Atreus Keyboard Assembly

1 Prerequisites

In order to assemble your keyboard, you'll need your kit plus a few other tools. The kit should contain these parts and a few spares:

- Case (top plate, switch plate, spacer, bottom plate)
- Cherry MX switches (37 blue, 5 red or black)
- Diodes (42)
- Keycaps (38 normal, 2 deep-dish, 2 long OR 40 normal, 2 long)
- Teensy 2 microcontroller
- Machine screws and nuts (8 each, either 4-40 or M3)
- USB mini cable
- Can of finishing wax
- Sandpaper

You'll also need to have these on hand:

- Soldering iron and thin solder
- Hot glue gun and glue
- Hookup wire (red and black 24 wire gauge is best)
- Wire strippers
- Toothbrush or other brush for applying finishing wax
- Multimeter (recommended)

It usually takes between three and four hours to finish the assembly.

The latest version of this document can always be found online.[1] If you're reading a black-and-white printed copy, you may find some of the diagrams and photos clearer in color onscreen.

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[1]http://atreus.technomancy.us/assembly.pdf

2 Cases

The wooden case will need finishing before the rest of the assembly begins. This should take about 45 minutes of work, you'll need to leave the pieces alone for a while to dry, so plan accordingly.

3 Switches
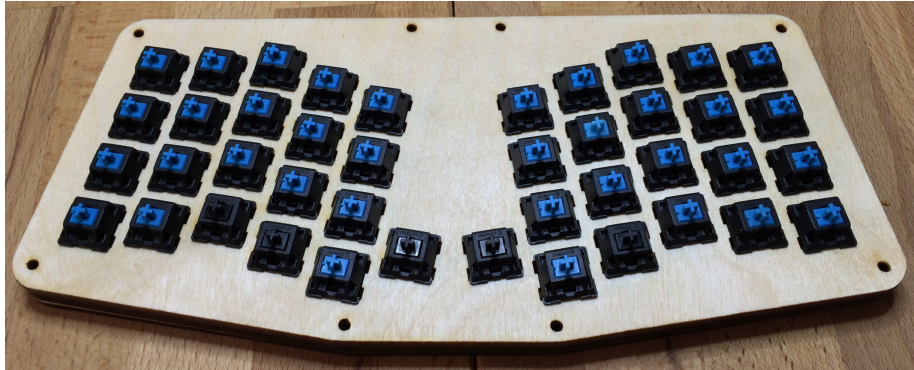
Start by placing your switches on the switch plate. The red stem (or black in some cases) switches should go where you intend to place the modifier keys. See the cheat sheet for a recommended positioning. Orient the switches so that the small notch on each one points to the bottom of the keyboard.

With the switches in place, turn the plate over and warm up your glue gun. Run a line of glue down the left and right side of each switch to secure it in place, column by column. Once the glue is dry you can begin the construction of the matrix.

Melt a blob of solder onto each pin as you go before attaching anything else; this will make it much easier to hold the diodes and wires in place.
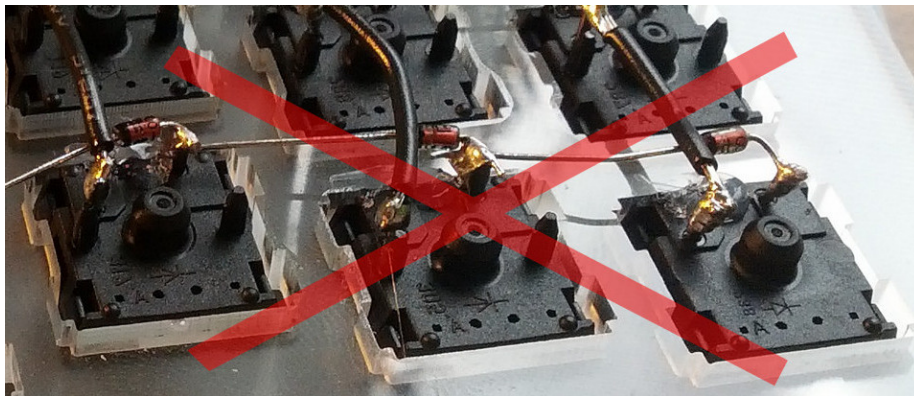
4 Diodes

Every switch needs a diode attached to it. We'll use a leg of each diode to connect the switches to the others in the same row while the other leg connects the diode to its switch. Note that diodes are polarized; that is, they have a negative leg and a positive leg. The positive leg is the one by the black ring, and the negative leg is the one you solder to the switch. Start from the outer column of each side and work your way in.

The positive leg of each diode needs to reach over the diode next to it to attach to its positive leg, so bend them to look like this.
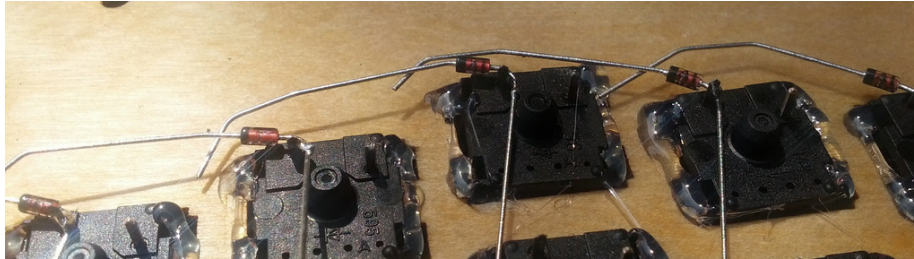
Start by soldering just the negative leg of each diode to the higher of the two contacts on the switch (the flatter contact). The positive leg should reach over to touch the positive leg of the next diode, with diodes on the left half reaching in to the right, and vice-versa. Don't solder the positive leg yet. Take care to avoid touching the diode leg to the other thicker contact of the switch.

The above image shows incorrect diode usage; see how the positive leg of one is connected to the negative leg of the other, instead of positive to positive.
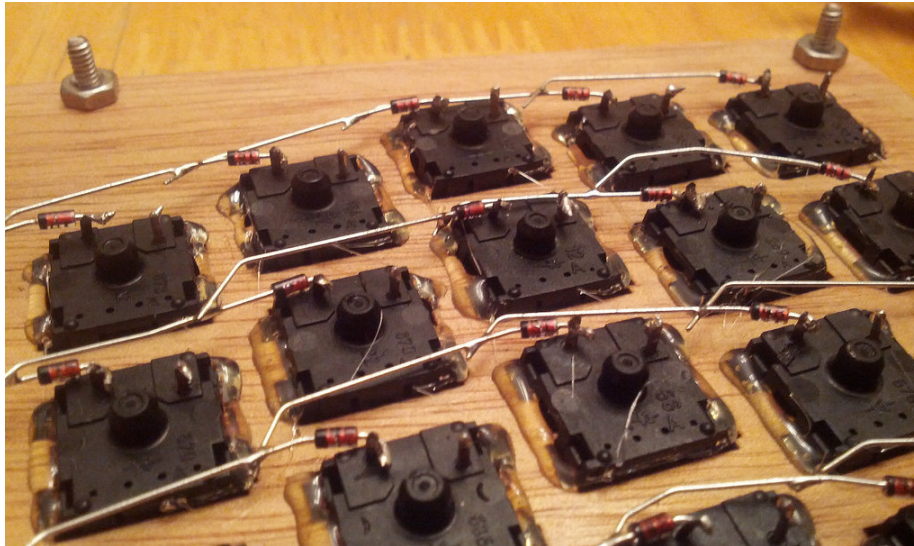
Once you've soldered a full row of diodes, you'll need to deal with the legs. Trim the remainder of the negative leg that extends below the switch contact, and solder the positive leg to the next diode in. Be sure to solder each positive leg to the next positive leg. The innermost column of diodes won't connect to anything yet, so you can trim their positive legs. They will get connected in the last step.
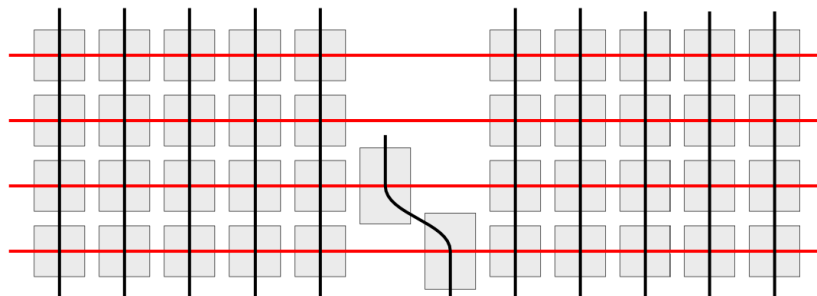
5   Columns

Next we'll wire the columns together. The negative contact of every switch in a column (the thicker, square-ish one) must be connected to those above and below it with a length of wire that has a few gaps in the insulation. Black wire is traditional for this. Cut a piece of wire long enough to reach from the negative pin of the top switch to the negative pin of the bottom, or about 6.5cm. Strip a couple centimeters of insulation from each end of the wire, then put your wire strippers at about 1/3rd of the way down and move the insulation up so only one cm is exposed at the end. Turn the wire over and repeat for the other side

so that you have three equal lengths of insulation and four exposed sections. Note that there is some room for error here, and that the length does not need to be perfectly consistent.
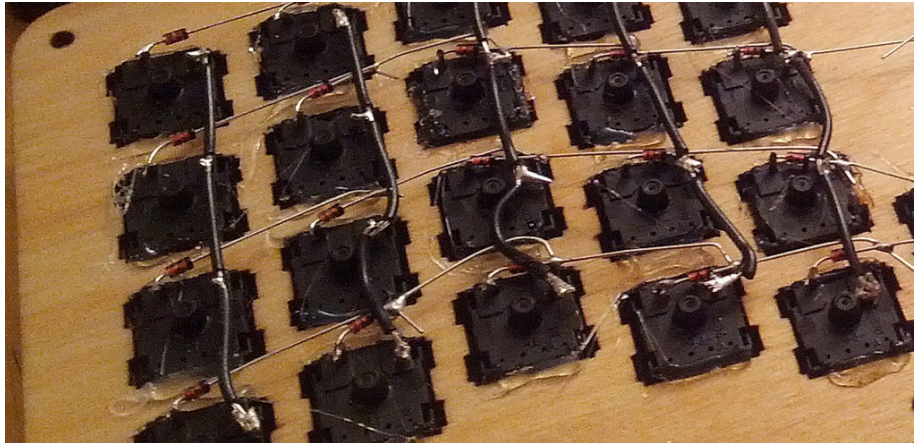

Once the wire is ready, solder each exposed section to a corresponding pin for each column. As you proceed in wiring the board, it would be wise to test your connections with a multimeter so you can catch problematic solder joints early on. Connect the positive lead of your multimeter (ideally with alligator clips) to a positive leg of one of the diodes in the row you wish to test. Then hold the other lead to the black wire of each successive column as you press the switches in that column one by one. Your multimeter should register continuity only while the switch is pressed.

Take care that the column wire is insulated at the point in which it crosses the legs of the diodes, since an electrical contact at this point would result in spurious key presses.

The middle thumb buttons require special explanation. They are wired as if part of a column that exists between the two halves of the board. One is wired to the third row, and the other to the fourth row, as in the diagram above. This column only has two keys in it; the firmware will treat it as a full column but will never get any reads from the top two positions. Please note that this diagram is from the perspective of having already flipped the board over to do soldering; when the board is right-side-up for use, it's backwards.

6 Microcontroller
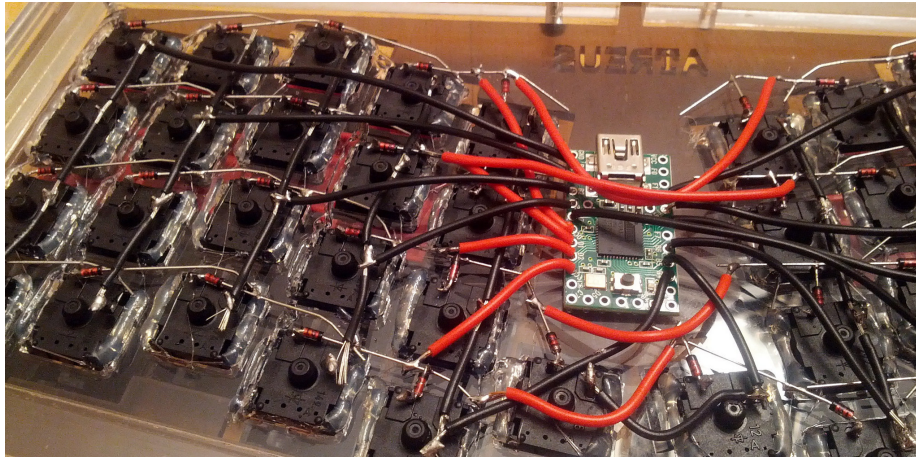
Next we'll connect the Teensy 2 microcontroller. All around the edge of the microcontroller board are "pins" (holes that don't actually have pins attached to them) which are labeled with a number and letter; we'll be wiring into pins D0-D3, B0-B7, and F4-F6, so locate these before starting. Note that pins D0-D3 and B0-B3 are consecutive on the Teensy, while higher pin numbers are scattered around the board.

Start with the left rows. You'll want to connect the top row on the left side into the D0 pin of the Teensy. The next row goes to D1, then to D2, and the bottom row to D3. I recommend using red wire for this.

Once these rows are all set, the next task will be to connect each column into its corresponding pin in the Teensy. Remember that any negative switch contact can be used to connect the column to the pin, so you can spread out your wires where there's room.

column	0	1	2	3	4	5	6	7	8	9	10
pin	B0	B1	B2	B3	B4	B5	B6	B7	F4	F5	F6

For the purposes of this table, columns are counted from the left in the upside-down position, that is, the position with the switch pins facing up for soldering. When right-side-up for use, column zero will be on the right.

Once you've connected the left side of each row to the Teensy, you'll need to connect the right side of the row to the left. Be sure that these connections all go to the positive side of the diodes and don't touch un-insulated column connections. Remember that the middle two thumb switches are not part of the same row; refer to the diagram above.

7   Wrapping up

At this point you should be ready to finish the assembly. Plug in the USB mini cable into the microcontroller and the other side into your computer. If the onboard LED flashes, it hasn't had the firmware uploaded yet. Type `make upload` from the firmware directory, and then press the reset button located on the Teensy. The firmware should be uploaded, and it should start acting as a keyboard. Now would be a good time to test each switch.

If there's a misbehaving switch, it's often caused by a cold joint. Reflow the solder on both contacts of the switch. If an entire row or column is out, it's probably the wires connecting to the microcontroller. If a switch sends keycodes when it's not pressed, some of the row and column connections must be touching where they shouldn't be.

If they all work, you can close the case. Simply place the switch plate on top of the spacer and bottom plate, and place the top plate on it. If you can close the case, you're all set. However, some USB cables are too large to allow the case to close. If this happens, you'll need to sand down the mini connector of the USB cable to reduce its height. Once you've gotten it down, you should be able to add the screws and tighten the nuts.

All that's left is to place the keycaps. Once you've pressed the keycaps on fully, it's difficult to remove them without compromising the solder connections, so take care when placing them. Your kit may have two "deep dish" caps with a smoother surface shaped slightly differently; if so these are intended to be placed on the index finger home row position (F and J in QWERTY) in order to help your hands find the home row without looking. The larger keycaps go on the middle thumb keys.

Congratulations. Enjoy your new keyboard.