

Extra notes on matrix construction

for the Hex-Keys Magpi # 108 Project
by Mike Cook

The design

First off let us say that to make this project you have to have access to a laser cutter. It consists of 98 note keys along with four control keys, that is a lot of keys to wire up. The keys are not velocity sensitive but the note velocity can be controlled with the rotary encoder knob. The other two keys shift the notes up or down an octave giving virtually the full range of MIDI notes. Also in order to keep the design available to the widest possible range of laser cutters, we limited the cut size to an A4 sheet of plywood, this also limited the size of the push keys.

The electronics

We need a 15 column by 7 row matrix, this would require too many Pico pins so we use two 74HS138 decoder chips, giving us up to 16 column drives for only 5 Pico pins. The diodes on the matrix allow more than one key to be pressed down at once without producing phantom key presses.

Mechanical considerations

Unless support is supplied between the keys at regular intervals the strip board will sag, so extra spacers are included on the top box. This sometimes interferes with the wiring and so the holes have to be bypassed with flexible wire. We also required a piece of strip board larger than we could find, so we had to patch three pieces of strip board to make the main board. Fortunately we could make this from just one piece of board. For a given height the width of a hexagon is an irrational number, so the keys are not exactly evenly spaced.

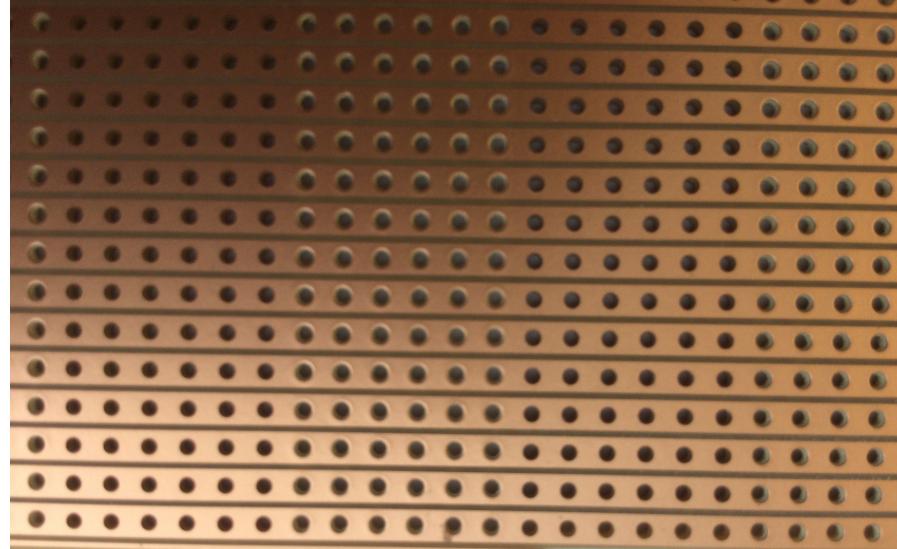
The strip board

The large main piece of strip board should have a notch cut out at the top right hand corner, 3 strips by 26 holes, by running a saw blade down it. Then enlarge the existing hole in the strip board to 3mm one strip down and one hole across from the top left hand corner, and do the same for the top left hand corner. Then, fasten both the middle board with a nut and bolt. If you can't see a strip board hole through all the 3mm hole then do not proceed and check you have things right.

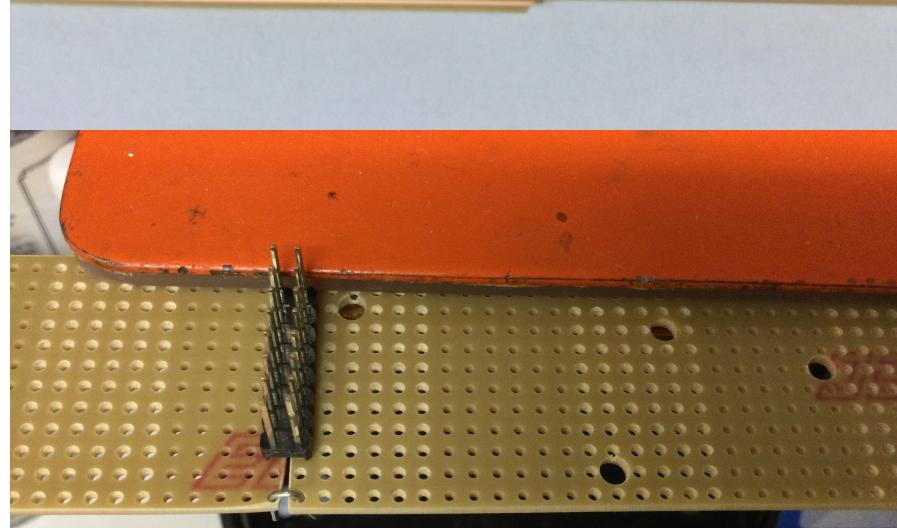
If you buy two sheets of strip board you will have enough length to not require the joining of the two smaller pieces.

Attaching the strip board to the middle layer

Identify the middle pillar support and do not drill through this, but drill through all the other holes into the strip board to enlarge them, and temporally fasten them to the middle layer to see if they all fit. Now a full strip of board has a sort of very thin guard strip at each side,



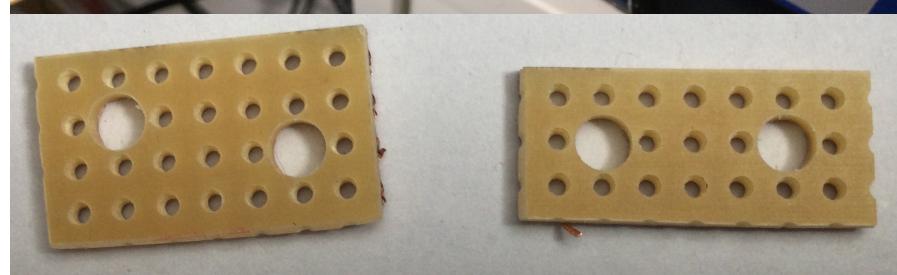
you need to file this away on the bottom side so you can fit the lower two strips while still preserving the hole pitch.



Sand the two smaller strips so they "butt up" together and using a short length of double row header pins to align them, solder a wire link between the top and bottom of the board.



Complete the rest of the links along the edge of the board. If you can remember don't make the links for rows 3 and 5 counting from the top as these will be needed for the diode. You will have to remove them when you get to that stage like we did if you forget.



Join the top piece to the bottom two pieces by making two small pieces of strip board and use them to



temporarily hold the two pieces together. Note the small notch on the bottom corner of the board, and the slot further along. The slot is formed by sawing down the two sides, and then using a Stanley Knife to repeatedly score both sides of the board. Then using a small pair of pliers gently rock the piece to remove from side to side until it cracks off.

The spacers were glued in place by a small drop of clear Gorilla glue and a screw just dropped in to make sure they were lined up with the holes. This was given 24 hours to set. Some of the glue inevitably got onto the thread, but a gentle twist of a screwdriver allowed them to be

removed. This caused a small amount of glue to get onto the thread but this was an advantage as this glue doesn't dry hard and acted as a shake proof nut protection.

Testing the matrix

Before you try out the matrix perform a few simple continuity tests with your meter. Our meter did not bleep when going through a diode but showed different readings. First check the continuity of the two wires on the switch, there should be none. If there is then this indicates a missing track break. Check that there is also no continuity between each column connections.