

ST4 – SWITCHABLE MIDI THRU BOX



An open-source project based on Arduino.

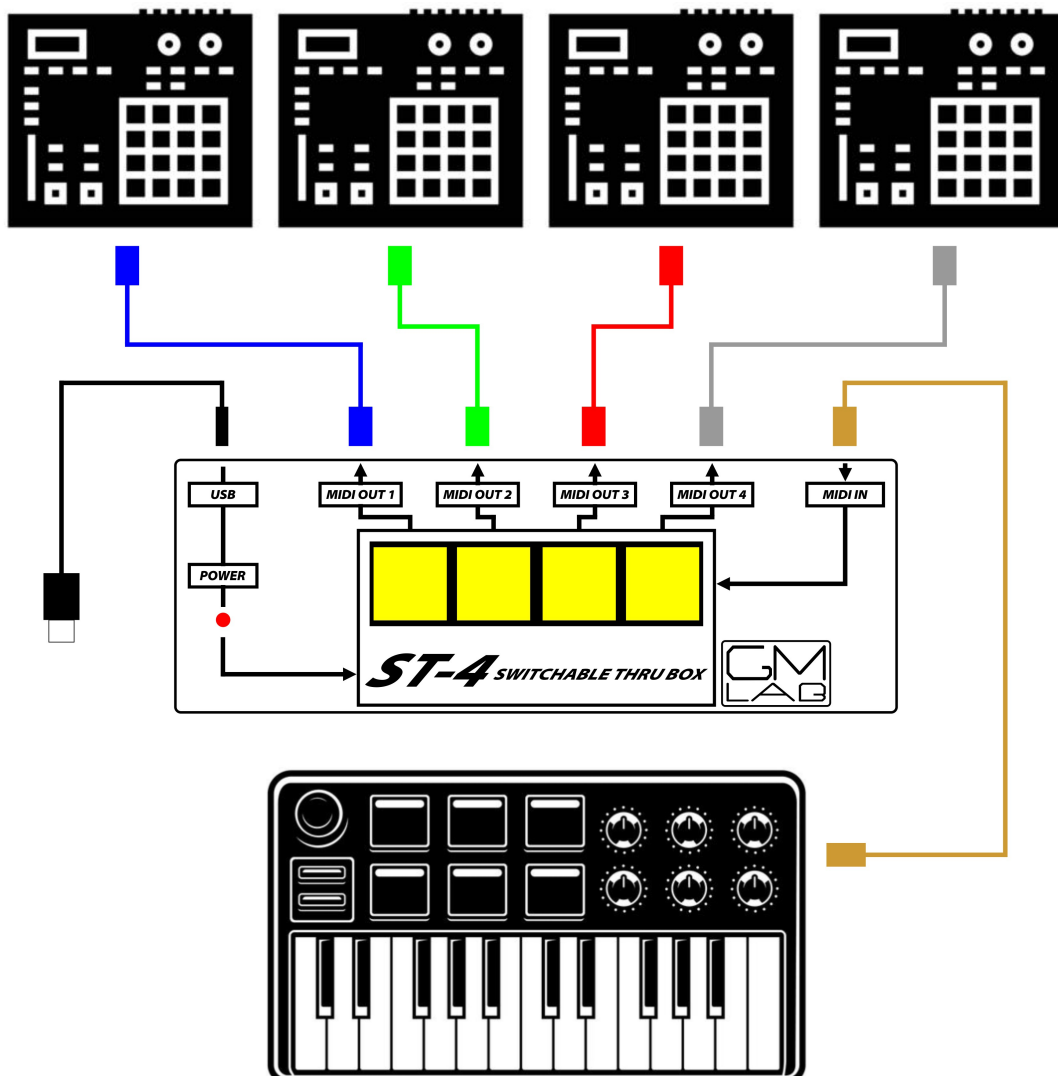
USER MANUAL

Congratulations, you are now the owner of ST4 switchable MIDI THRU BOX. Please read this manual in its entirety and keep it in a safe place for future reference. Have fun!

ST4 is a "Four port Switchable Thru Box", practically an easy and simple Midi Router, useful to control up to four synthesizers (or other MIDI devices) from one keyboard and switch quickly between them. Imagine you have one keyboard and up to four sound modules (synthesizers, drum machines, samplers, expanders, etc.) and you want to select which one you want to play from your keyboard. Just push the correspondent button and play, in any combination you like. The advantage of this box is that it will take into account notes still playing when the buttons are turned off, in order to avoid unwanted hung notes or incomplete Midi events. It can also function as a USB-Midi interface.

Use a 5V cellphone USB Charger/PSU to power ST4 and use MIDI ports to connect your instruments.

You can connect it with the provided USB Cable (well-known micro-USB for cell phones) to every keyboards/expanders able to recognize class compliant USB devices and you can take advantage of MIDI in thru that USB port.



DIY KIT MOUNTING INSTRUCTIONS

Welcome to the mounting instruction sheet for the GMLAB ST4 switchable MIDI THRU BOX kit. To assemble this kit correctly and set it up to work properly, a certain skill with electronics, mechanic and computers is required, plus some tools and a little bit of patience and attention.

REQUIRED TOOLS

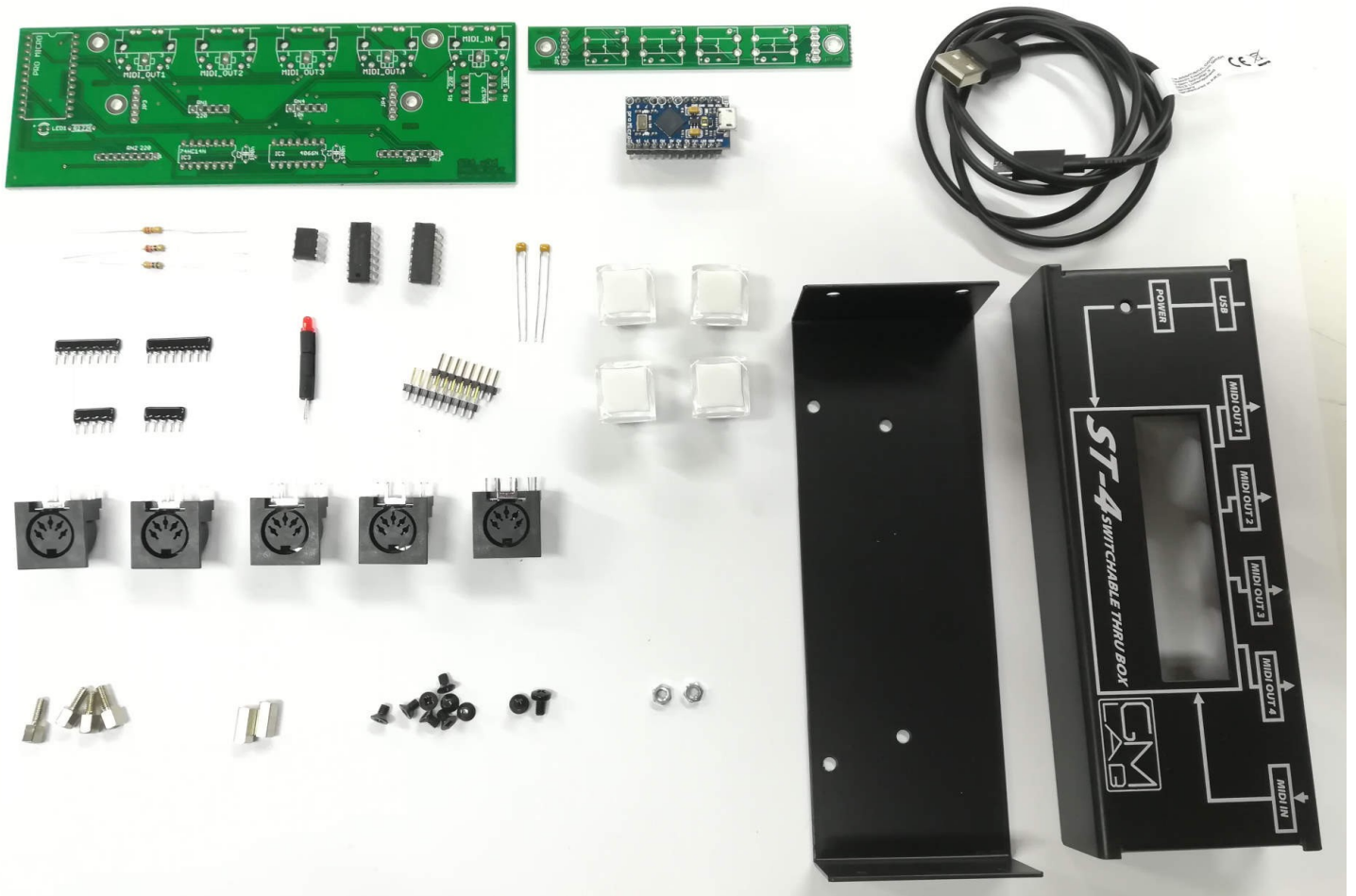
1. Soldering iron, preferably a temperature-controlled 60W iron with a 1,5 ~ 2,5 mm wide tip;
2. Solder, preferably good quality 0,8 ~ 1 mm diameter;
3. Good quality cutters;
4. Phillips screwdriver;
5. A computer with Arduino IDE installed.

PREPARATION

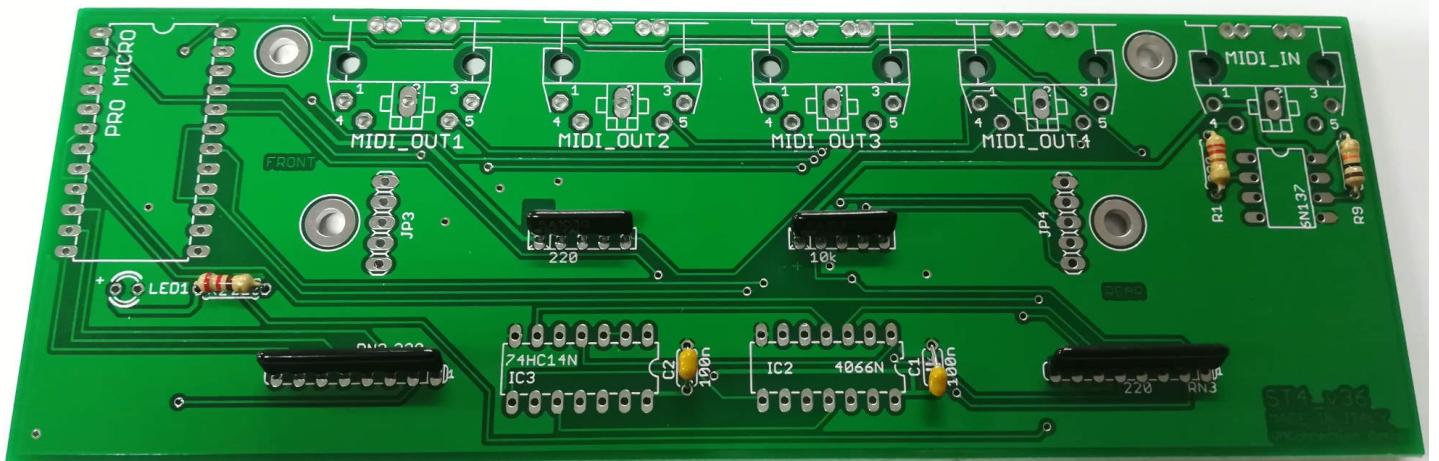
Prepare a clean and tidy surface, with just the required tools handy and make sure you have discharged your body from electrostatic charge by touching some metal object that makes contact with the floor. Optionally, wear an ESD wristband.

WHAT'S IN THE KIT

- 1x PCB ST4 main board
- 1x PCB ST4 switches board
- 1x Arduino Pro Micro (Leonardo clone)
- 1x Metal bottom piece
- 1x Metal top cover
- 2x 220ohm resistors
- 1x 10k0hm resistor
- 1x 6n137 optocoupler
- 1x 74hc14n IC
- 1x 4066 IC
- 1x 220ohm 5pins polarized resistor net
- 1x 10kohm 5pins polarized resistor net
- 2x 220ohm 8pins resistor nets
- 1x 3mm red led with 18mm spacer
- 2x 100nF capacitors
- 4x illuminated switches
- 5x MAB DIN5 connectors
- 1x male long sil strip
- 4x m3x5 hex spacers MF
- 2x m3x10 hex spacers FF
- 8x m3x5 flat head screws
- 2x m3x5 pan head screws
- 2x m3 hex nuts
- 1x USB - MicroUSB cable
- 4x rubber feets

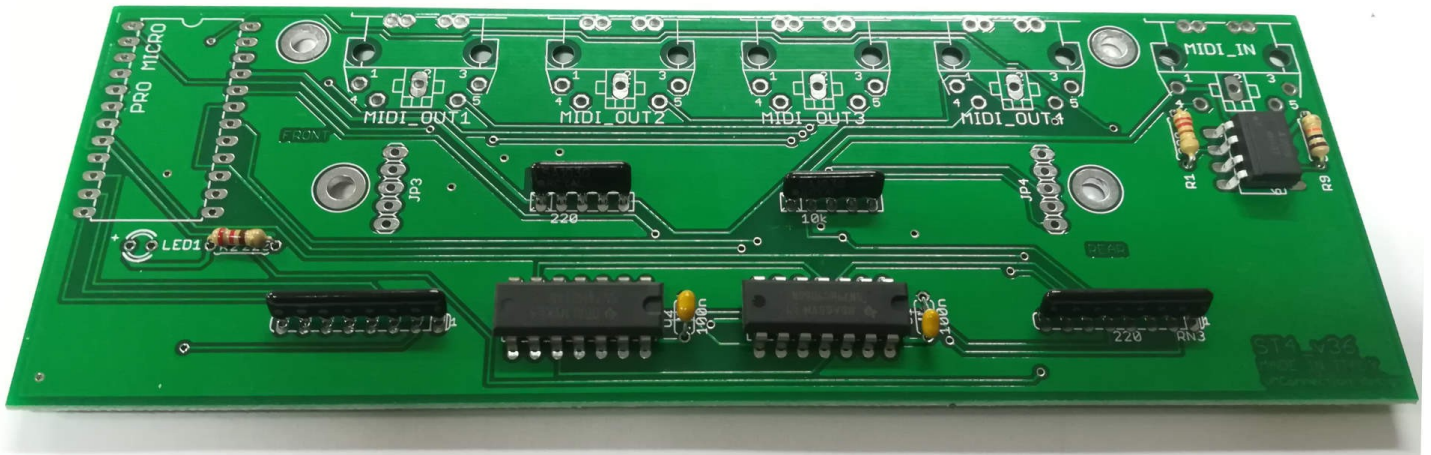


STEP 1: Let's start with ST4 mainboard from the passive components, from the lowest till the tallest. Take the resistors, bend the terminals 90 degrees and add them to the Main PCB in the correct positions (you can check the schematics, silkscreen in the board and the component numbering). Do the same with the resistor networks and capacitors.

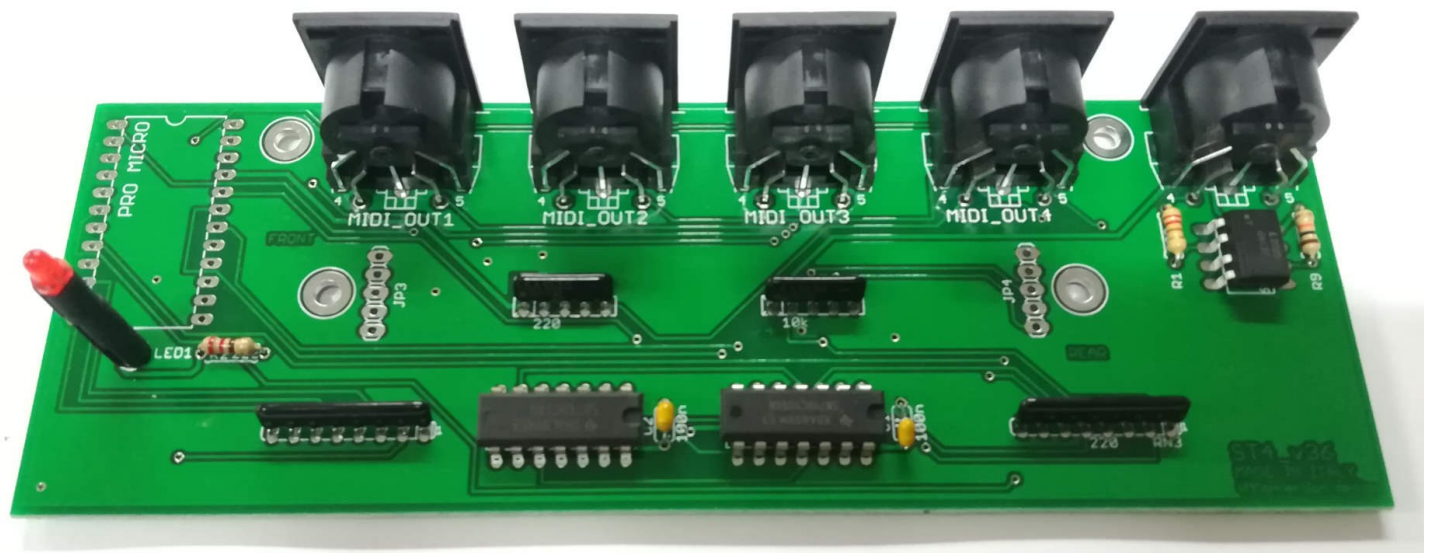


Note: the 5-pin resistors networks have a polarity: please pay attention to it. Polarity is marked with a white dot on the component itself, just match that dot with the pin in the circuit board marked with "+". The 8-pin resistors networks do not have any polarity.

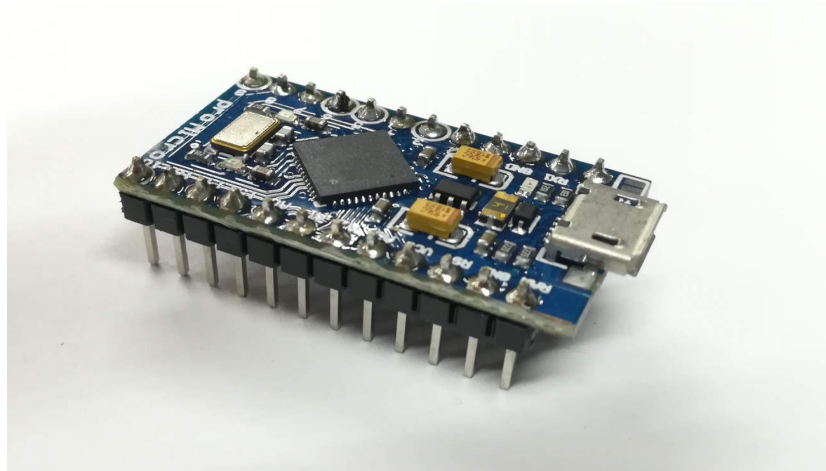
STEP 2: Add all the integrated circuits. Pay attention not to keep the solder pin for too long, and that all pins have been soldered correctly. Do not solder two or more pins together, each pin is soldered separately. Also pay attention to the direction. Drawings on the PCB have a notch on a side indicating where pin 1 goes. The same notch is generally present on the IC itself, or you'll also find a small dot or a vertical line on the left side, where pin 1 is.



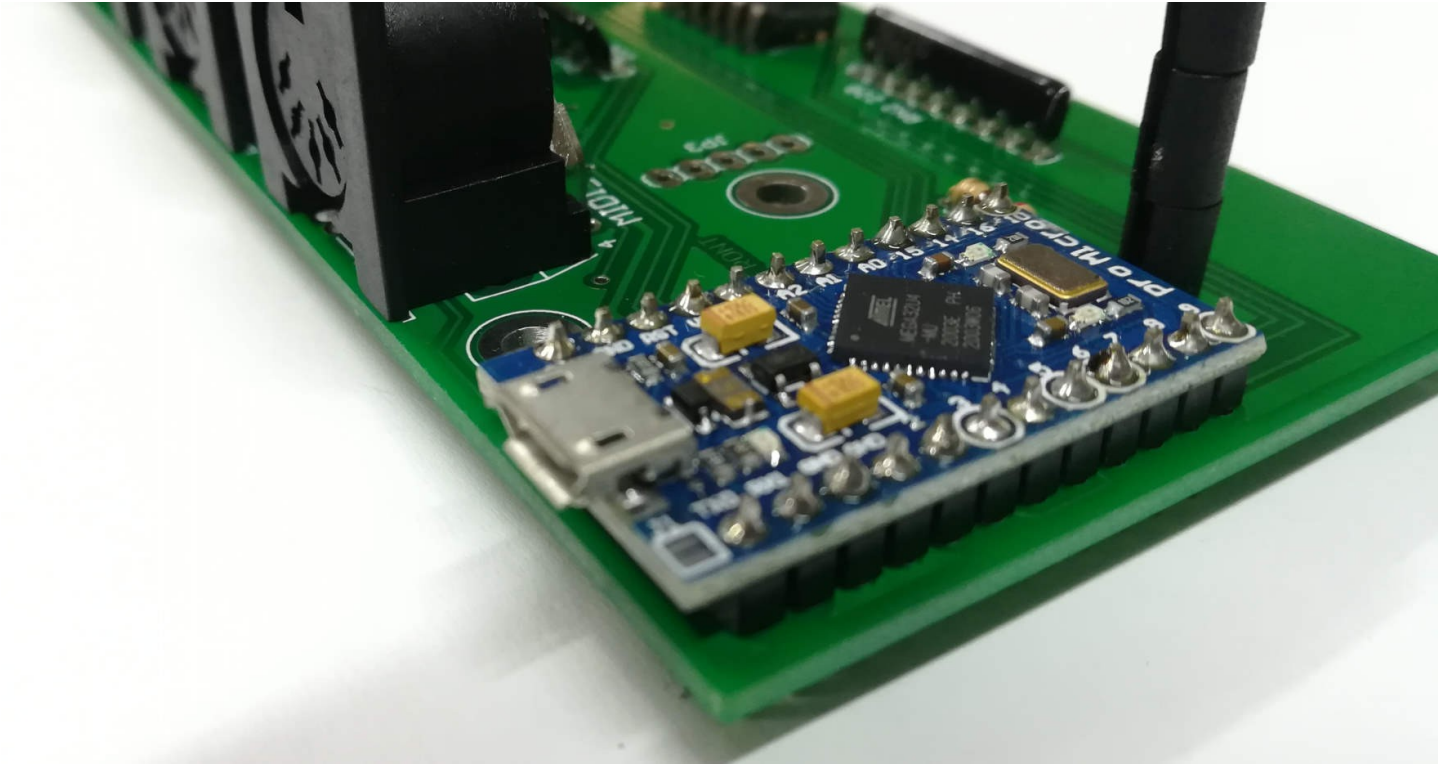
STEP 3: Mount the MIDI connectors and the LED with spacer. Refer to the image below.



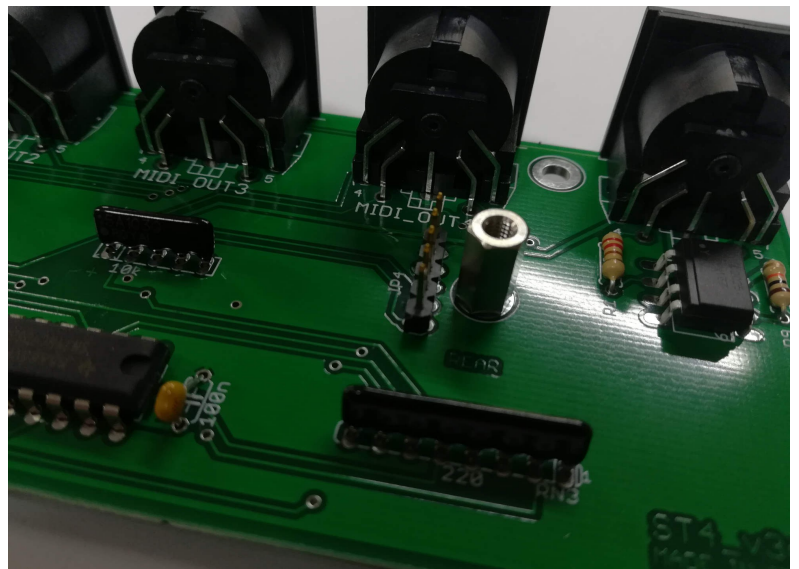
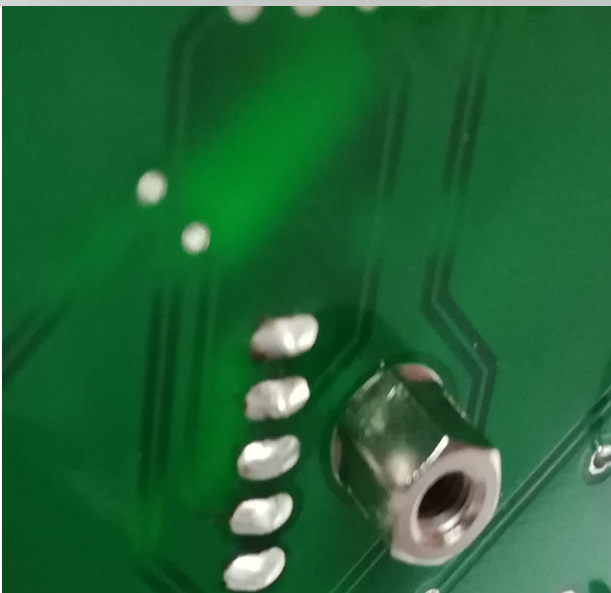
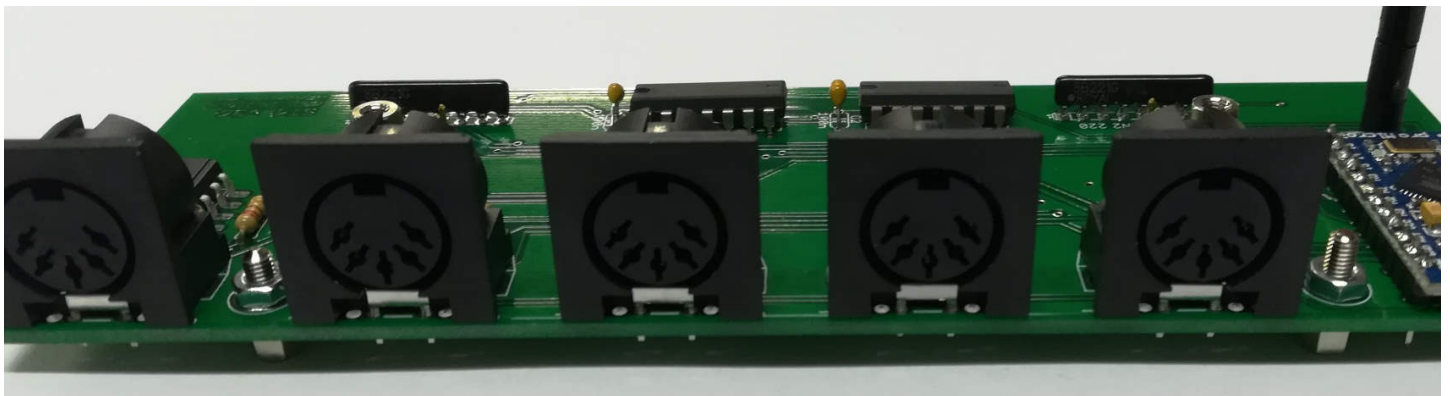
STEP 4: Add the the CPU board. Please note that the CPU comes **pre-programmed** with the default Arduino sketch and comes with all SIL terminals soldered.



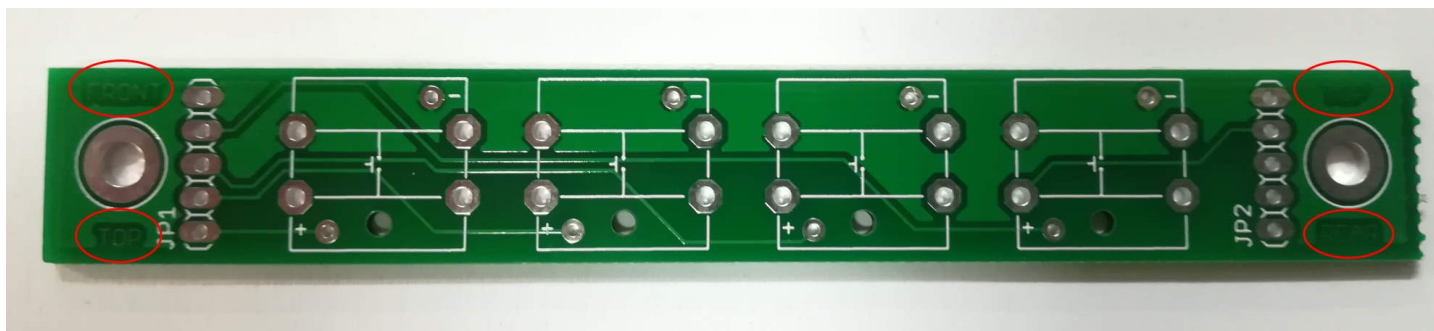
This board contains active SMT electronics and is subject to ESD and overheat, make sure that your soldering iron doesn't exceed 350 °C (~660°F) and don't keep the soldering pin on the solder pads for too long.



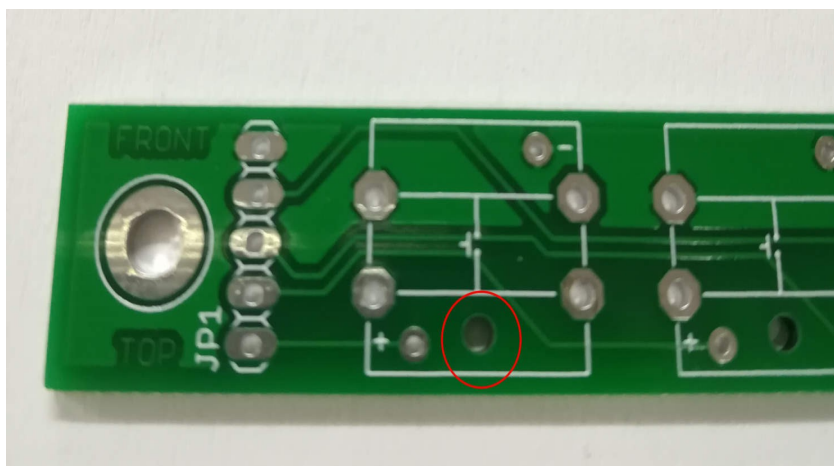
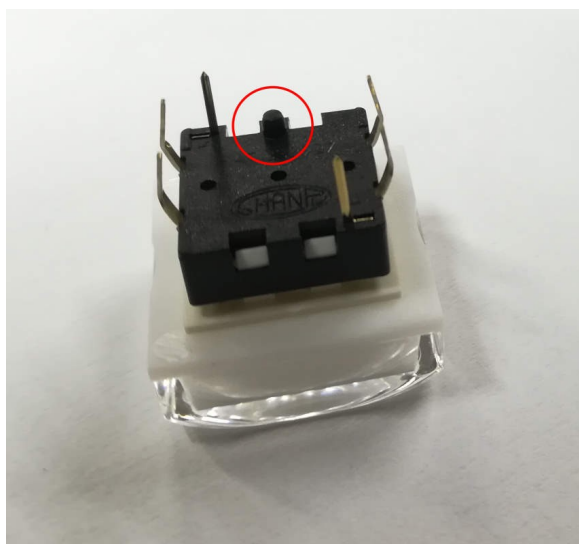
STEP 5: Mount the two rows of 5 SIL headers that will be used for electronic connection of this board to button board. Also mount the 2 m3x10 FF spacers using 2 m3x5 MF spacers. Mount the other m3x5 MF spacers and secure them with two nuts.



STEP 6: Now it's time to assemble the button board: this is extremely simple because it only accomodates 4 illuminated buttons. But in the same time this board has something important to keep in mind. The first one is the position and polarity of the board: taking a look at it you will find labels reading "TOP", "REAR" and "FRONT": the bottom side is labeled "BOTTOM". Buttons need to be mounted on the "TOP" layer.

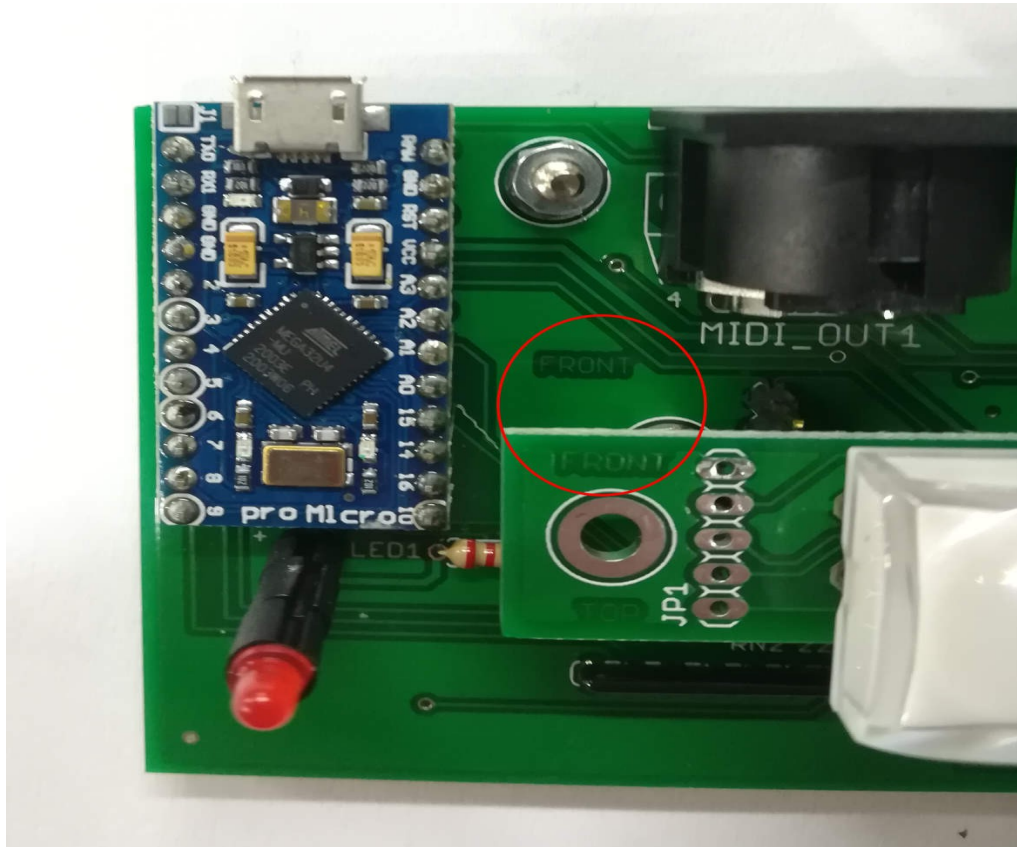


Second thing to keep in mind is the button polarity, they can enter and fully touch the surface of the board only if inserted correctly. There's a small ledge on the bottom of each button that has to fit the hole on the board. This indicates the right polarity for the buttons.

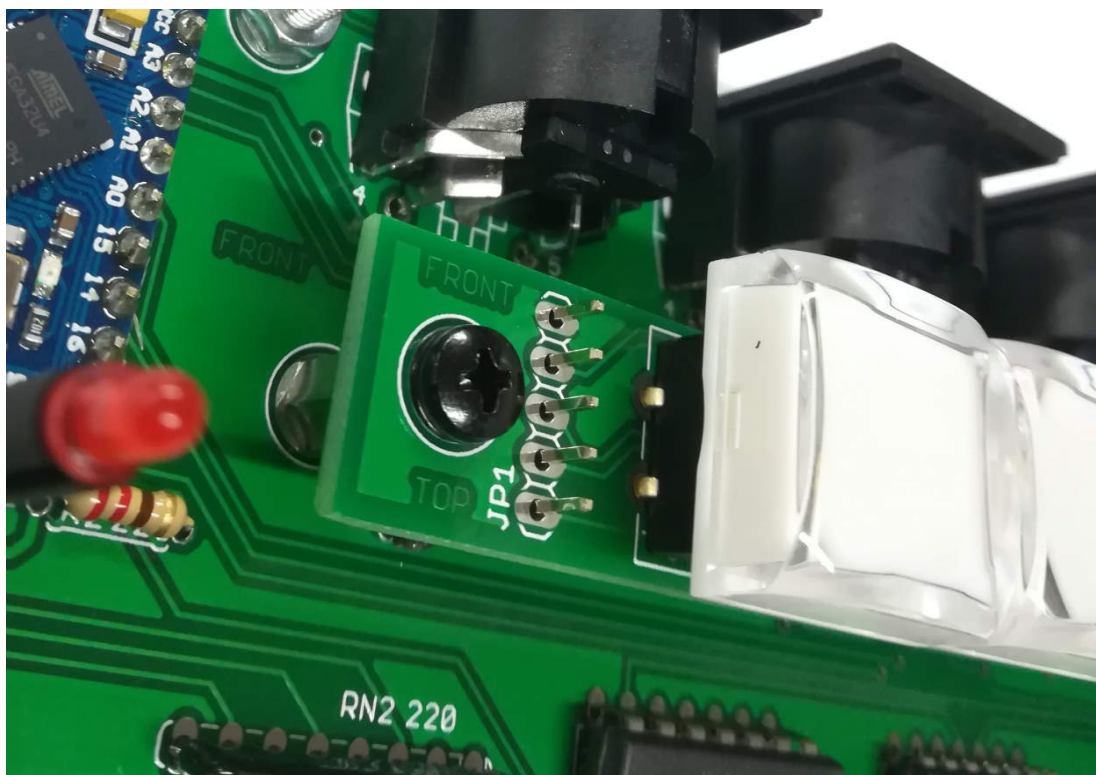


Once you are sure that all 4 buttons are well positioned, completely and evenly adherent to the board surface, you can solder them. Be careful with these switches, never pull them from the transparent upper dome or you will break them.

STEP 7: Take the switches board and align it to the motherboard taking a look at the silkscreens on both: simply align "FRONT" TO "FRONT" and "REAR" TO "REAR".



The 5 SIL headers on left side and the 5 SIL headers on right side must enter the holes on the button board. When this happens, just use the 2 m3x5 pan head screws to secure the two boards together on both sides: now you can solder the SIL headers.



STEP 8: Mount the bottom metal piece aligning the 4 holes with the 4 m3x5 MF spacers and **PARTIALLY** screw on them 2 flat head m3x5 screws. Do not completely thigten them otherwise you won't be able to go to next step.



Now take to TOP and **GENTLY** slide it to the bottom assembly paying attention to the LED and its hole in the metal top: note that the micro USB connector of the Arduino board is protruding the board, this is the reason why you have not completely fixed the ST4 board and the metal bottom: you need tolerance in order to let that connector fit its hole in the metal chassis.



Once in the right position, just **PARTIALLY** screw 2 m3x5 flat head screws on both sides of the chassis.



Now go ahead and insert the other 2 m3x5 flat head screws in the bottom and close all 4 completely. Insert the other 2 m3x5 flat head screws in the 2 sides of the chassis and close all 4 completely. If you need them, just peel and attach the 4 rubber feets on the bottom of the ST4.
And... the third board? well, you can use it as a keychain.



PROGRAMMING THE CPU WITH ARDUINO

PLEASE NOTE: The Arduino board supplied with the ST4 comes pre-programmed with the default ST4 sketch. If you don't need to modify the source code yourself, you can skip this whole section.

To program an Arduino board, you need a computer with Arduino IDE installed. Download it from the following URL:

<https://www.arduino.cc/en/Main/Software>

Install it on your computer following all the instructions given by the Arduino documentation.

If you haven't downloaded it yet, go to www.gmlab.it and download the Arduino sketch for the ST4 from the Document section.

PLEASE NOTE: before compiling the sketch, make sure you have installed the required libraries. The default sketch for the ST4 uses the following libraries (that should be installed separately using the IDE library functions, in case they aren't pre-installed):

- MIDI Library by *Forty Seven Effects* - https://github.com/FortySevenEffects/arduino_midi_library Used to generate MIDI messages to be sent to the UART PORT
- MIDI-USB Library
- EEPROM (built-in) Used to store and recall the current status into the internal EEPROM
- MillisTimer by *Brett Hagman* - <https://github.com/bhagman/MillisTimer> Used to obtain two timers with millisecond precision

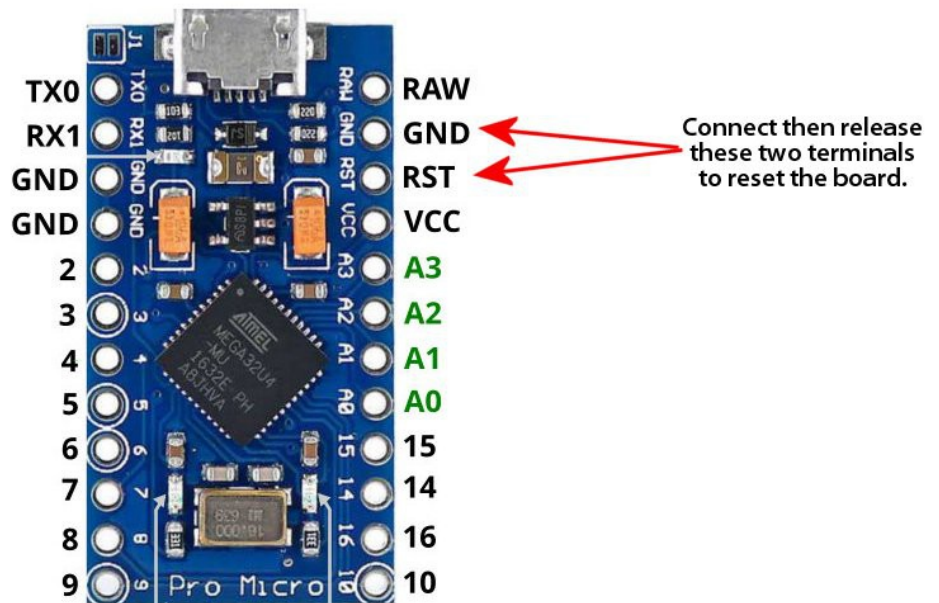
Connect the ST4 to your computer using the provided USB cable, start the IDE, load the sketch, then:

1. From the TOOLS menu, select BOARD -> Arduino Leonardo;
2. From the TOOLS menu, make sure the selected PORT points to Leonardo;
3. Click the icon with the arrow pointing right, this will compile the sketch and upload it to the board.

PLEASE NOTE: once the sketch is properly uploaded to the board, the USB port will not be seen by the IDE because it changes its function to USB-MIDI. To check that it is actually seen as a MIDI device, if you're using windows (preferred), download and install the free application MIDI-OX and check that the ARDUINO MIDI device is listed among your MIDI ports, select it as an input port to MIDI-OX and check that it is correctly sending the expected CC messages.

An alternative to installing MIDI-OX is this quick and easy web-based MIDI Monitor utility (requires Chrome): <https://www.gsidsp.com/midimonitor/>

In case you need to reprogram the board, one second before clicking the "LOAD" icon in the Arduino IDE, you have to "reset" the board by making a contact between the terminals labeled RST and GND using a small screwdriver.



PLEASE NOTE: The board has an internal button for the reset, you can push the button before starting to send the sketch to the board.

GMLAB ST4 is sold on-line on the web sites www.gmlab.it and on www.MyRigShop.com by V.M.Connection, an enterprise based in Veneto, Italy.

Get the source code for this and other project on our GitHub account:
<https://github.com/ZioGuido>

If you need spare parts or blank PCBs, just let us know.

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