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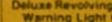
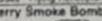
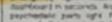
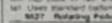
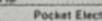
BUILD YOUR OWN MAN - MACHINE INTERFACE

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ODAY!

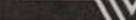
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SUPREMACY

★★★★★

High level plan - but be flexible!

- (Week 1) Keyboard layout/design
- (Week 2) Schematic design
- (Week 3, 4) PCB Layout and order
- (Week 5, 6) Case design and laser cut
- (Week 6) Off week?
- (Week 7) Solder/build
- (Week 8) Configure firmware and OS integration

This week's goals

Class

- Constraints, suggested parts, etc.
- Understand how your design choices impact the scope of the project

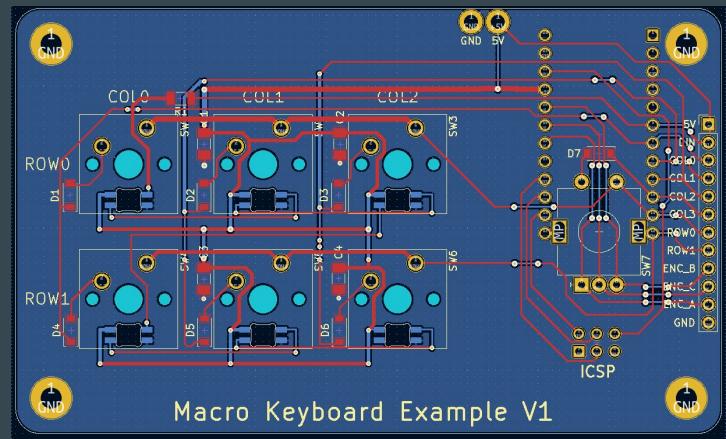
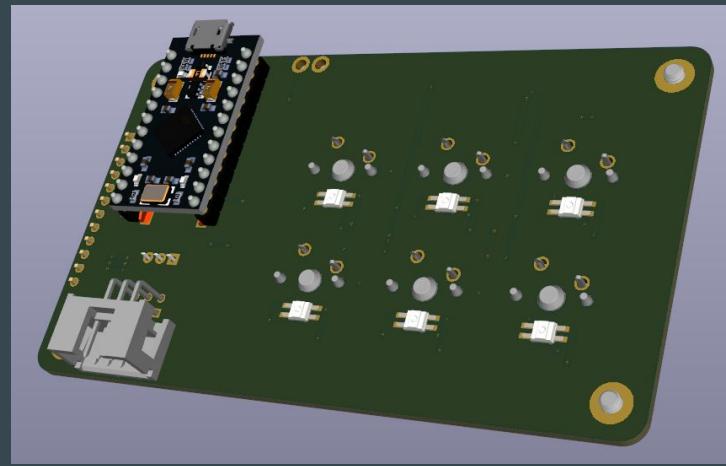
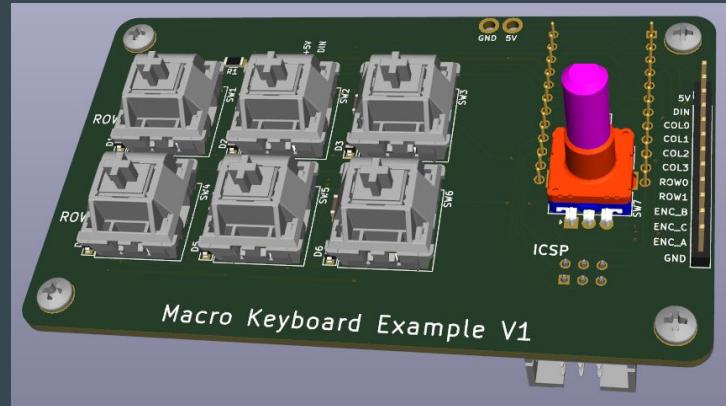
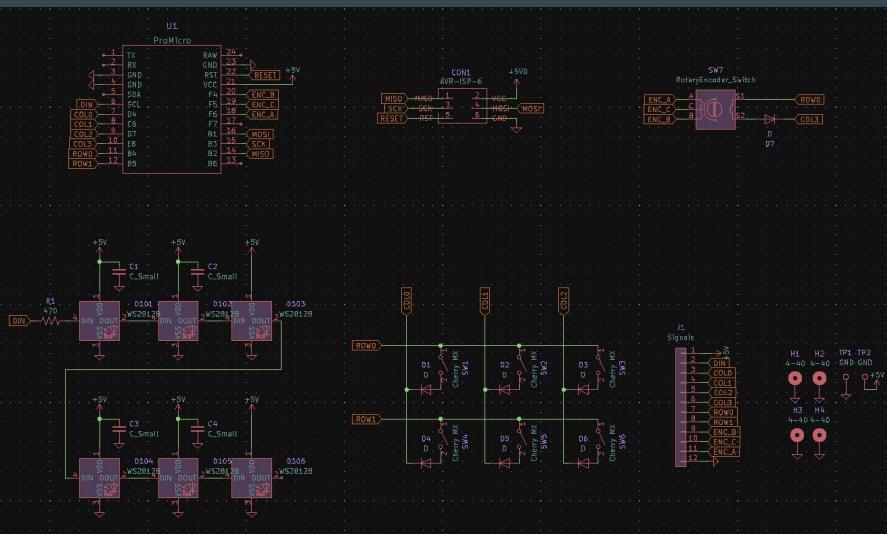
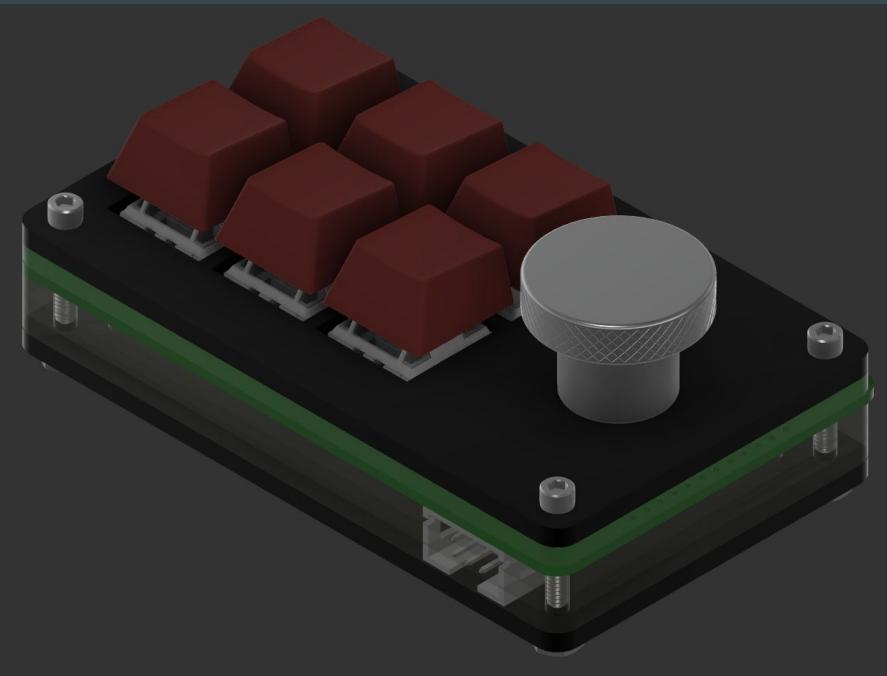


This week's homework, do your high level design:

- Layout
- Parts (which switches, LEDs, etc.)
- General notion on the enclosure

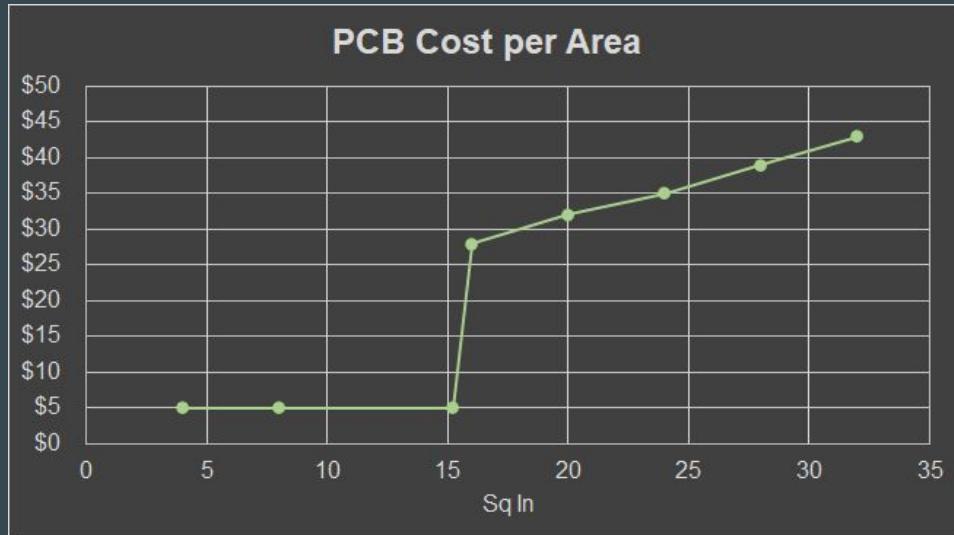


Example design provided

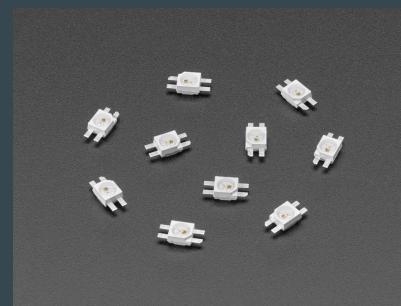


Some Suggestions

PCB Sweet Spot: Keep X and Y < 100mm (3.937")



LEDs: WS2812 Reverse Mount or 3mm Flangeless



Keys: Use Cherry MX, Kailh or similar

Cherry MX Blue



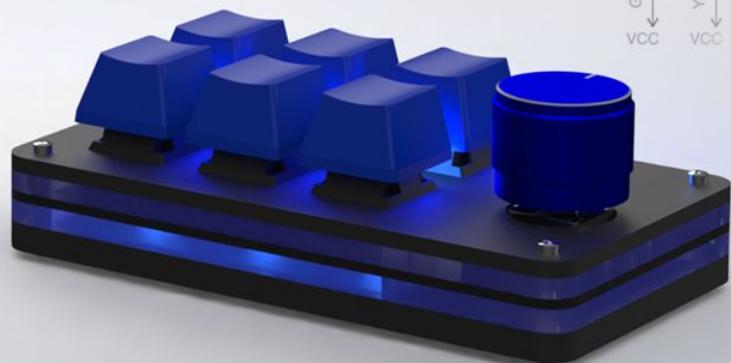
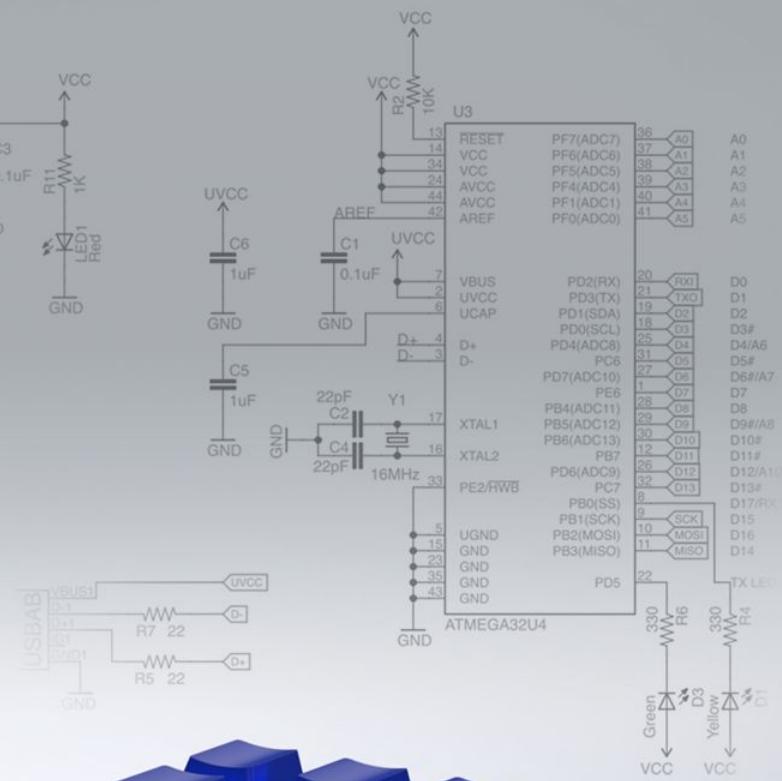
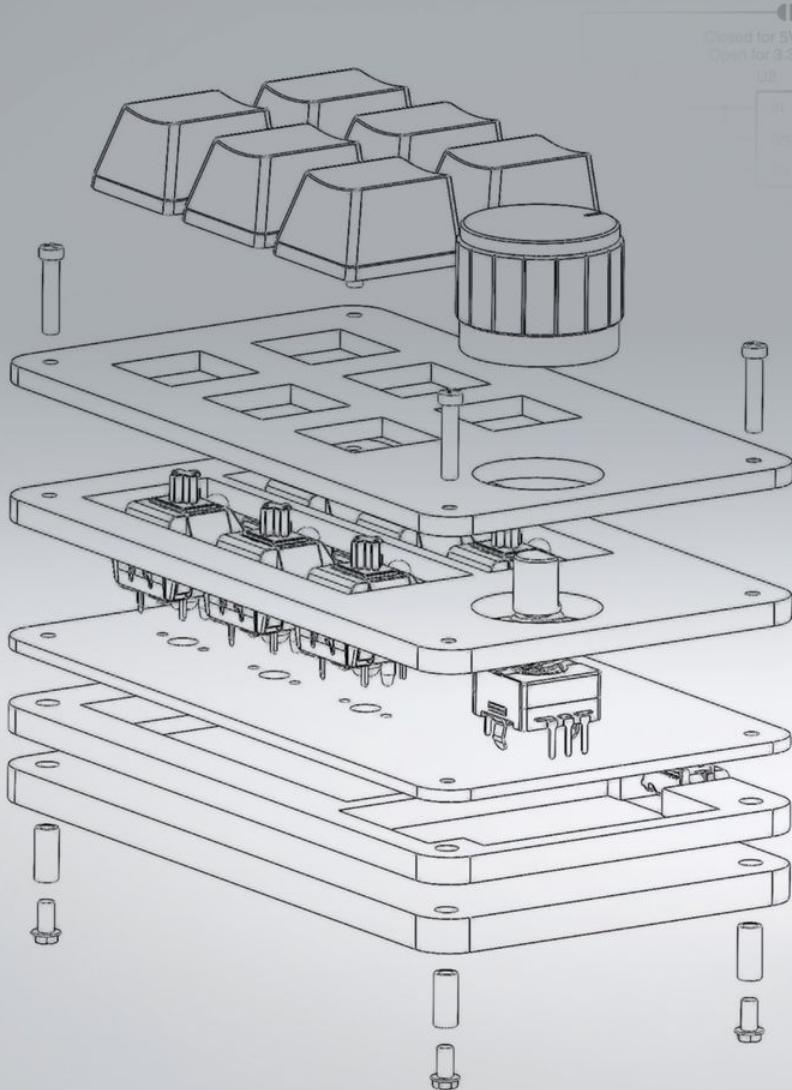
Clicky
60G force
[More...](#)

Kailh Brown



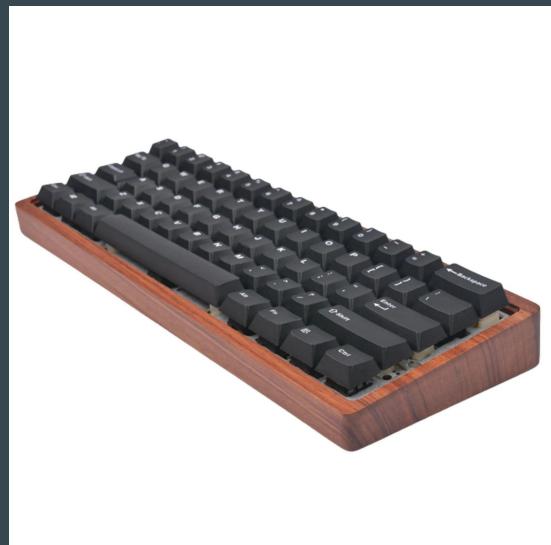
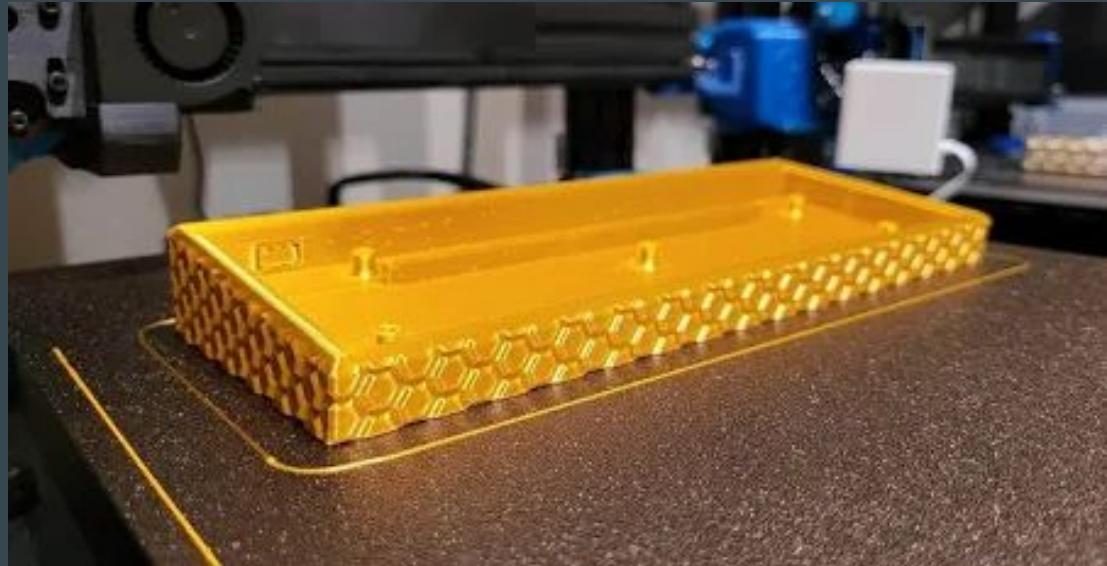
Tactile
45G force
[More...](#)

ANATOMY OF A KEYBOARD



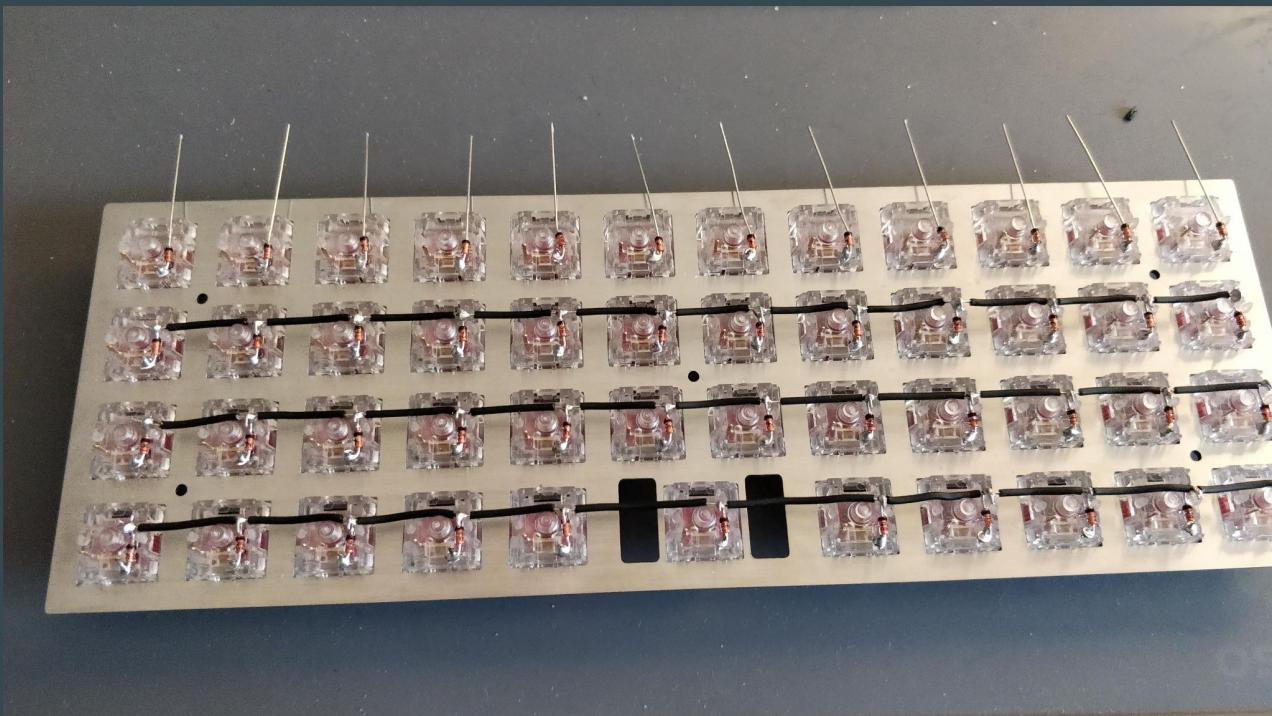
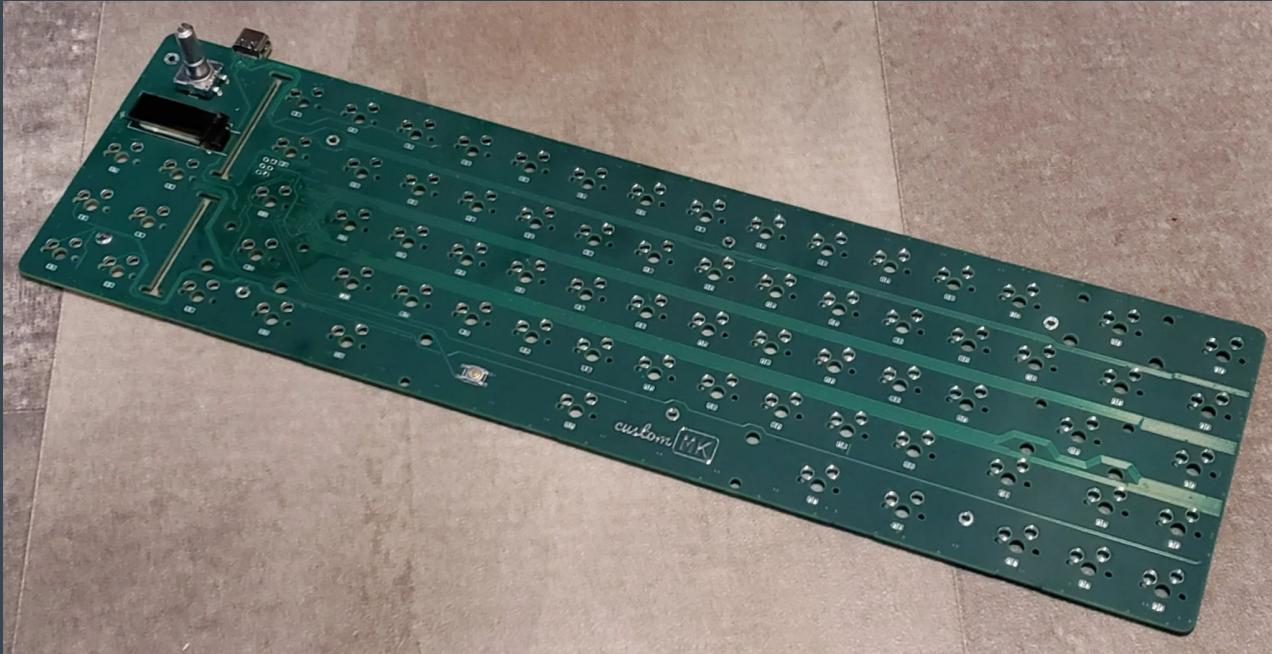
Case

- Adds mass
- Attaches everything
- Adds style
- Can be made of a variety of materials
- Can be made with a variety of construction techniques

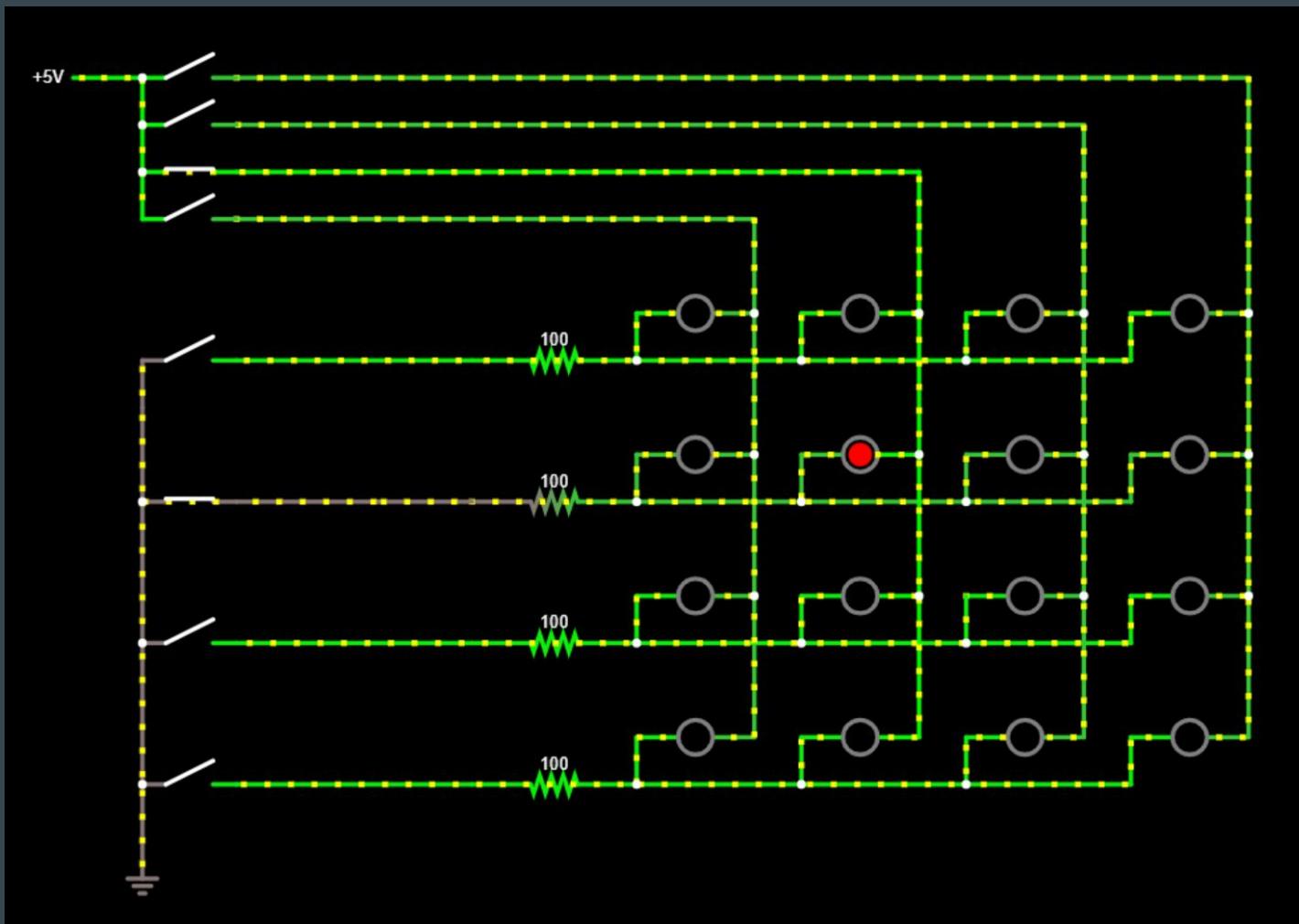


PCB

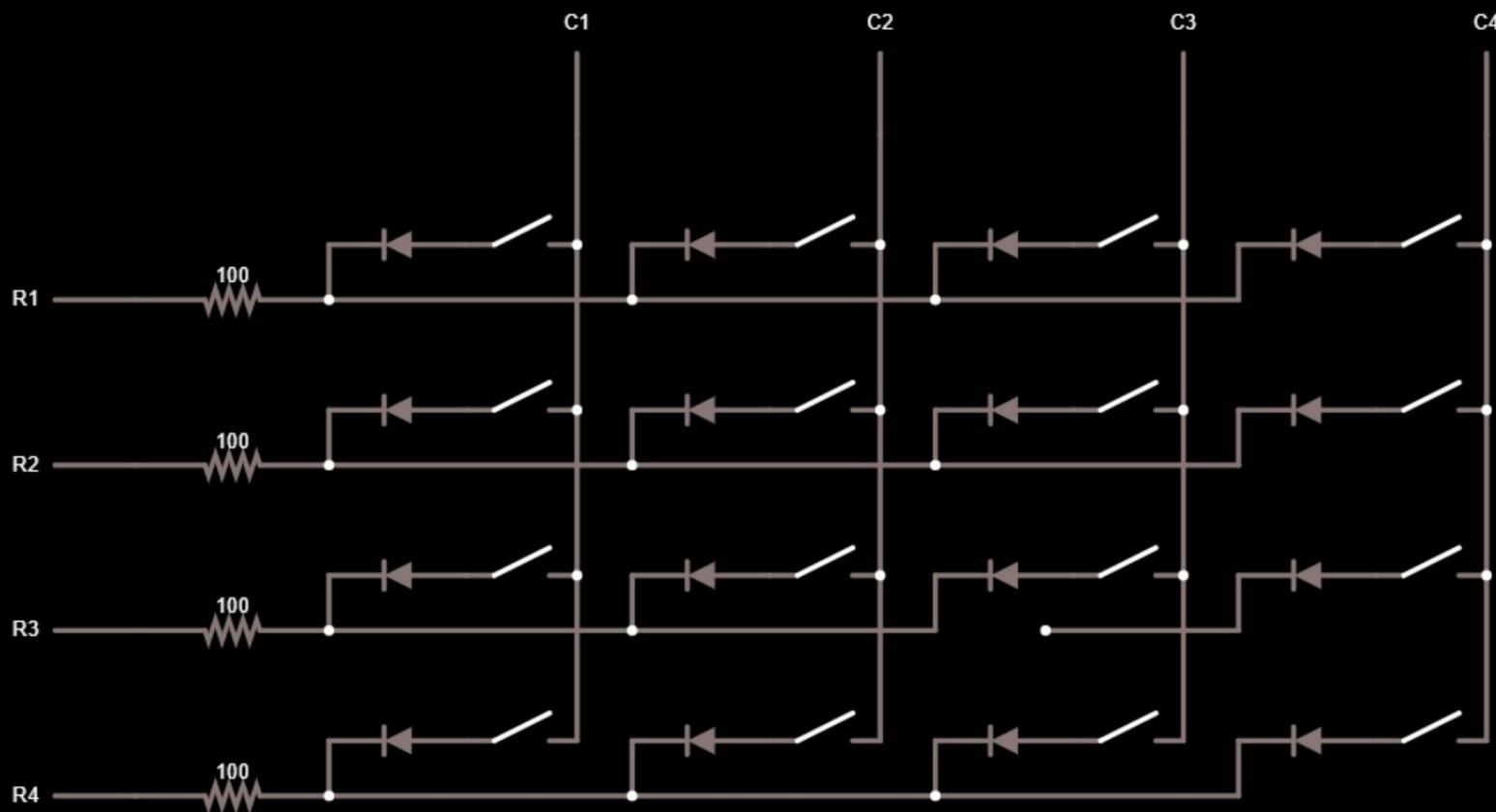
- All electronics are mounted to PCB
 - MCU
 - Scan Matrix
 - Switches
 - Diodes
 - LED's
 - USB Ports
 - OLED Displays
- Performs some structural duties but mainly for signals
- Do not actually need PCB at all.



Scan Matrix



Scan Matrix



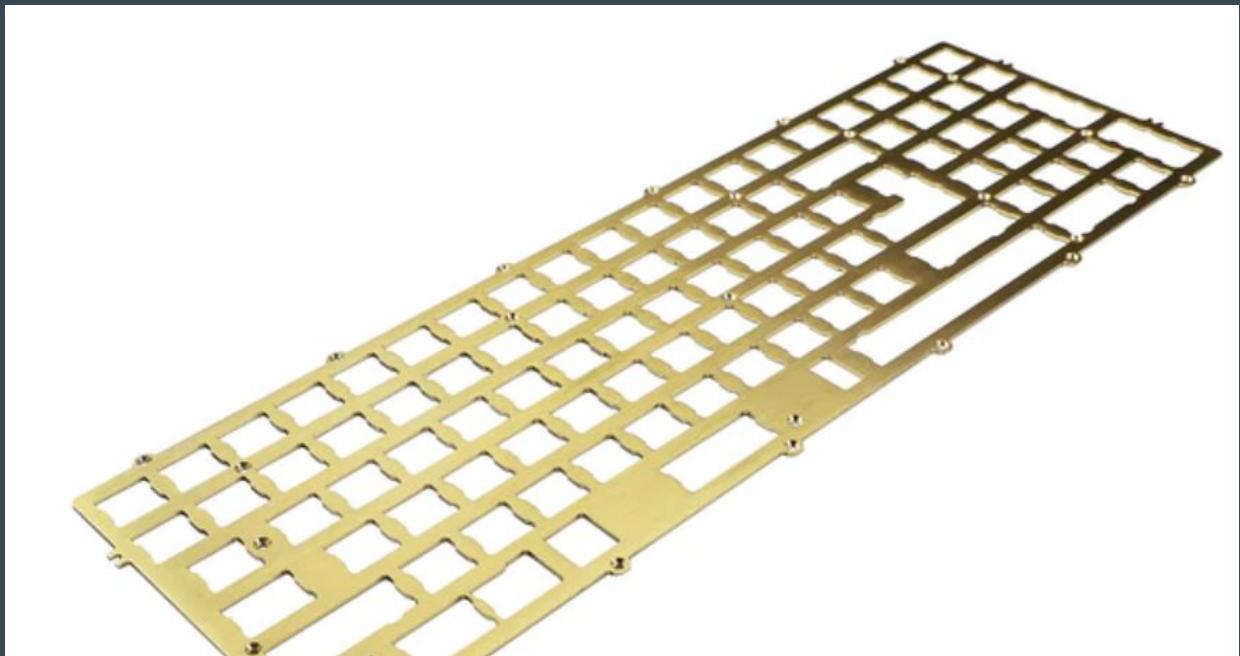
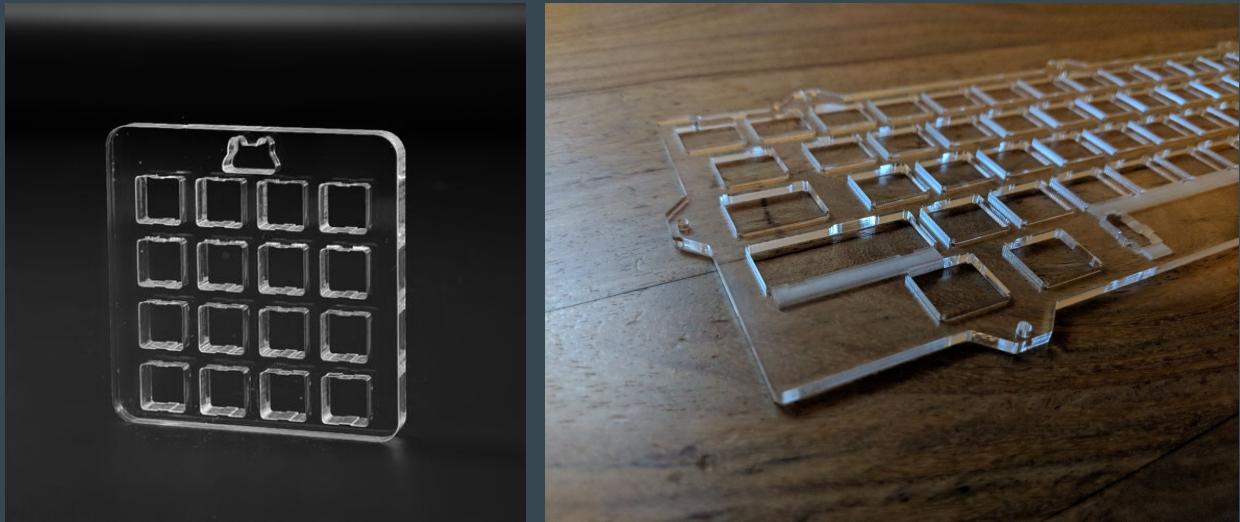
Firmware

- Written in C/C++, Python and assembly
- Compiled and installed on microcontroller
- Uses a previously discussed interface to communicate
- Manage key maps
- Debouncing
- Ghosting
- Rollover

```
28  /**
29   * Scan codes - last N slots in the HID report (usually 6).
30   * 0x00 if no key pressed.
31   *
32   * If more than N keys are pressed, the HID reports
33   * KEY_ERR_OVF in all slots to indicate this condition.
34   */
35
36 #define KEY_NONE 0x00 // No key pressed
37 #define KEY_ERR_OVF 0x01 // Keyboard Error Roll Over - used for all slots if too many
38 // 0x02 // Keyboard POST Fail
39 // 0x03 // Keyboard Error Undefined
40 #define KEY_A 0x04 // Keyboard a and A
41 #define KEY_B 0x05 // Keyboard b and B
42 #define KEY_C 0x06 // Keyboard c and C
43 #define KEY_D 0x07 // Keyboard d and D
44 #define KEY_E 0x08 // Keyboard e and E
45 #define KEY_F 0x09 // Keyboard f and F
46 #define KEY_G 0x0a // Keyboard g and G
47 #define KEY_H 0x0b // Keyboard h and H
48 #define KEY_I 0x0c // Keyboard i and I
49 #define KEY_J 0x0d // Keyboard j and J
50 #define KEY_K 0x0e // Keyboard k and K
51 #define KEY_L 0x0f // Keyboard l and L
52 #define KEY_M 0x10 // Keyboard m and M
53 #define KEY_N 0x11 // Keyboard n and N
54 #define KEY_O 0x12 // Keyboard o and O
55 #define KEY_P 0x13 // Keyboard p and P
56 #define KEY_Q 0x14 // Keyboard q and Q
57 #define KEY_R 0x15 // Keyboard r and R
58 #define KEY_S 0x16 // Keyboard s and S
59 #define KEY_T 0x17 // Keyboard t and T
60 #define KEY_U 0x18 // Keyboard u and U
61 #define KEY_V 0x19 // Keyboard v and V
62 #define KEY_W 0x1a // Keyboard w and W
63 #define KEY_X 0x1b // Keyboard x and X
64 #define KEY_Y 0x1c // Keyboard y and Y
65 #define KEY_Z 0x1d // Keyboard z and Z
66
67 #define KEY_1 0x1e // Keyboard 1 and !
68 #define KEY_2 0x1f // Keyboard 2 and @
69 #define KEY_3 0x20 // Keyboard 3 and #
70 #define KEY_4 0x21 // Keyboard 4 and $
71 #define KEY_5 0x22 // Keyboard 5 and %
72 #define KEY_6 0x23 // Keyboard 6 and ^
73 #define KEY_7 0x24 // Keyboard 7 and &
74 #define KEY_8 0x25 // Keyboard 8 and *
75 #define KEY_9 0x26 // Keyboard 9 and (
76 #define KEY_0 0x27 // Keyboard 0 and )
```

Plate

- Adds structure
- Maintains Alignment
- Dampens vibrations
- Key Stabilizers
- Adds mass
- Variety of materials



Switches

Mechanical

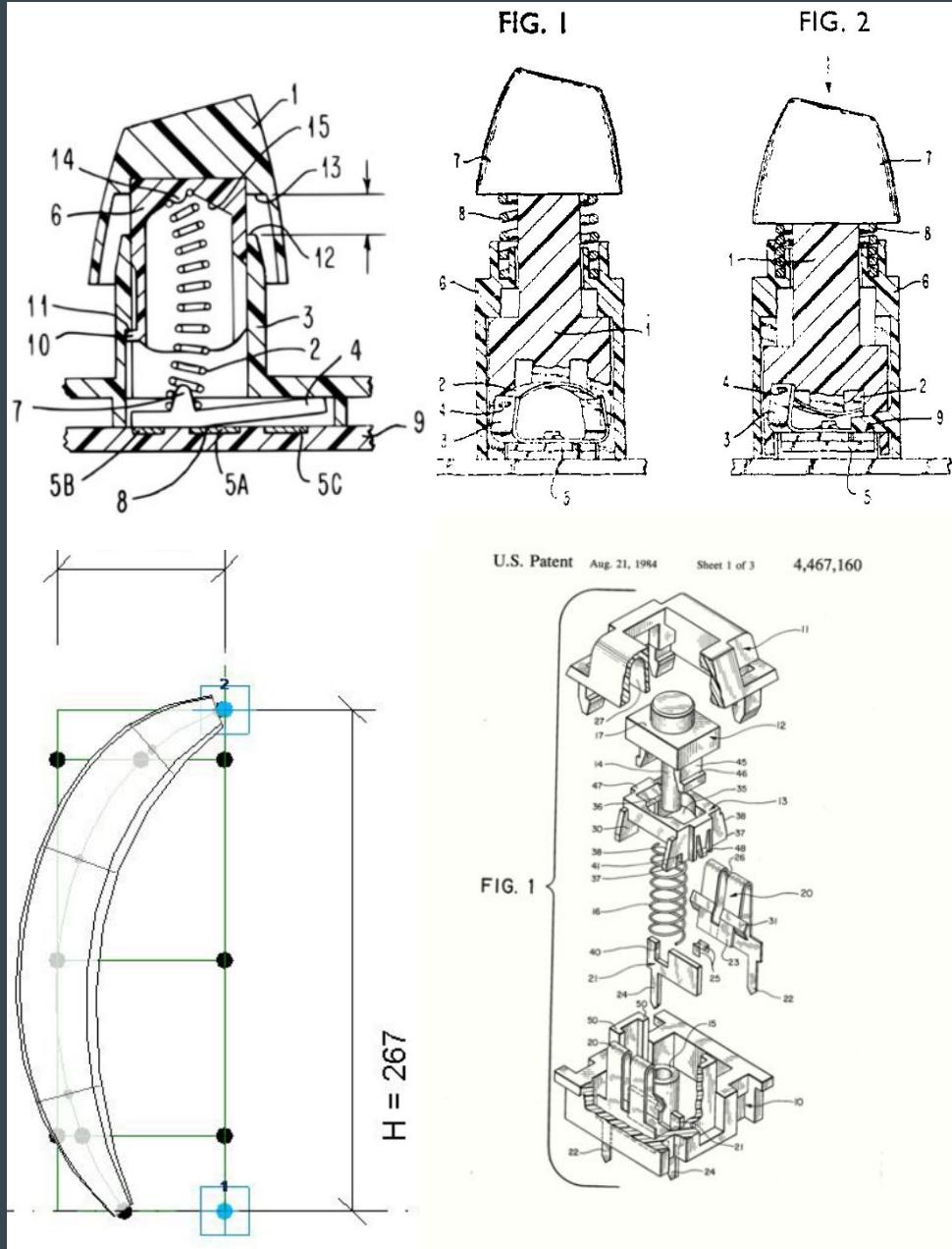
- Buckling Spring
 - Beam spring
 - Cherry MX
 - Electromechanical (Ducky)

Wrong

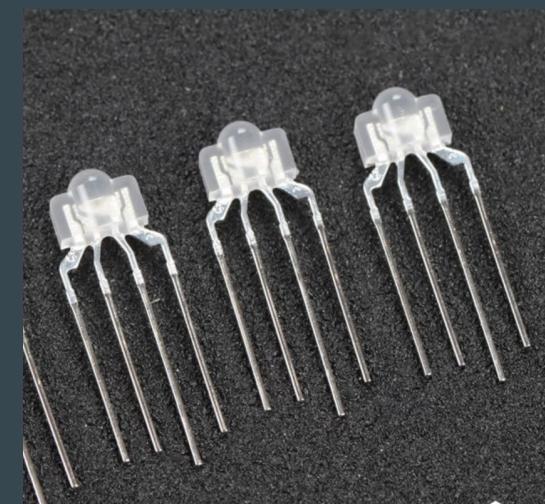
- Virtual (Touchscreen)
 - Membrane

Edible

- ## ○ Banana

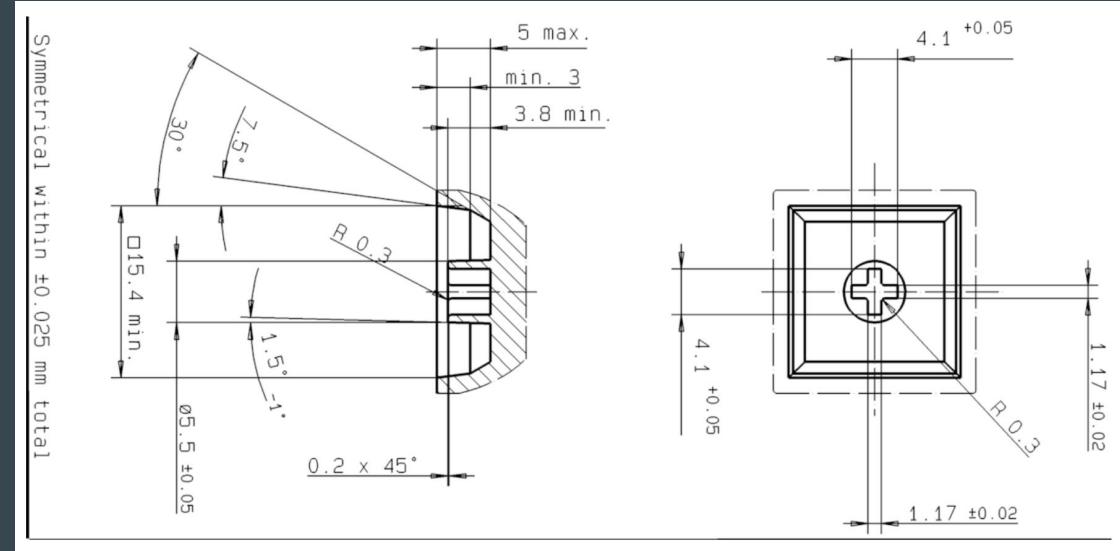
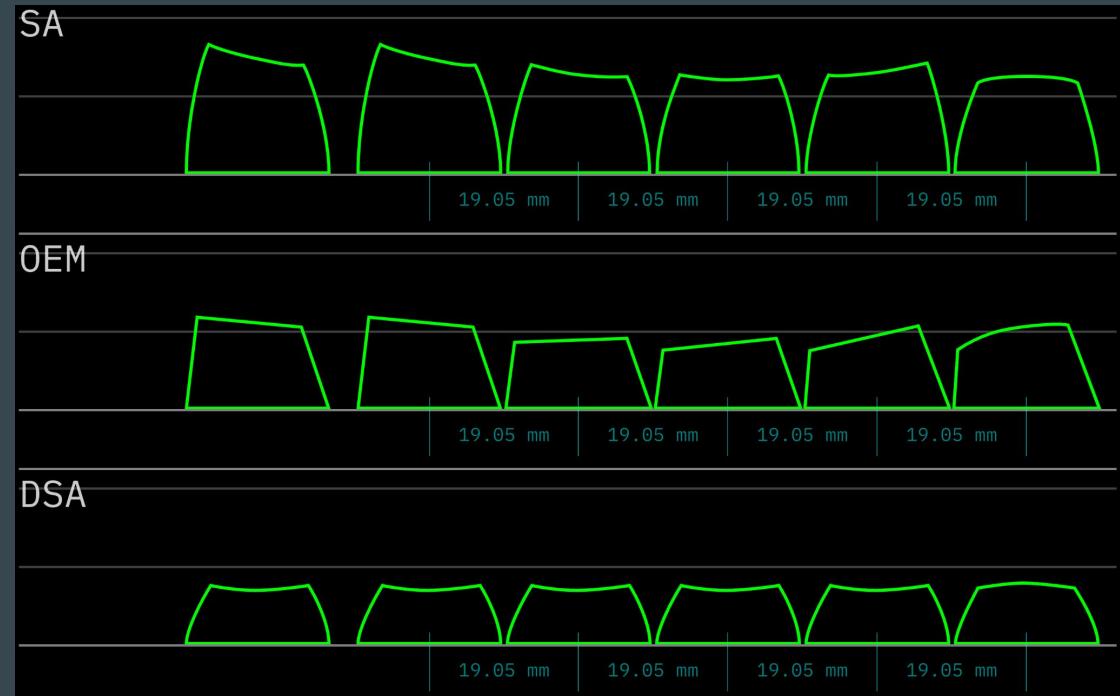


Illumination



Keycaps

- Many different profiles
- Unlimited colors
- Many materials
- Must fit your switches

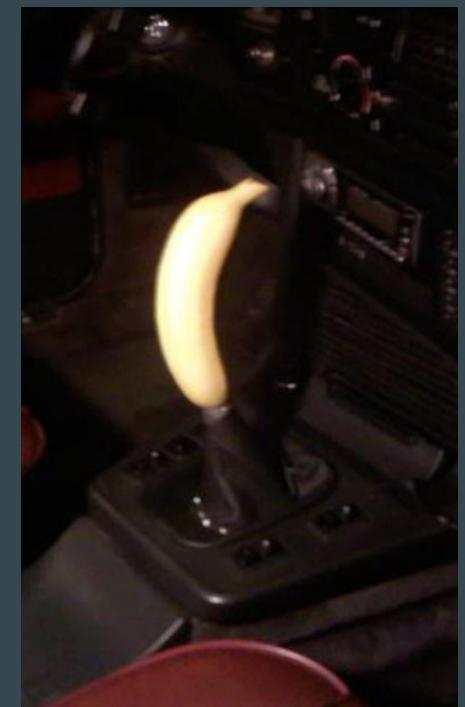
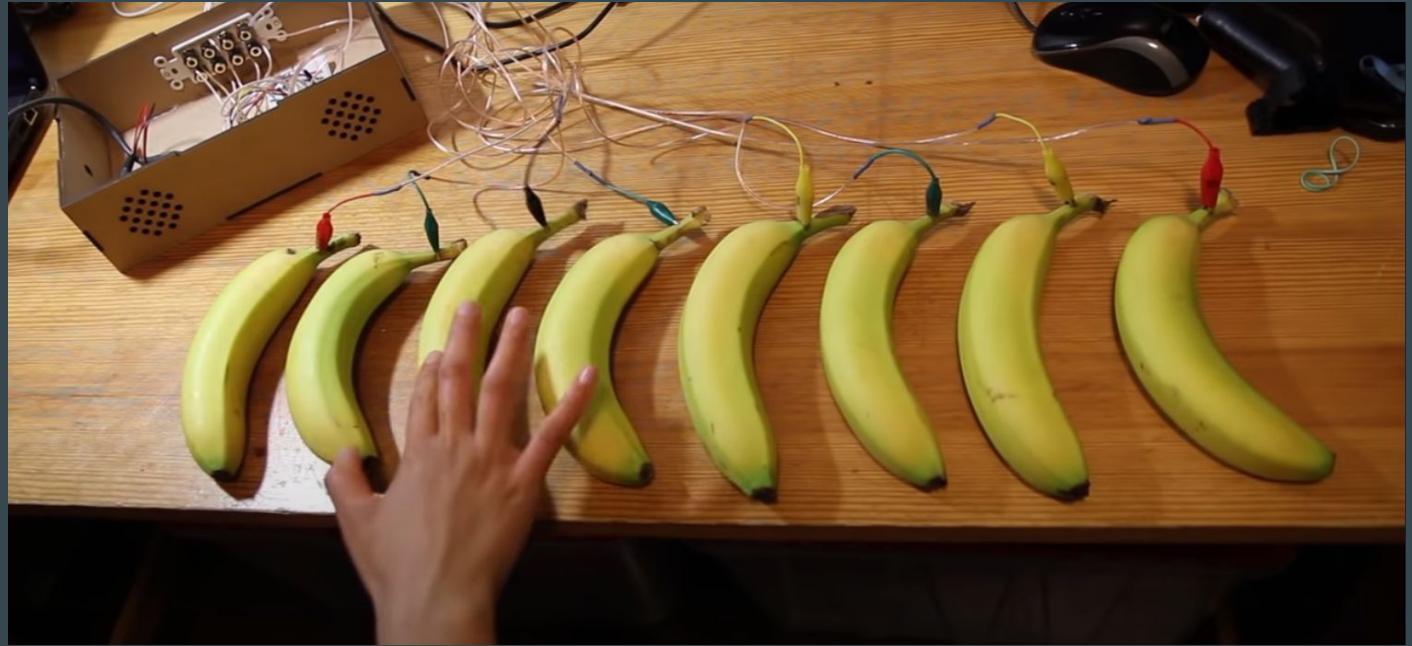
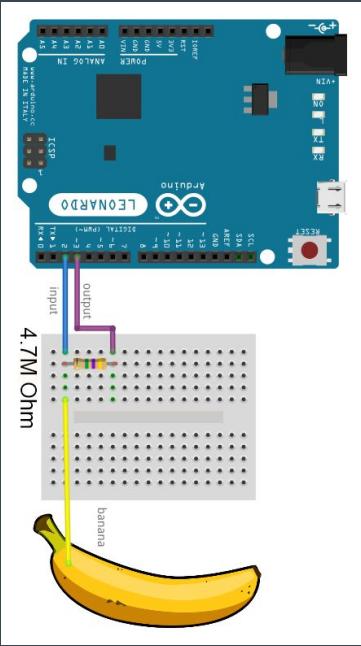


A brief history of the keyboard.



Is that all it does?

-Some Engineer's Spouse... Probably



Early Input Output

- Switch Boards
- Punch Cards
- Button Trees
- Tea Leaves
- Interns





Interface Standards

XT

- Its really old and didn't last long, who cares.

AT

- It's really old
- Same 5 pin DIN connector as XT
- Different communications protocol
- Others started using it. IBM said so

PS/2

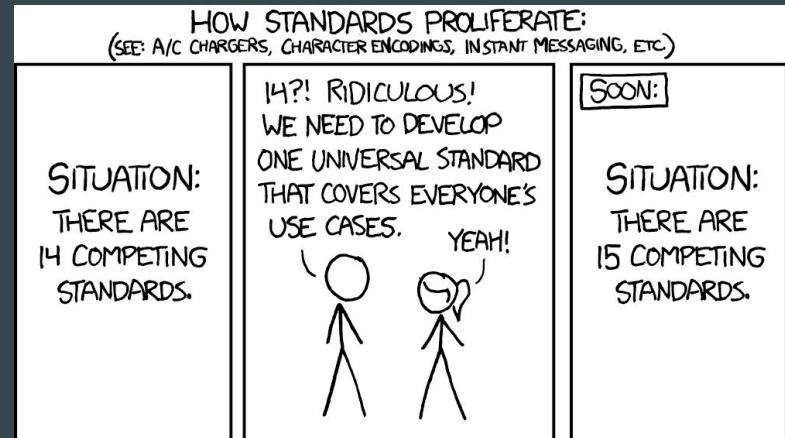
- Nothing new here, just a smaller connector
- Near zero latency
- *n*-key rollover
- Still available on certain motherboards
- The standard for almost 30 years.... IBM said so



USB

Standards are great.

Especially the ones that aren't standardized.



Wireless

- Proprietary Protocols
- Bluetooth
- Infrared



i went to knoxmakers and all i got was this lousy keyboard