# Wilba's MB-SEQ Construction Guide

**Please read the entire construction guide before buying parts or starting to solder anything.**

Here's a mind dump of the build process I followed to assemble the MB-SEQ PCB and panel.

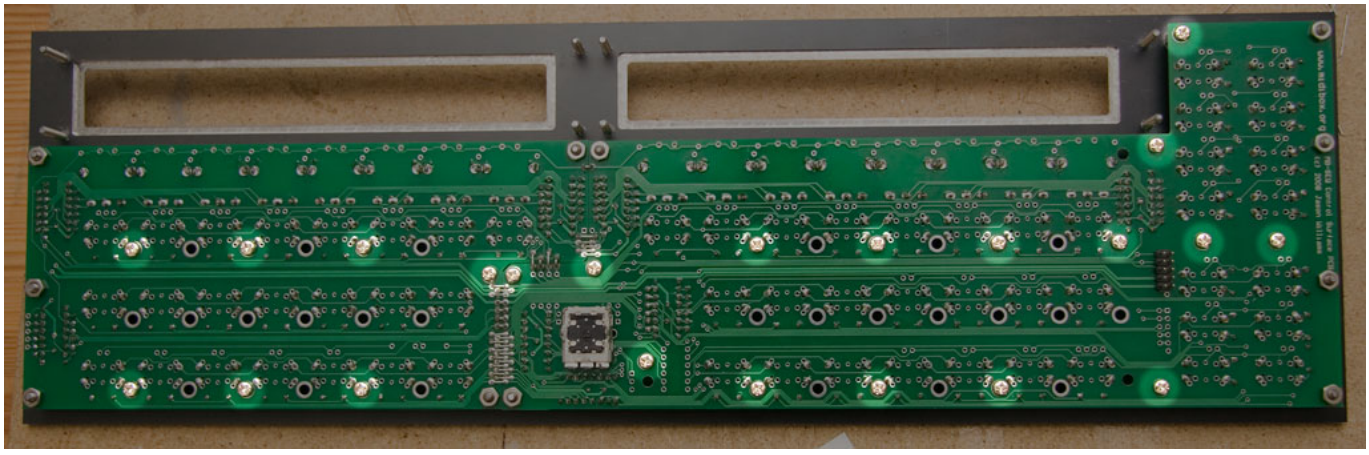
# Using a panel made by FPE/Schaeffer

If you are using a panel made by FPE/Schaeffer, then you need to attach screws to the panel to make “studs”. (Studs are like a screw shaft coming out of the panel). The studs are meant to attach the panel to a case and also support the PCB to the panel. Studs can be made out of 18mm lengths of M3 threaded shafts. Take a 20mm or longer M3 screw and cut it to 18mm of shaft using a Dremel and grinding disc. You can then round off the cut end by rolling it at a 45 degree angle on the Dremel grinding disc. Do not round off both ends! Later, you will put the screw's original end (the end that wasn't cut) into the threaded holes of the panel.

Gently screw the studs into the threaded holes of the panel. You do not want to damage the aluminium thread by accident.

Place the PCBs onto these studs and flat against the panel. You can now mark a circle on the panel with a pencil where you will place JB-Weld to glue the threaded spacers, i.e. through the mount holes of the PCB. You do not need to use as many threaded spacers as mount holes in the PCB. (The three mount holes without plating are for optional mounting of an ultracore PCB).

This picture shows where I located the spacers.



Now is a good time to do a “fit test” of the PCB and panel with temporarily mounted studs.

Attach 10mm spacers to the PCBs with the 3mm screws. **IMPORTANT: Align them to the centre of the mount hole!!!** You will soon be gluing them to the panel where they are placed.

“Snap-in” some switches and caps. If you are paranoid like me, put them all in, except S19,S33,S26,S40, to leave room for two clamps.

Place the PCBs onto the studs. Observe that the two halves can join with alignment between pads on either side, and still have the studs central to the mount holes.

Once you've tested that the studs fit into the panel and remain vertical, you can glue them into the panel.

Mix up a small amount of JB-Weld. You won't need much at all. Squeeze a line out of each tube of about 20mm.

**Take care here not to accidentally put glue on any of the studs where nuts or spacers will go - this will fill the thread and render the stud useless!**

To attach a stud, put a small amount of glue on the **uncut** end of the stud, no more than 2mm up from the end. You are aiming to put just enough to get into the thread, and not spill out of the hole. Then screw the stud into the hole and clean up any excess glue that might be on the panel. Excess glue on the panel will prevent the spacers (or the case) from mounting flat against the panel. You don't need much glue at all, the aim is to put just enough to stop the stud moving when screwing/unscrewing nuts on it. There is more than enough stud threaded into the hole for a solid joint.

Once all the studs are glued, do another fit test with the PCBs to make sure the studs are all mounted straight, but **do not** put spacers or nuts on the studs for this test.

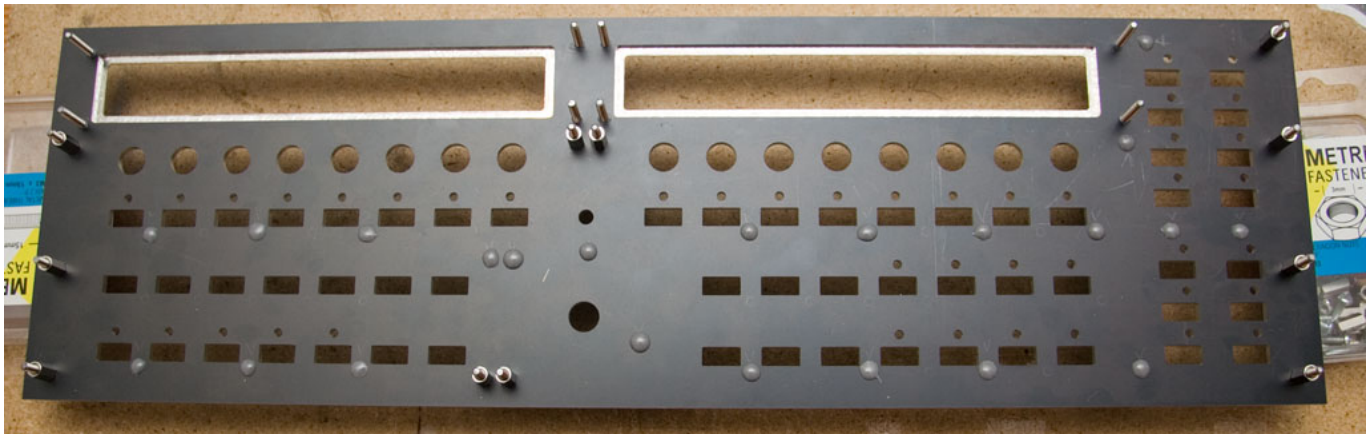
Put the panel aside for at least 8 hours.

Now is a good time to remove the switches and solder the diodes to the PCB. Cut the diode leads short, so you can save the rest of the lead (i.e. wire lengths) for using later when joining the PCBs.

Mount 10mm spacers to the studs. Note: the studs where the PCBs join will have spacers permanently, but the studs on the sides will not, as that is where the panel will mount to a case. You can temporarily put spacers on the sides to ensure a solid and parallel mounting of PCBs to panel when gluing studs to panel, and later when soldering LEDs.

Place the PCBs on the studs. Adjust the PCBs until they are aligned across the join. Use the pad holes as the best guide. Ideally the PCBs should fit together exactly. It's important to ignore the PCB outer edge and concentrate on the alignment between the two pads for the Beat LED, and that the studs are in the middle of the PCB mount holes. Once aligned, screw the nuts on the studs, flip it over and look at the switch caps. If they look aligned, then you've just rehearsed what you need to do next: glue the threaded spacers to the panel.

Remove the PCB and place blobs of JB-Weld in the positions marked on the panel, where they match with spacers attached to the PCB. The blobs should be ideally about 7mm diameter but only about 3mm high. What you do not want is a huge blob that will get squashed by a spacer and spread out through the panel holes! You can always add more glue after this first gluing, so putting less than you need is better than putting more than you need, i.e. just enough so there is glue between the entire spacer “base” and the panel. Use two wooden skewer sticks to put the blobs onto the panel, and remove excess if required.



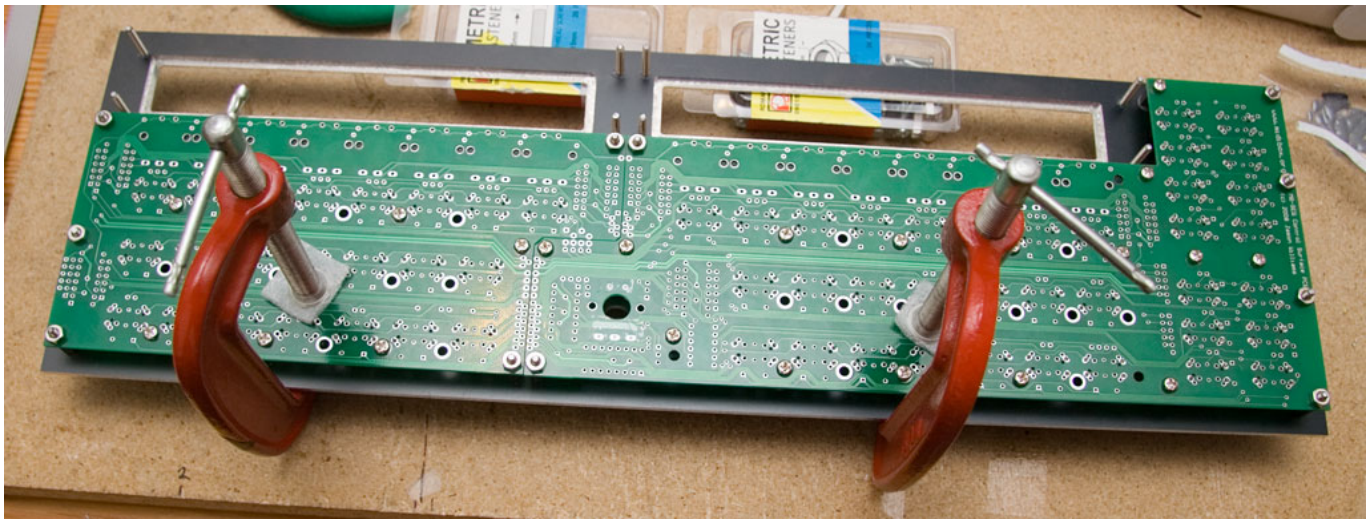
Do a final check that the switches (if you have them inserted) are properly inserted into the PCBs, and that the spacers are mounted in the right positions.

**Raise the panel off the table surface so the switch caps can go through the holes**

Here's where we repeat what you did before:

Place the PCBs on the studs. Adjust the PCBs until they are aligned across the join. Use the pad holes as the best guide. Ideally the PCBs should fit together exactly. It's important to ignore the PCB outer edge and concentrate on the alignment between the two pads for the Beat LED, and that the studs are in the middle of the PCB mount holes. Once aligned, screw the nuts on the studs, flip it over and look at the switch caps.

Add clamps to hold the PCB parallel to the panel. Sometimes the PCB might have a slight bend to it, observable by it being flexible in the middle even though you've used nuts on the outer edge. The clamps will push a few more of the spacers into the glue.



**NOW LEAVE IT ALONE FOR AT LEAST 12 HOURS!!!**

Before removing the PCB, now is a good time to start soldering the wires between the two PCBs.

# Joining the two PCBs

**This only applies to the prototype PCBs. The production PCBs (from bulk orders) are a single PCB.**

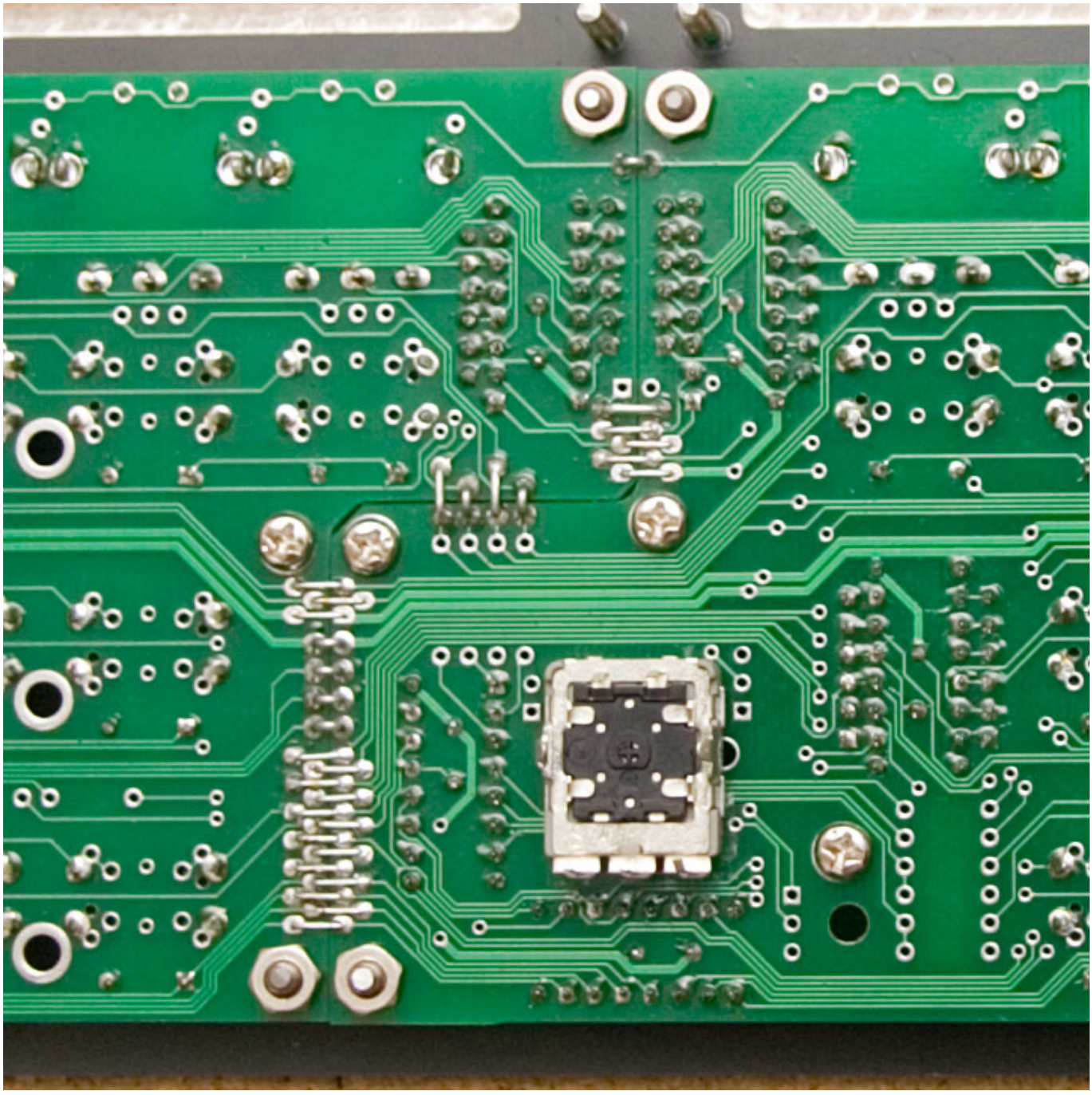
You're at this point if you had a panel with studs/standoffs built in, or just finished gluing the studs and spacers to the panel and the PCB/panel are still attached.

Bend wire into a square U shape (like a staple) and insert into pad holes between the two PCBs. Cut resistor or diode leads are ideal wire for this. I used thicker leads (like power diode or bridge rectifier leads) for the large round pads, but I think it doesn't matter. What's probably important is that the thin ones are flat against the PCB.

Solder the wires into the pads on the side now visible (i.e. the “bottom” side of the PCB). You are aiming to get solder into the plated hole. Make sure the wires don't touch the other pads or other wires.

Now you can detach the PCB, flip it over and trim/solder the wires from the other side.

The result is a PCB that's 16.6“ wide and as solid as if it was one piece.



It needs to be stressed to the people who just like to do things differently - **YOU SHOULD NOT USE FLEXIBLE WIRE, RIBBON CABLE, INSULATED WIRE, TRANSFORMER WIRE, ENAMELLED WIRE, ETC.**

# WARNING! WARNING! WARNING!

Some “16mm” rotary encoders, such as the Soundwell ones, have some extra nubs/protrusions on the encoder base. You will need to remove these nubs/protrusions for two reasons:

- the datawheel encoder is mounted to a hole in the PCB with a washer and nut. There is no hole in the PCB for any nub/protrusion. Therefore, to mount the encoder as close to the PCB as possible (and parallel too!), you need to remove the nub/protrusion.
- the step encoders are positioned very close to the step LEDs. The nub/protrusion overlaps the

space where the step LED is mounted.

I use a Dremel (rotary tool) with a grinding disc to remove the nubs/protrusions from my encoders. If you do not have this tool, you can use wire cutters and a lot of force… or call a friend who has some tools to help you.

# Soldering Components

The **suggested** soldering order is:

- diodes
- resistors
- 100nF radial capacitors (inside IC sockets)
- IC sockets
- resistor networks
- switches
- encoders
- LEDs

***NOTE THE ORIENTATION OF LED31/“step view” - it is opposite vs. the other LEDs!***

The LEDs should be soldered with the PCB and panel attached and perfectly aligned. The two parts of the PCB should also have been joined with soldered wire before soldering LEDs.

Rehearse/practice the following phase with a couple LEDs - inserting LEDs into the PCB, attaching the panel and flipping the panel and PCB.

Place LEDs into the PCB. Take extra care when placing the LEDs into the PCB. In particular, the Step View LED is of a different orientation to others nearby. Attach the panel. Flip the attached PCB and panel. Lay it down with the panel slightly raised so the LEDs can fall into the holes (the switch caps and/or encoder shafts keep it raised). Use LED leads to position LED into the panel holes. Solder the longer leads of all the LEDs. Check all the LEDs are at the same height - ones that are not can be adjusted by pushing the LED while reheating the solder joint.

If you are not using the exact same LEDs as I used, I suggest choosing resistors to match the LEDs you are using. In particular, it is likely the brightness of the bicolor LEDs will not be the same as the single color LEDs used, and you do not want the “step” LEDs being too bright, as often all 16 will be lit. Do this on an experimenter's board with a 5V supply. Even though it is hard to believe, LEDs in an 8-column matrix, i.e. which are only lit at most 1/8th of the time, are only slightly dimmer than when powered with a constant supply. Therefore, whatever brightness you get using a constant 5V supply will look good in the LED matrix.

I used 220 Ohm resistors for SmashTV's green 3mm LEDs and 220 Ohm for SmashTV's red 5mm LED (the “Beat” LED). For the bicolor LEDs I used (and may come with your PCB), I used 470 Ohm for the green and 1K for the red.

| Part | Suggested Value | Purpose |
|---|---|---|
| R1 | 470 Ohm | bicolor LED (green) |

| | | |
|---|---|---|
| R2 | 1 K | bicolor LED (red) |
| R3 | 470 Ohm | bicolor LED (green) |
| R4 | 1 K | bicolor LED (red) |
| R5 | 220 Ohm | single color LEDs, left side |
| R5A | 220 Ohm | single color LEDs, right side |
| R6 | 220 Ohm | single color LEDs, left side |
| R6A | 220 Ohm | single color LEDs, right side |
| R7 | 220 Ohm | single color LEDs, left side |
| R7A | 220 Ohm | “Beat” LED and J3:1 (cathode=J3:2) |
| R8 | 220 Ohm | single color LEDs, left side |
| R8A | 220 Ohm | unused LED at J3:3 (cathode=J3:2) |

* If you are not using green 3mm LEDs from SmashTV, you may need to change 220 Ohm to something else. For red 3mm LEDs from SmashTV, use 470 Ohm or 1K. For blue LEDs, consult a psychiatrist.

# Parts List / Placement

Please use the following list to stuff your PCB accordingly (yet incomplete):

| **Part** | **Description** |
|---|---|
| U1,U2,U3,U4,U5,U6 | 74HC165 |
| U7,U8 | 74HC595 |

| **Jumper/Connector** | **Description** | **Connecting to** |
|---|---|---|
| J1 | DIN/DOUT | to CORE/CORE32 Wiring 1:1 with J8/J9 |
| J2 | DIN/DOUT | to additional control elements in the Chain |
| J3 | Beat LED | optional Beat LED connection (if not mounting LED to PCB) |
| J4 | Datawheel Encoder | to PCB using Wires |
| J5 | Datawheel Switch | (optional) for encoder with switch |

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