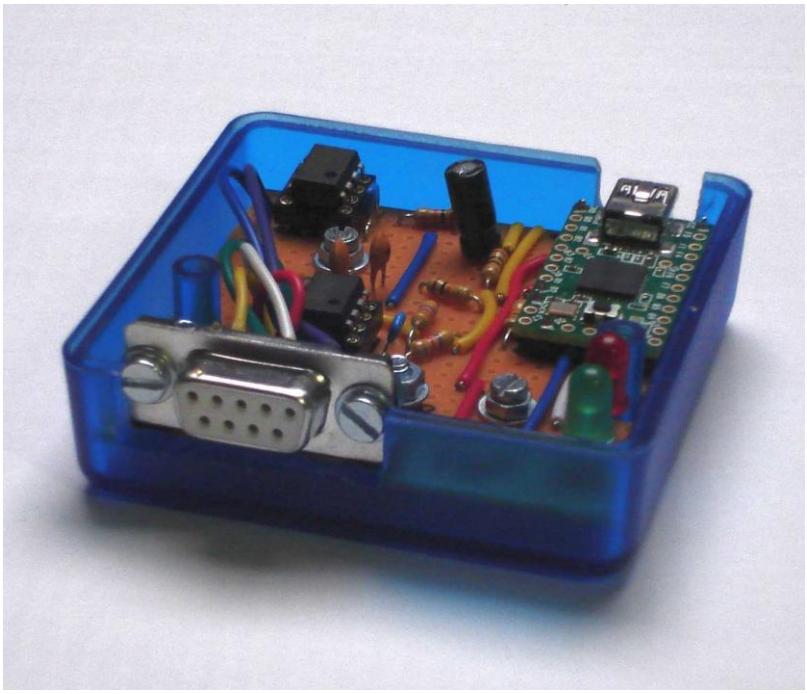
EMuSer

USB ←→ RS422 Adapter
for use with E-Mu Emax, Emax II, Emulator II and Oberheim DPX-1

CONSTRUCTION MANUAL



COPYRIGHT

CONTENTS

DISCLAIMER

Version Number: **This is version 1.02 build 1B (February 2019)**

EMuSer definition: **The EMuSer package consists of:**

- a Teensy 2.0 Atmel AVR based hardware device (produced by PJRC.COM LLC)
- a LUFA based firmware *(USBtoSerialEmu_Teensy2_0_v1_02_1.HEX)*
- a LUFA serial driver for Windows *(optional)*
- EMuSer_ConstructionManual_v1_02_x.pdf (construction manual)
- EMuSer_UserManual_v1_02_x.pdf (user manual)

Copyright: The construction manual and the information, specifications and designs that can be found in the construction manual are provided free of charge for **personal use** and **non-commercial purposes only**. No other usage of the construction manual nor of the information, specifications and designs that can be found in it is allowed. **Building and selling EMuSers for commercial purposes is not allowed.**

The **firmware** is subject of a specific copyright, because it uses LUFA code. The copyright is based on the MIT license.

The following copyright is applicable on the firmware:

LUFA version: The firmware is based on the LUFA library version of 24 SEPTEMBER 2009 (LUFA 090924) . Earlier and later versions of LUFA are not compatible with the EMuSer firmware. The latest version of the firmware is USBtoSerialEmu_Teensy2_0_v1_02_1

Credits and history: The roots of the EMuSer go back to an early prototype that had been built by Julian Higginson and which was based on an Atmel AT90USBKEY processor board. Many thanks to Julian who sent me his prototype for further investigation ! As the prototype didn't work yet, changes were required both on a hardware level and on a firmware level, resulting in the EMUCOMBOX. As a next step the processor board was replaced by the smaller Teensy2.0 and a proper PCB layout and mechanical design - including casing - was designed, resulting in the device called EMuSer. The EMuSer has been designed by Kris Van de Cappelle. A construction manual and user manual were written by Kris Van de Cappelle as well.

Accountability / Responsibility:

The author is not responsible for any errors or damage caused by the EMuSer hardware, software or the output produced by the EMuSer hardware or software.

Using this hardware and software is at risk of the user.

E-Mu Systems is not responsible for any errors or damage caused by the EMuSer hardware or software or the output produced by the EMuSer hardware or software.

Oberheim Electronics/ECC/Gibson is not responsible for any errors or damage caused by the EMuSer hardware or software or the output produced by the EMuSer hardware or software.

PJRC.COM LLC is not responsible for any errors or damage caused by the EMuSer hardware or software or the output produced by the EMuSer hardware or software.

Atmel Corporation is not responsible for any errors or damage caused by the EMuSer hardware or software or the output produced by the EMuSer hardware or software.

Do not use this hardware, software or the output produced by it if you don't agree with this disclaimer.

Trademarks:

EMAX, EMAX-SE, EMAX-SE-HD, EMAX PLUS, EMAX-HD, EMAX II, EMAX 2, Emulator II, Emulator III, Emulator IIIX and SoundFont® are trademarks of E-Mu Systems.

DPX-1 and Oberheim DPX-1 are trademarks of Oberheim Electronics/ECC/Gibson

AVR, AT90USB1287, AT90USBKEY and FLIP are trademarks of Atmel Corporation.

TEENSY, TEENSY++, TeensyLoader are trademarks of PJRC.COM LLC.

VERSION INFORMATION

Changes in version 1.02:

Following features, improvements and changes have been implemented since the previous version:

No hardware changes, only some small firmware updates:

- The meaning of the EMuSer's orange LED has been slightly changed
- The support for POSIX compatible baud rates has been improved.

The new version of the firmware is USBtoSerialEmu_Teensy2_0_v1_02_1.HEX
It is backward compatible with the previous versions, so any software which worked with the previous version of the EMuSer should still work with the new version of the EMuSer.
The manuals have been updated: the new meaning of the orange LED is explained, the Oberheim DPX-1 is added to the list of supported samplers, the cable layout for the Oberheim DPX-1 has been added and some text sections have been revised.

Build history of version 1.00:

Build 01.00.01 – 2010-11-03: Initial version

Build 01.00.02 – 2010-12-28: Two capacitors C4 and C5 have been added to increase compatibility with Emulator-II Rev1 CPU boards (thanks for the hints Arti !). This is a small fix which can easily be applied to Build 1 boards.

Build 01.00.03 – 2012-05-12: To further increase the compatibility with Emulator-II Rev1 CPU boards, the specification of capacitors C4 and C5 has been changed.

Build 01.00.04 - 2014-05-29: To increase communication reliability, there's a choice between a (newer version of the) LUFA USBToSerial driver and a specific 64-bit USBToSerial64Bit driver.

Build history of version 1.01:

Build 01.01.01 – 2016-05-05: Initial version

Build history of version 1.02:

Build 01.02.00 – 2016-07-02: Initial version, not released to public

Build 01.02.01 – 2017-06-24: Initial version, released to public (identical to build 01.02.00)

Build 01.02.01B - 2019-02-23: Manuals have been updated with respect to C4 and C5 capacitors

Test conditions:

This version has not gone through an extended testing cycle.

This version has been tested on following hardware:

- AMD Athlon 64 3000+ 1.8 GHz with internal floppy drive and with 512 MB Ram running Windows XP
- Intel Core i5-3210 2.5Ghz 8GB Ram, without floppy drive, running Windows 7 Home Premium
- HP Pavilion X2 12 running Windows 10 Home Premium
- Apple Macbook Air running Mac OS X El Capitan and Wine.App version 1.8-rc4.
- EMAX Keyboard with SCSI and SE upgrade (type 1000) and internal card reader SCM PCD-50B running OS Plus 1.0
- EMAX II Turbo Rack 4MB (type 2213) running OS 2.14
- EMAX II Turbo Keyboard 4MB (type 2212) running OS 2.14
- EMAX II Turbo Keyboard 8MB (type 2205) running OS 2.14
- EMULATOR II+ Keyboard 2x512Kb (type 6050) running OS 3.10
- Oberheim DPX-1 running OS 2.2

Your help:

The EMAX, Emulator II and Oberheim DPX-1 community can be considered the perfect "testing team" for the EMuSer :-)

You can report bugs and problems to *esynthesist [at] yahoo[dot] com*

Support:

I am not a professional hardware and software builder.

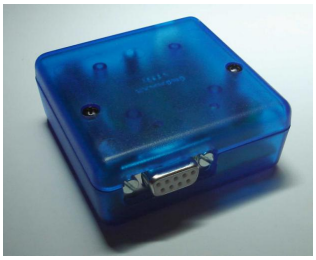
This means I don't have a lot of time to give support on the EMuSer.

I will try however to respond to as many questions and problem as possible.

INTRODUCTION

The EMuSer is a custom designed USB←→RS422 adapter that can be used with the E-Mu Emax-I, Emax-II, Emulator-II samplers and the Oberheim DPX-1 sample player.

The EMuSer ("**E-Mu Ser**ial") is the successor of the original EMUCOMBOX, which was a bigger and more expensive device based on the Atmel AT90USBKEY board.



The reason why the EMuSer has been created is because most commercially available USB←→RS422 adapters currently on the market do not support *synchronous communication.*
The E-Mu Emax I, Emax II and Emulator II samplers and the Oberheim DPX-1 sample player however require synchronous communication: the RS422 port on the computer must be capable of being *externally clocked* by the clock installed in the E-Mu sampler and the Oberheim DPX-1 sample player.

In order to use the EMuSer, a serial communications driver is required. The standard serial driver provided in Windows (usbser.sys) and Mac OS X (the ACM-CDC driver) should be OK. If the EMuSer is not detected by the operating system, an .INF file for the Windows driver is included in the EMuSer software package[1]. See chapter "Installing the EMuSer Driver".

This driver supports only standard Windows serial communication instructions, which don't include the enabling and disabling of external clocking.
Because of this constraint, the EMuSer firmware has been designed in such way that when receiving a "set baud rate to 500000" instruction from the driver, it will *not* set the internal clock to 500000 baud but it will rather switch to external clocking and will expect an incoming clock signal from the connected device.

In order to support software that only allow POSIX compliant baud rate values, there are two additional baud rate values that have a specific meaning for the EMuSer firmware:

- the "set baud rate to 50" instruction has the same meaning as the "set baud rate to 500000" instruction
- the "set baud rate to 38400" instruction will instruct the EMuSer firmware to use normal, asynchronous communication at a MIDI compatible speed.

50 and 38400 are POSIX compliant baud rate values, as opposed to e.g. 500000 and 31250.
An example of software that requires POSIX compliant baud rates is Wine on Mac OS X.

The EMuSer can be used as a standard USB - RS422 adapter, both in synchronous and in asynchronous mode.

The EMuSer supports standard RS422 communication, so the usage of the device is not limited to E-Mu samplers only. The pin layout of the D-SUB DB9 Female connector complies with the RS422 standard (see later).
But - as explained before - the only pitfall when using the EMuSer as a standard RS422 adapter is that the baud rates 50, 38400 and 500000 are not supported in *asynchronous (=standard)* mode.

The EMuSer is not commercially available.

[1] The EMuSer serial driver's .INF file is exactly the same as the original LUFA UsbToSerial driver's .INF file provided in the LUFA 090924 library

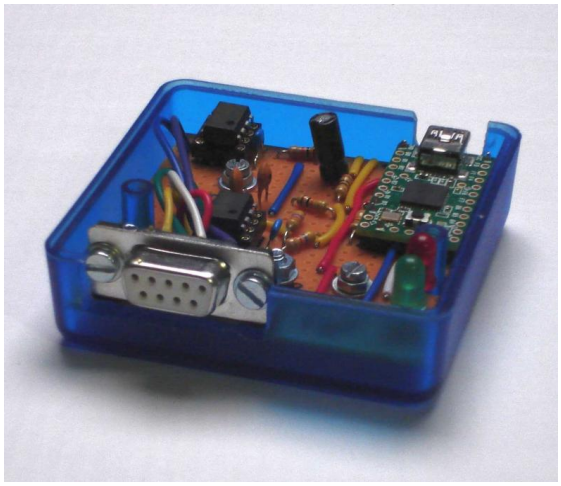
To obtain an EMuSer you will have to build it yourself based on the instructions and schemas provided in the "EMuSer Construction Manual" document. You don't have to be a professional electronics specialist to create the EMuSer. However some basic-to-medium soldering skills are required to assemble the unit.

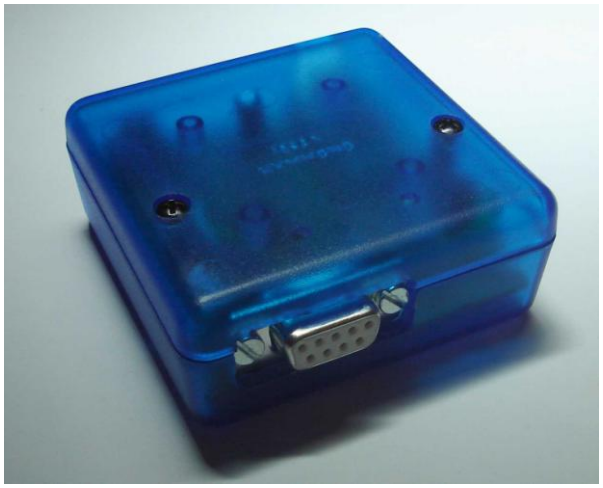
PARTS LIST

Introduction

The EMuSer uses an PJCR.COM Teensy 2.0 board (based on the Atmel AVR ATMEGA32U4 microprocessor) as its main component.
This device is available from PJRC.COM LLC at a very affordable price.
The Teensy board alone is not sufficient to be used as an USB ←→ RS422 adapter for E-Mu samplers though. Some additional components must be connected to the Teensy. The two most important ones are the RS422 driver and receiver ICs.

The pictures below shows the EMuSer built into its plastic case.





The EMuSer connects to:

- The computer via a Mini-B USB port; a *mini-B to standard-A USB cable* is required to connect the EMuSer to the computer.
- The E-Mu sampler via a D-SUB DB9F port; a specific serial cable is required depending on the type of sampler: a *custom DB9M-to-DB9F cable for connecting to the Emax/Emax-II, a custom DB9M-to-DB25M cable for connecting to the Emulator-II*, or *a custom DB9M-to-DB9M cable for connecting to the Oberheim DPX-1*.The design of these cables is explained in this document.

This construction manual assumes that the EMuSer will be built into a **transparent plastic case** sized 66mm x 66 mm x 28 mm (2.6 inch x 2.6 inch x 1.1 inch). We used the 1593JTBU transparent blue ABS Plastic case from Hammond Manufacturing.

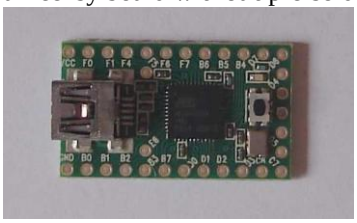
If you will use another case, please be aware that the size of the print board and the position of the holes for the screws may have to be changed. This could even have impact on the position of the components on the print board.

The remainder of this document is based on the 1593JTBU (or similar) type of case.

Note: pictures of all parts can be found throughout this document.

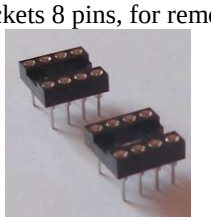
Electronic components for EMuSer device

- I1: Teensy 2.0 board (based on Atmel AVR ATMEGA32U4)
  Attention ! Use a Teensy board **without** pre-soldered pins.

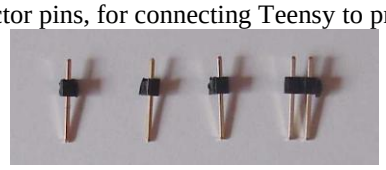


- I2: UA9638C Dual Differential Line Driver
- I3: UA9637AC Dual Differential Line Receiver
- C1: Capacitor Electrolytic 10µF (50V)
- C2, C3: Capacitor Ceramic 100nF
- C4, C5: Capacitor Ceramic 22pF-39pF (in some cases values up to 220pF may be required)
- R1: Resistor 10 Ohm
- R2, R3, R4: Resistor 10kOhm
- R5, R6: Resistor 4700 Ohm (→ 5100 Ohm also possible)
- R7, R8: Resistor 330 Ohm
- D1: LED Red
- D2: LED Green
- T1: Terminal connector D-SUB DB9-Female

- IC Sockets: (optional) 2 DIP IC sockets 8 pins, for removable driver and receiver ICs



- Male connector: 5 male connector pins, for connecting Teensy to print board

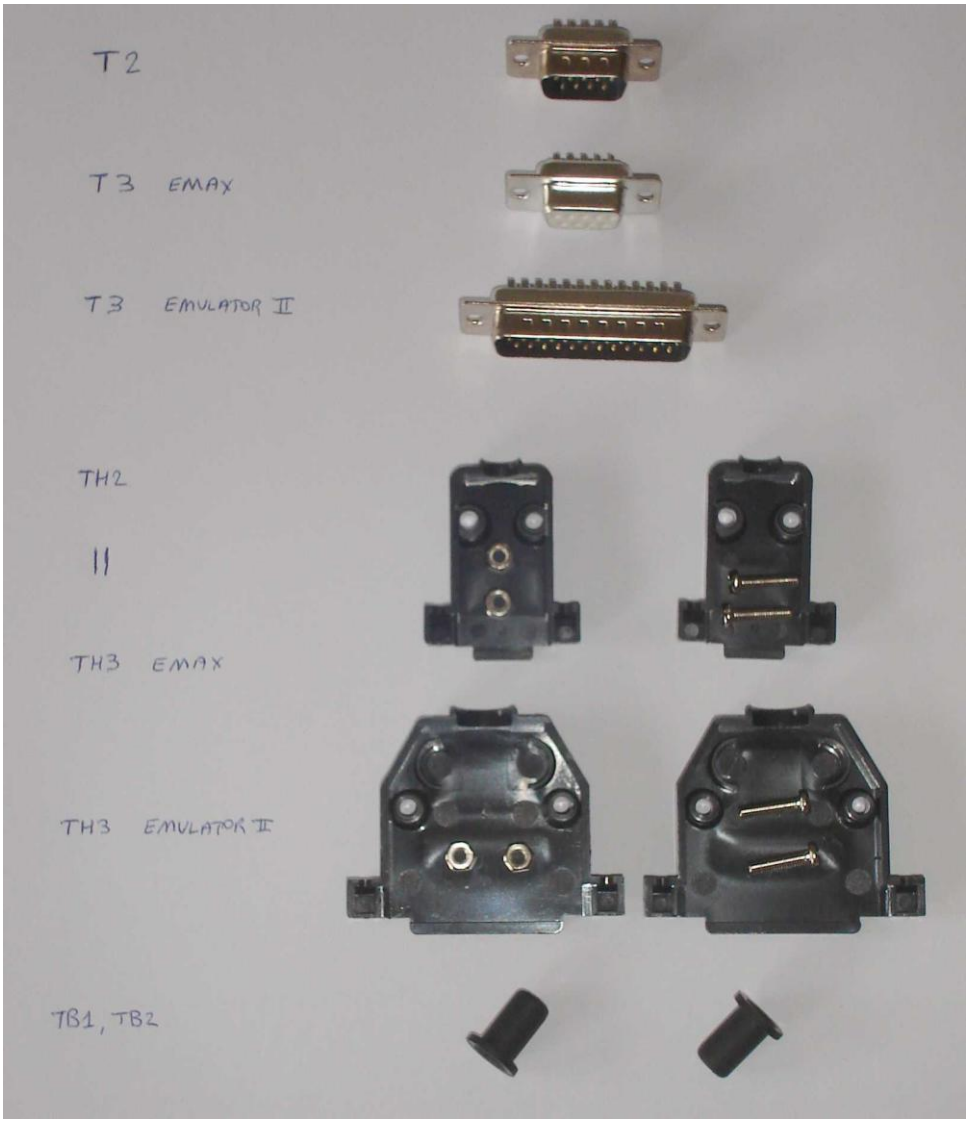


- Wires: some small wires for use on board; total length approx. 60 cm (24 inch).
  We used different colours (see later).

- Print board: 5.9 cm x 5.9 cm (2.3 inch x 2.3 inch) print board with copper **lanes** (!).
  Distance between soldering islands must be RM = 2.54 mm (0.1 inch).
  Diameter of holes must be 1 mm (0.0393 inch).
  Thickness of print board: 1.5 mm (0.0590 inch)
  Both cardboard and epoxy versions can be used.

Components for cables

- USB mini-B to standard-A cable for connecting the EMuSer to a computer
- Serial cable for connecting the EMuSer to an E-Mu sampler:
  - T2: Terminal connector D-SUB DB9-Male (EMuSer side)
  - T3: if Emax/Emax-II: Terminal connector D-SUB DB9-Female (Emax side)
    if Emulator-II: Terminal connector D-SUB DB25-Male (Emulator II side)
  - TH2: (Plastic) Cover/Shell for D-SUB DB9M connector
  - TH3: if Emax/Emax-II: (Plastic) Cover/Shell for D-SUB DB9F connector
    if Emulator-II: (Plastic) Cover/Shell for D-SUB DB25M connector
  - TB1, TB2: (optional) Cable boots for conducting the cable into the TH2/TH3 hoods.
  - Cable: 1m → 2m (40 → 80 inch) shielded cable containing 6→8 wires (we used 8)

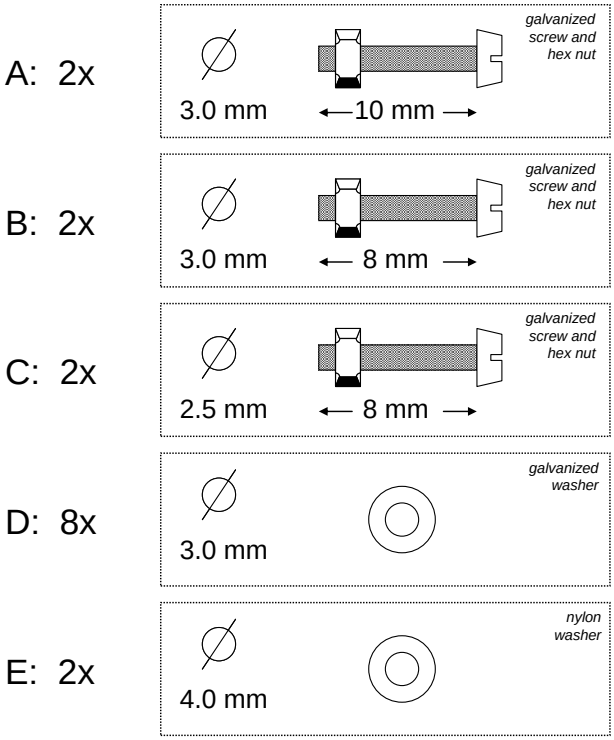


Mechanical components for EMuSer device

- Case: Hammond Manufacturing transparent blue ABS plastic case type 1593JTBU
  (size: 66mm x 66 mm x 28 mm = 2.6 inch x 2.6 inch x 1.1 inch)
  Make sure to use a transparent case in order to see the LEDs.

- D-SUB9 bracket: Mounting angle/Bracket for attaching the D-SUB 9F connector to the print board

- Screws & hex nuts:
  A: 2x screw+hex nut: galvanized steel, diameter 3.0 mm, length 10 mm (see picture)
  B: 2x screw+hex nut: galvanized steel, diameter 3.0 mm, length 8 mm (see picture)
  C: 2x screw+hex nut: galvanized steel, diameter 2.5 mm, length 8 mm (see picture)
- Washers:
  D: 8x washer: galvanized steel, diameter 3.0 mm (see picture)
  E: 2x washer: nylon, diameter 3.0 or 4.0 mm (see picture)



SCHEMAS

Schema for EMuSer device

The picture below shows the schema for the EMuSer. Although the schema is not drawn 100 pct in accordance with international standards, the design should be sufficiently clear.

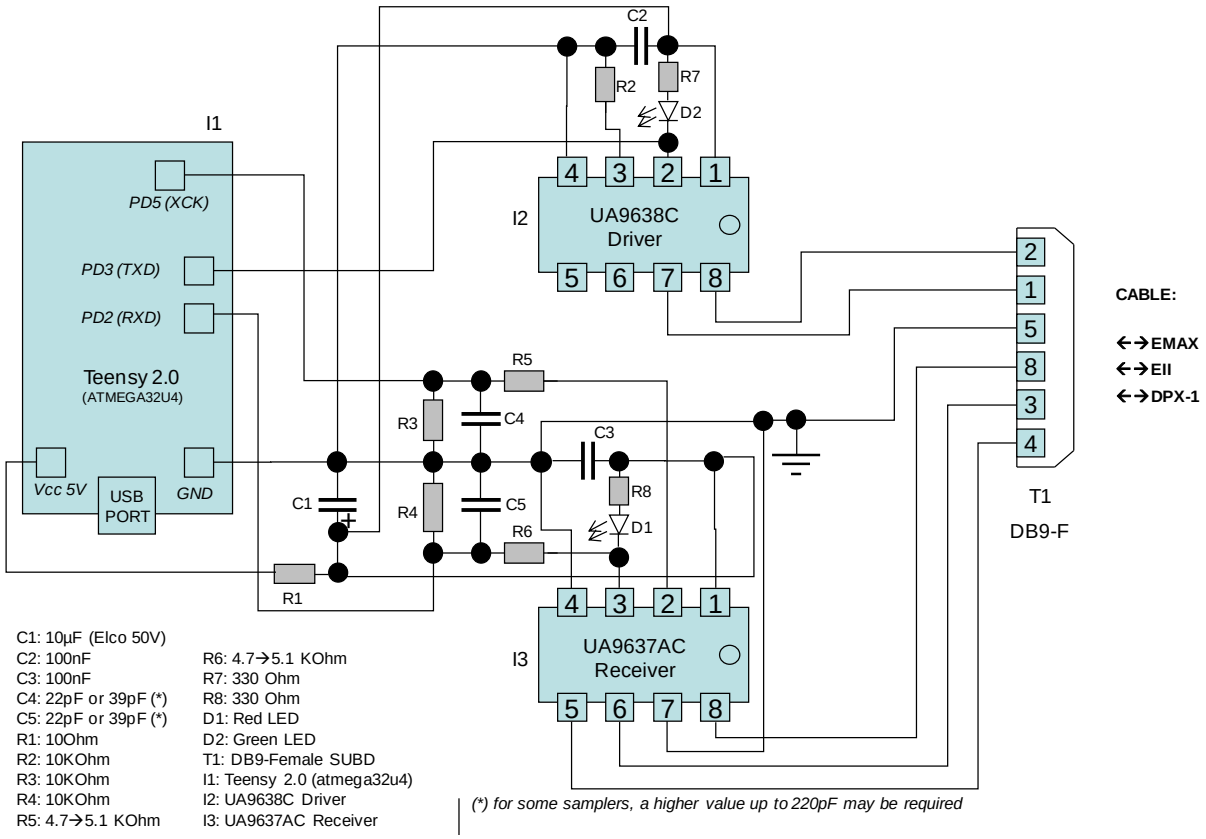
Convention:
If two lines cross each other through a fat "black bullet", the lines are **connected** to each other at this intersection point:

(3 lines are connected to each other)

If two lines cross each other without a fat "black bullet" in the intersection, the lines are **not connected** to each other.

(2 lines are not connected to each other)

E-MuSer v1.02.01B USB ←→ RS422 Interface for Emu Samplers



C1: 10µF (Elco 50V)
C2: 100nF
C3: 100nF
C4: 22pF or 39pF (*)
C5: 22pF or 39pF (*)
R1: 10Ohm
R2: 10KOhm
R3: 10KOhm
R4: 10KOhm
R5: 4.7→5.1 KOhm
R6: 4.7→5.1 KOhm
R7: 330 Ohm
R8: 330 Ohm
D1: Red LED
D2: Green LED
T1: DB9-Female SUBD
I1: Teensy 2.0 (atmega32u4)
I2: UA9638C Driver
I3: UA9637AC Receiver

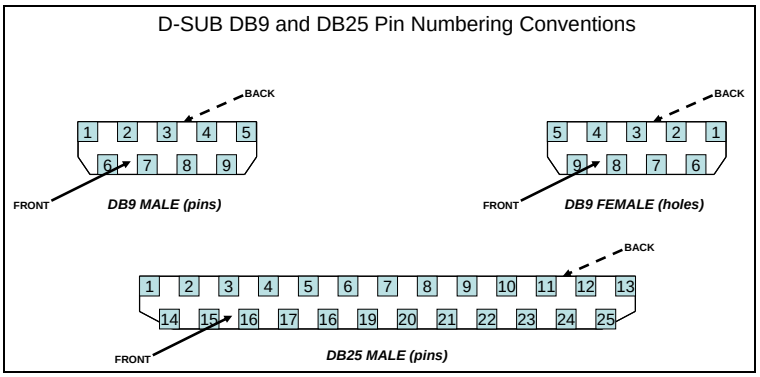
(*) for some samplers, a higher value up to 220pF may be required

Schemas for Serial Cables

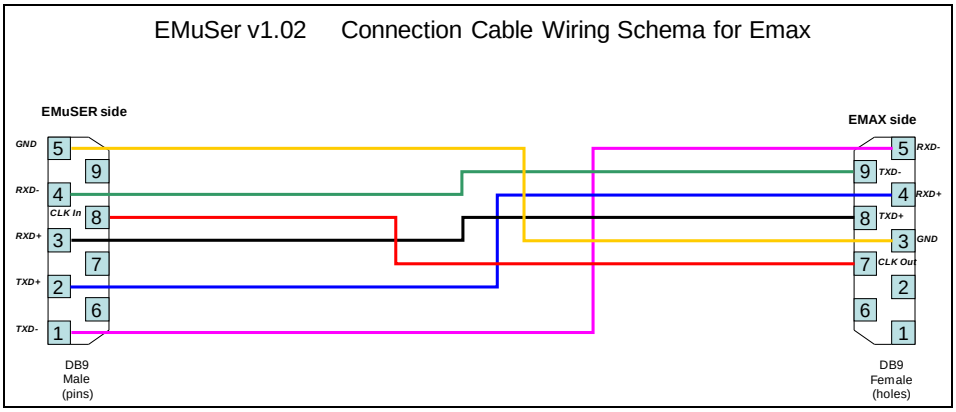
The pictures below show the schemas for the serial cables between the EMuSer and the Emax, Emulator II or Oberheim DPX-1

Convention:

- See “Schemas for EMuSer Device”
- The pin numbering follows the international standards, as depicted below:

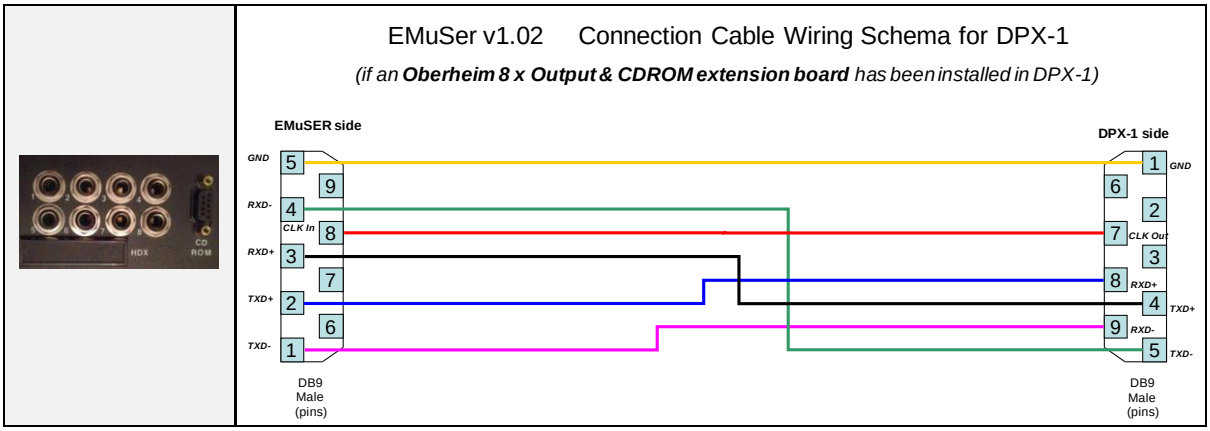


Cable configuration for Emax/Emax-II:



Cable configuration for Oberheim DPX-1:

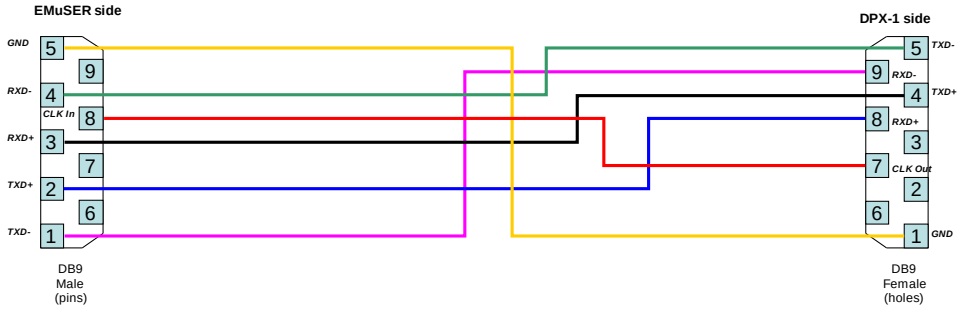
The connector type (DB9M or DB9F) of the cable's connector at the DPX-1 side depends on the type of CDROM interface board installed in the DPX-1 !



Note: since both ends of this cable have the same physical connector (male DB9) but with a different pin assignment, it's strongly recommended to label the left connector with "EMuSer" and the right connector with "DPX-1". If the cable would be reversed, the communication will not work and the EMuSer or DPX-1 could be damaged.

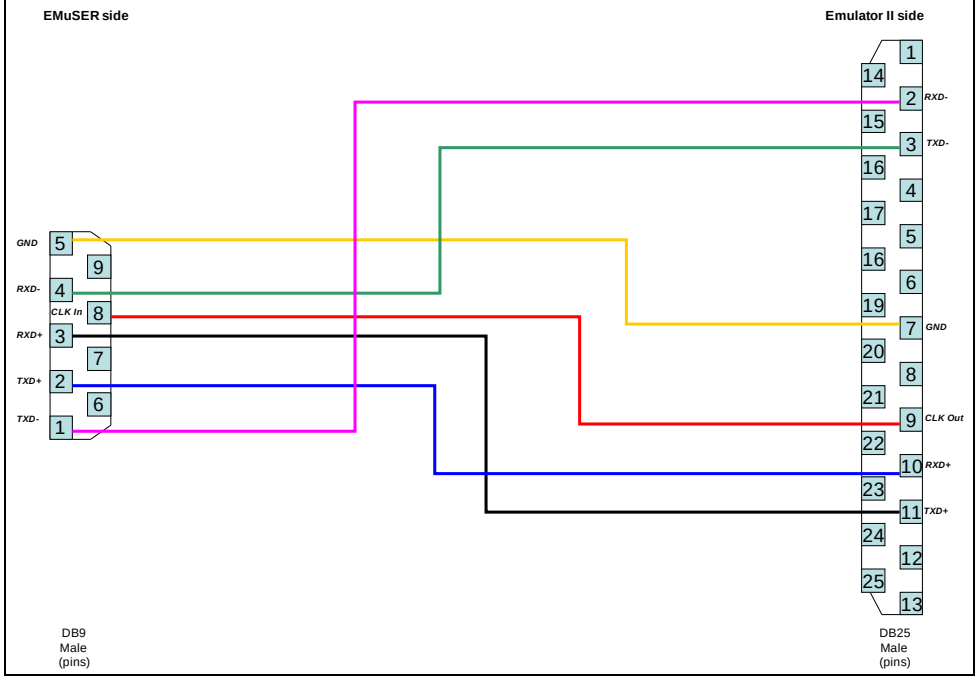
EMuSer v1.02 Connection Cable Wiring Schema for DPX-1

*(if an **OMI CDS3 to DPX1 interface board** has been installed in DPX-1)*



Cable configuration for Emulator-II:

EMuSer v1.02 Connection Cable Wiring Schema for Emulator II

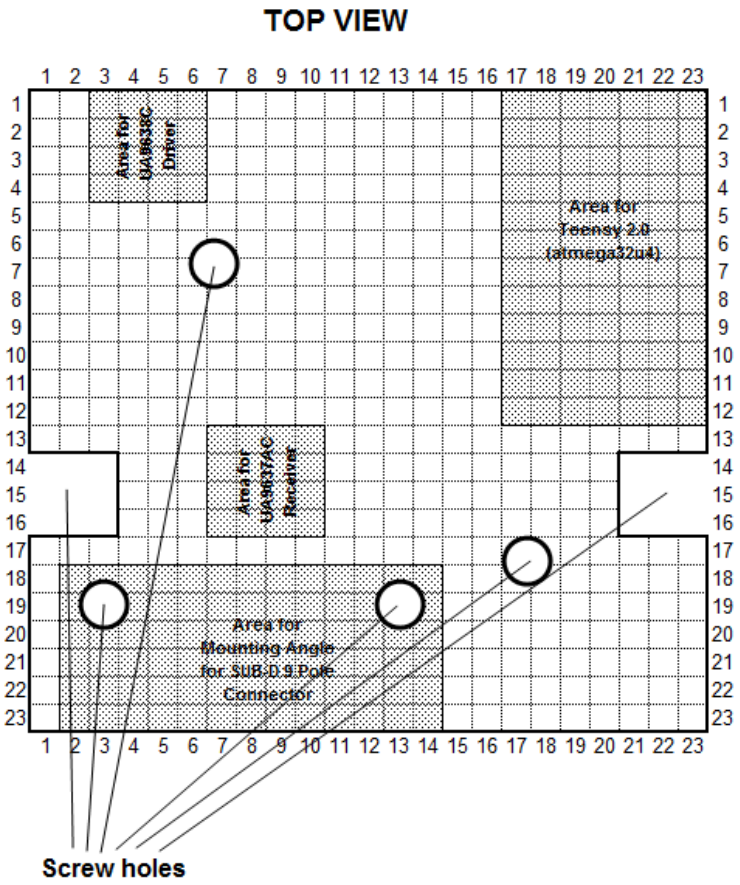


CONSTRUCTION

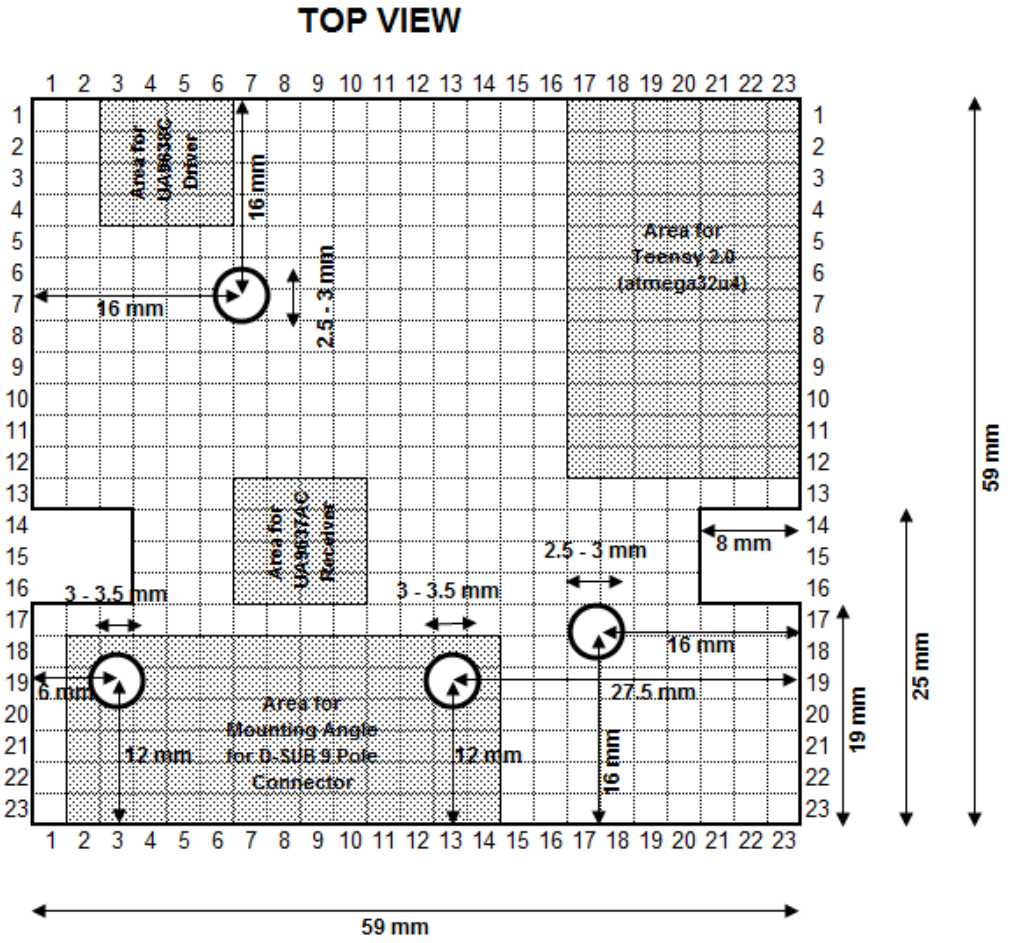
This chapter explains how to build the EMuSer device step-by-step.
Every step is illustrated with pictures and drawings.

STEP 1: Prepare the print board

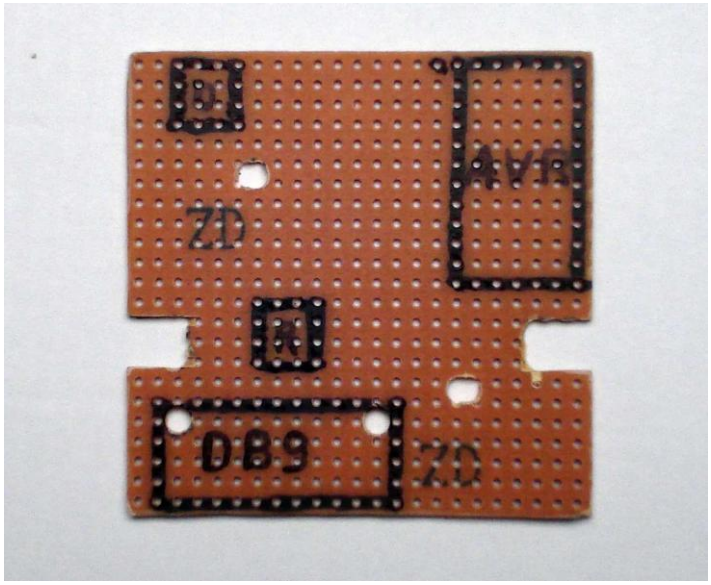
- Create a small print board with copper lanes sized 59mm x 59mm (you can use a Multitool or a small saw to cut this small board from a standard commercial print board of e.g. 100mm x 160mm)
- **Hint:** make sure the 59mm x 59mm size is as accurate as possible:
  - If it's bigger, it will not fit into the case which has an internal size of 60mm x 60mm
  - If it's smaller, it will be sitting too loose in the case; its fixation would have to rely completely on two small screws which could result in damage after plugging in and out cables many times
  - The 59mm x 59mm size results in a print board of 23 x 23 solder islands/holes.
- Make sure the orientation of the print board is correct, before starting drilling and milling the print board. Following conventions are used throughout this document:
  - The top view is the side of the print board without copper (only cardboard or epoxy)
  - The bottom view is the side of the print board holding the copper lanes
  - In all pictures in this document, the copper lanes go from left to right, i.e. they are horizontally oriented (both in top view and bottom view pictures)
  - The numbering index surrounding the printboard drawings corresponds to the solder islands/holes in the printboard.
- Remove two small parts of the print board on the left and right side to make room for the screw holders of the case
- Make 4 additional holes for the screws which will (1) fasten the print board to the case and (2) fasten the DB9 terminal bracket to the print board.



- All metrics and distances can be found in the following drawing:

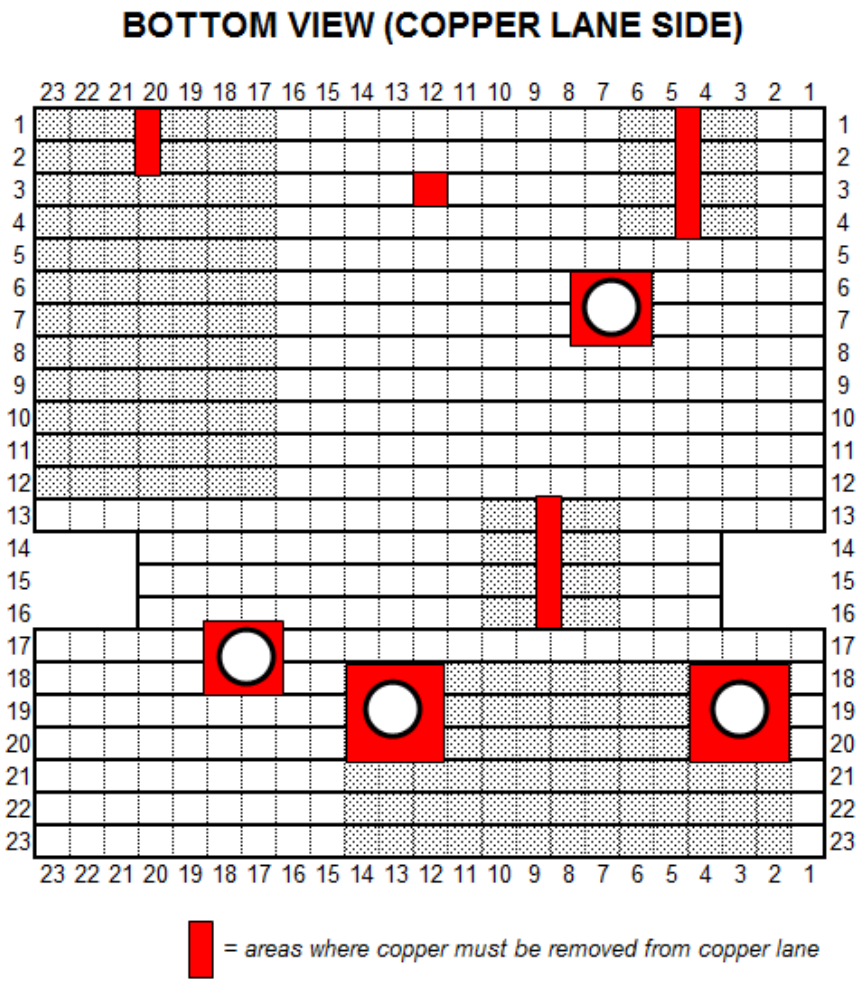


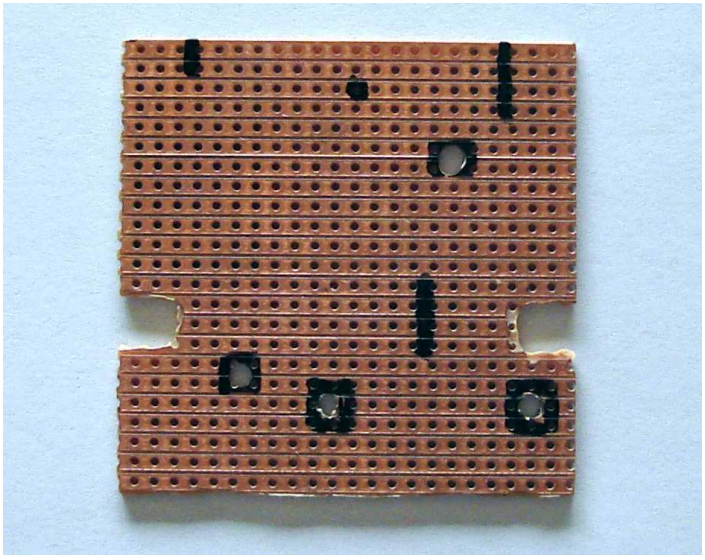
Following picture shows the top of the print board, on which the future position of some components is already marked:



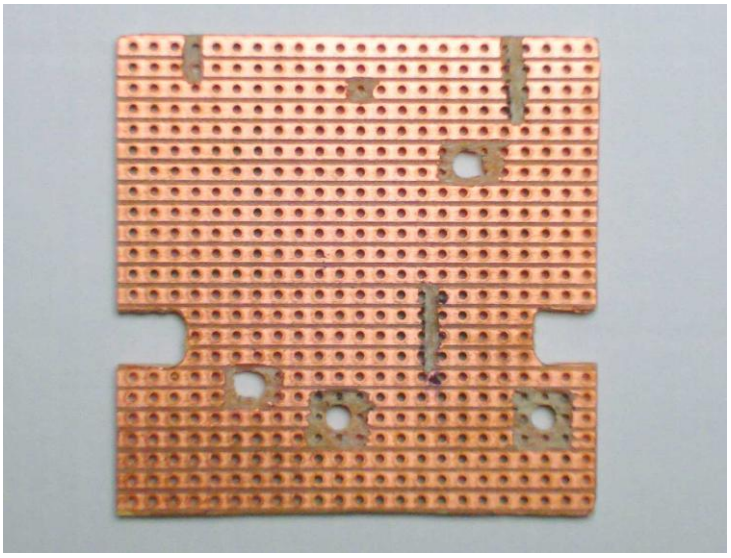
Hint: Before continuing, it's a good idea to check now if the print board fits precisely in the case. Because once you start soldering components on it, it will be difficult to re-shape the print board…

- In order to prevent shortcuts, some of the copper must be removed; you can use a Multitool or a sharp knive to cut away the copper. The following picture and photos show which parts of the copper must be removed:





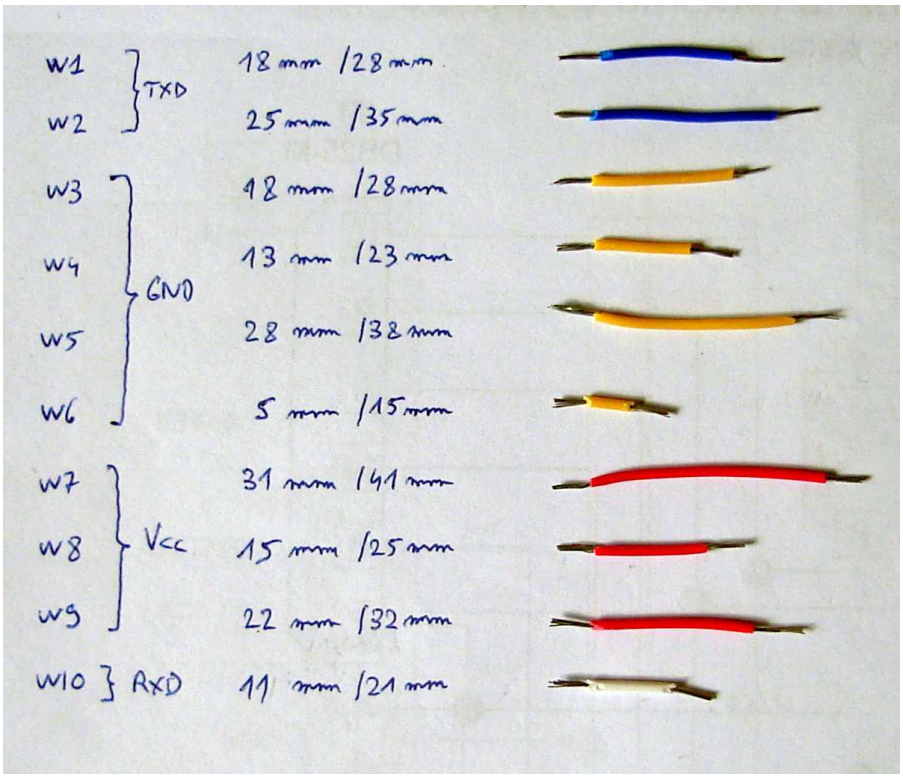
The following picture shows the bottom view after the removal of the copper:



- **Hint:** Use a multi meter (resistor meter) to check if the cupper lanes on both sides of each “cut” are 100 pct isolated from each other.

STEP 2: Solder the wires to the print board

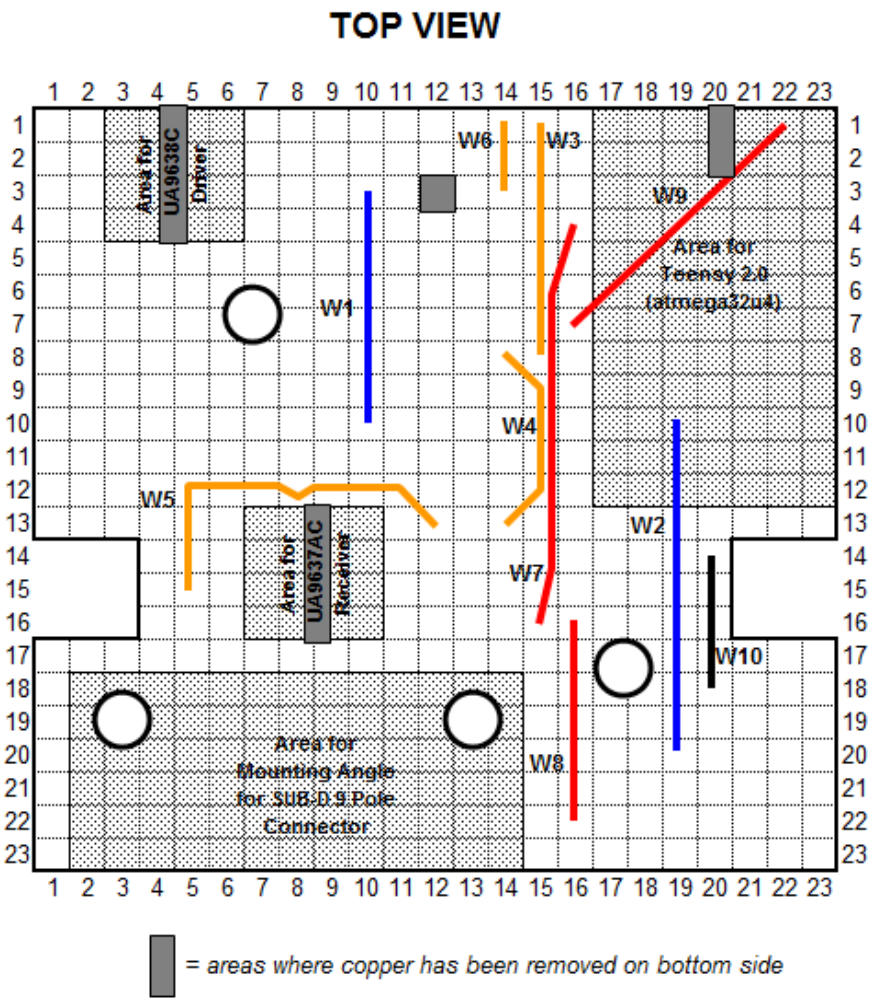
- The copper lanes on the print board are not sufficient to assure all connections between the EMuSer’s components. Some additional connections must be added. This is accomplished by soldering 10 small wires on the board.
- Here’s an index of all wires you need. Four different colours are being used, depending on the objective of the connection (GND=ground, VCC=5Volts power supply, TXD=transmit data, RXD=receive data):



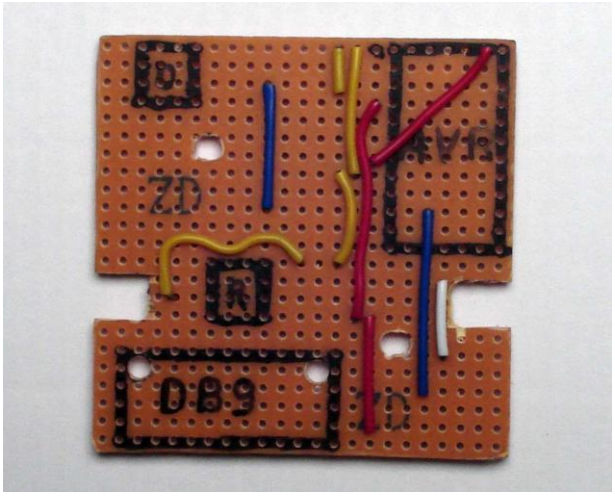
The distances mentioned in the index picture must be interpreted as follows:

18mm/28mm means: the total length of the wire is 28mm, of which 18mm is still shielded; the other 10 mm (2 times 5mm on each end) are blank for soldering purposes.

- The following drawing shows where the wires W1 → W10 from the index should be soldered – note that this is the top view. The actual soldering of the wire's endpoints must of course be done on the bottom side of the print board.

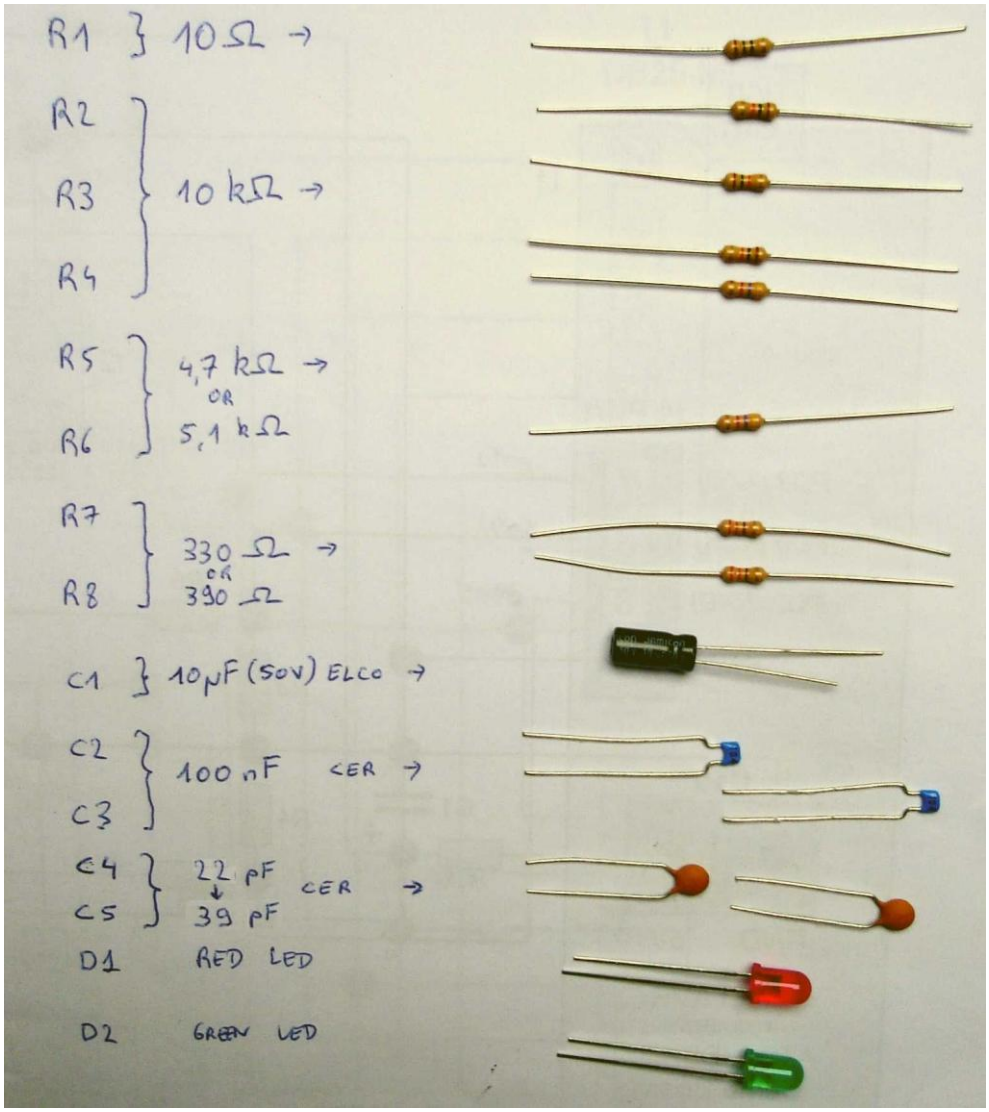


- The result can be found in the following picture:

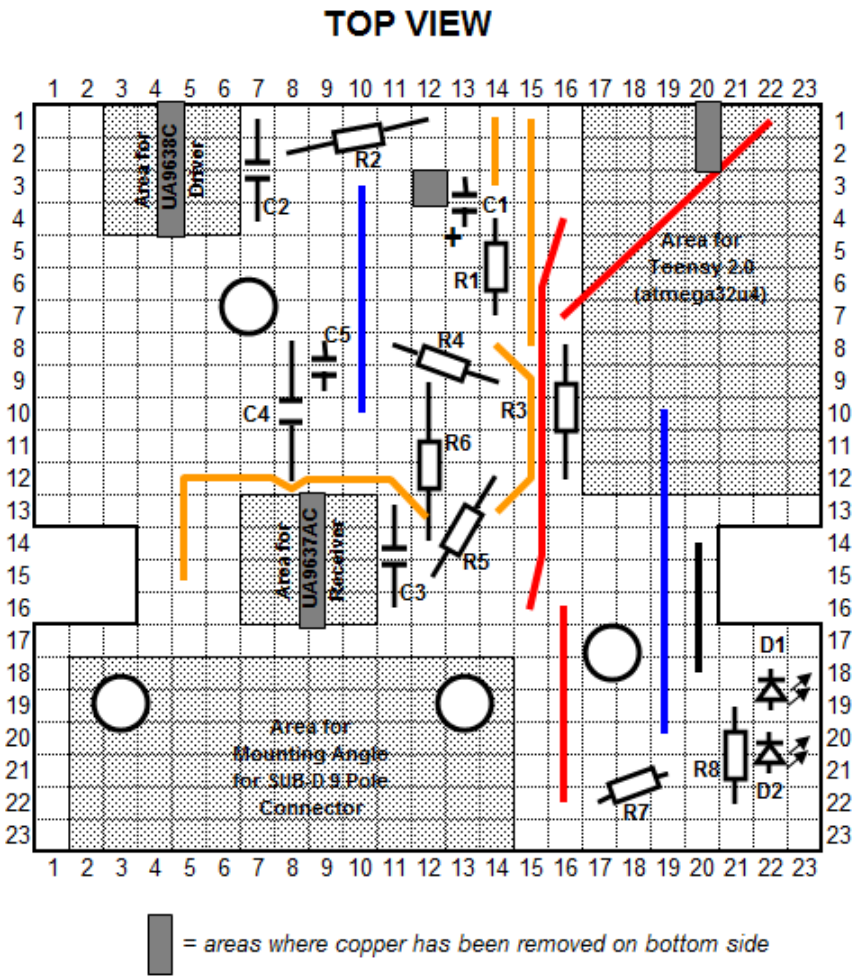


STEP 3: Solder the passive components on the print board

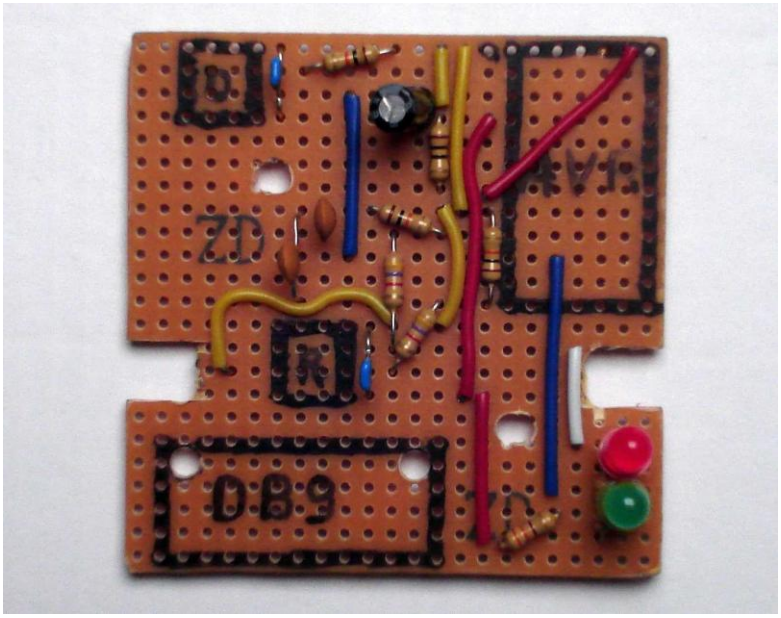
- Now it's time to add the passive components to the print board: i.e. resistors, capacitors and LEDs
- Here's an index of the required passive components. Their index reference is the same as in the schemas in the previous chapter.



- **Note:** capacitors C4 and C5 are very important for the stability and reliability of the serial communication with some Emulator-IIs. Especially Rev1 CPU boards require the presence of these capacitors, and even then a proper choice of their value is important. A value of 39 pF (or 22 pF) can be used as a default value, but in case of failing communication it may be necessary to replace them by capacitors with a higher value (up to 220pF).
- **Hint:** make sure that the polarity of the elco and LEDs is correct:
  - The negative pin of the elco capacitor is typically indicated by a chain of minus-signs ('-') on a light grey background on the capacitor. This pin should be soldered on position Row3/Column13 on the print board (the positive pin is soldered on Row4/Column13)
  - The negative pin of a LED is typically indicated by the shortest leg/pin of the LED, called cathode. For LED D1, this pin should be soldered on position Row18/Column22. For LED D2, this pin should be soldered on position Row20/Column22.
- The following drawing indicates where to the components should be attached to the print board (top view); the soldering is of course done on the other side of the print board (bottom side).



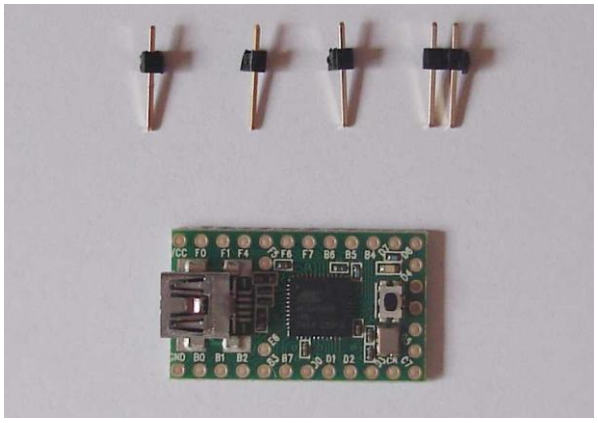
- The result can be found in following picture:



- **Hint:** it's time again to inspect the board for unwanted shortcuts and bad connections ! Use a multi meter for this.

STEP 4: Solder the Teensy and IC sockets on the print board

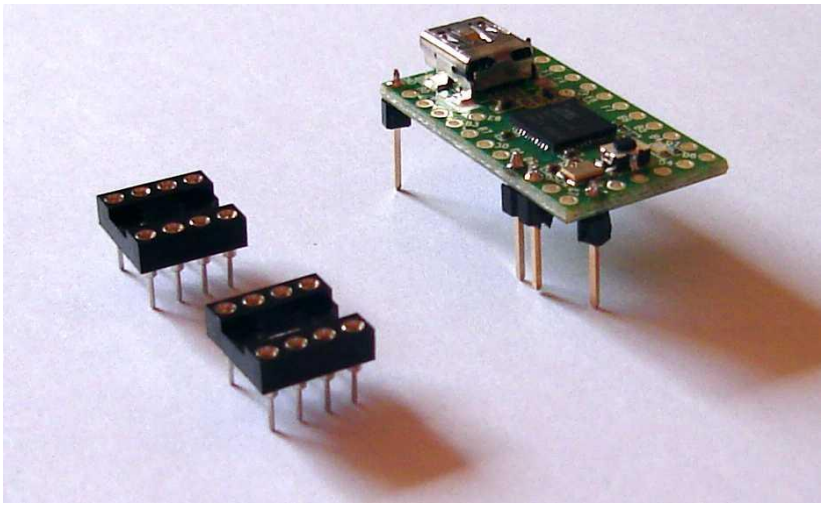
- The Teensy 2.0 board can now be installed on the print board. However, since the Teensy board has no pins yet, we first have to solder 5 “male connector” pins to the 5 endpoints of the Teensy which are being used by the EMuSer. These 5 pins are:
    - GND
    - VCC = +5V
    - PD2 = RXD1 = endpoint 7
    - PD3 = TXD1 = endpoint 8
    - PD5 = XCK1 = endpoint 23



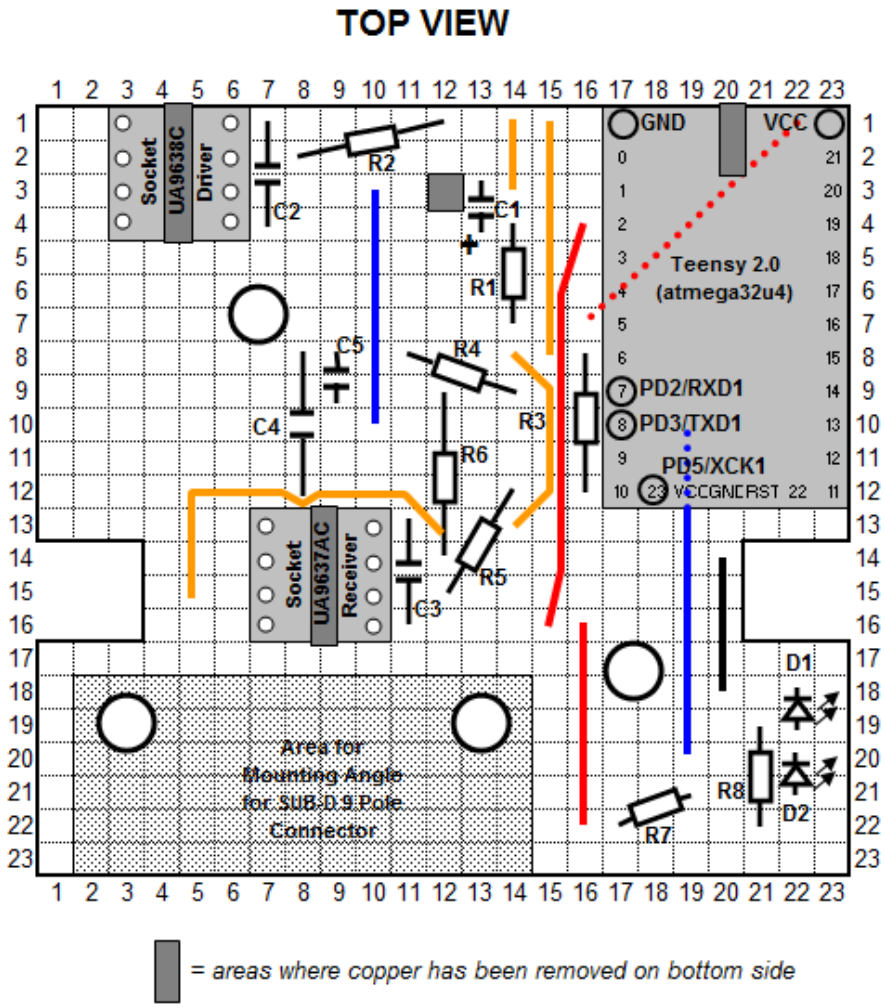
Hint: you can keep two of the male pins connected to each other (for PD2 and PD3, as shown in the upper right corner of the picture) – the male pins used here are typically sold as a series of 36 pins connected to each other…

Soldering the pins to the Teensy is simple but be aware that the soldering islands are pretty small so don’t use too much tin solder and don’t heat the Teensy too long. The soldering is – of course – performed at the top side of the Teensy board.

- If you don’t want to solder the two serial ICs (driver and receives) directly on the print board, you can solder 2 optional 8-pin DIP IC sockets to the board now. These sockets will hold the driver and receiver ICs. Here’s a picture of the Teensy with its 5 pins and the two IC sockets:

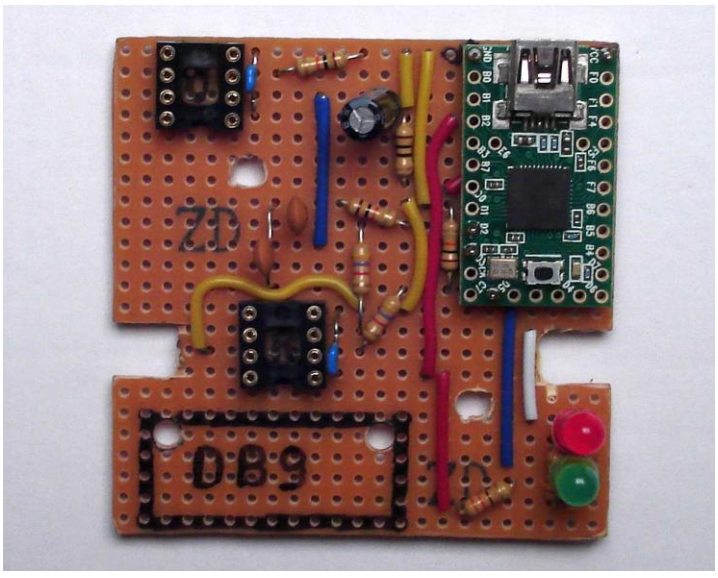


- The following drawing shows the print board with the Teensy and IC sockets depicted on it:



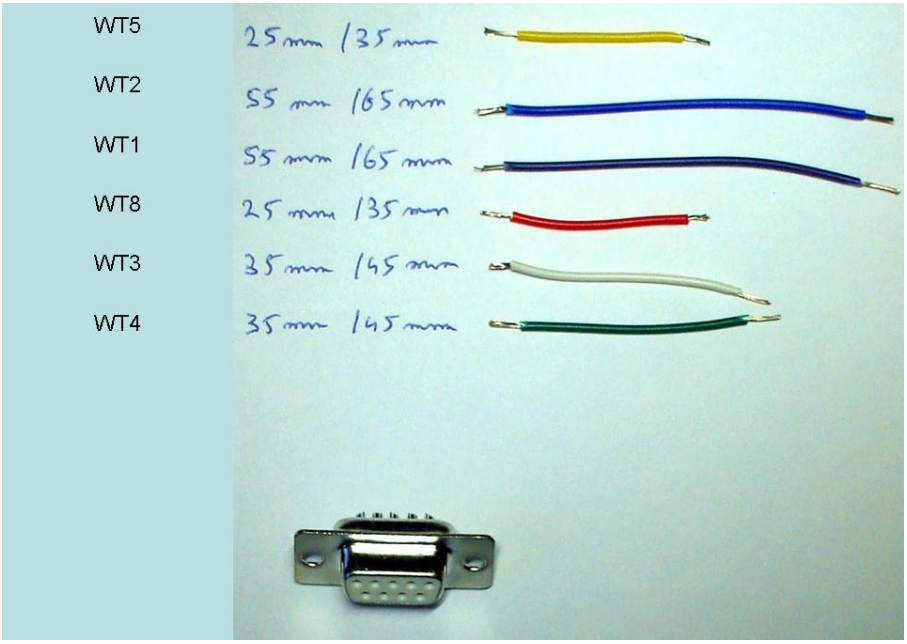
Hint: if the IC sockets have a notch (indicating pin 1 of the IC), you should install the socket with the notch at the bottom, i.e. on Row4 for the driver IC and on Row16 for the receiver IC.

- The result can be found in following picture:

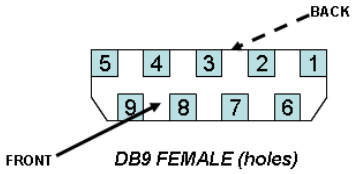


STEP 5: Install the D-SUB 9F connector on the print board

- Let's prepare now the DB9F connector so that it is ready to be installed on the print board. 6 wires must be soldered to the DB9F terminal connector. Here's an index of the wires and their sizes:

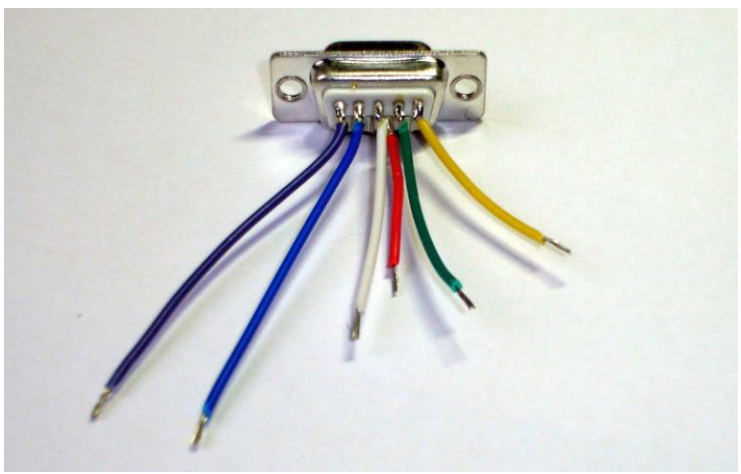


In the index number of each wire (WTx) the x refers to the DB9F pin number to which the wire should be soldered. Here's the convention for the pin numbering on D-SUB connectors:

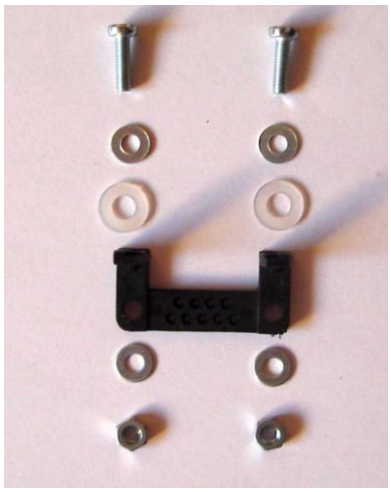


Note that the pin numbers are typically also mentioned on the connector itself; also take into account that the backside pin numbering (where the wires must be soldered) is the mirror (opposite) of the frontside pin numbering. The pin assignments chosen for the EMuSer is compliant with the generally accepted RS422 pin assignment (pins 1 → 5), which makes the EMuSer also suitable as a normal RS422 adapter.

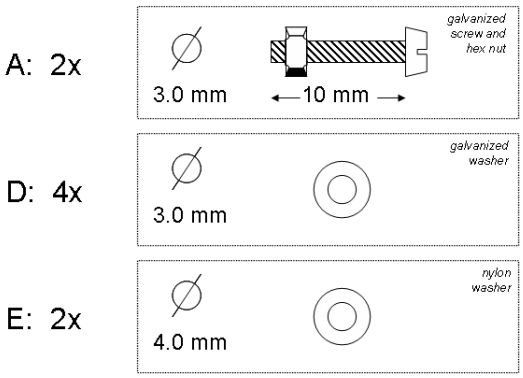
- The result can be found in the following picture:



- The DB9F connector will be installed on the print board by using a “mounting angle” or “bracket”. The following pictures show which screws, hex nuts and washers can be used to fasten the bracket on the print board:

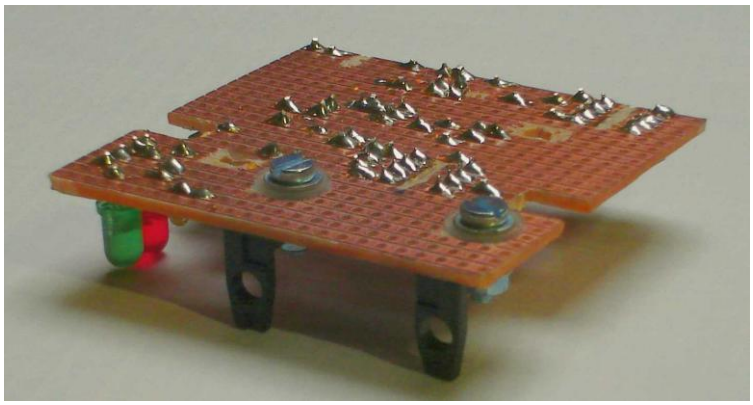


The screws, washers, bracket and hex nuts as shown from top to bottom in the above picture are in the order in which they should be used on the print board from bottom side to top side.

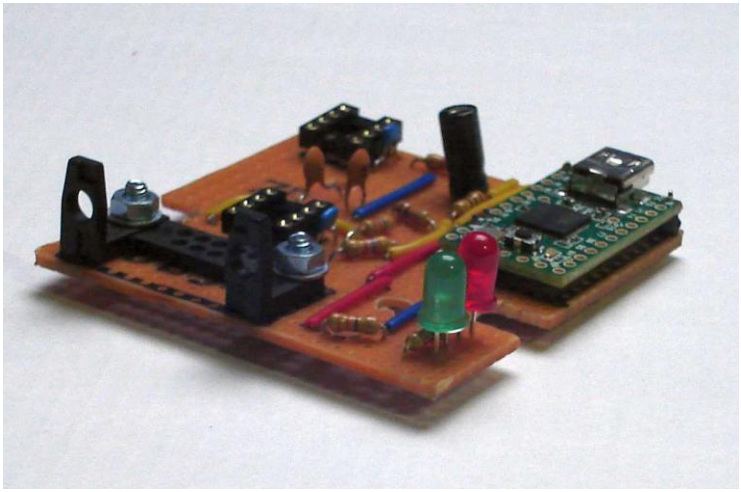


Hints:

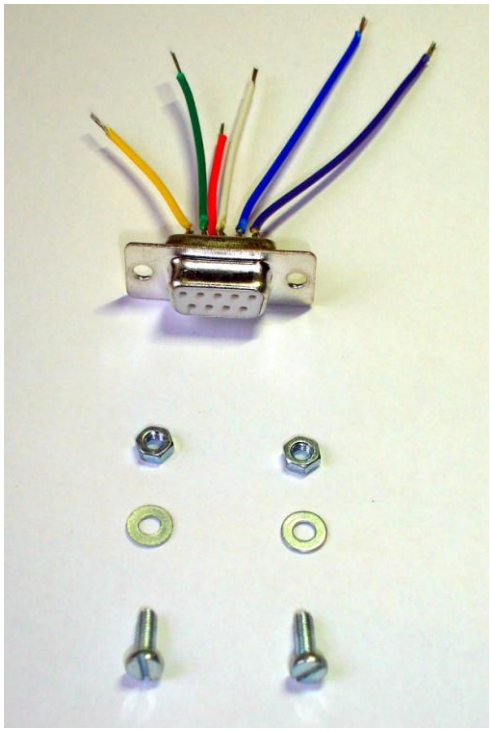
- Install the screws from bottom side to top side; if they would ever get loose, the screws are too large to be able to float around in the case’s small area beneath the print board; this can be a precaution measure to prevent shortcuts.
- The nylon washers are used between the steel washer and the bottom side of the print board, again as an additional precaution measure to prevent shortcuts. See picture below.

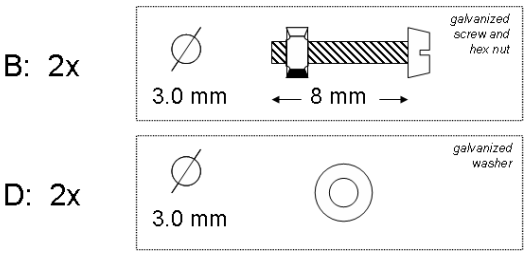


- The result can be found in the following picture:

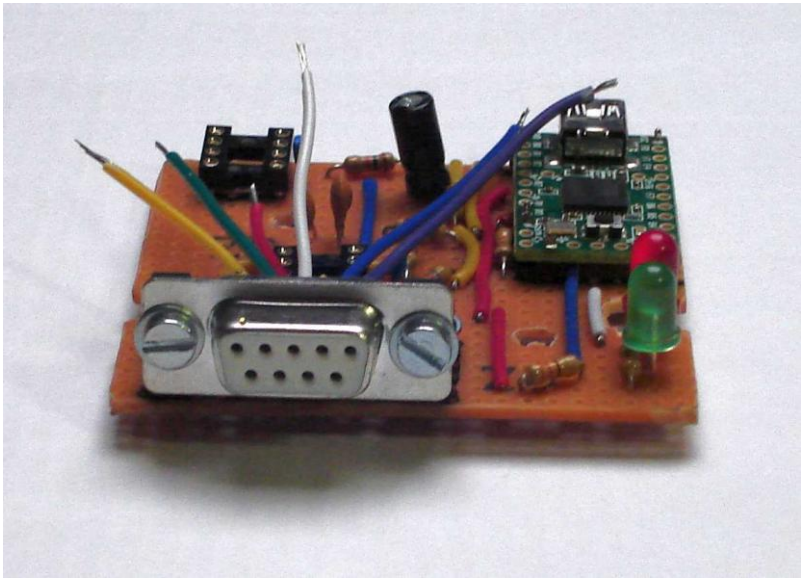


- Finally the DB9F connector with its wires must be installed on the print board. First fasten the terminal to the mounting bracket using following screws, hex nuts and washers:

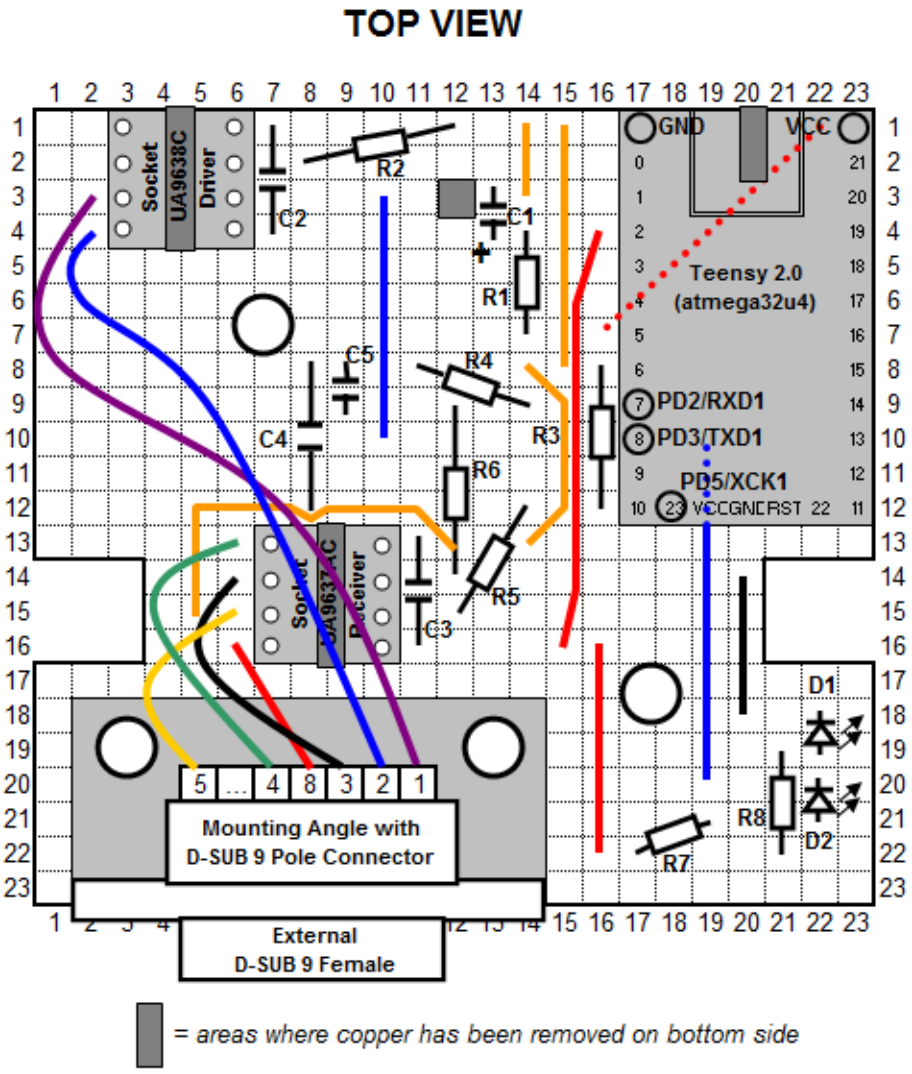




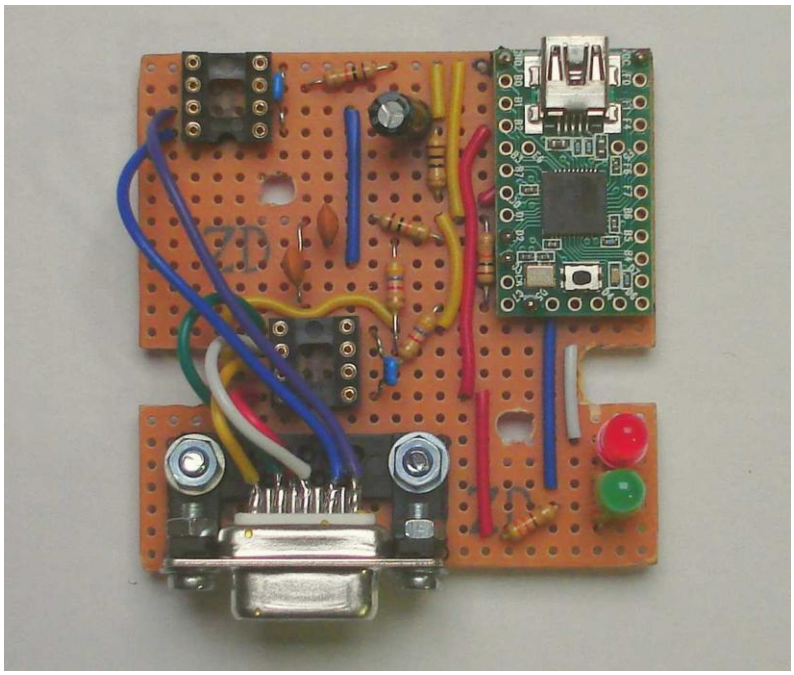
The result looks like this:



- Then solder the 6 wires to the print board as shown in the next drawing:

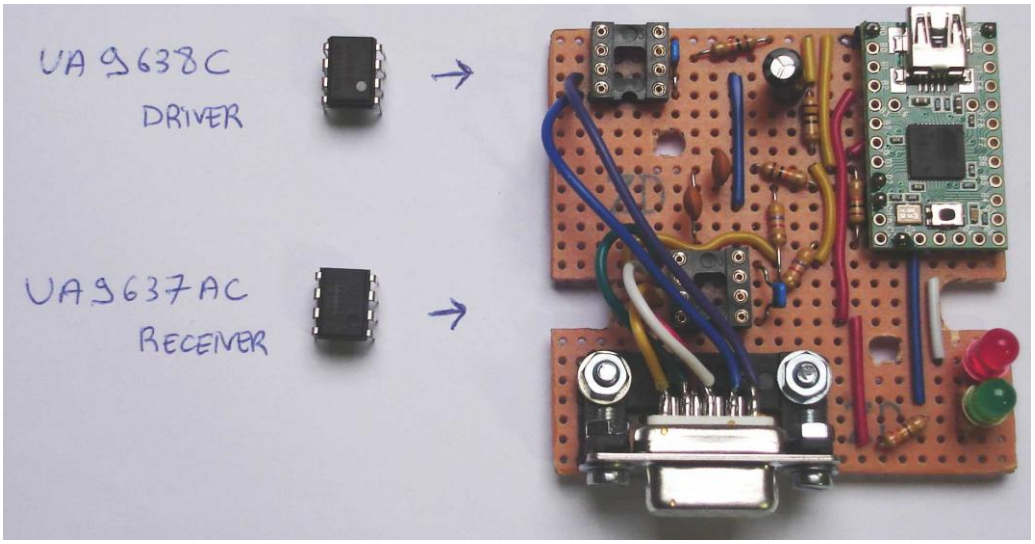


- The result can be found in following picture:



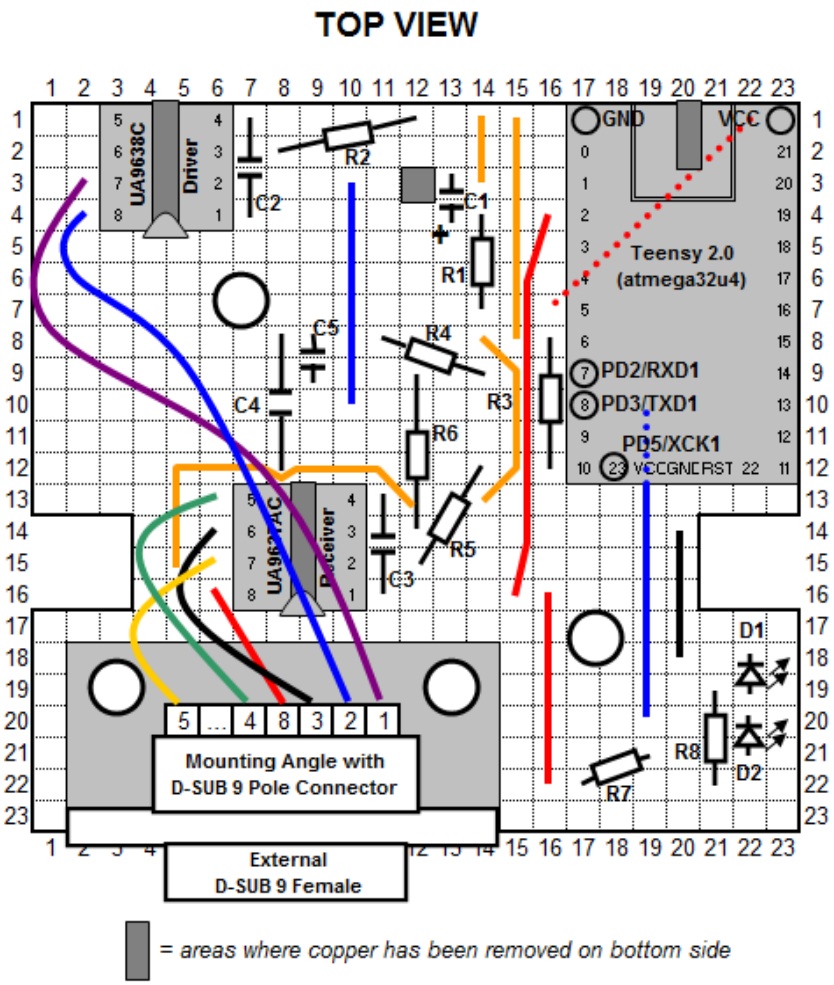
STEP 6: Install the two ICs into their sockets

- If you have chosen to solder two IC sockets in step 4, you can now plug the UA9638C Driver IC and the UA9637AC Receiver IC into their sockets.

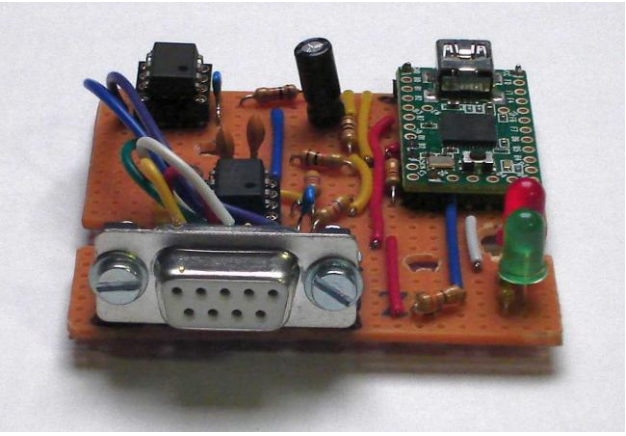


Hint: Make sure that the ICs are installed in the right direction: pin 1 must be at the bottom right side for both ICs (see drawing). In order to identify pin 1 on the ICs, there should be an indicator on the IC:

- Either a notch at one side, which indicates the side of pins 1 and 8 (not in our picture)
- Or a small circle on the top of the IC in the corner of pin 1 (as can be seen in the picture above)



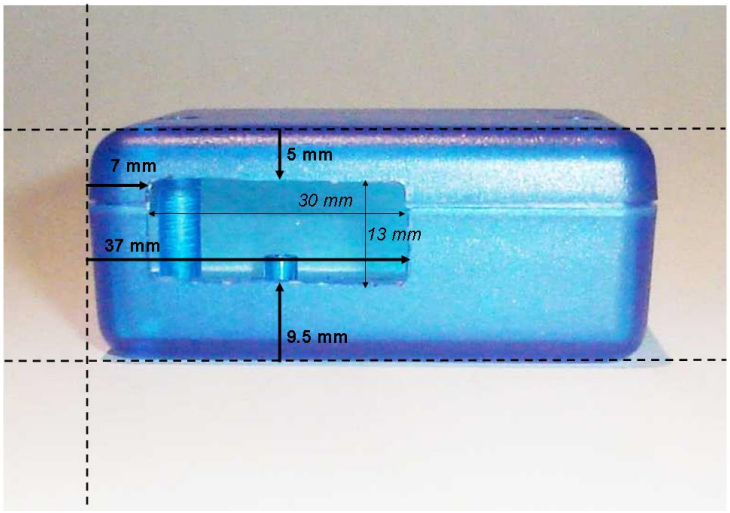
- If you have chosen to solder the ICs directly on the print board, it's time now to do it.
- The result can be found in the following picture:

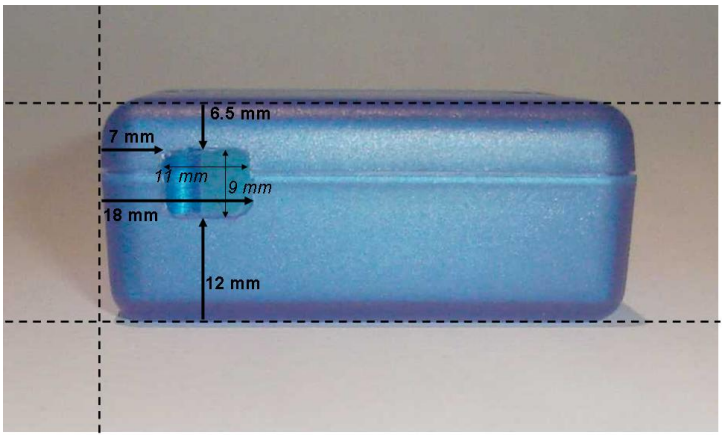


STEP 7: Prepare the case / case

- The 66mm x 66mm x 28 mm transparent blue case must be prepared for holding the EMuSer board. Two holes must be created for:
  - The DB9F connector
  - The mini-B USB connector

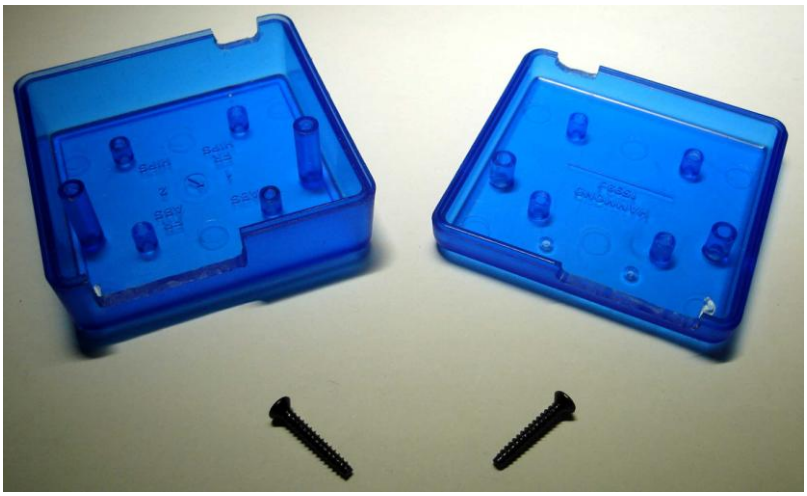
- The following picture shows the sizes of the holes to be created. Use a Multitool to remove the plastic from the case.





Hint: make sure to create the holes in the correct sides of the case: use the main screw holes of the case as a reference ! They should both be at the side of the DB9F terminal connector.

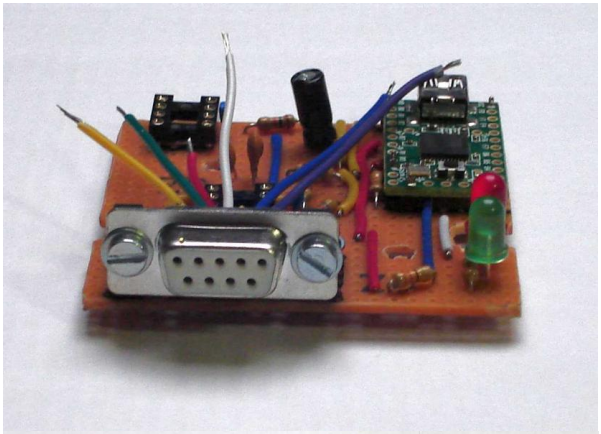
- The result can be found in the following picture:

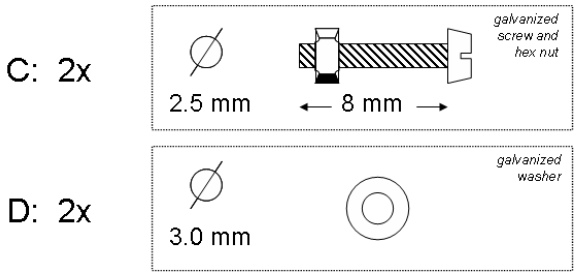


STEP 8: Install the print board in the case

- The print board should fit pretty well (but 'tight') in the case; since there's almost no margin taken into account between the print board size and the available room in the case, the print board will not suffer from getting loose when (un)plugging cables on a regular basis.

- In addition we will attach the print board to the case using two small screws and washers. The smallest length of screw we could find was 8mm which is too long for the available holes in the case. To resolve this we use two hex nuts to "shorten" the depth of the screw into the holes.



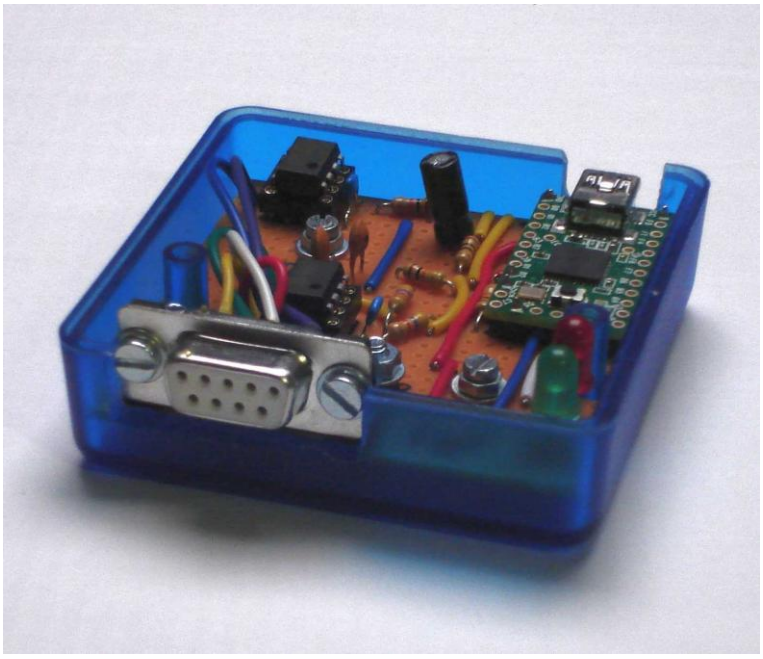


Hint: before installing the print board into the case, it might be a good idea to fix a small isolating (plastic) coating to the bottom side of the print board, as a precaution measure to avoid corrosion and short cuts; remember: the bottom side is full of "blank" conductive copper ! This coating can easily be fixed by using a special "plastic" spray.

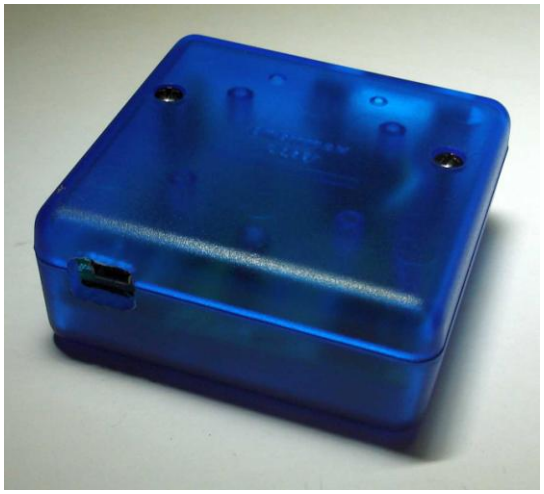
Hint: don't screw/unscrew the print board too often on/from the case: the available holes in the case are not really meant for holding screws and are quickly 'worn out'. If that's the case, you can always fasten the board to the case with some glue.

Hint: it's a good idea to cover the metallic parts of the two screws, nuts and washers on the top side of the print board with an isolating layer, e.g. with some silicone fixation product (not shown in our pictures)

- The result can be found in the following picture:



- Close the case with the two screws provided in the original enclosure package (OK… perhaps wait with that until you have installed the firmware – see next chapter ☺).



STEP 9: Build the serial cable

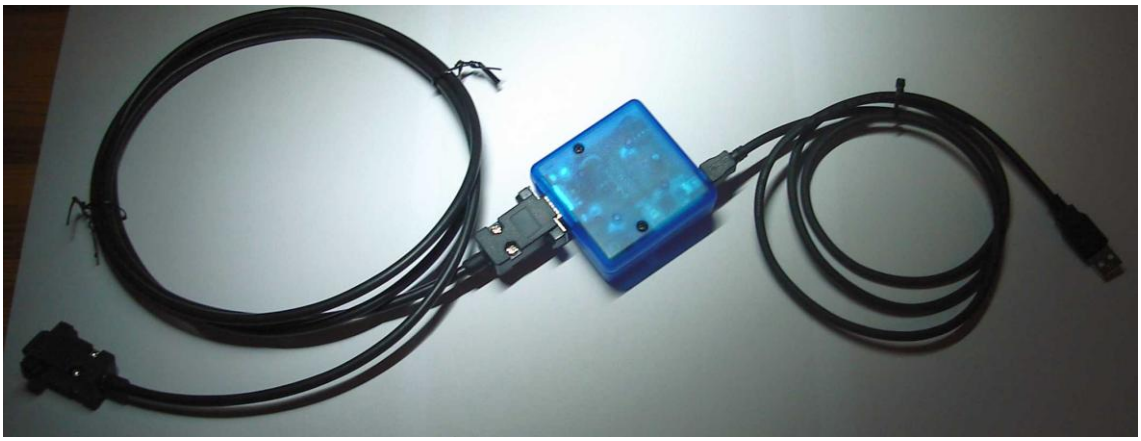
- Depending on the E-Mu sampler you will use with the EMuSer, you will have to create a cable with:
  - Either a D-SUB DB9F connector, if you're using an Emax/Emax-II
  - Or a D-SUB DB9M connector, if you're using an Oberheim DPX-1
  - Or a D-SUB DB25M connector, if you're using an Emulator-II

  The other side of the cable should connect to the EMuSer and requires (in both cases) a D-SUB DB9M connector.

- The cable should contain at least 6 wires and they should be shielded; the length of the cable should not exceed 3 meters, but we recommend 1 → 2 meters. We used 2 meter 8-wire cables, of which two wires are not used.

- The detailed configuration schemas for the cables can be found in chapter “SCHEMAS”.

- The result can be found in the following picture. The picture shows the EMuSer with a USB cable and an Emax cable:



INSTALLING THE FIRMWARE

The EMuSer needs specific firmware for use with the E-Mu Emax I, Emax II, Emulator II and Oberheim DPX-1. This firmware is provided with the EMuSer in a file called **USBtoSerialEmu_Teensy2_0_v1_02_1.hex.** (there are also firmware versions available for EMuSer variants based on the AT90UBSKEY (EmuComBox) or the Teensy++2.0 boards)

Newer versions of the firmware may be available on the EMuSer web page. Please check www.emxp.net for updates of the firmware.

In order to install this firmware on the EMuSer, you need software which can transfer software to the Teensy 2.0 board. This software is called **Teensy Loader**.

Downloading and installing Teensy Loader

Teensy Loader can be downloaded from the PJRC website http://www.pjrc.com.
At the time of writing the following URL provides a direct link to the Teensy Loader download page:
http://www.pjrc.com/teensy/loader.html

Teensy Loader must not be installed. The software can be started immediately by running (double-clicking…) the Teensy.exe program file in Windows or by double-clicking the Teensy application in the downloaded DMG file on Mac OS X[2].

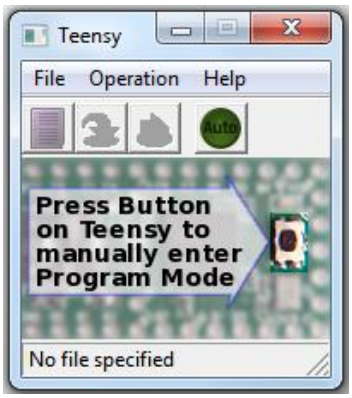
Installing the Teensy Loader / HalfKay driver

The Teensy board and Teensy Loader software use the HalfKay bootloader and protocol to update the firmware of the Teensy.
HalfKay is supported out-of-the box by Windows and Mac OS X.
So no drivers must be installed.

Installing the EMuSer firmware with Teeny Loader

Teensy Loader is ready now for uploading the EMuSer firmware to the Teensy board.
To install the firmware, follow next steps:

Step 1: Start Teensy Loader by starting (double clicking) the Teensy.exe file (Windows) or Teensy application in the DMG file (Mac OS X). The operating system will ask your for a confirmation. After confirmation the Teensy Loader window will appear:



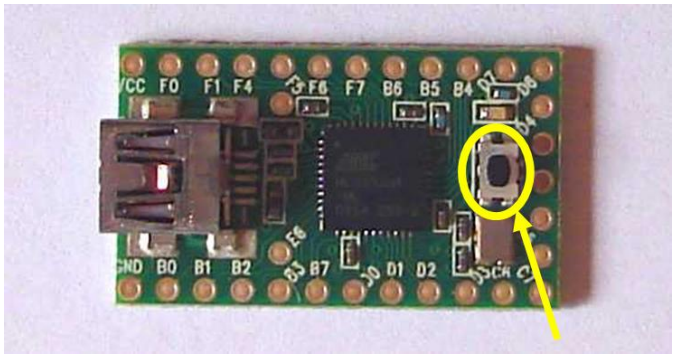
Windows

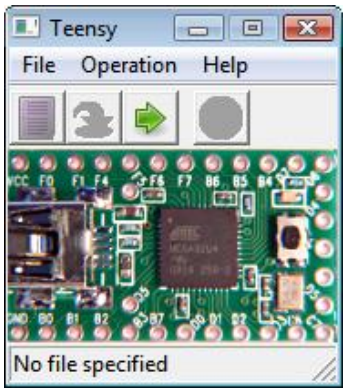
Mac OS X

[2] or macOS - in this manual we refer to the Apple Mac operating system as "Mac OS X"

Step 2: Connect the EMuSer device to your computer with a mini-B USB ←→ type A USB cable. If the Teensy board inside your EMuSer has been used for other (non-EMuSer) purposes before, there may be already some firmware installed into the Teensy. When using Windows, Windows *might* detect this and inform you that "a new hardware device" has been connected. If this is the case, just cancel any attempt of Windows to install the drivers for that "unknown" firmware.

Step 3: Press the small button on the Teensy Board inside the EMuSer (see picture below). The Teensy Loader software will detect the Teensy board now and will show a picture of the Teensy Board. Also, the green arrow button ("Reboot") will be activated.

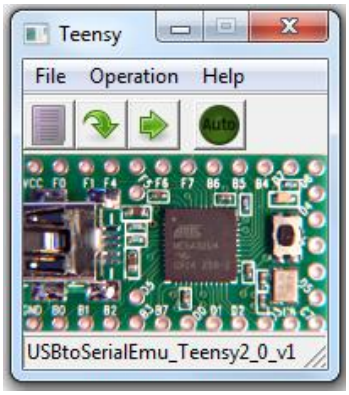




Windows

Mac OS X

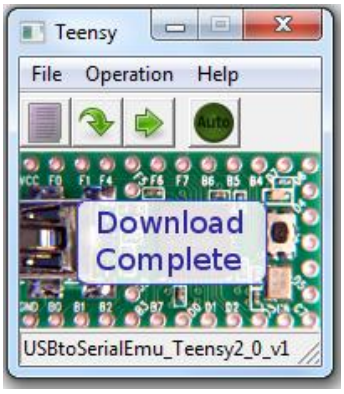
Step 4: Select "File" → "Open HEX file" (Mac OS X: click the left button) and select the USBtoSerialEmu_Teensy2_0_v1_02_1.hex file which has been provided with the EMuSer package, or which has been downloaded from the EMuSer webpage. The window should change into:



Windows

Mac OS X

Step 5: Press the "bowed arrow" button ("Program"). This will transfer the firmware to the EMuSer. After the transfer, the Teensy Loader window should change into:



Windows

Mac OS X

Step 6: Press the "horizontal arrow" button ("Reboot"). This will reboot the EMuSer and make it run as aUSB ←→ RS422 adapter.
Windows or Mac OS X will detect that new hardware has been installed. When using Windows, the operating system might ask for an appropriate driver, although Windows 7 or higher should recognize the device as a serial port.

Windows only: if Windows did not recognize the EMuSer as a serial port device, see next chapter "Installing the EMuSer driver" to continue the installation.

INSTALLING THE EMUSER DRIVER (WINDOWS ONLY)

The EMuSer should be detected automatically as a "USB serial device" by Windows 7 or higher and by Mac OS X. In that case this chapter can be skipped.

If for someWindows does not detect the EMuSer however, you should install the serial driver before using the EMuSer USB←→RS422 adapter.

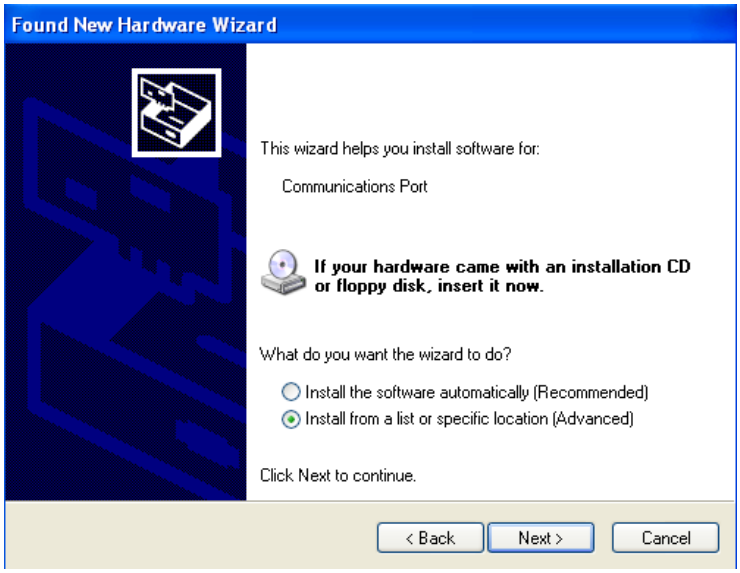
(Note that the HalfKay driver from the previous chapter is NOT the same as the driver for actually using the EMuSer. HalfKay is only required to install the firmware into the EMuSer)

To install the EMuSer serial driver on your Windows PC, follow the next steps:

Step 1: connect the EMuSer to your Windows PC with the USB cable

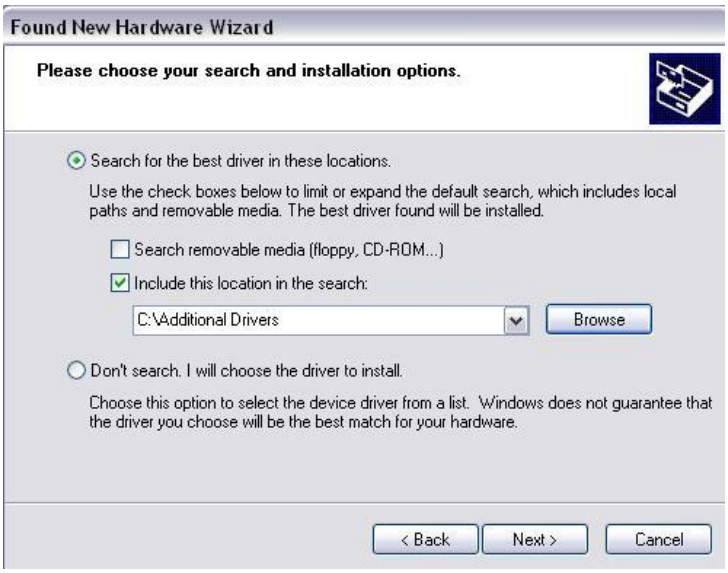
Step 2: Windows will detect new hardware and will ask to search for software. Choose “No, not this time” and press NEXT.

Step 3: choose “Install from a list or specific location (Advanced)” and press NEXT:

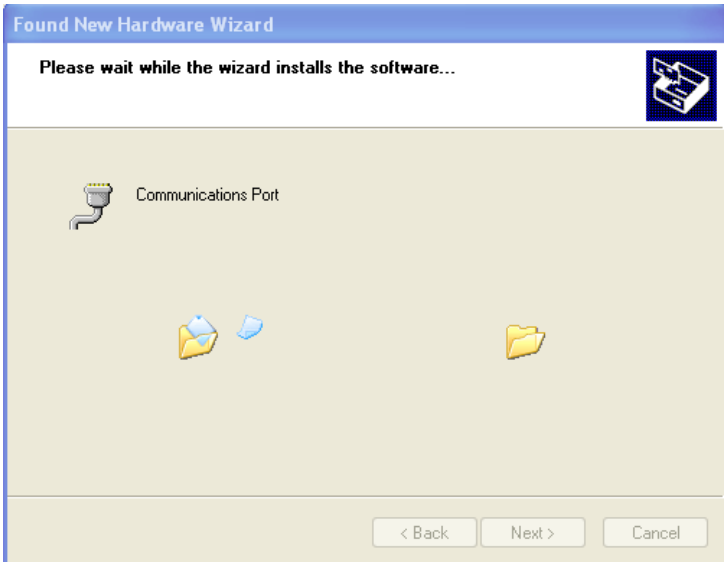


Step 4a: Make sure only *one* of the serial drivers provided in the EMuSer zip package is stored in the folder to which you have extracted the files from that zip package. Normally the driver file called LUFA USBToSerial.inf should work fine for both 32-bit and 64-bit Windows operating systems, but in case of any problem on 64-bit Windows you can use the USBToSerial64Bit.inf driver as an alternative. If both files have been extracted from the zip package, remove one of them now.

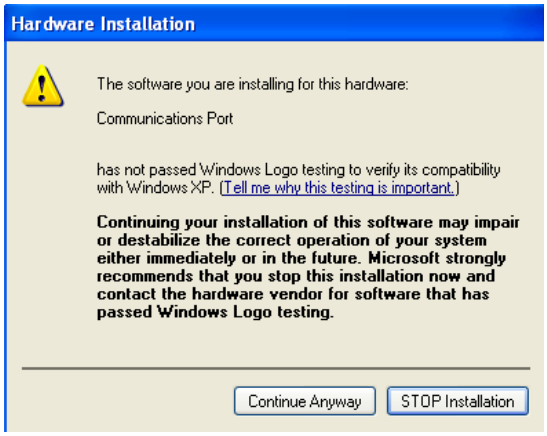
Step 4b: Choose "Search for the best driver in these locations", select "Include this location in the search" and press the BROWSE button. Browse to the folder to which you have extracted the LUFA USBToSerial.inf or USBToSerial64Bit.inf file from the EMuSer zip package (see also step 4a). After having clicked on this folder (here: C:\Additional Drivers\), press OK. Then press NEXT.



Step 5: Windows is now installing the driver…

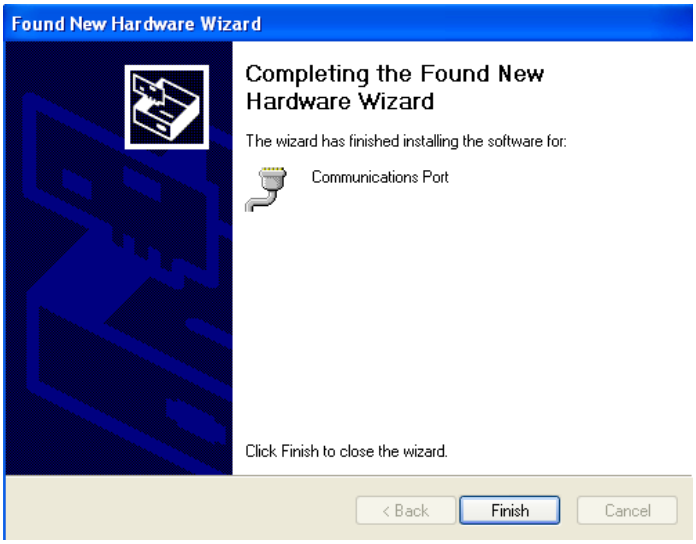


If Windows raises a warning about the compatibility, press CONTINUE ANYWAY.



Press NEXT after the installation is finished.

Step 6: Installation is finished. The orange LED should be ON now on the Teensy board. If the EMuSer is not connected to an E-Mu sampler or if the E-Mu sampler is not powered on, the red LED may be ON too…



The EMuSer is ready for use with software like EMXP now.

GNU FREE DOCUMENTATION LICENSE

GNU Free Documentation License
Version 1.2, November 2002

0. PREAMBLE

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The "Document", below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as "you". You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A "Modified Version" of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A "Secondary Section" is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject (or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding

them.

The "Invariant Sections" are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The "Cover Texts" are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A "Transparent" copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called "Opaque".

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The "Title Page" means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

A section "Entitled XYZ" means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as "Acknowledgements", "Dedications", "Endorsements", or "History".) To "Preserve the Title" of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution

and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.
B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.
C. State on the Title page the name of the publisher of the Modified Version, as the publisher.
D. Preserve all the copyright notices of the Document.
E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.
F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.
G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.
H. Include an unaltered copy of this License.
I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.
J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.
K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.
L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.
M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.
N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.
O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties--for example, statements of peer review or that the text has

been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or

distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See http://www.gnu.org/copyleft/.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the

Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

LAST PAGE