

Column Modules for Mechanical Keyboards

The next step for Configure-It-Yourself keyboards

What are they

A column module is a physical unit holding the keys for one column of the keyboard that the user can easily install into or remove from the keyboard. It consists of:

- A flexible PCB, with
 - Room for 6 hot-pluggable switches.
 - A dupont connector for plugging into the main PCB. The interface should allow both for passive column PCBs with key switches only, and for column PCBs with more advanced functionality that might even need a small on-board I/O expander or other chip.
- A plastic frame to hold the PCB, with
 - Slits to install the PCB with no tools, and supports to stabilize the PCB around the hot-pluggable switches.
 - A way to attach it to a keyboard in a standardized way.
 - A slot that secures the PCB's dupont connector.

Advantages

Modularity

There are many people who's primary (physical) tool of trade is a keyboard and who's looking to make it work just the way they want it, but with no interest in soldering or spending weeks on home-built electronics.

Ergodox was commercialized to great effect, with switches and keycaps configurable just as easily as Lego. Once you've tried hot-pluggable switches, there's no going back.

Making key columns hot-pluggable is the next step in Configure-It-Yourself (CIY) keyboards, allowing users to mix and match not only the physical characteristics of the keys and switches, but also actual keyboard functionality.

Enables partial upgrades

There are some pretty good keyboards out there. Perhaps you have one that you are fairly satisfied with. Yet, there's that one thing you'd like to change. With modular columns, chances are that you could make improvements without buying an entire new keyboard.

Example 1: Add LEDs

Maybe you have a keyboard without key LEDs and find that you want just one key to have an LED. That'd be quite possible, you just get one column PCB with LEDs, one switch and one keycap.

Example 2: Adjust column staggering

Many alternative keyboard designs put the keys not in a grid, but stagger the columns i.e. place columns at slightly different distances from the user to account for the fingers having different length.

The problem is that no two people are the same, and there is no one size that fits all.

To make your keyboard fit your hands, you could get a keyboard chassis with custom column staggering, or even better, one with adjustable column staggering. You can keep your keyboard's main PCB and column modules, thereby reusing parts representing the majority of the cost.



Example 3: Adjust number of keys

Some keyboards might require modules with 3 keys while others require 5 or 6, yet others might be resizable to allow the user to switch between modules of different sizes. Either way, you won't have to buy new PCBs, switches or keycaps; only column frames and perhaps a keyboard chassis.

Example 4: Adjust curving

Do you want your keyboard flat, or maybe try out deep keywells? You'd need new column frames, but not necessarily much more. You could choose a keyboard chassis that supports adjustable curving, or maybe you want to get a couple different ones that are sleeker but less flexible. Either way, you keep your PCBs, switches and keycaps.

Enables users to combine vendors

If your keyboard has hot-pluggable switches, you don't have to get all parts from the same vendor. Rather, you can combine switches and keycaps to your liking.

That's all good, but let's not stop there. Since the column modules contain PCBs, not only the physical feel but the actual functionality of your keyboard can be composed from different vendors. After buying a keyboard that support column modules, you could upgrade it incrementally to include a wide range of components, for example:

- Feedback components such as

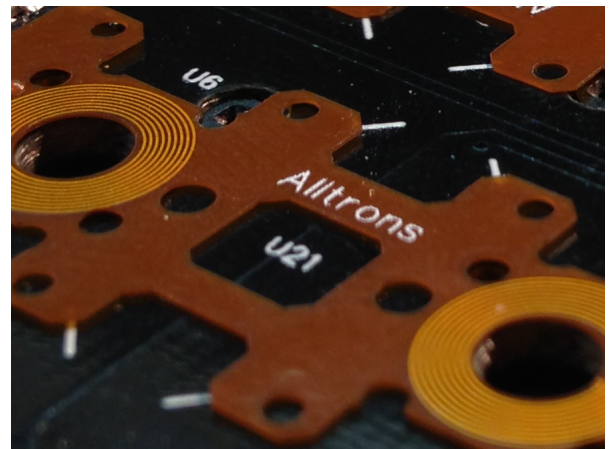
- RGB LEDs
 - Vibrators
 - Speakers
- Input components such as
 - Pressure sensitive analog key switches as a pointing device or for gaming
 - Trackpoint/trackball modules
 - Fingerprint readers
 - Dials
 - Voice or whistle control

Eases obstacles to commercializing inventions

The community around mechanical keyboards is surprisingly large, yet some might think there is surprisingly little commercially available. It's hard to commercialize a high-quality product. It'd be easier if you didn't have to deliver everything in order to make your one little invention usable, right?

Take for example [this great invention](#) that turns ordinary key switches into pressure sensitive, analog keys. Imagine the pointing devices and game controllers we could have built into our keyboards if this was actually available, yet the only product is a development kit that at the time of writing is out of stock.

Maybe you'd like this technology in an inverted-T to create a decent pointing device. If your keyboard had modular columns, the people at Alltrons would only need to offer column PCBs for sale with this technology and get a patch into QMK. Buy three of them and insert them into your existing keyboard with no soldering.



Little variability

Column modules can offer an obscene amount of flexibility for users while still requiring quite little variability in production, making them easy to mass produce.

- The column frame only needs to vary depending on physical layout such as number of keys and curve radius.
- The column frames don't need to be very visible, so they can all be black.
- The column PCBs only need to vary depending on functionality.
 - A standard flexible PCB with 6 keys can be folded to function in a frame with less than 6 keys.
 - The PCB should be flexible enough to be used in frames with varying curve radiuses.
- A single vendor doesn't need to provide any variability at all. Just make and sell a keyboard with standard-compliant column modules, and you will already provide a lot of

extra value to your customers in the form of post-market flexibility. Or you could make just keyboards without the column modules, or just some special type of column module or even just a column frame or PCB.

Testability

- Column modules can be manufactured, tested and sold individually.
- Keyboards made to work with column modules can be tested via the dupont plugs and sold without column modules, switches and keycaps. Such testing can be automated to a greater extent, which should make manufacturing cheaper. This also allows users to reuse column modules, switches and keycaps to a greater extent.

Disadvantages

Difficulty

There will be quite a few technical hurdles to overcome to make column modules a reality. For example:

- Physical interface between column frame and keyboard chassis: How do you make a standard that
 - Provides the necessary stability during use?
 - Allows the module to be connected/removed without soldering?
 - Allows the creation of keyboards that can be adjusted for column modules of different curvature and number of keys?
 - Allows the design of compatible modules that are 2 columns wide, if necessary (e.g. for a pointing device)?
- Electrical interface between column PCB and main PCB: How do you design a standard that
 - Allows for low-functionality column PCBs to have low cost?
 - Allows for unpredictable later inventions to be added as a column module to older keyboards with only a firmware update?
- Physical interface between column frame and column PCB: How do you design a standard that
 - Allows the column PCBs to be inserted easily?
 - Provides the necessary stability during use?
 - Supports at least the most common functionality such as key switches and LEDs? (For more advanced functionality where the column PCB and column frame is sold together, this standard can be ignored entirely)
- PCB flexibility: The column PCBs need to be flexible enough to
 - Bend along different curvatures.
 - Bend to get unused key spots out of the way.
 - Bend to shorten the distance between keys, since different curvature will result in different distances between keys at the PCB layer.

Overcoming these difficulties will require the community to come together and share their work to arrive at an open standard that works.

Price

A keyboard built with column modules will be more expensive than without. However, the advantages are so great that I believe many will be willing to pay the price. For many people it might end up cheaper in the long run anyway, with reusability, partial upgradability and all. A modular keyboard is a keyboard built to last, and we already know that people are willing to pay several hundred dollars for a high-quality and only slightly modular keyboard when they could've gotten a basic one for \$5.

Bulkiness

There is a risk that making a keyboard more modular will make it bulkier. Care will have to be taken to avoid as much bulk as possible, especially when developing the standard. However, bulk is not as critical for a keyboard as for e.g. a smartphone. A few millimeters of extra bulk is unlikely to matter much.

Existing, similar things

- The [Genesis 2.5](#) has a lot of what's described here. With modular rows, it achieves configurable curvature without having to replace any hardware at all. It looks like each row module has an independent microcontroller. However, since it's the rows that are modular, you won't be able to adjust column distances.
- The [Squeezebox](#) has modular columns that are physically adjustable in a lot of ways.

FAQ

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