V-Controller version 2 building guide

By sixeight at vguitarforums.com

Introduction
Here is a quick guide for building the V-Controller, a dedicated MIDI controller for Boss GP-10 / Roland GR-55 and Roland VG-99. Building this device should cost around 40 hours and $200 - 400 for parts, depending on the cost for the enclosure.

Features of the V-Controller:

- 13 displays, 16 buttons and multi coloured LEDs, MIDI, USB and RRC2 connectors.
- Patch selection - view of patch names for all three devices.
- GP10 and GR55: change fixed parameters on each patch. Display tells you which parameter is changed and buttons have a colour that shows you the type of FX you select.
  And control of assignments via cc messages. Parameter names and colours displayed for the most common parameters.
- VG99: pedal simulates an FC300 for CTL-1 to CTL-8. Parameter names and colours displayed for the most common parameters. Also fixed parameters are supported
- Momentary, toggle, three, four and five state buttons for parameters.
- Global Tap Tempo: all devices pick up the tempo from the V-Controller. There is the option to keep this tempo on all patches on all devices.
- US-20 simulation: smart muting of GP10, GR55 or VG99 by switching off the COSM guitar/synth/normal PU on the devices that are not active.
- Autobass mode: sends a CC message with the number of the lowest string that is being played (CC #15)

Additional documents:

- PDF, DWG and DXF files for the enclosure: https://github.com/sixeight7/VController_v2/tree/master/Enclosure/Metal
- STL files for the 3D printed files: https://github.com/sixeight7/VController_v2/tree/master/Enclosure/3D%20printing
- PDF and JPG file of the PCB schematic and design: https://github.com/sixeight7/VController_v2/tree/master/PCB

Parts list:

Enclosure

- Metal enclosure
- Coloured plastic wrapping
- 5x 3D printed LCD supports (1 large, 4 small)
- 52 2,2mm x 6,5mm screws for LCDs (http://www.microschroeven.nl/index.php?item=zelftapper-roest-vrij-staal-met-bolkop-2_2mm-x-6_5mm--diverse-verpak_&action=article&group_id=20000109&aid=964&lang=nl)
- Various screws for enclosure

Built in components

- 1x large 16x2 LCD character display (Buydisplay.com: 5V 16X2 1602 Character LCD Display,White on Black,High Contrast - ERM1602DNS-4-5V)
- 12x 16x2 LCD character displays (buydisplay.com: 5V Character Display Module 16x2 LCD Datasheet White on Black - ERM1602DNS-1-5V)
- 13x i2C display modules – you will need half in the 0x20 to 0x27 address range and half in the 0x38 to 0x3F address range. Order at several ebay companies
- 16x momentary foot switches – ebay: (http://www.ebay.com/itm/271930278587)
- 16x 5mm neopixel LEDs
- 16x LED holders
- 1x MIDX10 circuit board – courtesy of Robert from Primova.

PCB

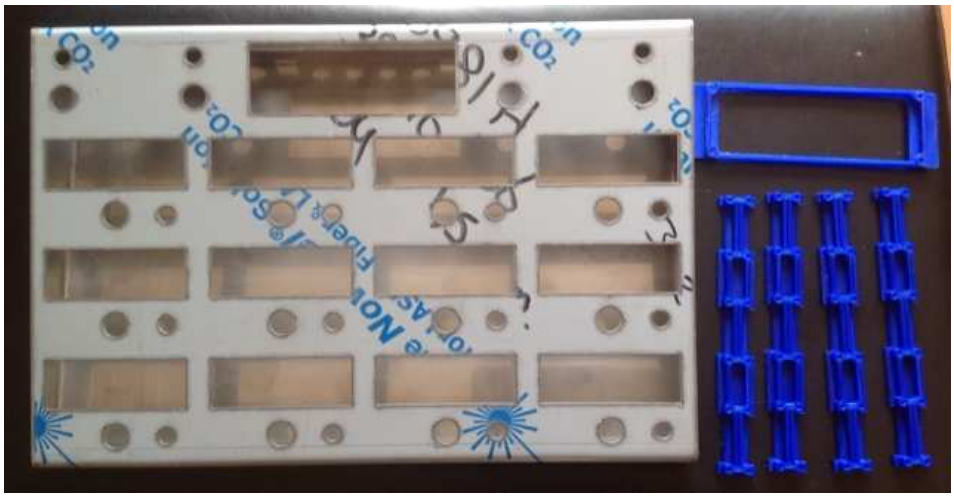
- Teensy 3.2
- Pin strips (male and female) for holding the Teensy in place
- 2 strip matrix PCB laminated paper, 160x100 mm
- 3 6n138 optocoupler
- 24 LC512 I/P serial EEPROM
- 4x 8 pin IC socket
- 2x 5 pin din socket (MIDI)
- 1x USB male socket type A
- 1x USB male socket type B
- 4x jack socket 6.35 mm stereo
- 2x 2N7000 MOSFET TO92
- 7x 1N5817 shottky diode
- uA7805 Voltage regulator
- dual row pins + jumpers
- 3x 100 uF capacitor, 16V
- 1x 220 uF capacitor, 16V
- 7x 100 nF capacitor

- 8x 1k resistor
- 5x 10k resistor
- 3x 4k7 resistor
- 3x 220 resistor
- 3x 270 resistor
- 6x 47 resistor

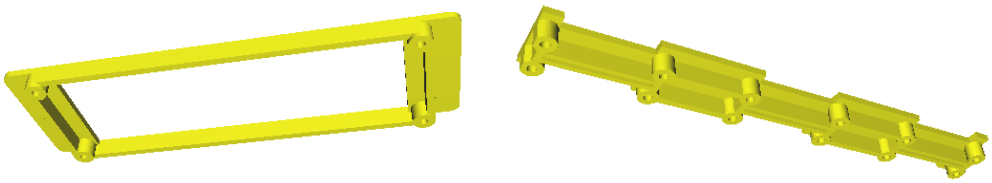
Connecting wires with Dupont connectors:

- Housing (50 pcs): http://www.ebay.com/itm/50Pcs-4P-Dupont-Jumper-Wire-Cable-Housing-Female-Pin-Connector-2-54mm-Pitch/191674305715
- Pins (200 pcs): http://www.ebay.com/itm/100pcs-2-54mm-Dupont-Jumper-Wire-Cable-Housing-Female-Pin-Connector-Terminal-/201415005503?hash=item2ee545153f:g:uTUAAOxyEFFTlolS
- Crimping tool: http://www.ebay.com/itm/SN-28B-Pin-Crimping-Tools-2-54mm-3-96mm-28-18AWG-Crimper-0-1-1-0mm-For-Dupont-/371220718126?hash=item566e7aa22e:g:S4QAAOSwQJhUmLTr
- Right angle single row pins (10 pcs): http://www.ebay.com/itm/10PCS-40-Pin-2-54mm-Right-Angle-Single-Row-Pin-Header-PCB-For-Arduino-/181918870015?hash=item2a5b35a9ff:g:qb4AAOSwhcJWNJB7
- Wire in different colours. (I got 8x 10 meters wire in different colours)

Enclosure
I found a metal company that does laser cutting to build the enclosure for me. Bending the enclosure was done at a different place, but it would be wise to have both done at the same place. See additional documents for building plans for the enclosure.



3D printing:
I was able to get this done for free at my working place. The holes in the 3D design are 2.5 mm, but turned out to be smaller when printed. The 2.2 mm screws fitted fine without the need of extra drilling. Drilling is scary, because the 3D supports may melt.

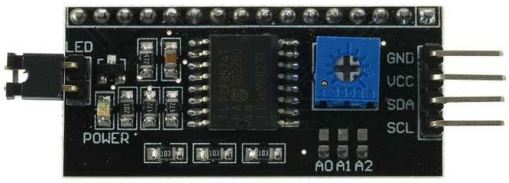


The 3D supports are attached to the enclosure with glue. I used Bison Kit. Tested beforehand if the glue would not make the 3D printed supports melt. I cut one support in half.

Finally the blue plastic wrapping was attached to the enclosure and the holes were cut out.

Displays and i2C modules

You will need 13 i2c modules. On most of these adapters you can set the i2c address (with A0, A1, A2 – see picture below)



Some of these adapters have the PCF8574T chip. These are in the 0x20-0x27 i2c address range. Others have the PCF8574AT chip. These are in the 0x38-0x3F address range.

As every adapters needs a unique i2c address and each address range only has eight addresses, we will need some with the PCF8574T chip and some with the PCF8574AT chip.

I ordered several i2c displays at four places. My result was: one batch of adapters with the PCF8574T chip (0x20-0x27 range) and two batches with the PCF8574AT chip (0x38-0x3F addresses) and one with adapters in both address ranges.

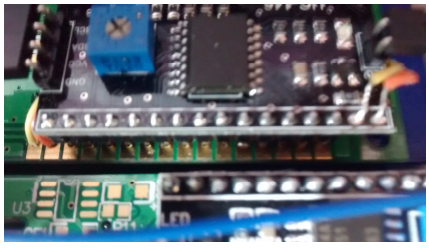
What I have learned:

- It doesn't matter what they advertise, you'll never get what you expect from these Chinese sellers. Two of them published the adapter at a different address from the one I received.
- Two packages from different sellers came from the same factory
- After receiving the packets it is almost impossible to tell where it came from. None of the numbers or names on the package correspond to the seller or ebay mails.
- I am lucky that the one 0x20 - 0x27 one actually looks different, so I know where it came from. But if I will receive one at the same address the next time I order them is a gamble.
- these ebay sellers do not often respond to english mails...

So getting the right adapters is quite hard and you need a bit of luck, unless you spend more money and buy them from more reliable sellers (in USA or UK)

Connecting the adapters to the displays:

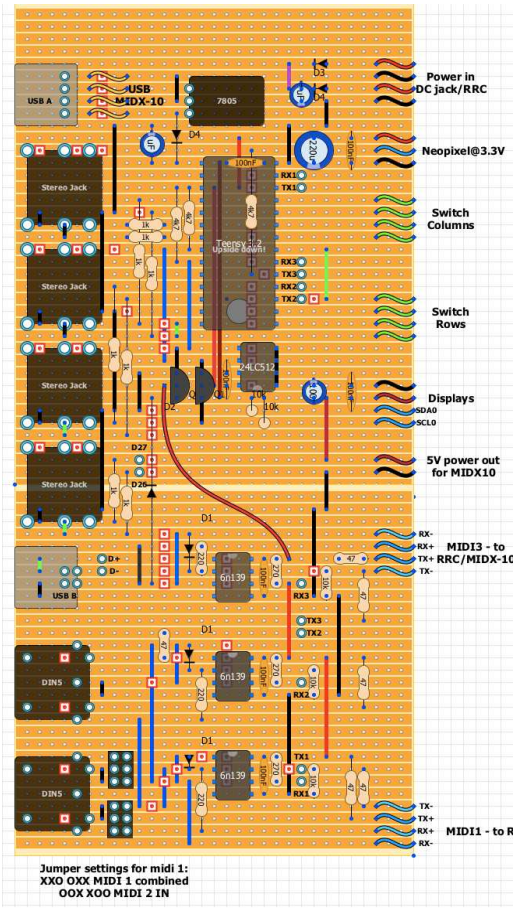
This is straight forward for the small displays. The large display has a different pinout. On the picture below you can see two wires running from pin 1 and 2 on the display to pin 13 and 14 on the i2c interface. Pin 1 - 12 of the i2c module is connected to pin 3 – 14 of the display.

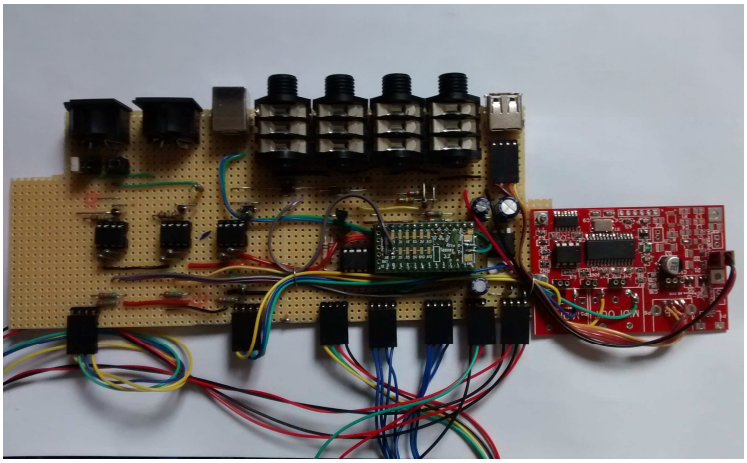


Building the PCB

The PCB has built after the enclosure was ready. First the connectors were attached and then I checked whether they fit the enclosure. With some additional filing everything fitted well.

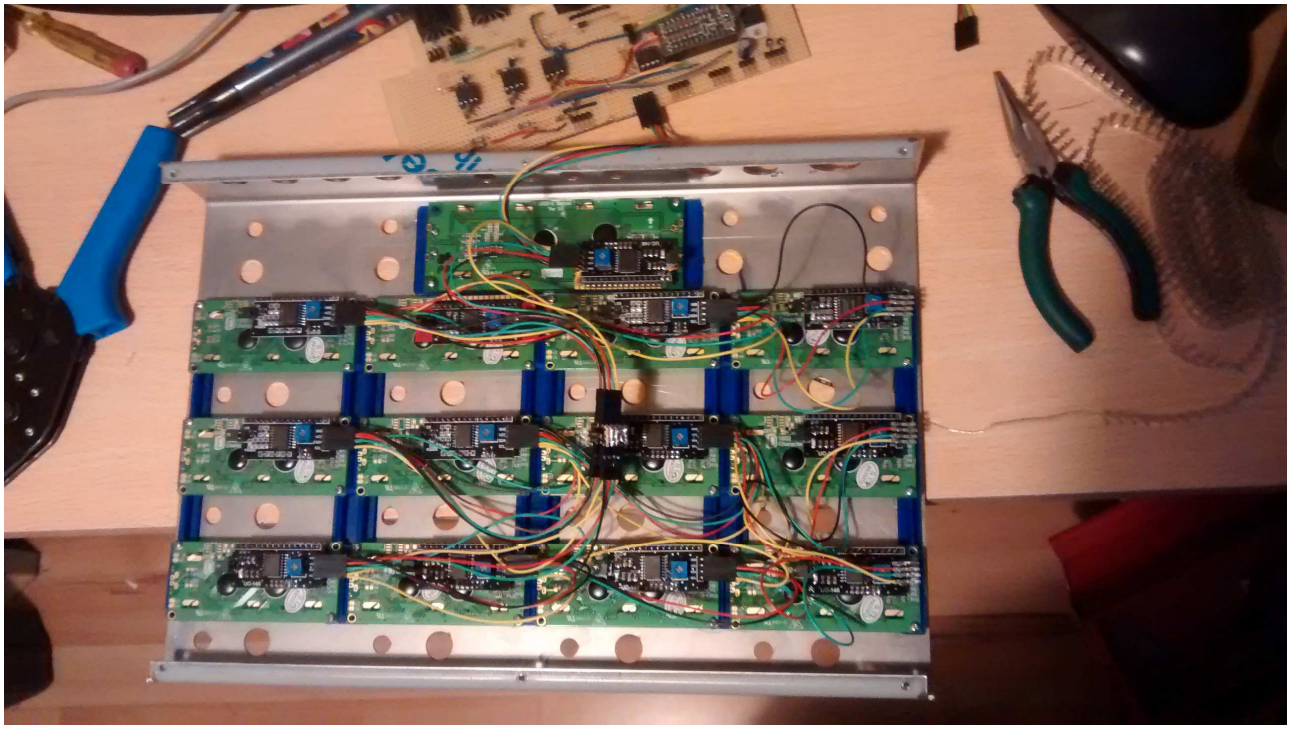
See additional documents for schematic and large PCB design..





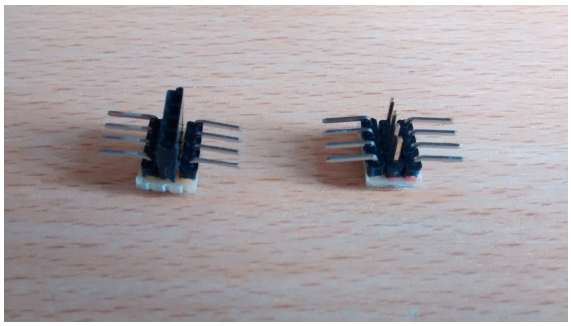
Putting it all together

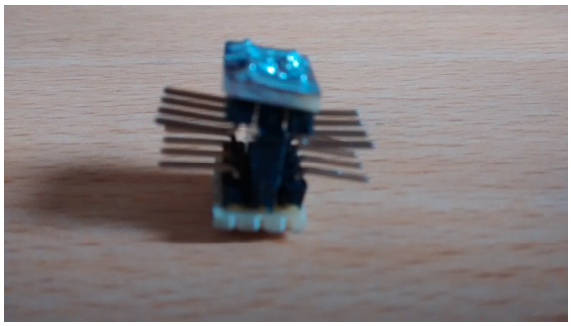
First put all displays in the enclosure and build Dupont wires for the displays.



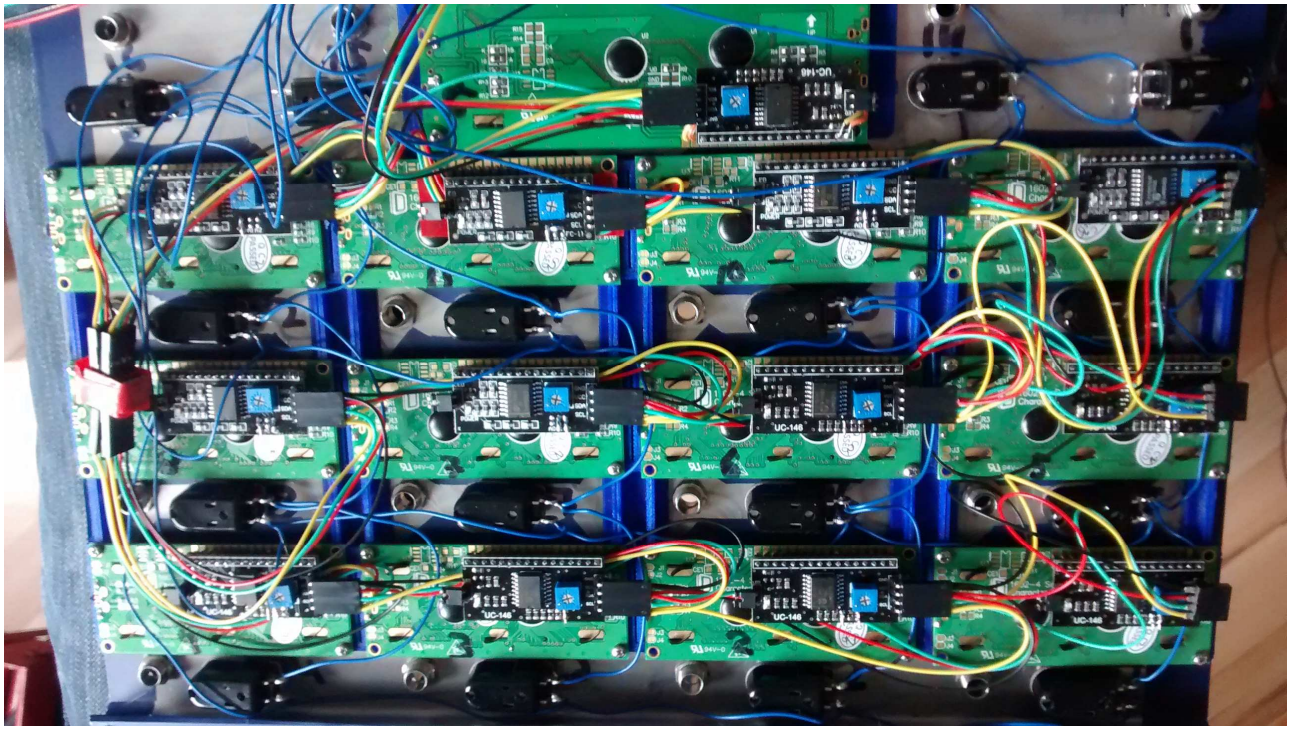
The displays are connected together in groups of four. The four pins of the i2c bus are all connected together. I made three dupont wires with five connectors each and one with three connectors each. The last one connects the main board with the large display and the “junction point”

Junction point
See below. Built this to connect three groups of displays together with the main display and board. I added insulating tape of the outside to avoid short circuiting the i2c bus.

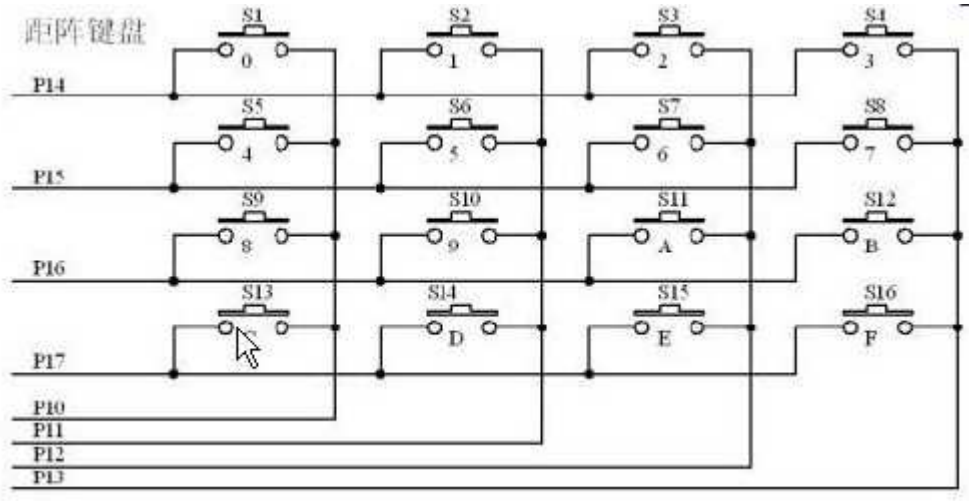




Adding switches and LED holders



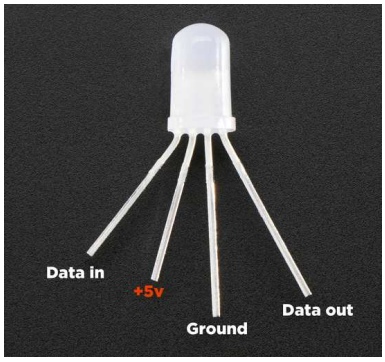
The switches are connected in a matrix:



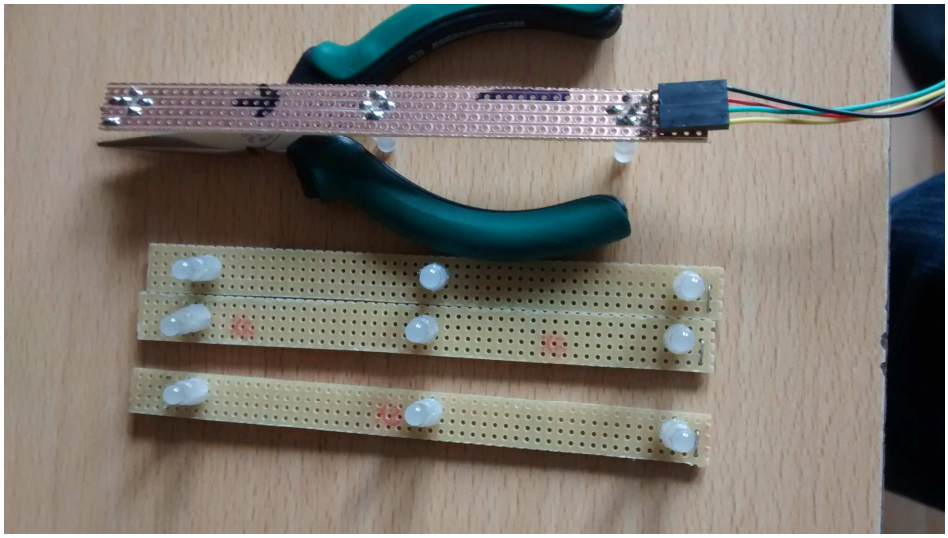
P10 – P13 are the switch columns, P14 - P17 are the switch rows

Adding Neopixel LEDs

The neopixel LEDs are connected in a large chain. Every data out is connected to the next data in:



To make connection easier I added small PCB strips to make the connections:

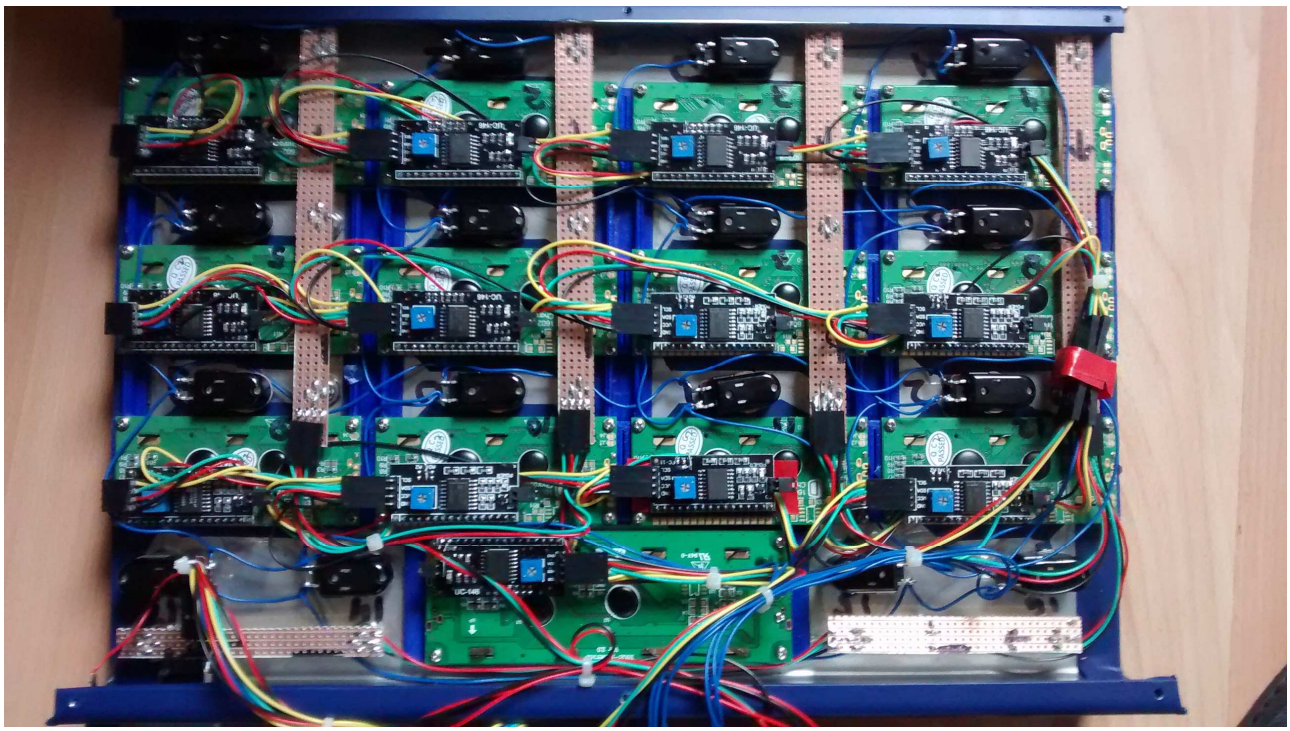


The colours of the wires are wrong. Pinout of the connector form top to bottom is: Ground, data out, +5V, Data in. One strip is used to get the data in from the connector to the bottom of the strip. A small wire jumper connects it to the bottom LED.

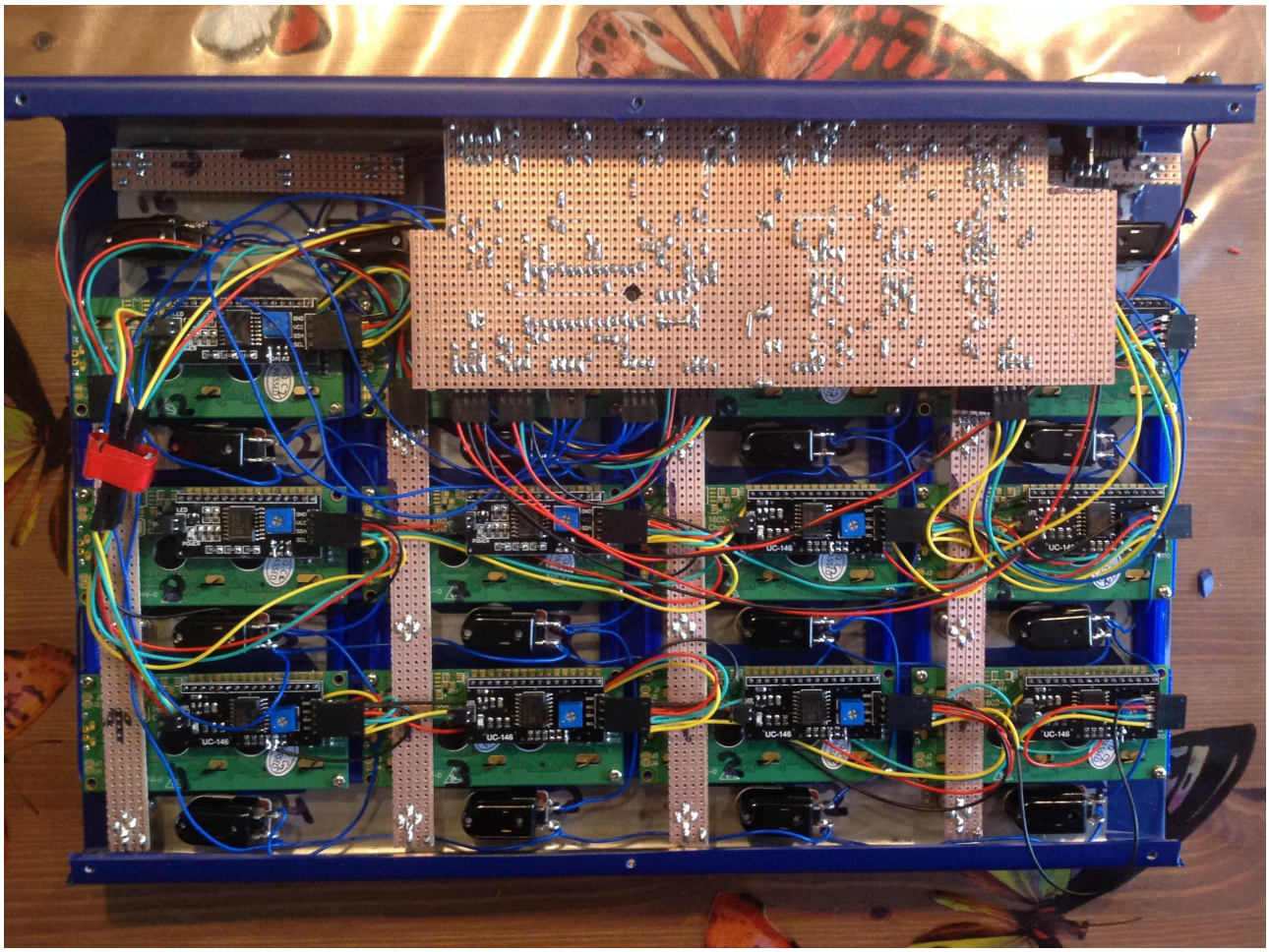
Make sure you check it all fits before soldering it to the board.

Also made smaller PCB for the top row of LEDs

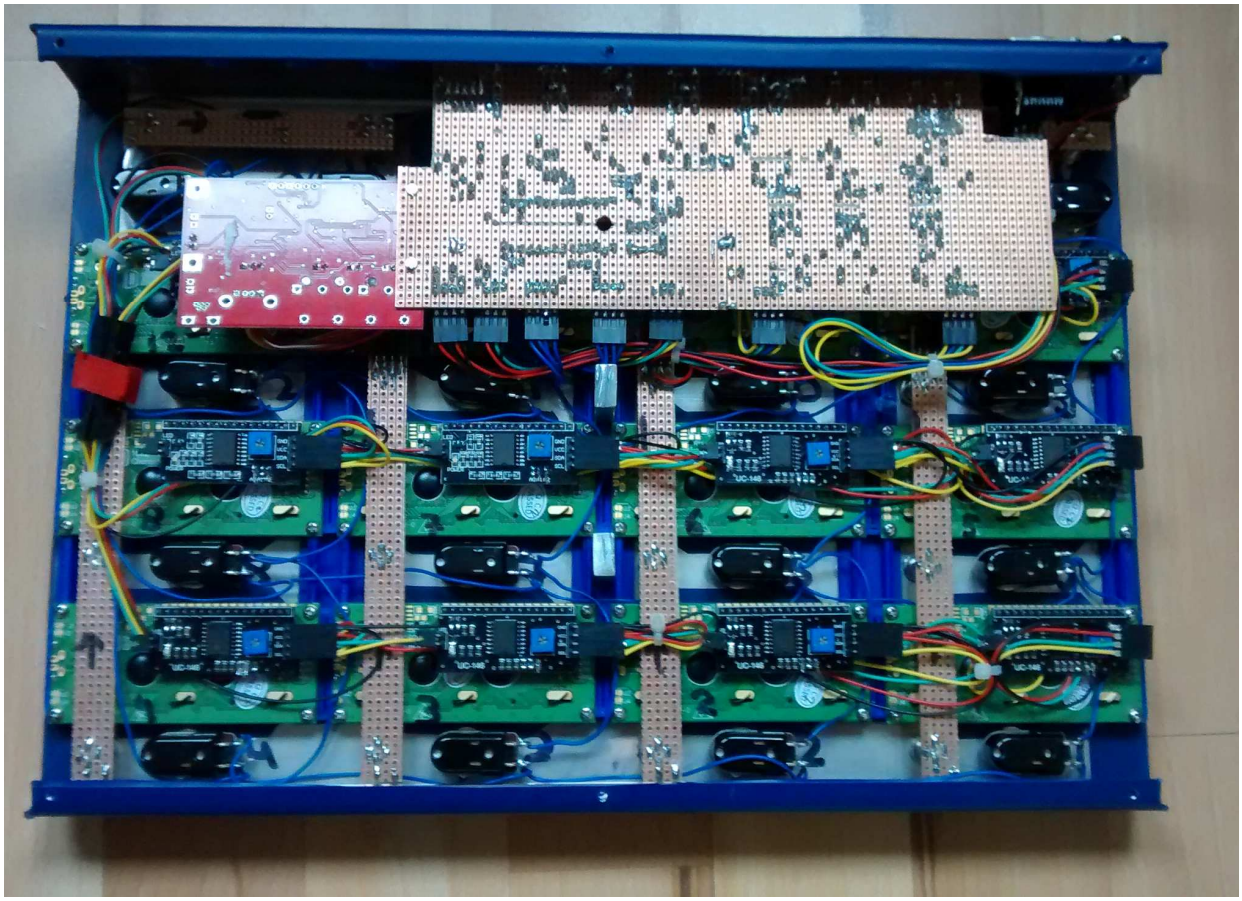
The following picture shows the Vcontroller with the LED boards attached:



After testing the main PCB was added and the board tested:



Finally all the loose wires were tied up with tie-wraps:



I also added small supports in the middle. These are the rectangular shapes you see there.

Firmware
Fimware can be downloaded and installed from github:
https://github.com/sixeight7/VController_v2

You will need the correct LiquidCrystal library, which can be found here:
https://bitbucket.org/fmalpartida/new-liquidcrystal/downloads/LiquidCrystal_V1.2.1.zip

Additional information:
Check out my blog at vguitarforums.com:
http://www.vguitarforums.com/smf/index.php?topic=15154.0