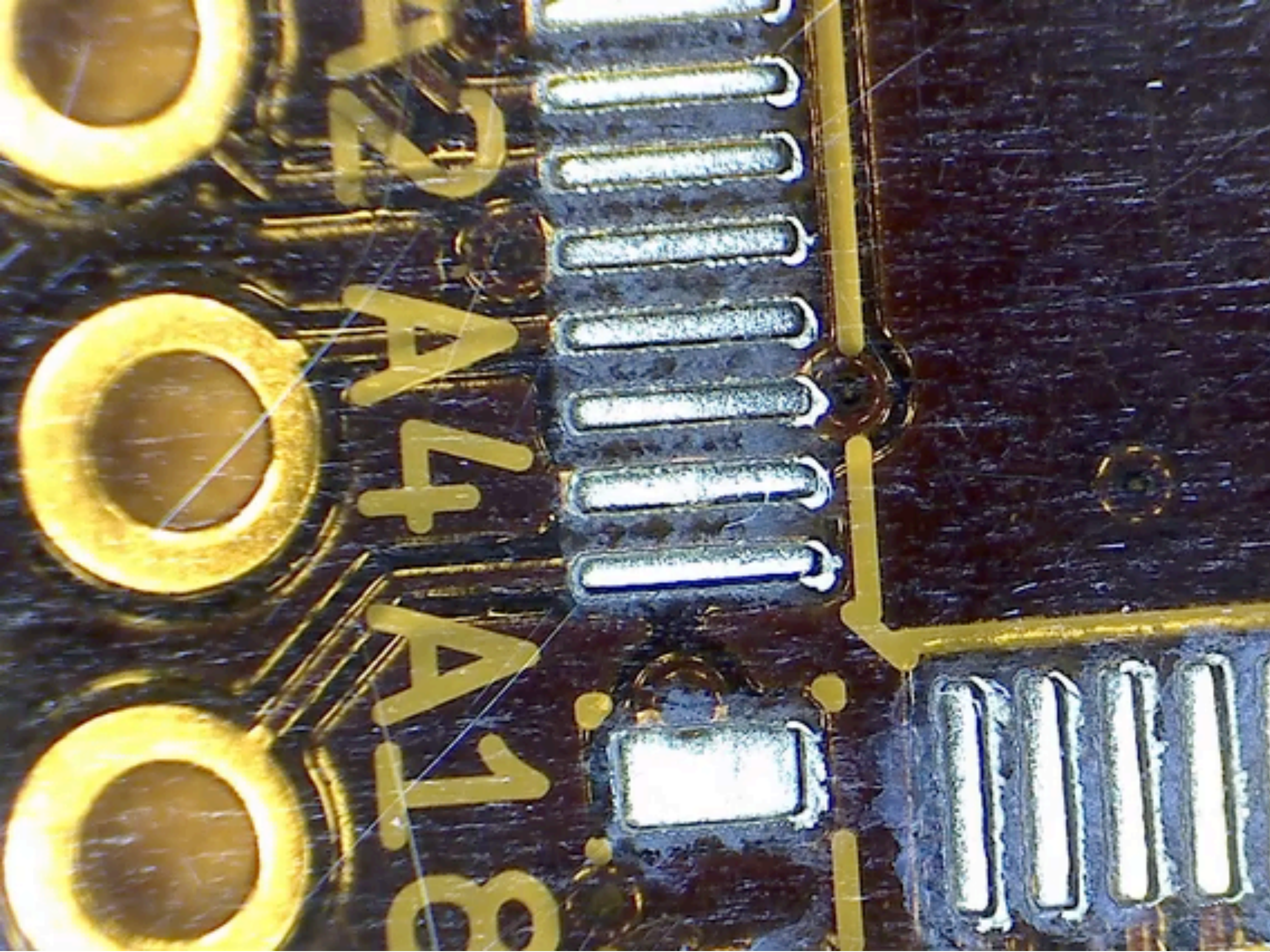
We bring you high quality, lead free boards (ENIG finish), manufactured in the USA, and shipped for free to anywhere in the world.

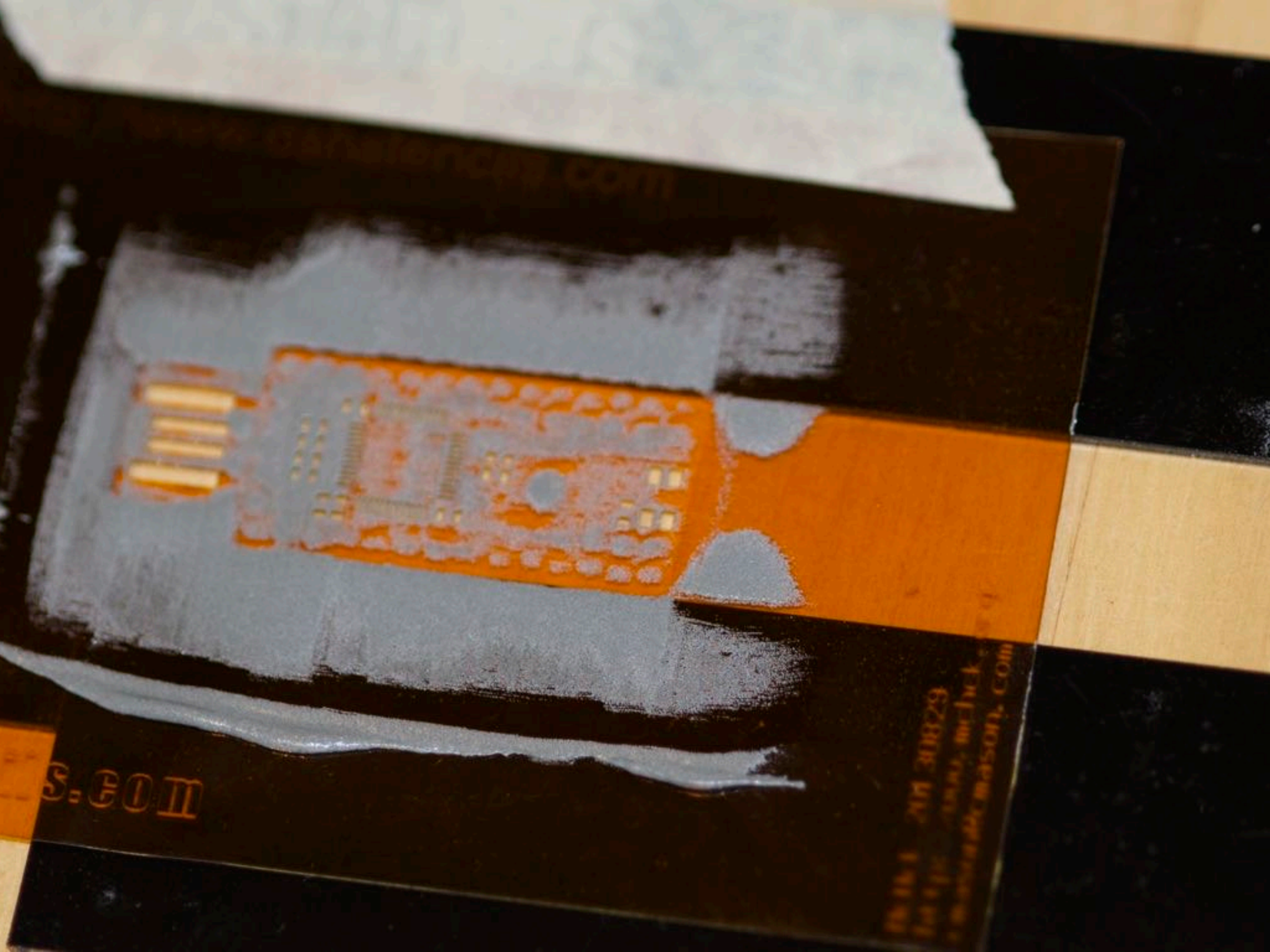
2 layer boards are \$5 per square inch (with 3 copies of your board included in that price) and ship in under 12 calendar days from ordering.

4 layer boards are \$10 per square inch (also including 3 copies of your board), go to the fab every 2 weeks, and have a 2 week turn time from the fab.

We can also support larger runs. See [the pricing page](#) for a full list of offerings.



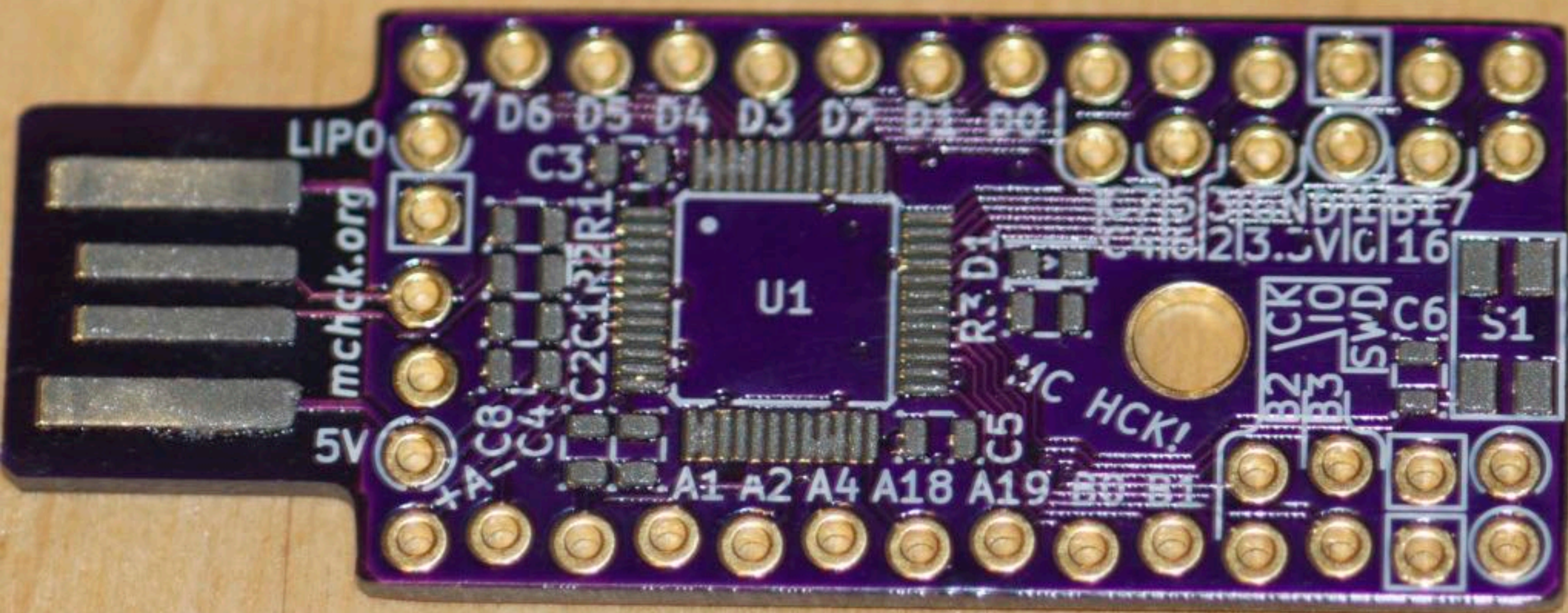


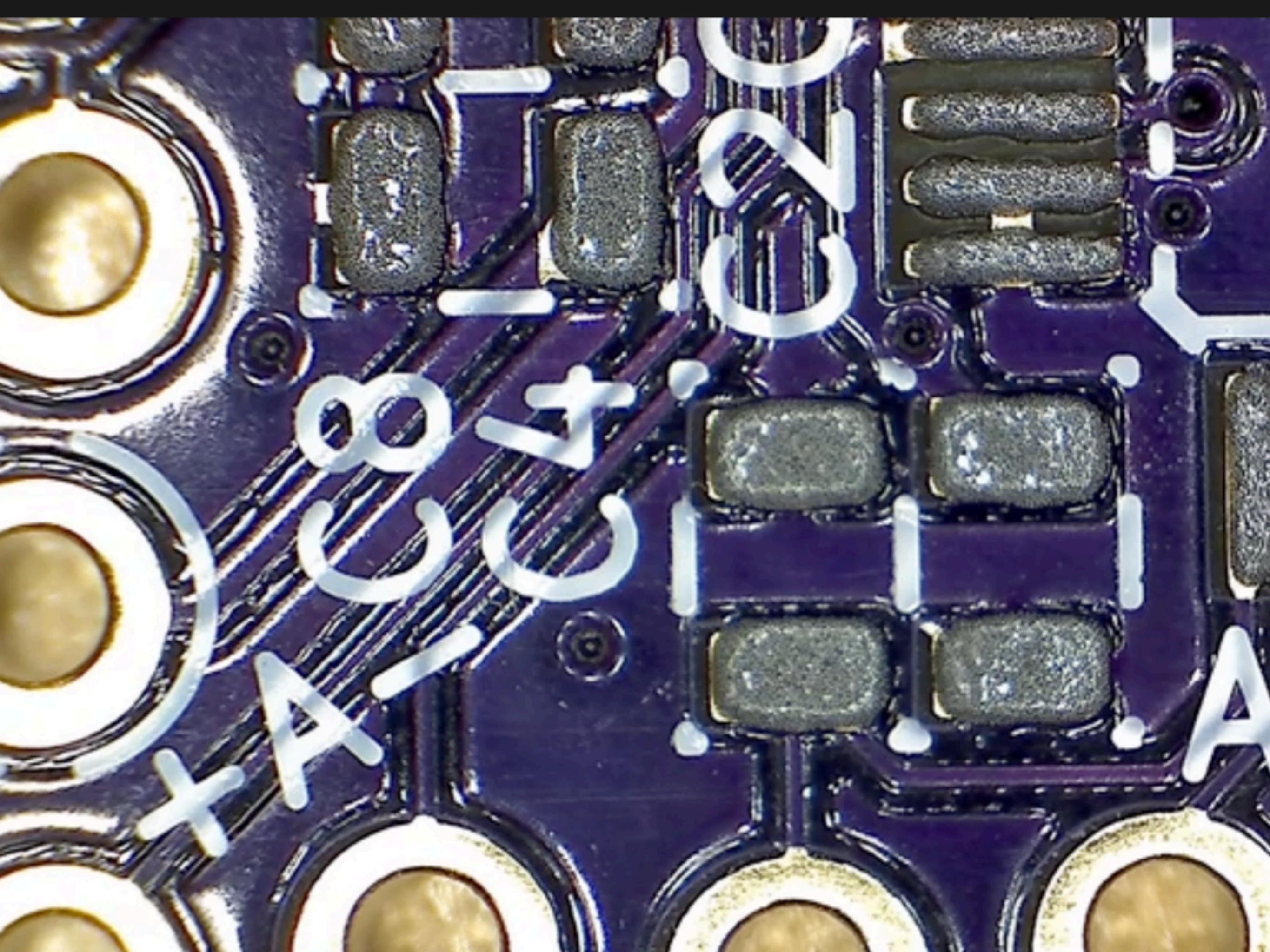


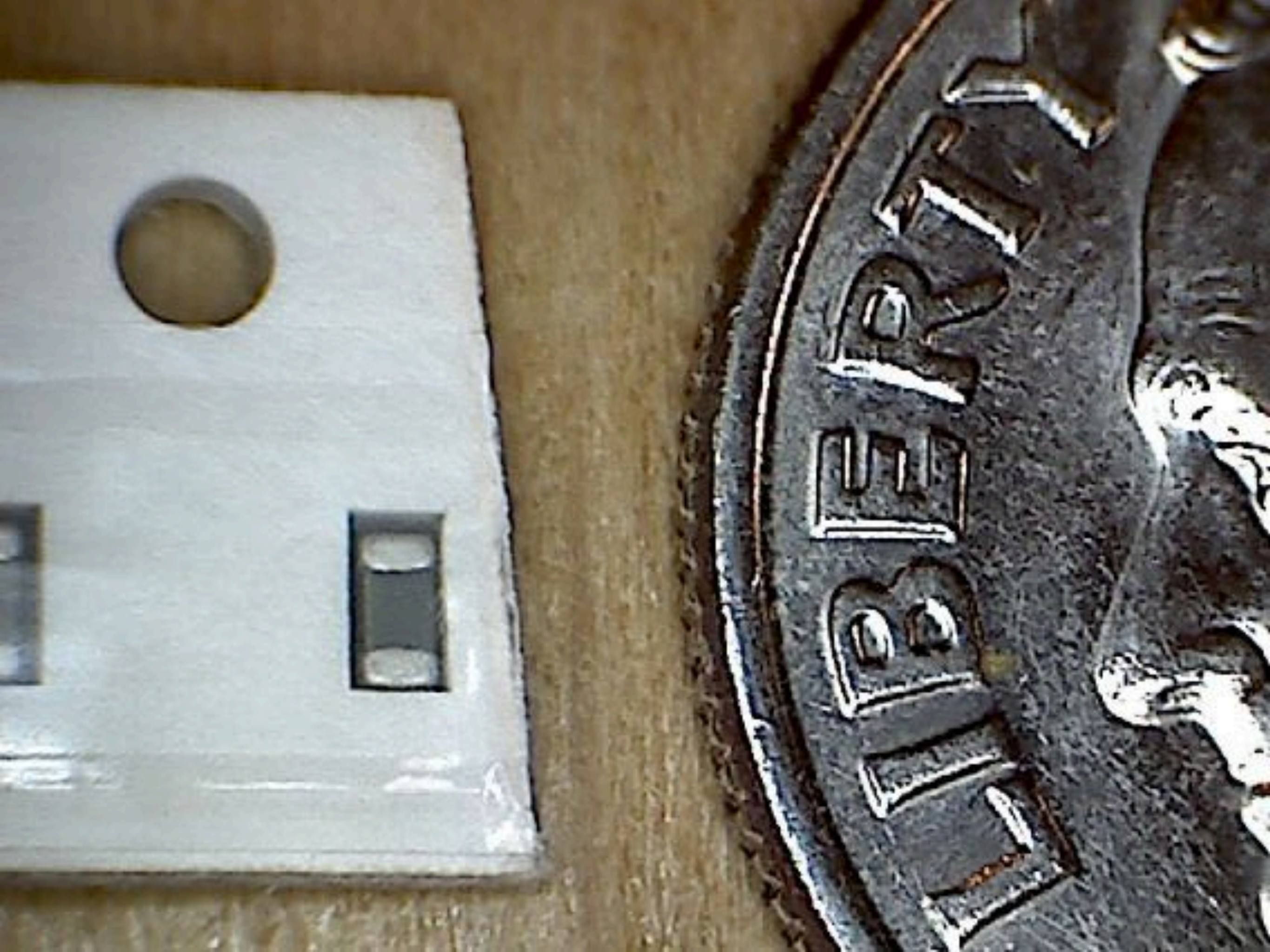
www.construction.com

S.COM

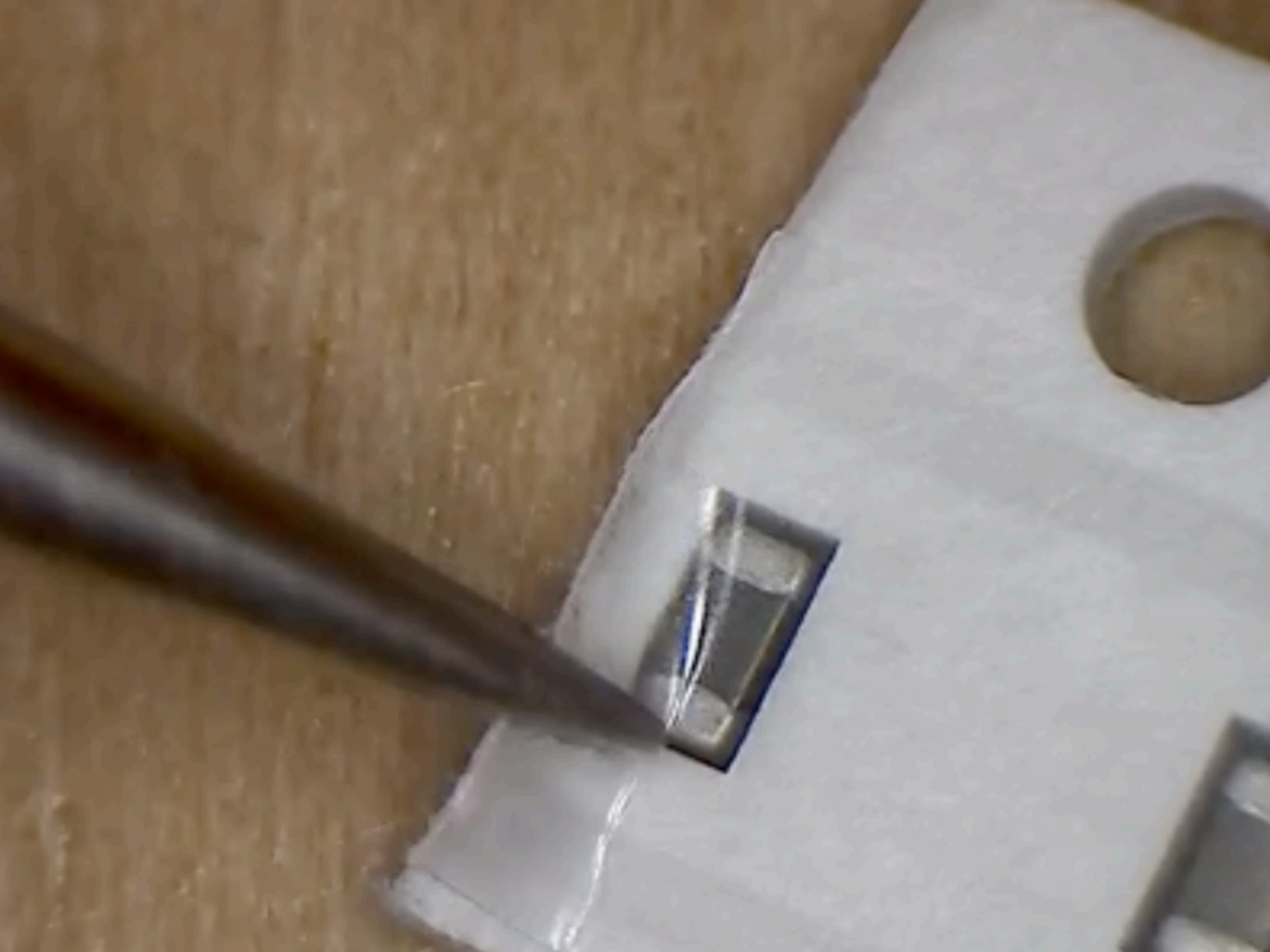
2011 30829
62800 WZ
www.construction.com

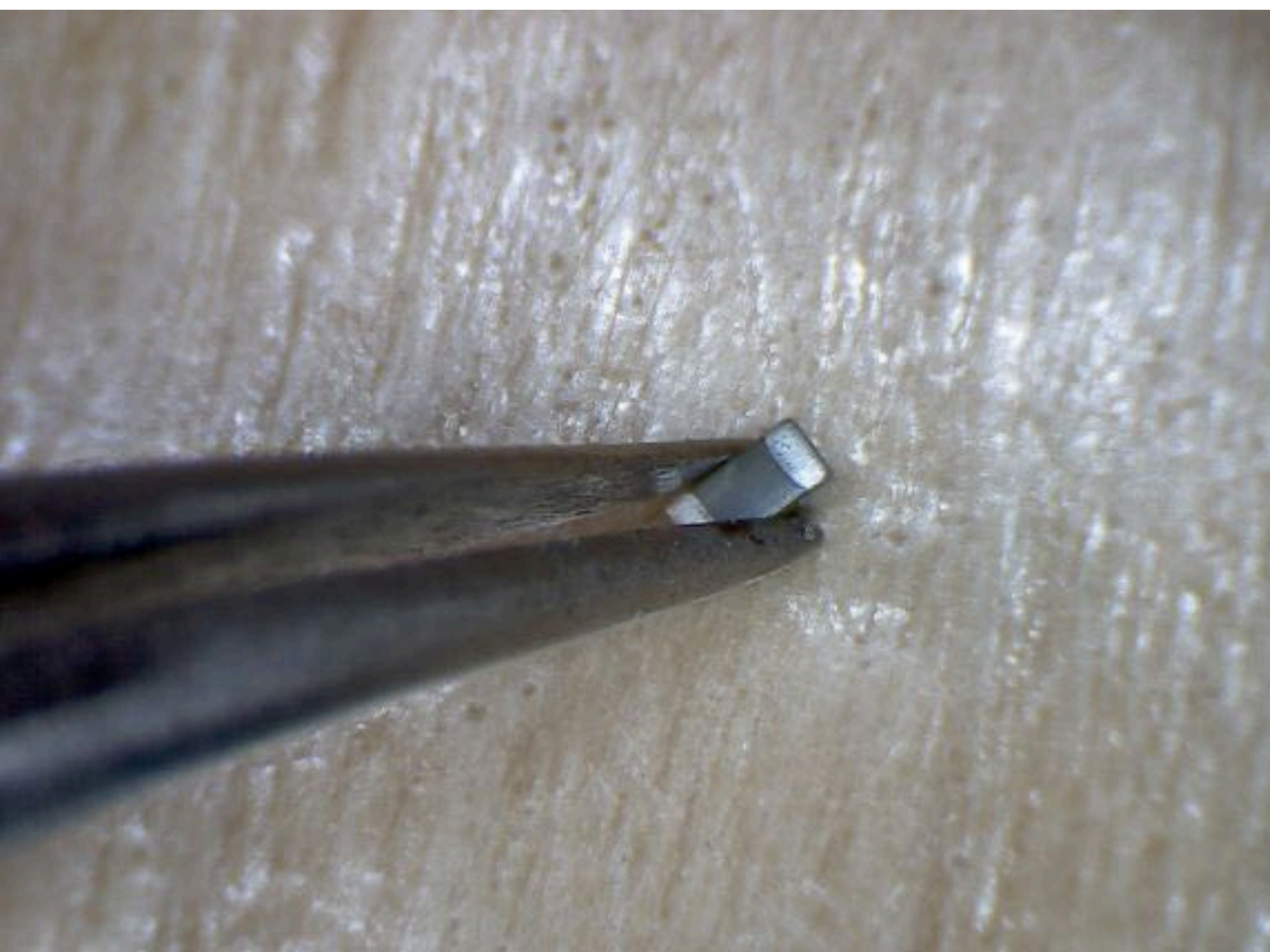


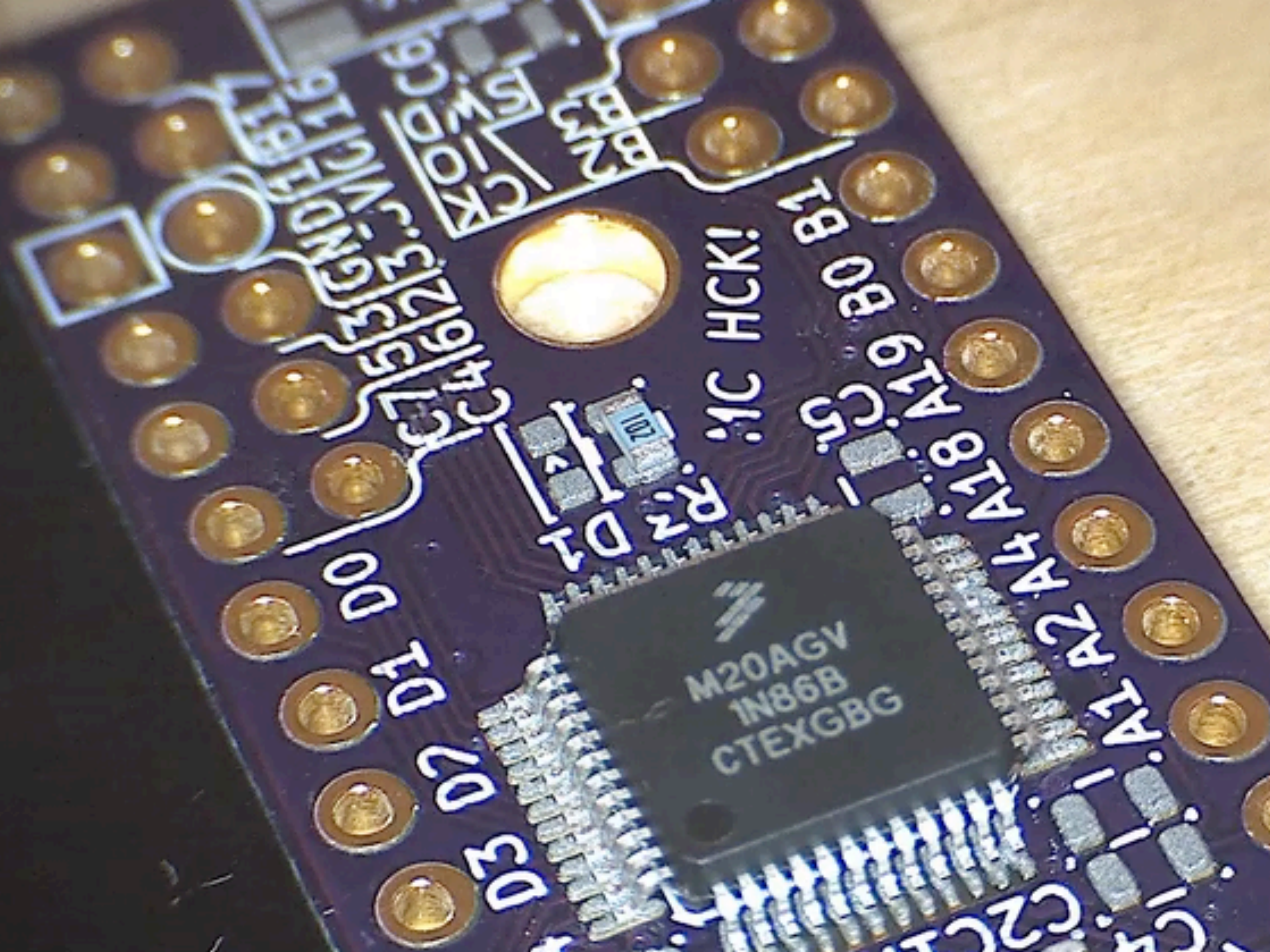












M20AGV
IN86B
CTEXGBG

!1C HCK!

6T9 B0 B1

8T8 A18

A4 A2

A1

D0

D1

D7

D3

1616

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

0T8

1T7

2T6

3T5

4T4

5T3

6T2

7T1

8T0

9T9

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4T4

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7T1

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9T9

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7T1

8T0

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9T9

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7T1

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5T3

6T2

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8T0

9T9

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7T1

8T0

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5T3

6T2

7T1

8T0

9T9

0T8

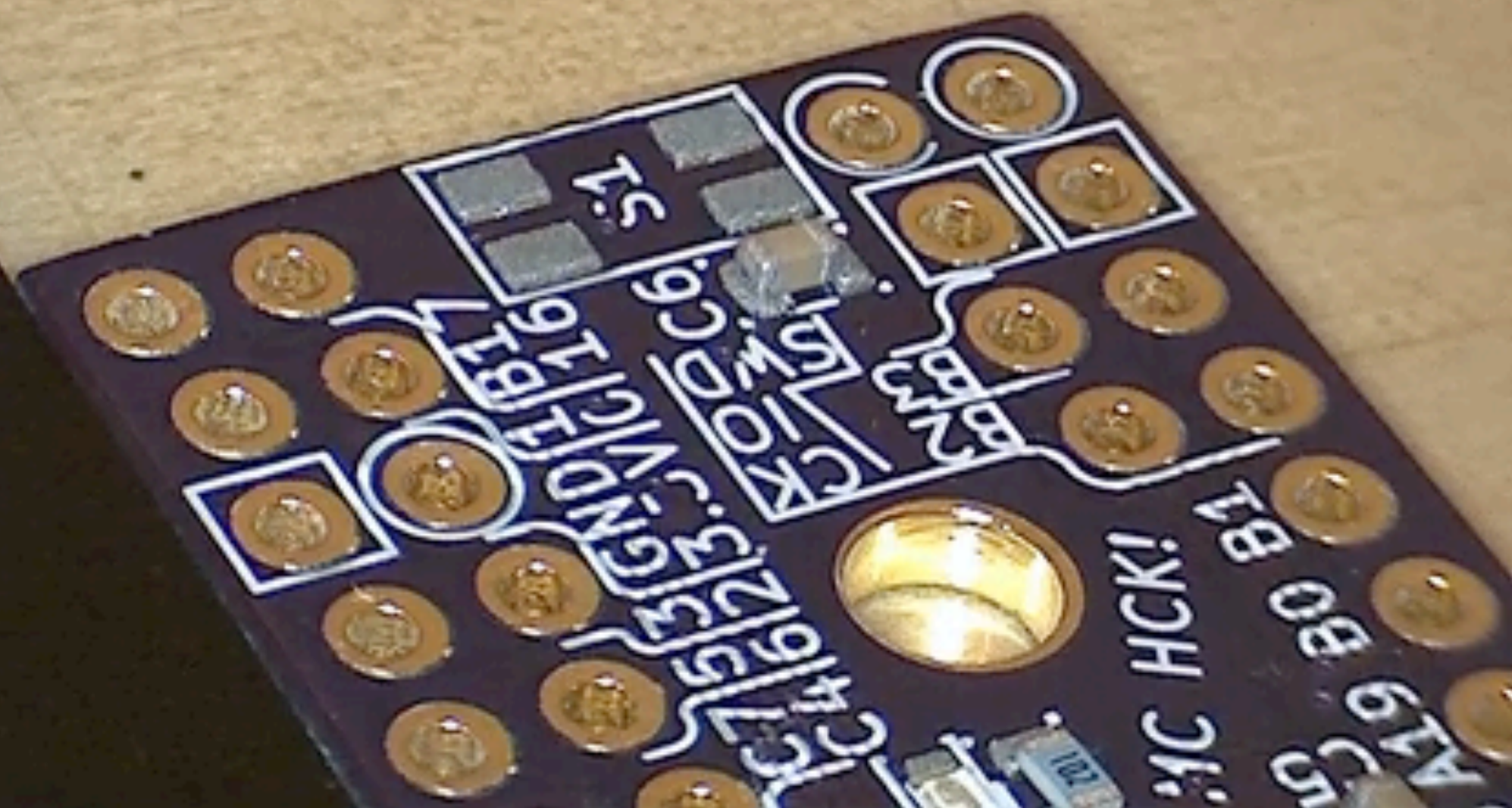
1T7

2T6

3T5

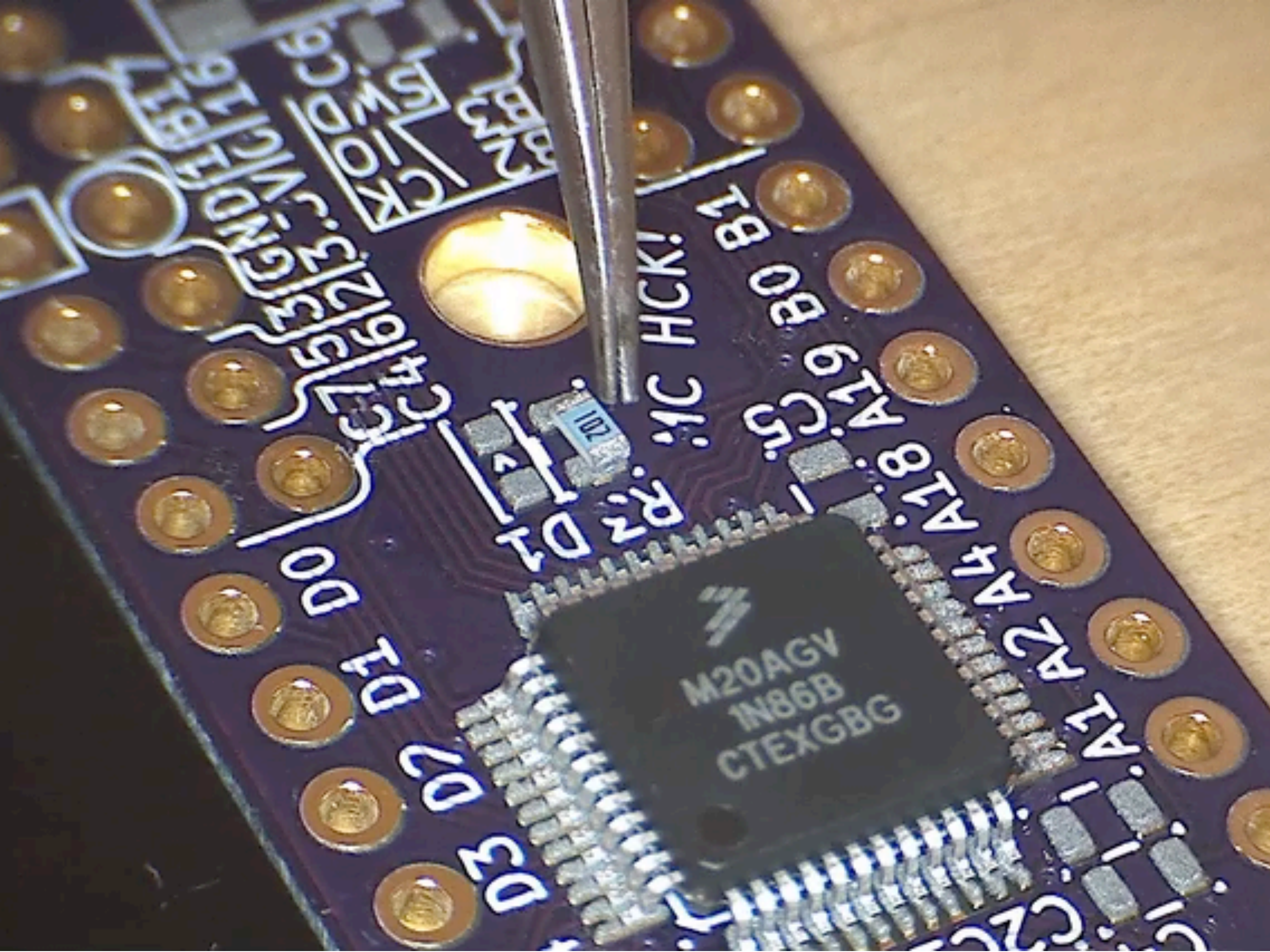
4T4

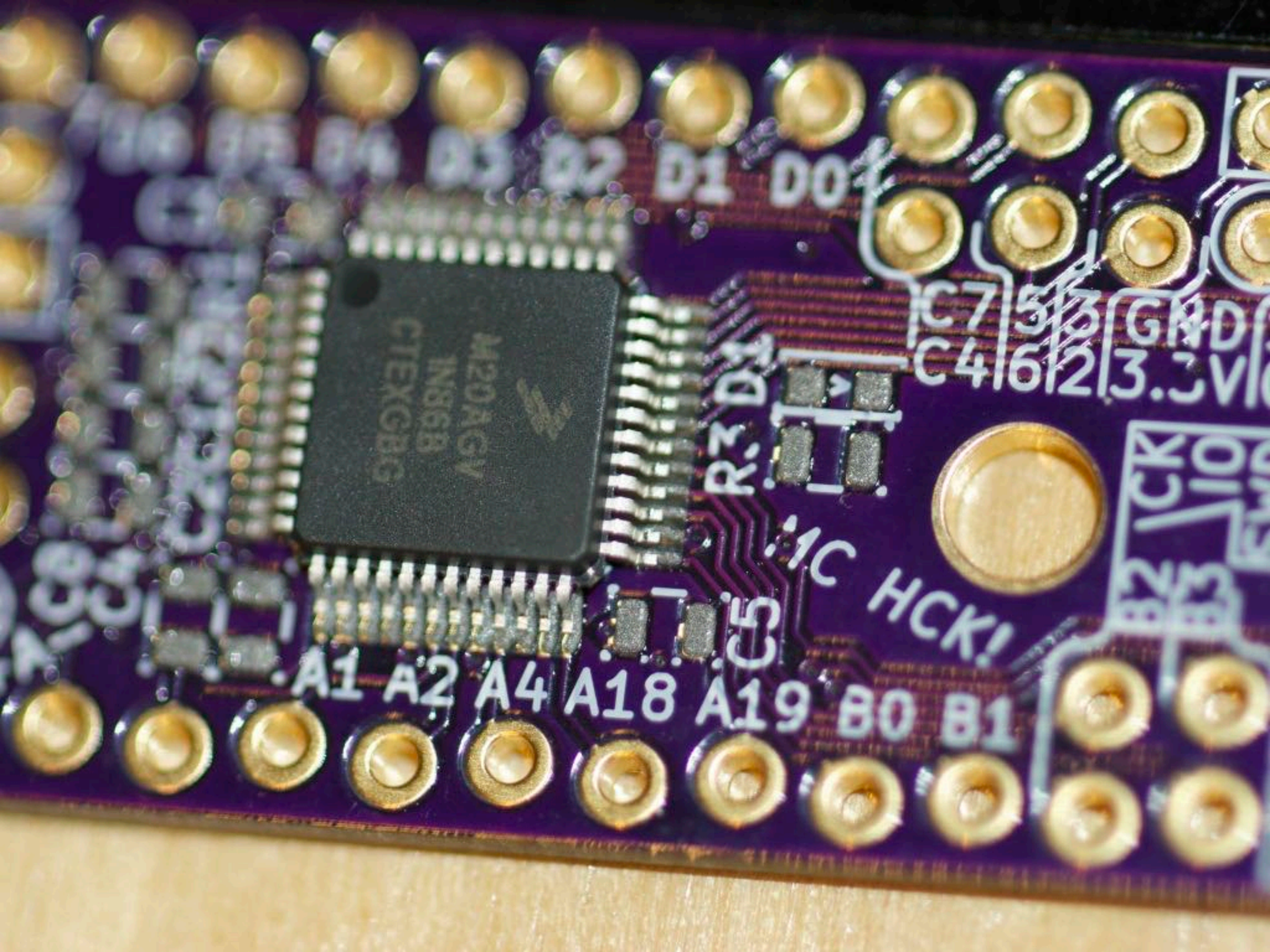
5T3



Techniques

- Don't try too hard.
- Use fluid motion. Can drop from above.
- Rest/press your hand against something, such as your other hand.
- Placement does not need to be exact, as surface tension will pull part into place, but does need to be on pads.
- Avoid adjusting if possible.





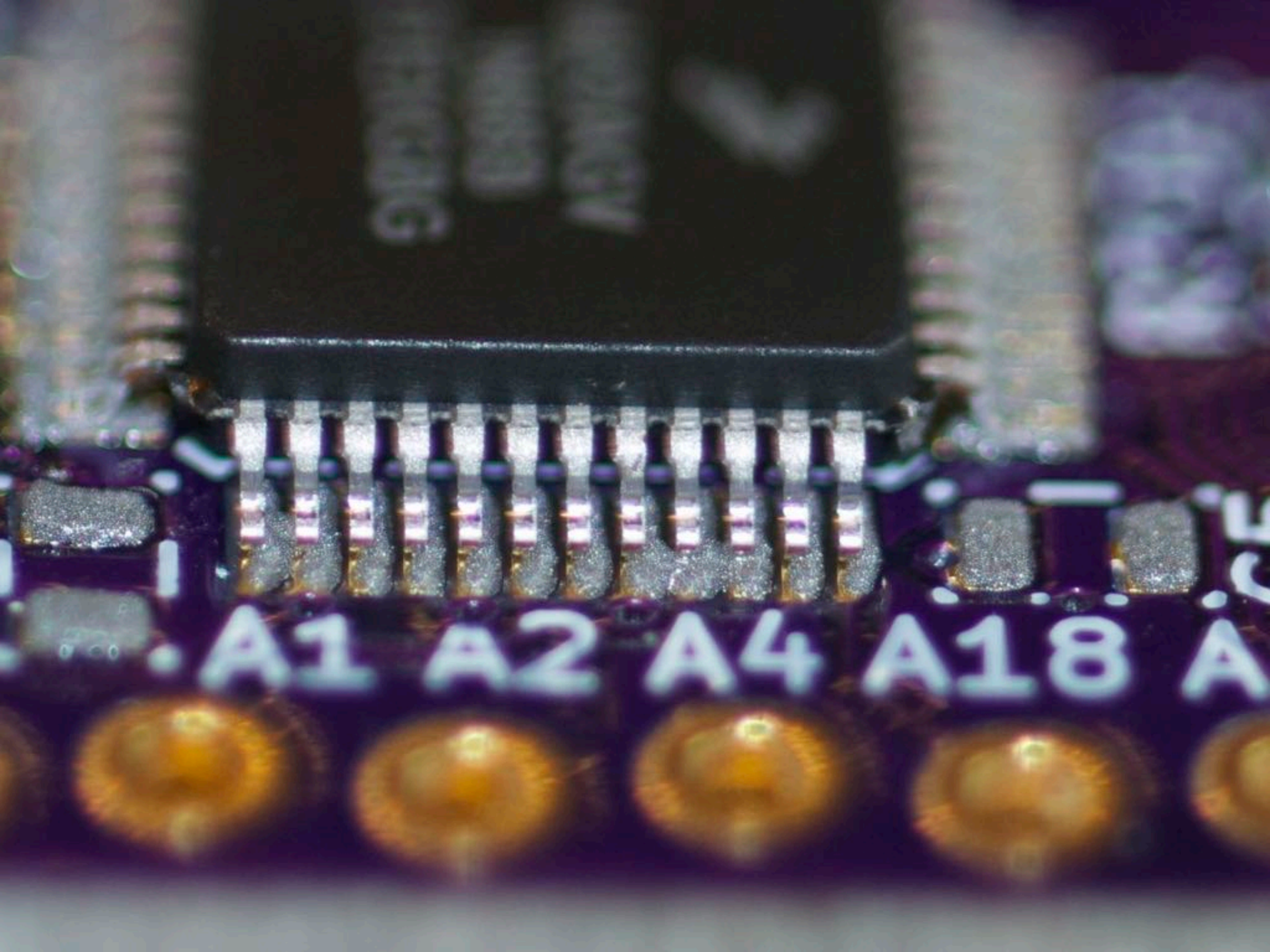
M20AGV
IN868
CTEXG8G

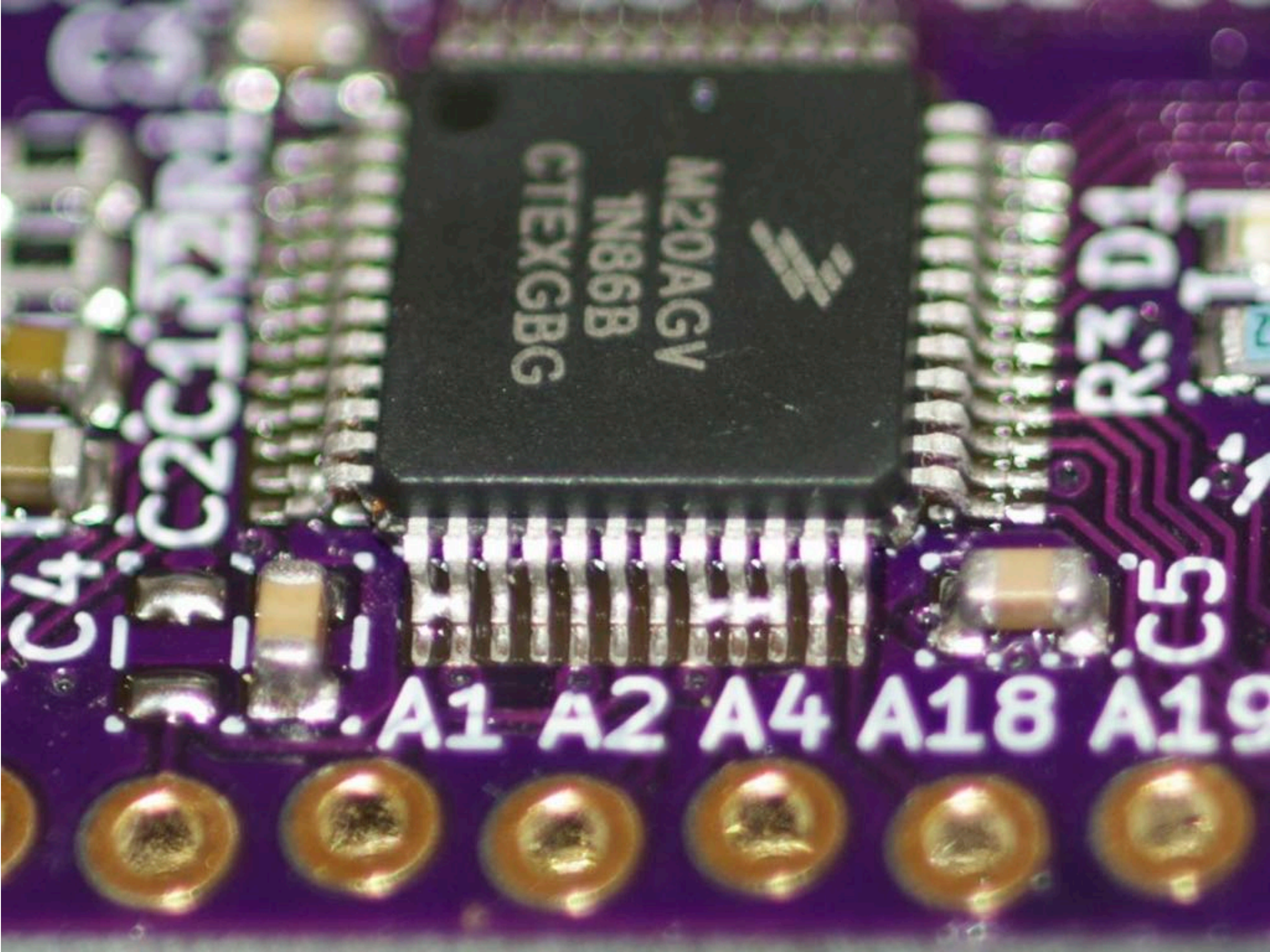
R3 D1

C7 5 3 GND
C4 6 2 3.3V

HCK!

A1 A2 A4 A18 A19 B0 B1





M20AGV
IN86B
CTEXGBG



A1 A2 A4 A18 A19

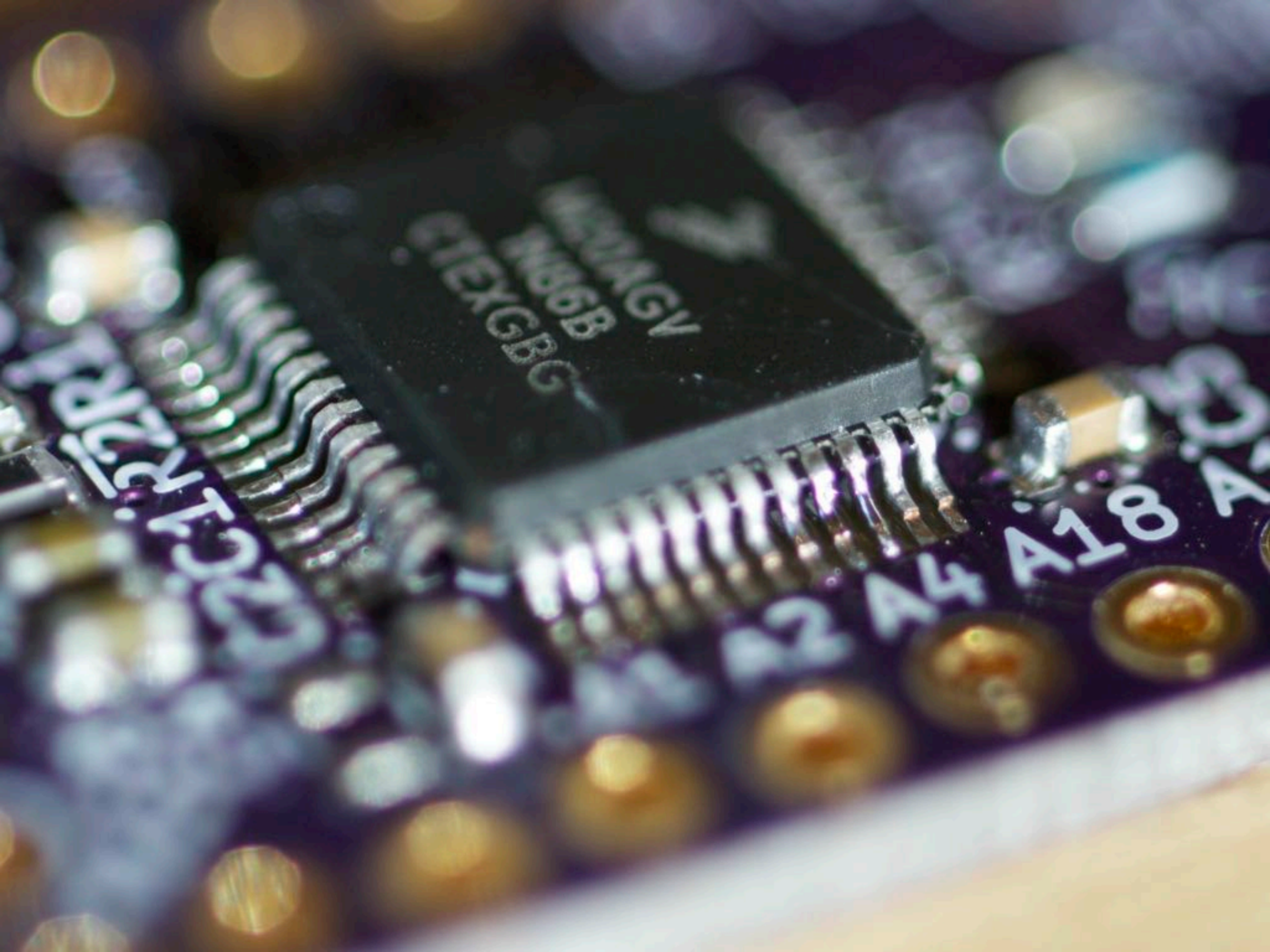
C4

C5

R3

R3

C2C122



AGW66B
C12R

C12R

A18

A4

A2

Techniques (QFP)

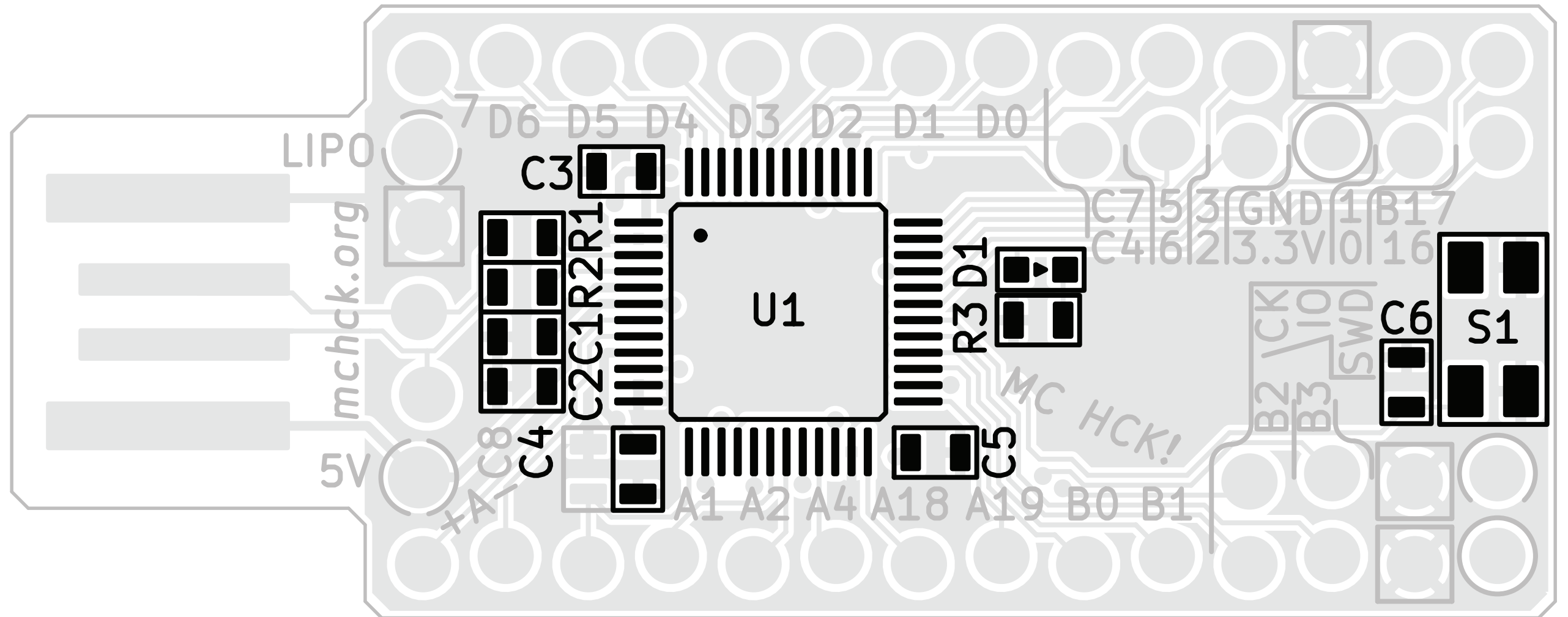
- Look directly down on part.
- Check registration on all four sides before setting part down.
- Look in between leads for purple or gold.
- Shift part back and forth in both directions to see that there is purple between each lead.



Process

- Sand board
- Obtain parts (will describe each)
- Practice placing three parts
- Screen print on solder paste
- Place parts for realz
- Heat on hot plate: solder reflows
- Program bootloader

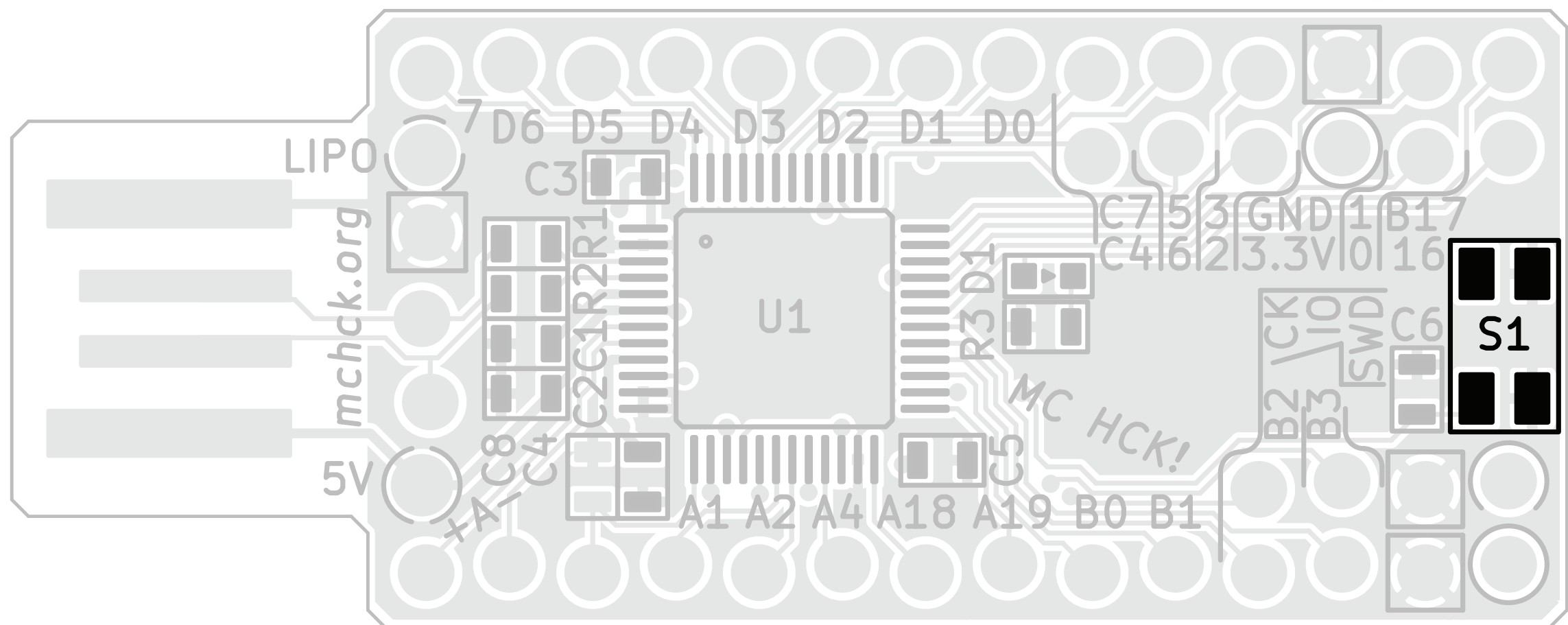
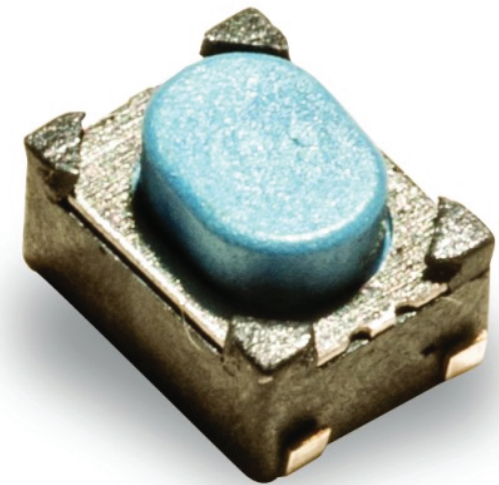
12 parts total, 8 different parts



— S1

Pushbutton

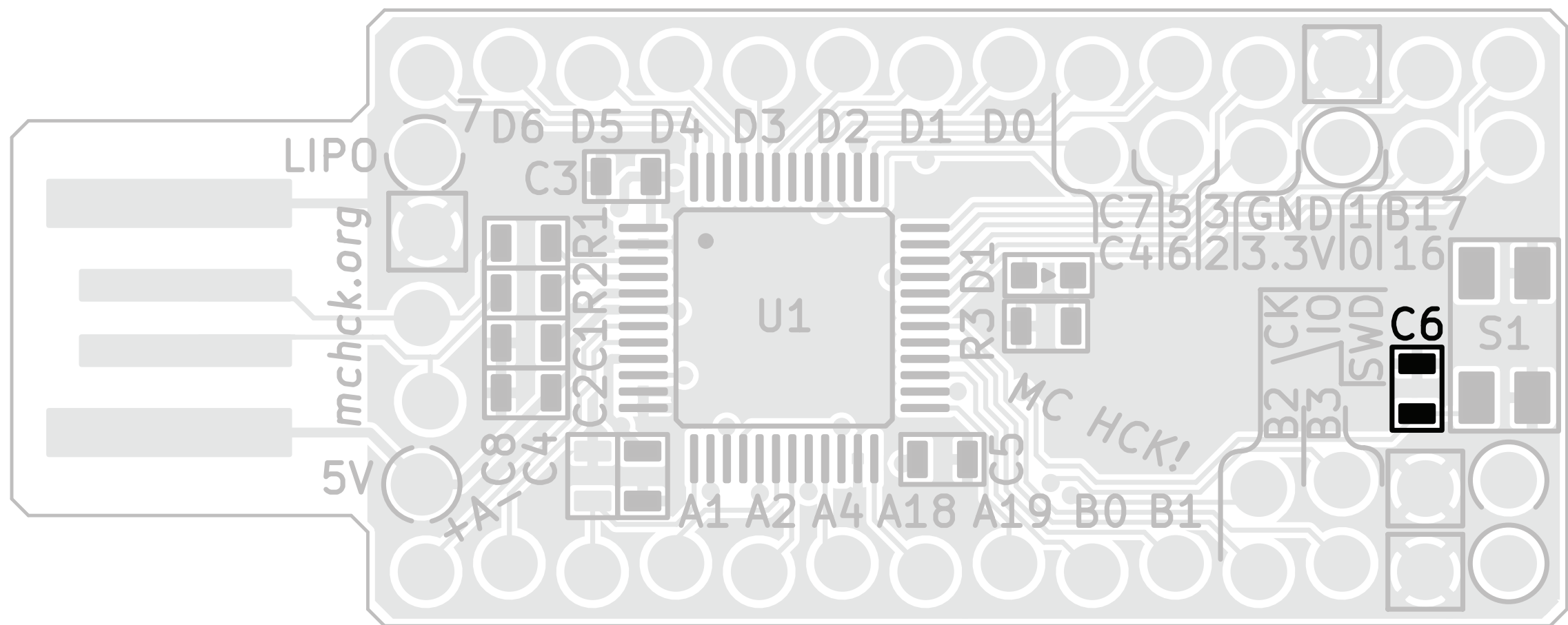
\$0.218



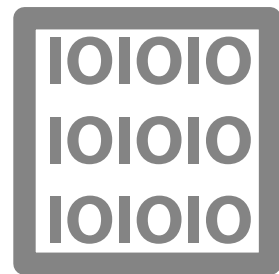
This **pushbutton switch** lets you change the microcontroller into a “bootloader” mode where it will accept a new program.

⊢ C6

Capacitor, 100 nF \$0.019

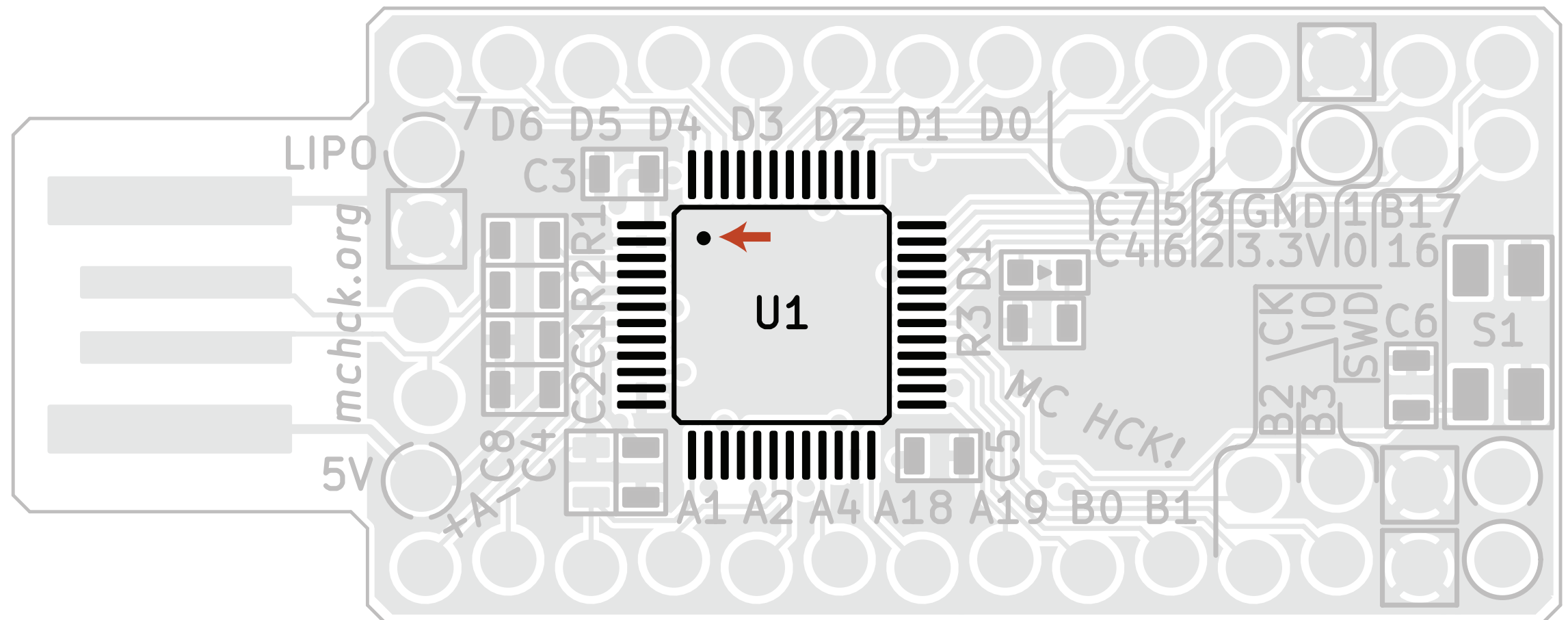
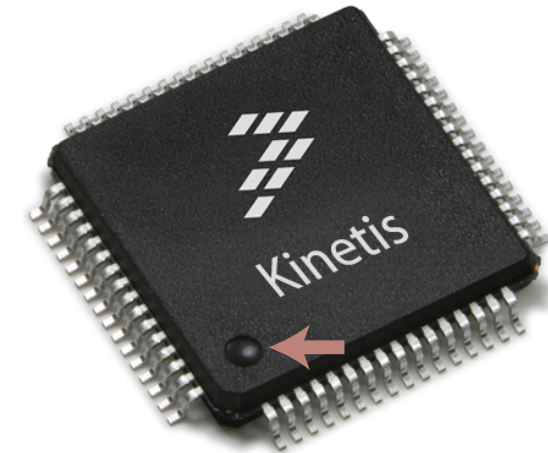


Debouncing capacitors smooth out chatter that occurs when a push-button switch is pressed, preventing false triggering.

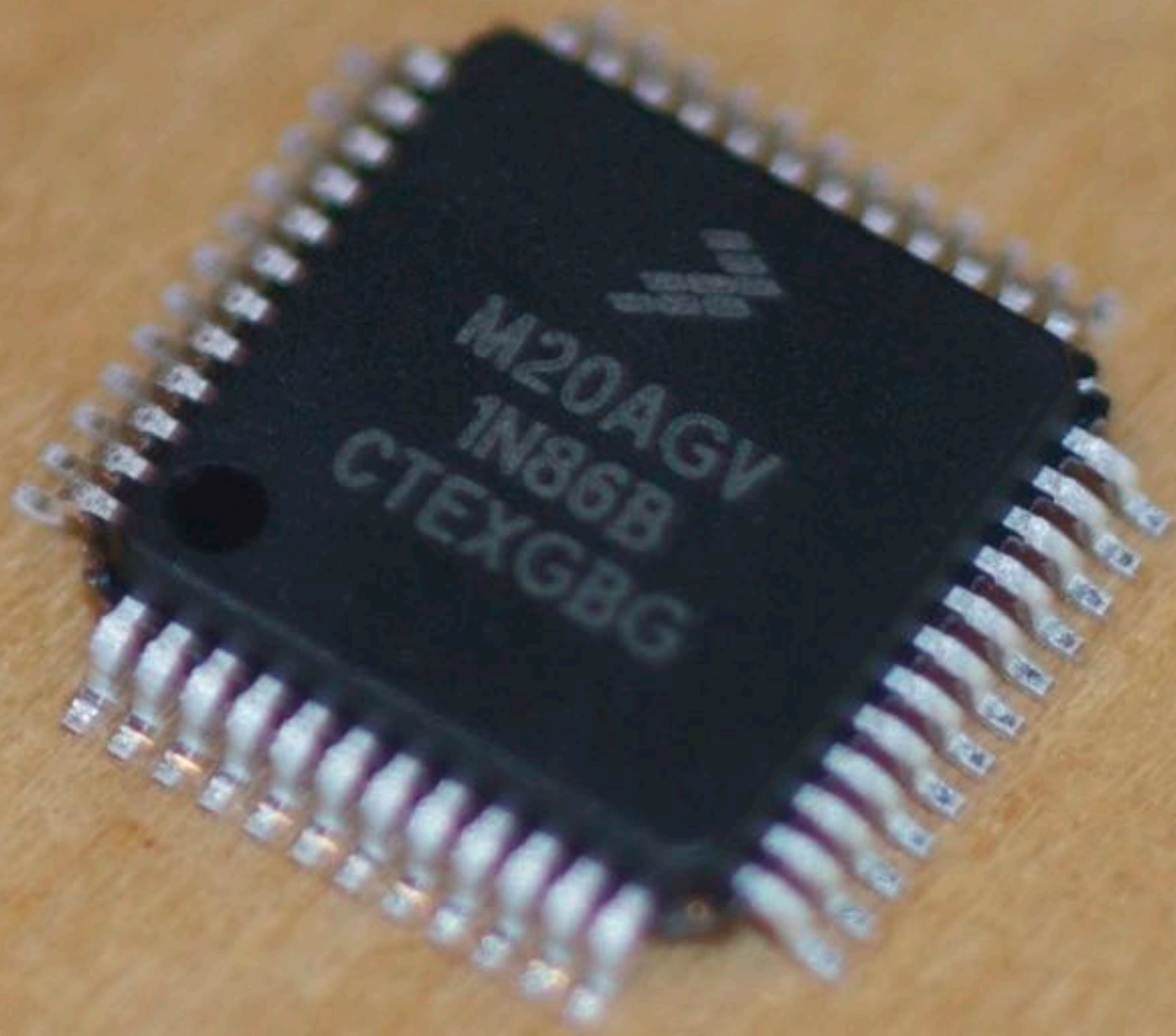


U1

Microcontroller \$4.12

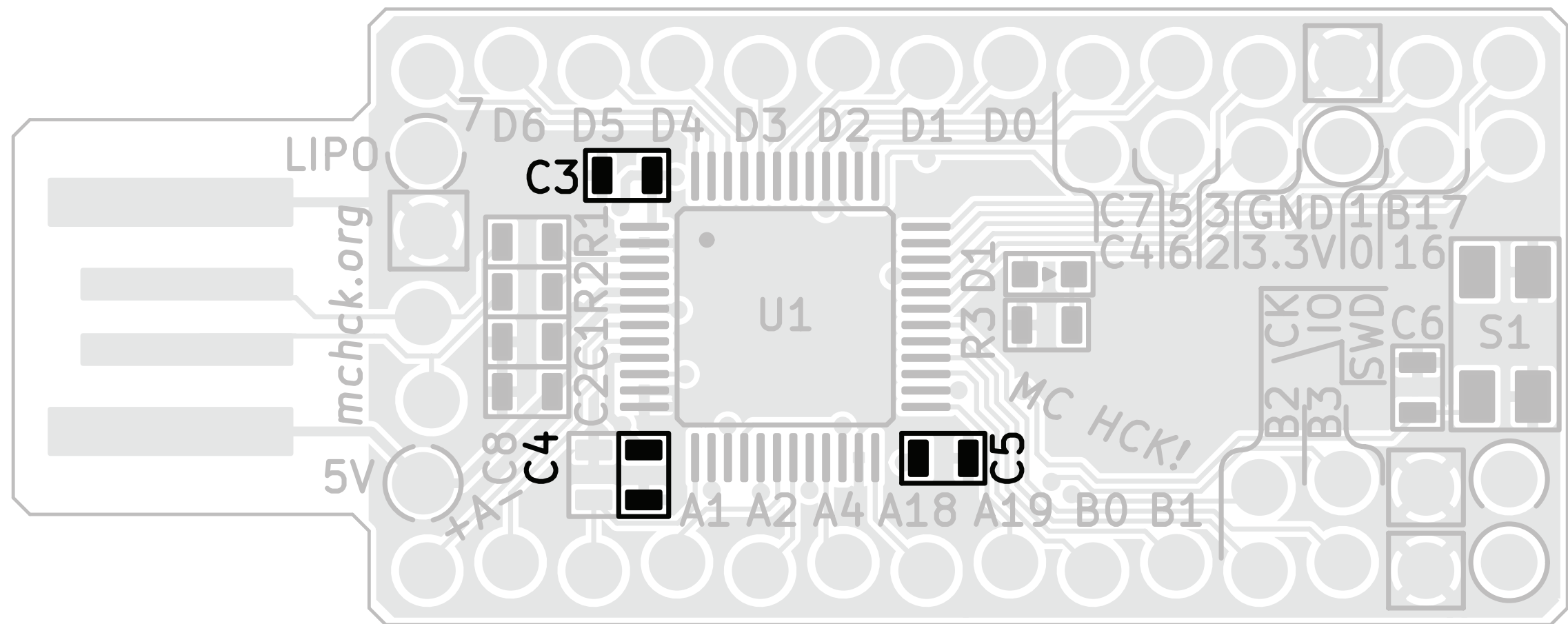


The **microcontroller** is the brain of the operation. It has a ton of different features all on a single tiny silicon chip. This chip, a Freescale Kinetis MK20DX128, is an ARM microcontroller, similar to but less powerful than the CPU in your phone or tablet. Note the *alignment dot*.



|| C3, C4, C5

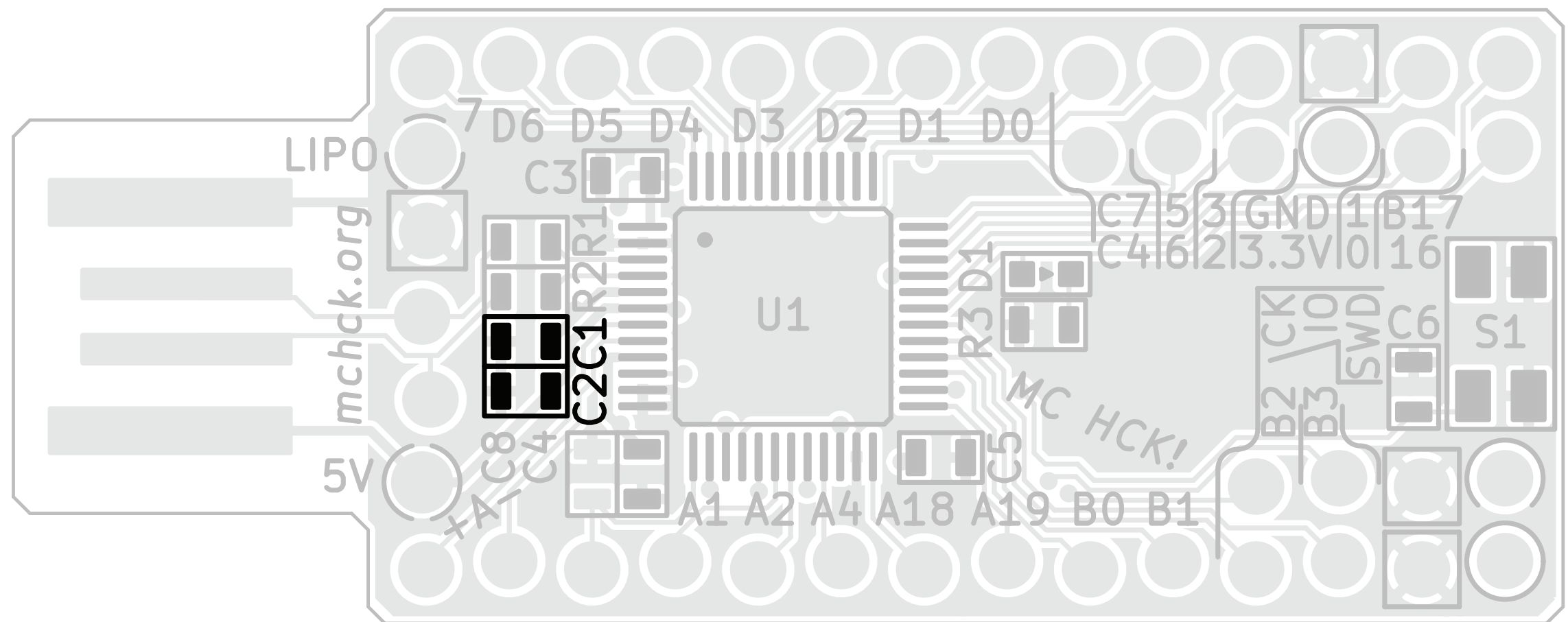
Capacitor, 100 nF \$0.019



Bypass or decoupling capacitors reduce digital switching noise by providing a small reservoir of fast-reacting current close to a potentially noisy digital chip to smooth out sudden changes in current draw.

⊢ C1, C2

Capacitor, 2.2 uF \$0.033

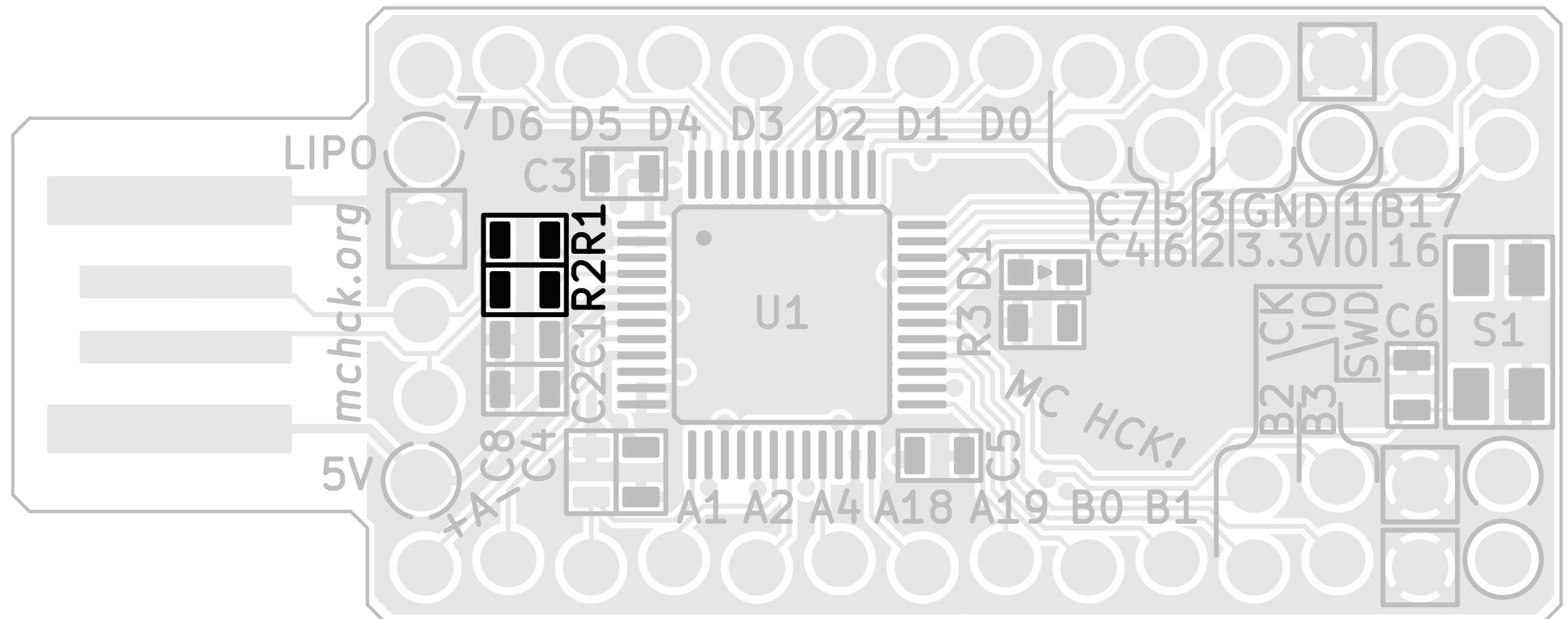
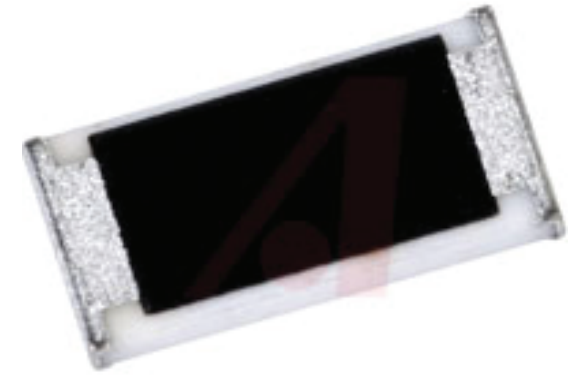


Bulk capacitors act as larger reservoirs of current close to power hungry components, preventing brown-out when

R1, R2

Resistor, 33 Ω

\$0.007

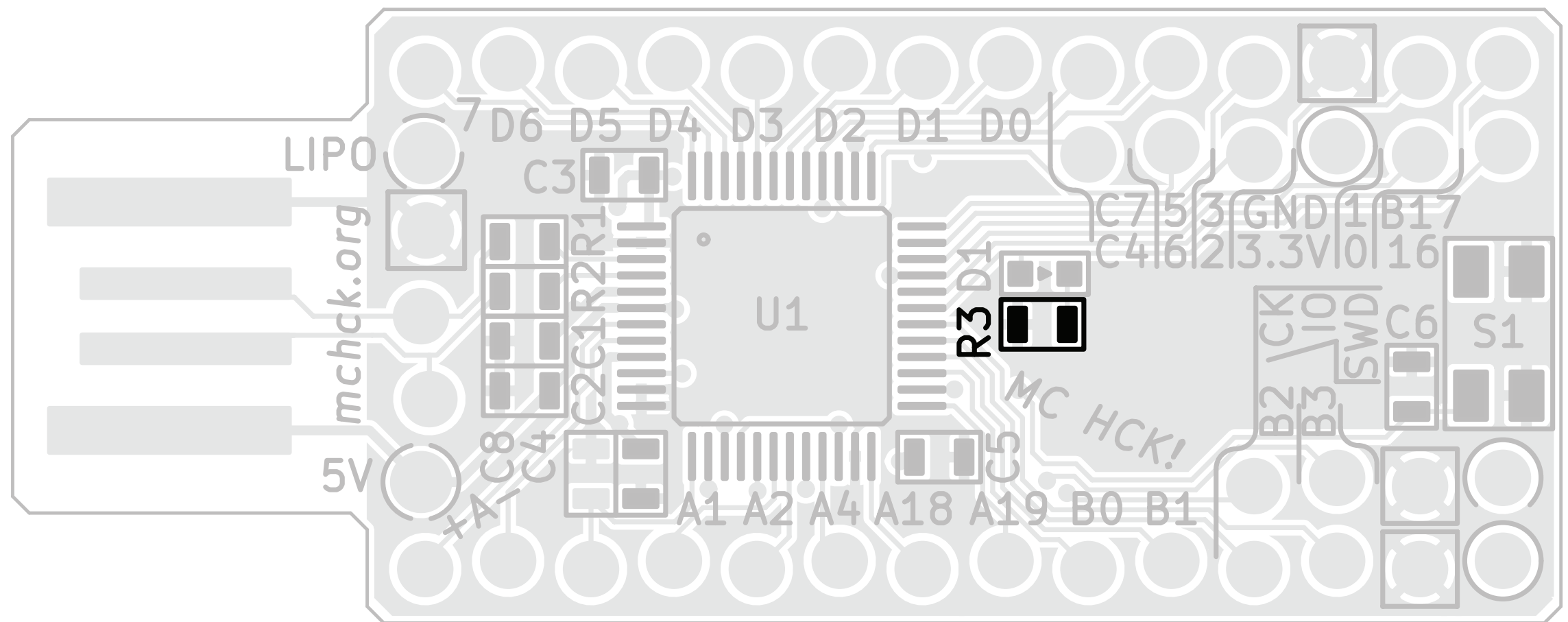
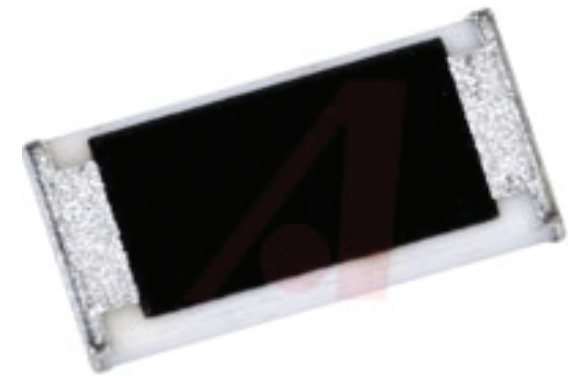


Termination resistors prevent electrical reflections in the USB cable that might cause the host computer to incorrectly call a 1 versus a 0. The black side is normally placed facing up.

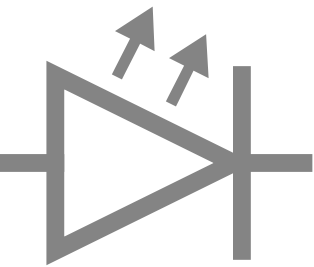
 **R3**

Resistor, 1k Ω

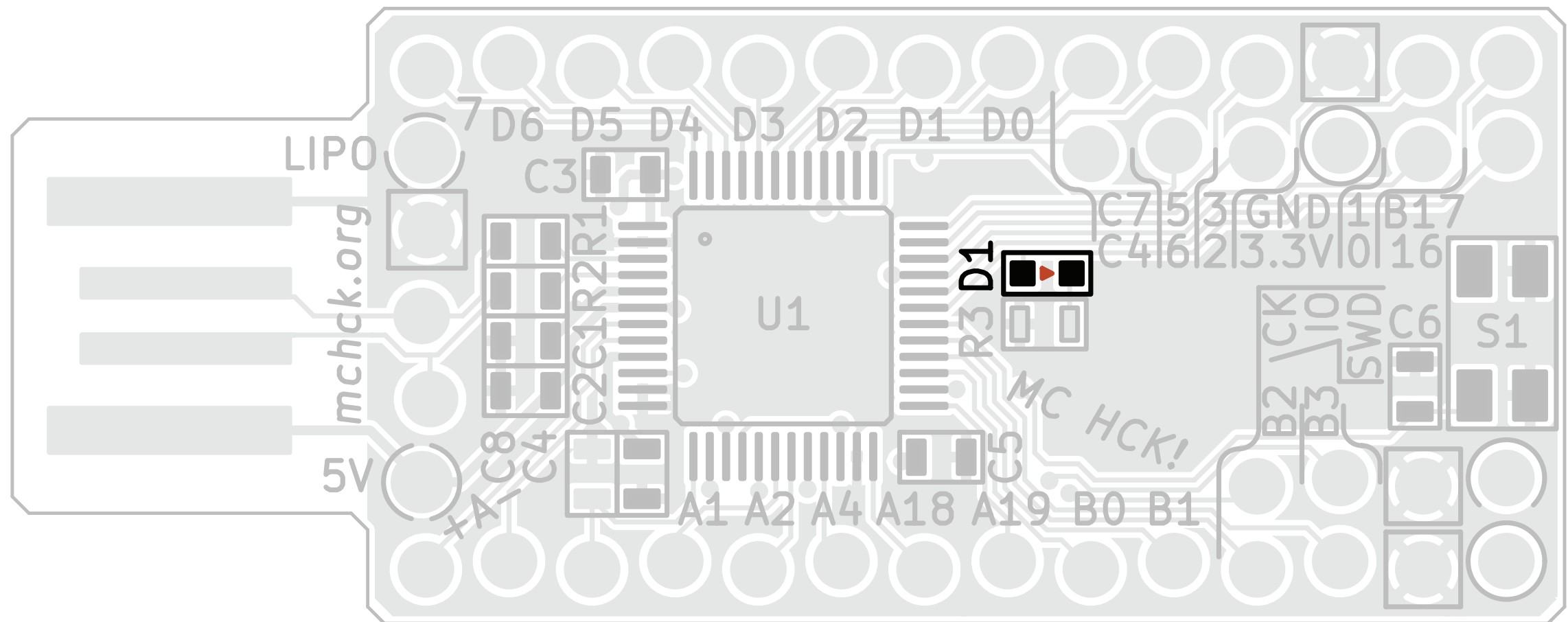
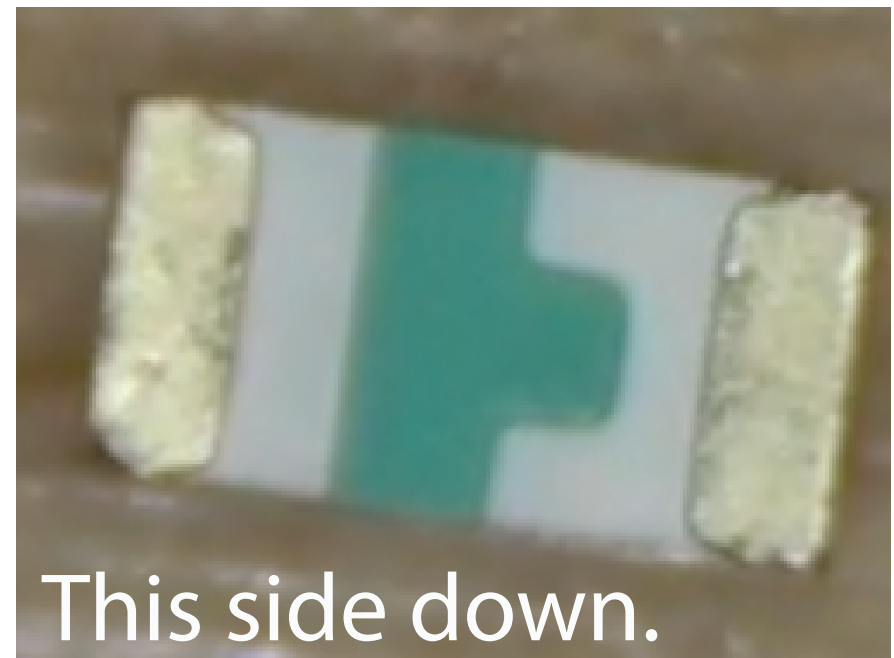
\$0.007



This **current limit resistor** prevents too much current from flowing through the LED, which could cause it to fail.

 **D1**
LED

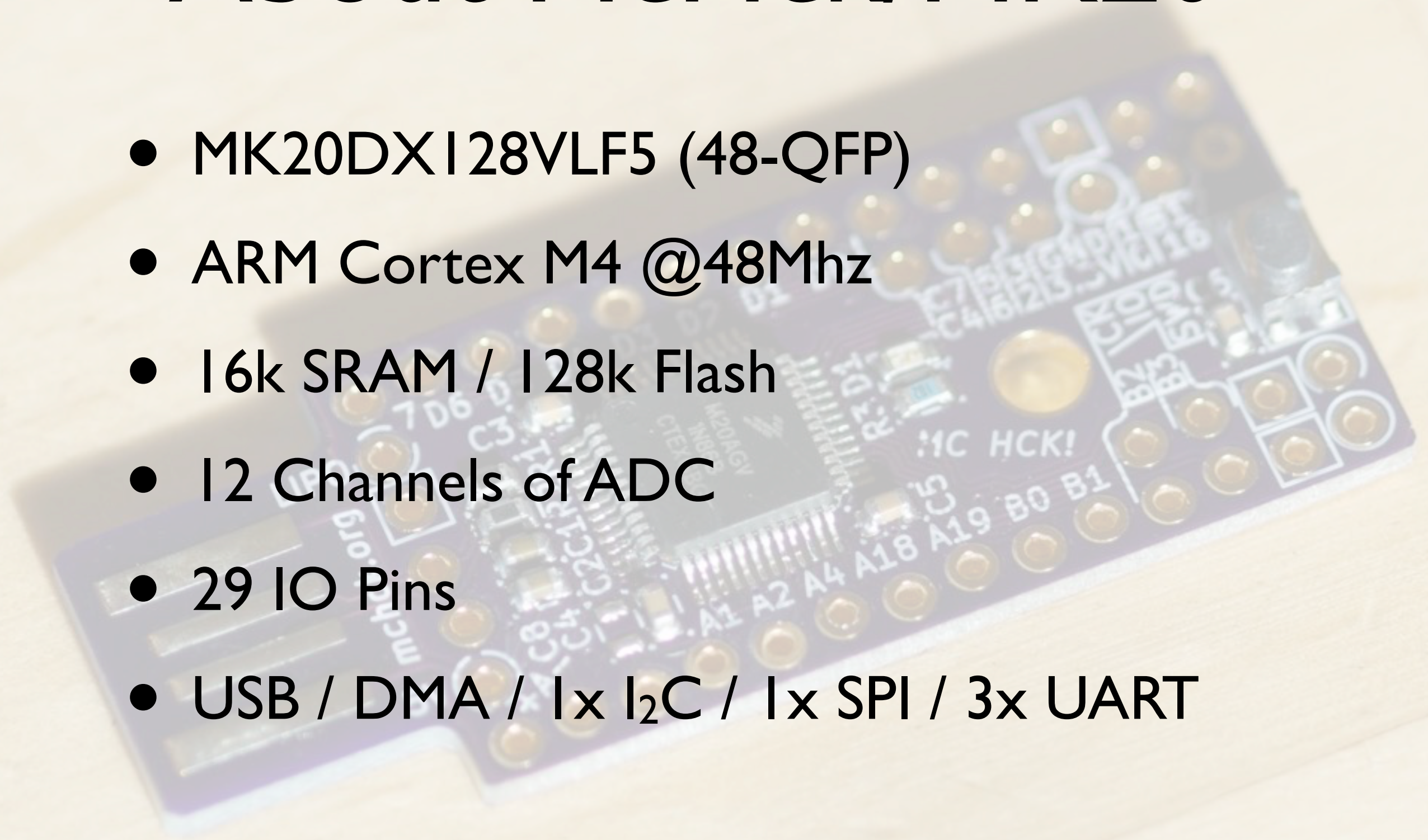
~\$0.10



This **light emitting diode** is like a tiny light bulb that glows when you pass current through it. Note the **direction arrow** (on the back in green) if you put it in backwards, it won't light up!

About McHck/MK20

- MK20DX128VLF5 (48-QFP)
- ARM Cortex M4 @48Mhz
- 16k SRAM / 128k Flash
- 12 Channels of ADC
- 29 IO Pins
- USB / DMA / 1x I₂C / 1x SPI / 3x UART



vs. Arduino

- 32-bit vs 8-bit
- 3.3V vs 5V
- Teensy 3

