STM32 Nucleo-L746 based USB to MIDI or RS-232 Interface

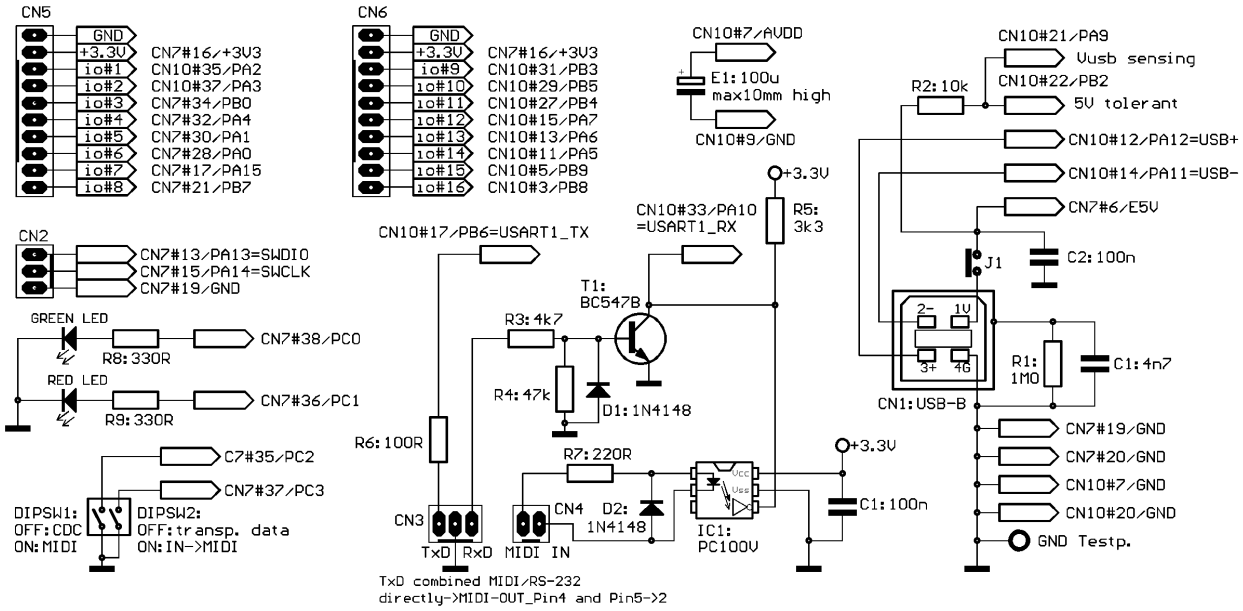
 03 December 2021

Hardware DIY construction manual for STM32 Nucleo-L476RG

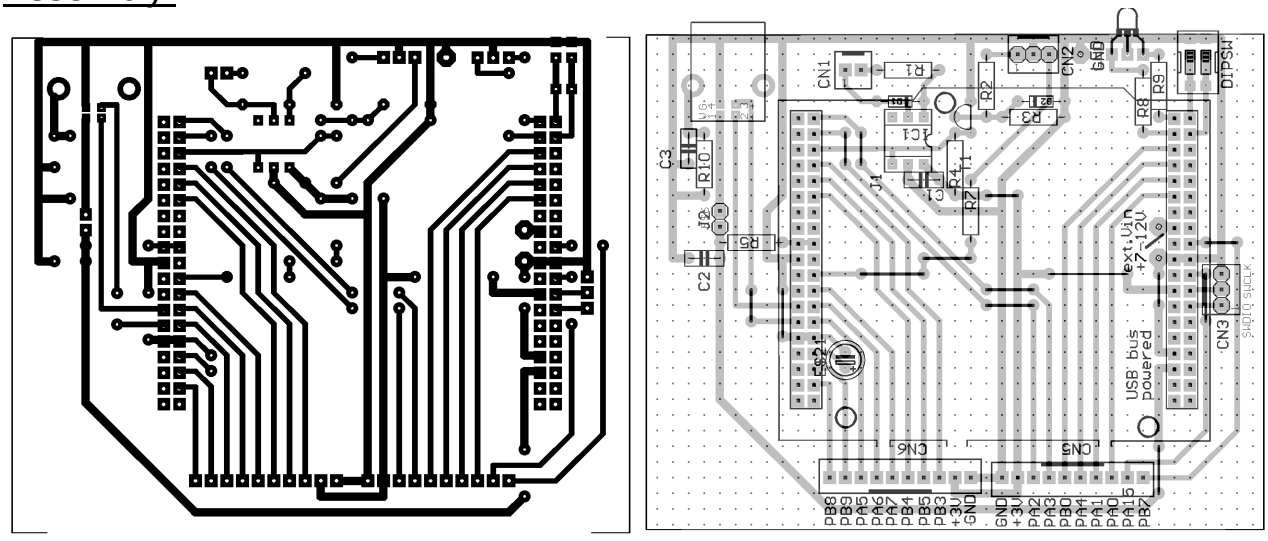
Because etching of PCBs is critical without experience and special tools, a Veroboard design is proposed here. **It has to be mounted below the Nucleo board** instead of "shield" position. Of course, it can be etched on a 1 layer PCB. A1:1 layout TIF file is available for download.

If you only need a USB to MIDI or RS-232 converter, it is not necessary to assemble the complex input change trigger wiring.

Schematic diagram:



Assembly:



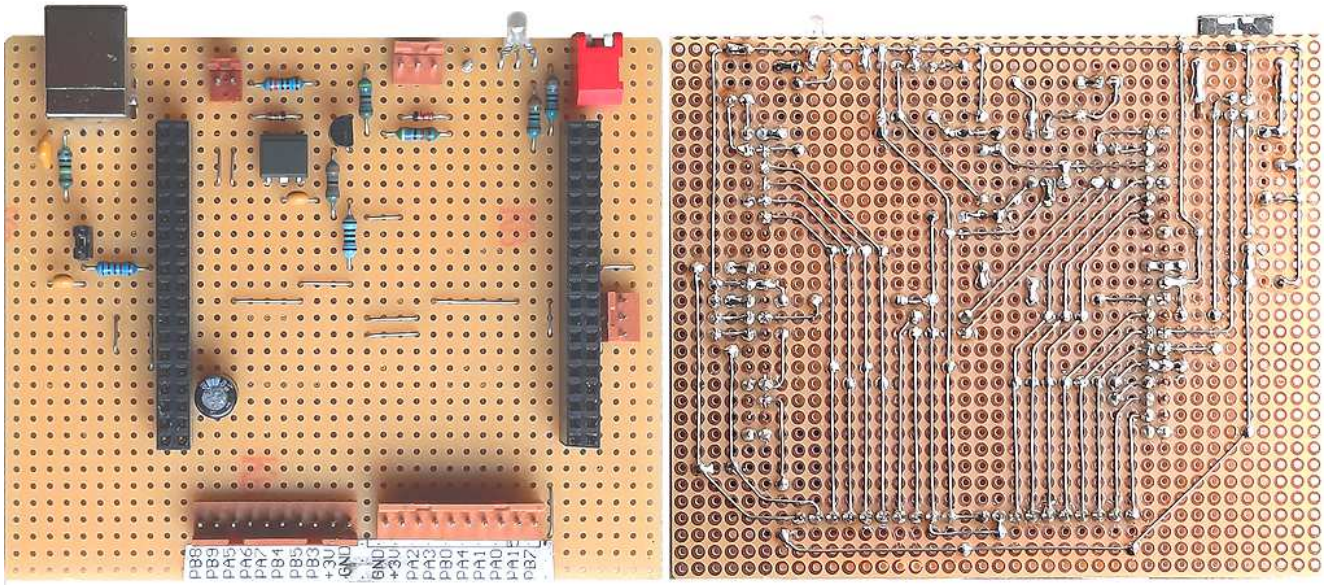
In contrast to the previous hardware version, V_{USB} is connected permanently with PA9. So it is possible (but less recommended), to supply the board with external power 7..12V DC. Due to Veroboard limited wiring resolution, the wire is put via PB2, which is HiZ input and 5V tolerant. J1 is only used for measurement of supply current. For longterm practical use it should be shorted with solder.

Take care to assemble CN3 (SWD programming connector) a little bit tilt. Else it would be difficult to connect the programmer there.

The ST-LINK programmer is provided on the Nucleo board. For practical use and to save supply current, it is recommended to cut off the ST-LINK part. Use it as extra benefit for other STM32 projects. For details see the Nucleo manual. The programmer module can be used standalone for external programming via the 3 pin connector CN3 provided on the Veroboard. No external connection of supply voltage and Reset is needed, but the Nucleo reset button must be pressed to connect the external ST-LINK.

How to program external parts with the Nucleo, read its manual. A special driver packet must be downloaded from the STM website and installed.

Build a programming cable (max 25cm)**:**
--- connect the 2nd pin of the Nucleo SWD connector (counted from the side towards the Mini USB connector) with pin PA14 of our board (CN3).
--- connect the 3rd pin with Ground of our board (CN3).
--- connect the 4th pin with pin PA13 of our board (CN3).
--- start the ST-LINK software. Click item "Connect" of the "Target" menue while the Reset button is pressed. Release the Reset button. After short time, a screen with the connection report and a listing should appear. When you are connected, select "Program&Verify" from the "Target" menue, select and upload the hex code. After programming, remove the programming adaptor, but is not absolutely necessary.
When the programmer is used standalone and the programming software sends a problem like "no target voltage", connect the 3.3V output (pin next to text U1) of the regulator (5 pins) on the ST-Link part with R23 (4.7 kOhm, pad directed towards the SWD connector) to pretend a supply voltage of the programmed device.



Special parts:

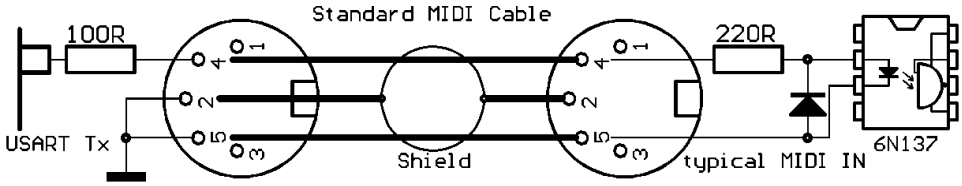
STM32L476 Nucleo-64 board, source: Reichelt, www.tme.eu, Mouser, Farnell, RS-Components
LED: V-L-115-WEGW, source Conrad 187496. Flattened side directed to PCB for correct colors.
Other dual red/green LED types may be used, but then values of R9 and R10 have to be adjusted
Optocoupler: PC900V, source: Conrad 184098
socket arrays for Nucleo: source: Reichelt MPE 094-2-50, 2 pcs, have to be shortened manually
connectors for MIDI/RS-232/pushbuttons: source Reichelt PS 25/2G BR, PS 25/3G BR, PS25/10W BR

The supply current of the STM32L476 version including the ST-LINK part and inclusive some potentiometers varies between about 65 and 80 mA. Particularly each LED of the ST-LINK part uses about 10mA! When the ST-LINK is cut off, the supply current is in the order of 32-40 mA.

The STM32L476 is driven by a free running oscillator (MSI clock) which is locked with the 32kHz quartz crystal mounted on the Nucleo board (LSE clock) and provides very good stability.

This way, no hardware modification is needed to operate the Nucleo with the ST-Link part cut off**, except solder bridges SB62 and SB63** (position see Nucleo manual) must be closed with a dot of solder. Else PA2 and PA3 are not available as external I/O.

MIDI OUT with 3.3 V "logic0" level:



The circuit described here has been tested with following types of MIDI IN:

PC900V + 220Ohm: 6.2mA, 1N137(different manufacturers) + 220Ohm: 4.8..5.6mA,

iRig Midi2: 6.4mA very old MIDI Sport4x4: 6.2mA, newer MIDI Sport1x1: 5.6mA

The drive current depends strongly on the forward voltage drop of the optocoupler LED.
Typically the optocouplers used for MIDI interfaces need a trigger current of ca. 2mA.

Care must be taken about pin PB8, which supports the alternative BOOT0 function.
There exist several MCU versions, some with a bug in the bootloader. I have never made any special handling block the bootloader and never had problems.
In case of trouble (e.g. module does not show any response at power on), connect PB8 provisionally to Ground with an 100kOhm resistor or similar.

contact: wschemmert@t-online.de