

OLIMEX

TERES I



Do-It-Yourself
Open Source Hardware and Software
Hacker friendly Modular Laptop

Manual revision 1.2

November 2017

OLIMEX Ltd, Plovdiv, Bulgaria

<https://www.olimex.com/>

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1. *What is TERES I?*

The TERES I is an Open Source Hardware and Software Do It Yourself Laptop running Linux on a quad core 64-bit ARM processor. It's very light, weighing less than one kilo, and convenient to carry when travelling. The TERES I has a stylish and elegant shape and an 11.6" LCD screen. You can play video, browse the Internet, write programs. The laptop mainboard has eMMC flash with Ubuntu Mate and basic programs for Internet browsing, Open Office, Arduino, IceStorm FPGA Verilog tools, a video player and so on. You can of course add software from the Ubuntu repositories.

2. *Where does the name come from?*

Teres I was the first king of the Odrysian Kingdom. This kingdom covered most of what is now present day Bulgaria. The Odrysian state was the first Thracian kingdom that acquired power in the region, by the unification of more than forty Thracian tribes under a single ruler. Modern Plovdiv, the city where this laptop was designed, is located in Bulgaria, and was originally a Thracian settlement. The golden mask of King Teres I was discovered in 2004 in the Valley of the Thracian Rulers near the city of Kazanlak.



3. *What makes this laptop different?*

The TERES I laptop is completely Open Source Hardware and Software, so people can learn and study the system. The CAD files and full source code are on GitHub that everybody who has knowledge or wants to learn how it's done can download and modify and use for their own needs.

This puts incredible power and flexibility in the hands of the user. If you want to implement new features nothing stops you. If you need another processor, more power, more memory, a better LCD, you are free to do this and tailor this laptop to your needs. If you do not like the Linux distribution you have access to the sources and can generate any Linux distribution to your taste. The Android SDK by Allwinner, and we make an Android image to run on TERES I.

The laptop is fully modular which means that there are number of possibilities to expand it. We have several ideas in mind: to add FPGA and so to be able to add to the laptop capabilities as a Digital Storage Oscilloscope, and Logic Analyzer, making it into a powerful portable laboratory instrument. These expansion modules are currently work in progress and you can follow the development on our FPGA page at www.olimex.com

Another advantage is that all the components of the laptop are available for purchase, so if something breaks you do not have to throw away the complete laptop but just replace the broken part. Thus TERES I is ecological and Earth friendly, helping to reduce electronics waste.

There is big educational benefit to having a TERES I, as you can build it with your child and to teach them what is inside the computers and how they work. Your child will learn about the basic computer components, how they are assembled, and in case of trouble can learn to repair it, so this may spark an interest in electronics and programming. Assembling the laptop is very easy and even small child will be able to do it under adult supervision and control.

4. *Why does Open Source matter so much?*

Open Source gives you freedom.

First, you know everything about your laptop, you have access to the schematics, there is nothing hidden. You have sources for the Linux distribution so you also have control of every bit of your laptop.

Second is the educational aspect. You can learn lot by viewing how others have done something.

Third, Open Source gives you independence and security, as you have access to everything, so you can be calm that if something happens you can always have freedom to fix it.

Proprietary products do not come with source code, and you have no access to the schematic, you can't modify what you do not like, you have little ability to repair your product which you paid for if it breaks.

5. *Where are the sources?*

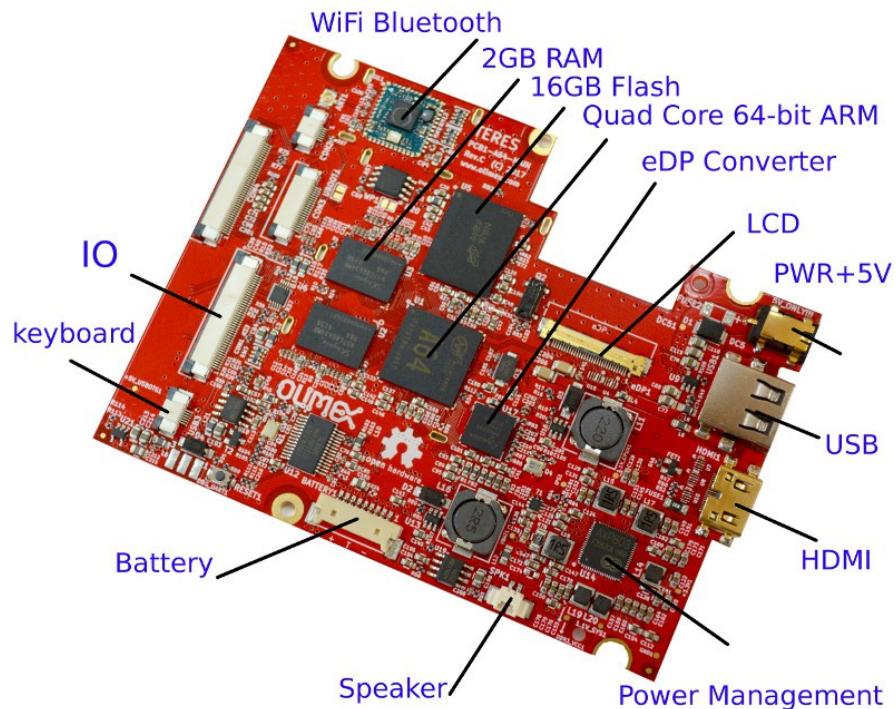
TERES I sources are available at GitHub: <https://github.com/OLIMEX/DIY-LAPTOP>. The Hardware and Software are in separate folders, as there will be other versions of the PCB's with other processors,

the current Hardware files are in A64 folder. More to come in future. The Software has building scripts for Linux. Scripts for Android will be added when available.

6. *Introduction to the TERES 1 hardware*

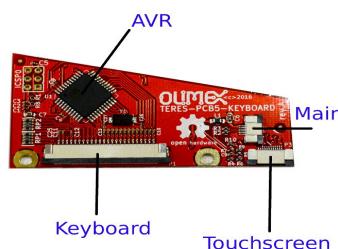
The TERES I electronics consists of five boards. All of them are designed with KiCAD Open Source Software [<http://kicad-pcb.org/>]. You can download KiCAD and open and edit all the PCB files.

The **MAIN** board contain the A64 processor, RAM and Flash memory, Power management, LCD converter, connectors to different interfaces:

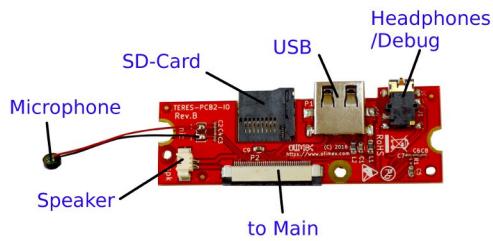


More main boards with different processors and memory configurations will come. They will work with all other existing boards and will just increase the laptop speed and memory performance.

The **KEYBOARD** controller board has an AVR processor on it which could be programmed with Arduino. It handles the keyboard and touch pad interfaces.



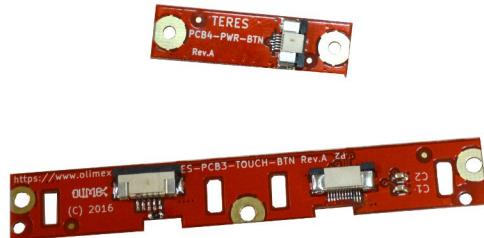
The source of for the AVR firmware is on GitHub. This Keyboard controller board allows you to completely reprogram the keyboard mapping and response according to your own taste. The touch screen parameters also can be changed. You can upload new firmware to the keyboard controller while working with the laptop.



The **IO board** contains the USB connector, Headphone/Debug connector, SD card, Speaker connector and Microphone.

The **TOUCH** buttons board contains two buttons for left and right mouse click emulation.

The **PWR** button board is for the keys which power on and power off the laptop.



7. *Building the software*

Follow the build scripts instructions from [GitHub](#).

We are working on a HOWTO explaining the Laptop peripherals and the parameters they have which you can change.

8. *What do you get in the package?*

Here is the list of items you will receive:

- PCB1 – Main PCB with A64 processor, 2GB RAM, 16GB eMMC. It is in an ESD protective bag. Please handle with proper anti-static precautions.



- PCB2 – IO PCB with microphone, connectors for: speaker, USB, SD-card, headphones.



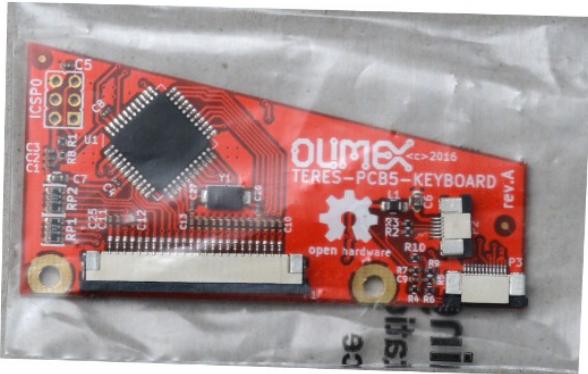
- PCB3 – TOUCH two button PCB.



- PCB4 – PWR PCB with button for power on/off.



- PCB5 – KEYBOARD PCB with controller of the keyboard and touchpad.



- #005 – Bottom body plastic part, packed in bubble wrap to protect from scratches.



- #006 – Keyboard body plastic assembly.



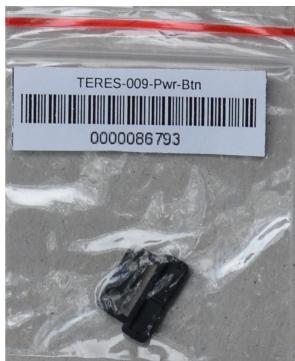
- #007 – LCD plastic frame.



- #008 – LCD back plastic body.



- #009 – Plastic power button.



- #010 – Plastic touch buttons.



- #011 – Left speaker.



- #012 – Right speaker.



- #013 – Transparent LED pipe.



- #014 – Set of screws: M2x1.5 mm – 4 pcs; M2x3 mm – 9 pcs; M2x4 mm – 17 pcs; M2x5 mm – 12 pcs.



- #015 – LCD 11.6". It has protective foil on top.



- #016 – Left and Right hinge set.



- #017 - Mat set. There are four rubber pads for the bottom of the laptop, two circular pads for LCD frame screws cover and four self adhesive mats for holding the battery.



- #018 – Magnet for cover close sensor.



- #019 – camera.



- #020 - camera lens.



- #021- Big and small dust protectors.



- #022- touchpad cover



- #023 – Touchpad.



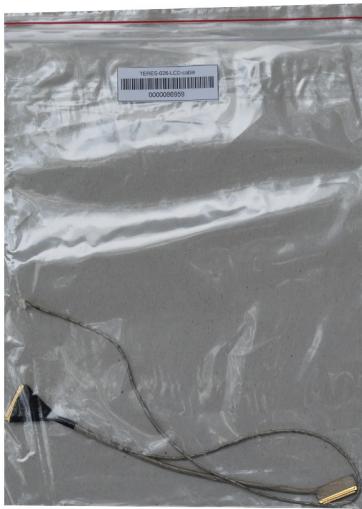
- #024 – LiPo battery 9500 mAh.



- #025 – WiFi/Bluetooth antenna.



- #026 – LCD/camera cable.



- #027 – Flat cable Main-IO.



- #028 – Flat cable Power-Main, Flat cable Main-Keyboard.



L1000-A00-7000-#7000-B00

- #029 – Flat cable Touchpad-TouchButtons.



- #031 – Flat cable Keyboard-TouchButtons.



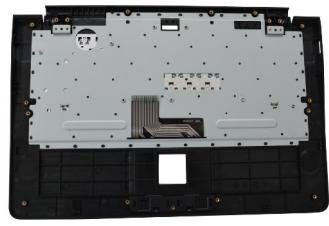
- #032 – Power adapter EU Style 5V 3A with 3 meter cable and LED status GREEN/RED indicator with sockets for UK and US.



9. How do I assemble my TERES-I?

Before you start the assembly please prepare your workplace, cover your desk with a soft textile which will prevent scratching the laptop plastic parts.

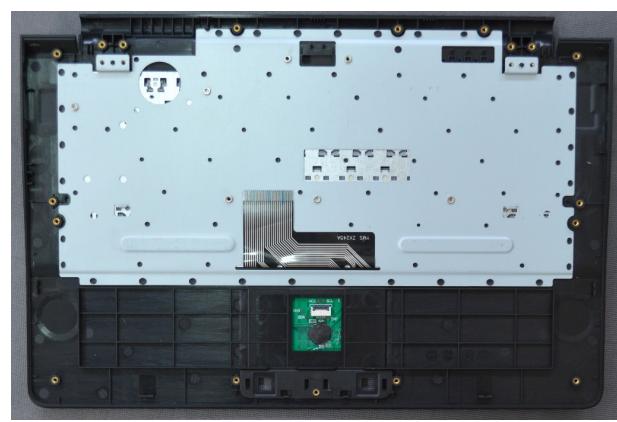
We begin the assembly with the **TERES-006-Keyboard**:



First let's attach the touchpad **TERES-023-Touch** to the keyboard body:



The touchpad uses double sided adhesive tape. Please remove the protective foil and place it on the top side of the keyboard body like this:



You must be careful about the touchpad connector orientation. The connector must be pointing UP.



The touchpad fits very tight on the upper plastic. You should place it with an even surface and completely recessed.

Next step is to place on top of it **TERES-022-Touch-Cover** and **TERES-010-Touch-Btns**:



The final result must look like this picture:



The next step is to attach the TERES printed circuit boards to the keyboard body. For this purpose we will use the **TERES-014-Screw-Set**. Note that in this set there are 42 screws of different kinds:

- M2 x 1.5 4 pcs
- M2 x 3 9 pcs
- M2 x 4 17 pcs

- M2 x 5 12 pcs

Every screw has its location and you should put it to the exact place without mixing screws with different lengths as this may damage the plastic parts if the wrong screw is used.

Also, do not screw with great force as it may break the plastic. Be gentle.

For the PCB's the M2 x 3 screws must be used.

Next the **TERES-PCB3-Touch** PCB is to be assembled:



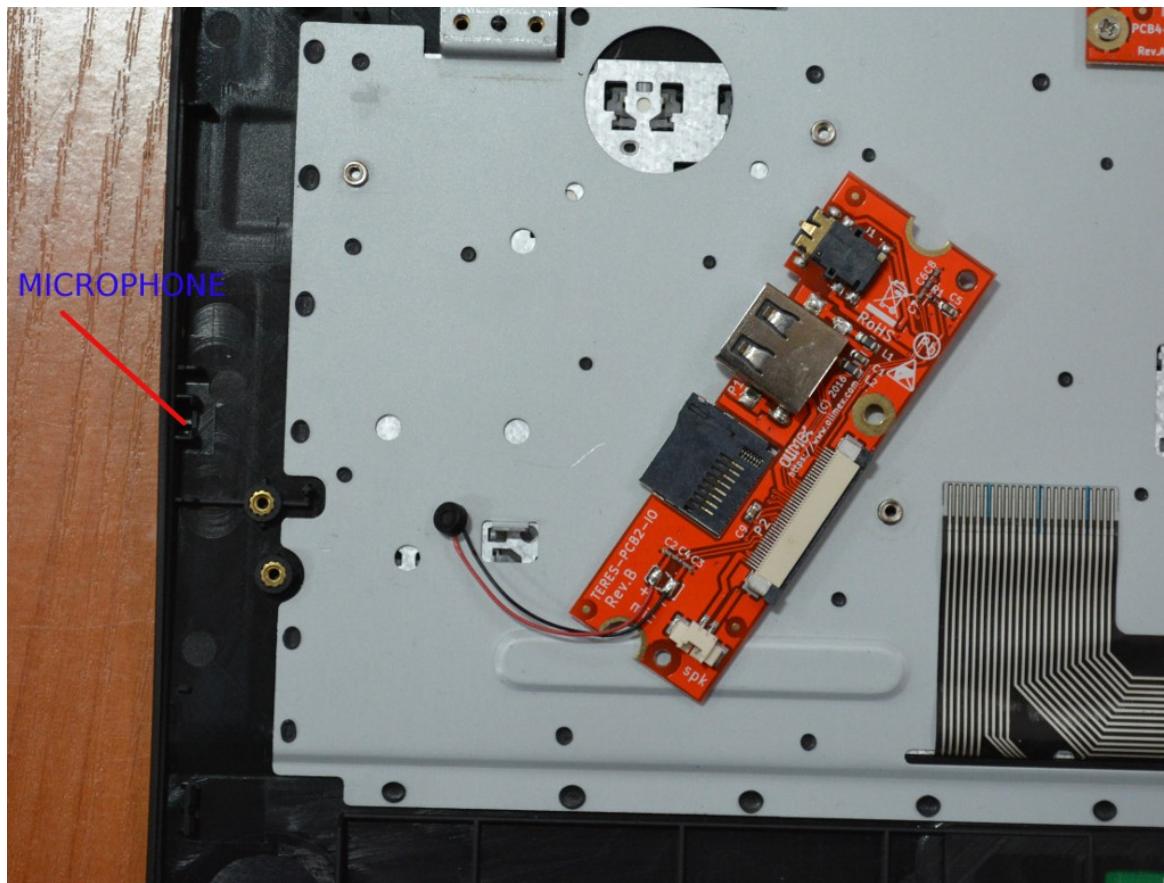
Here it is attached to the keyboard body. Note that only the middle screw is used, the other two will be screwed with the bottom cover plastic:



The next PCB to attach is the **TERES-PCB2-IO**:



This board has the microphone which has first to be placed in the side pocket specially designated for it.



After the microphone is put in place, slip the board at an angle to the side openings for the SD card, USB, and Audio connector and then place down.



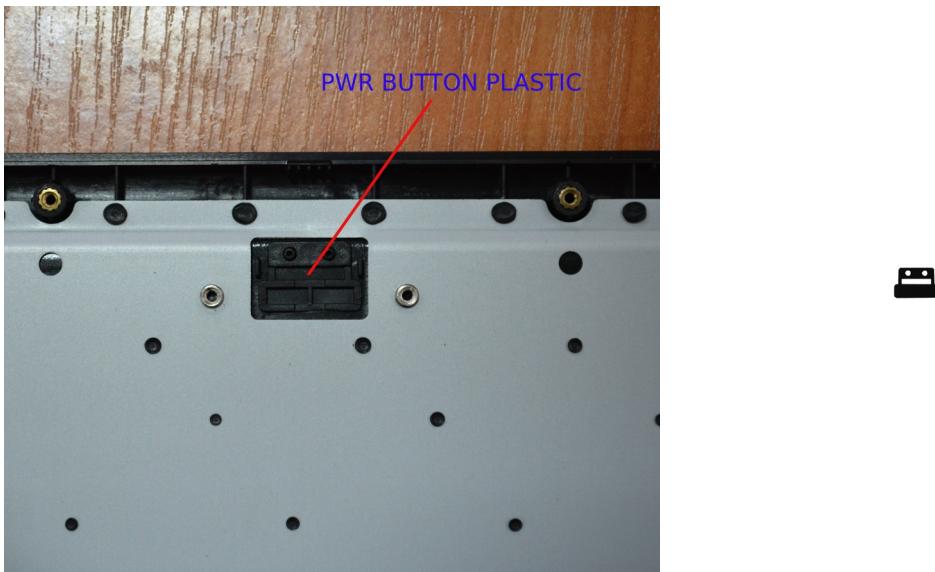
Then use one M2 x 3 screw to fix the board:



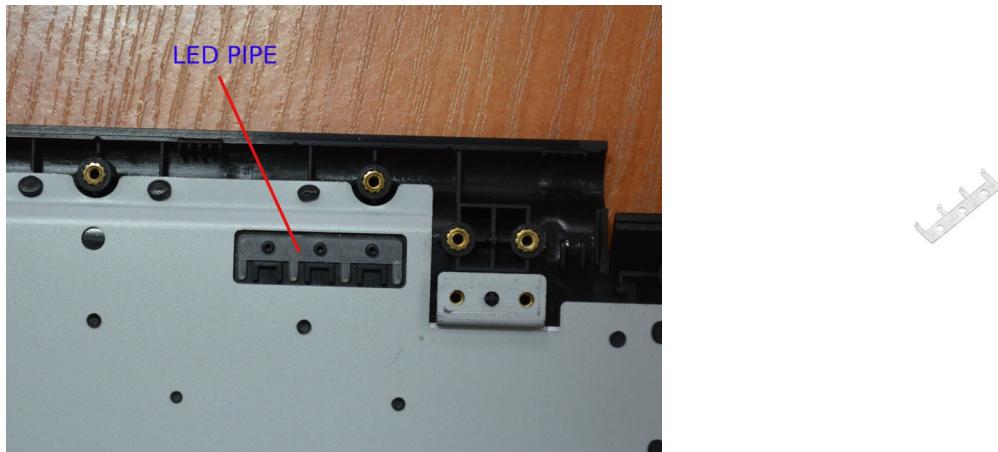
Please make sure that the side connectors are well aligned:



Next you put the PWR button plastic:



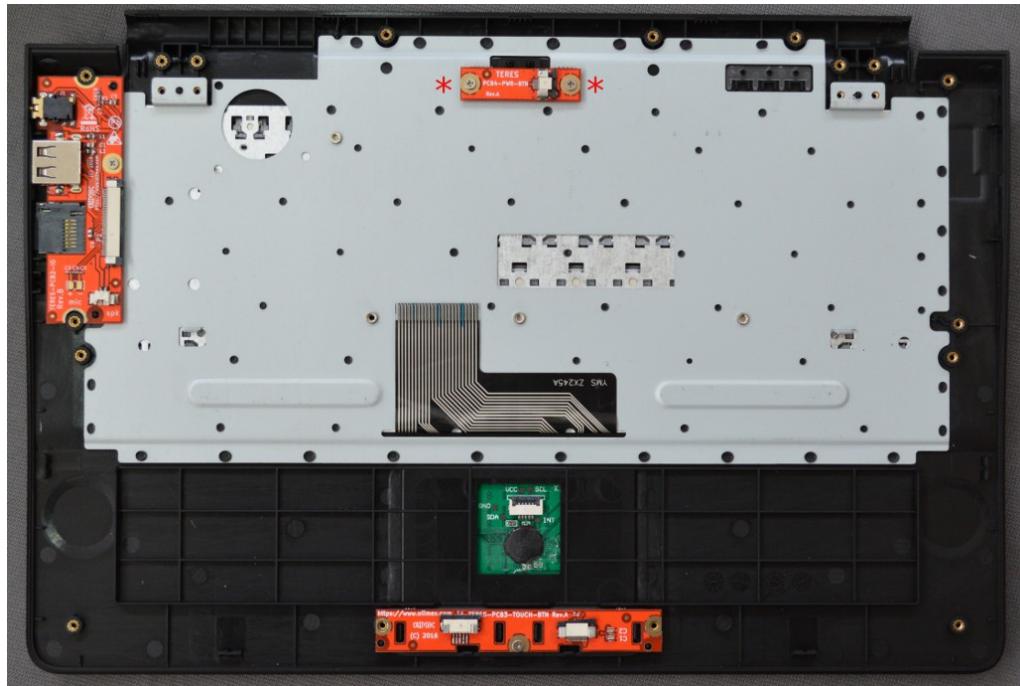
Then the LED pipe:



Next let's attach the **TERES-PCB4-Btn** for the power button:



The **TERES-PCB4-Btn** is attached with two screws M2x3 mm, connector on right side:

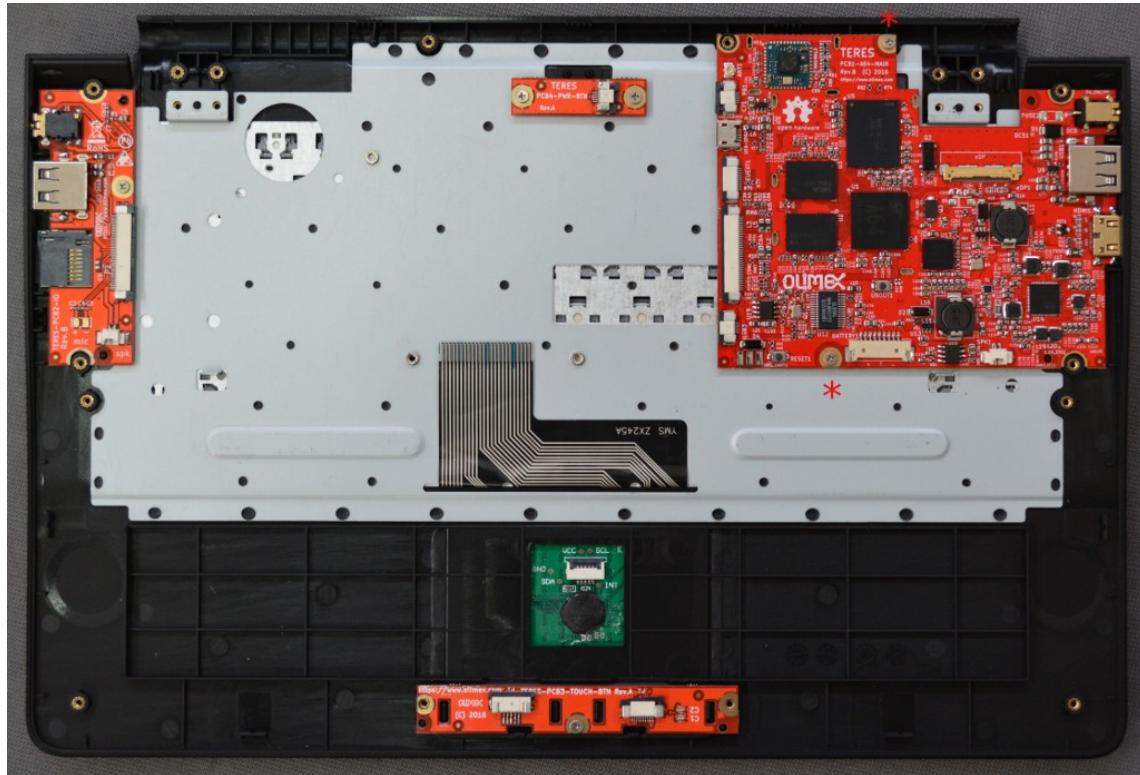


The next step is to assemble the big **TERES-PCB1-A64**:



This is the main board and you should handle it very carefully without bending or dropping it, etc. This board is also very sensitive to static electricity.

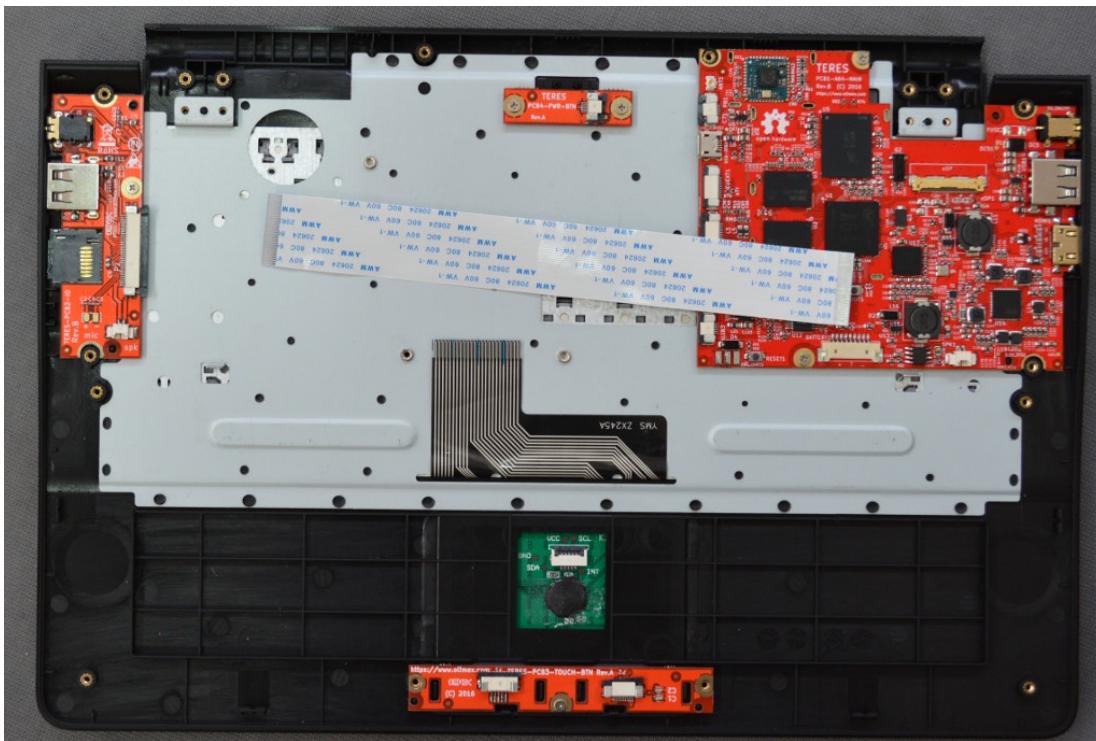
It's a bit tricky to put it in the correct position as you have to slide it right so the connectors enter in the side openings. If you succeed you will see all the PCB support nuts from the keyboard body pass exactly through the openings of the PCB. You need just two M2x3 screws to attach it:



Again you must check if the side connectors are aligned:



Now we have to connect **TERES-PCB2-IO** with **TERES-PCB1-A64**. For this purpose we use the Flat Cable **TERES-027-FPC-IO-Main**.



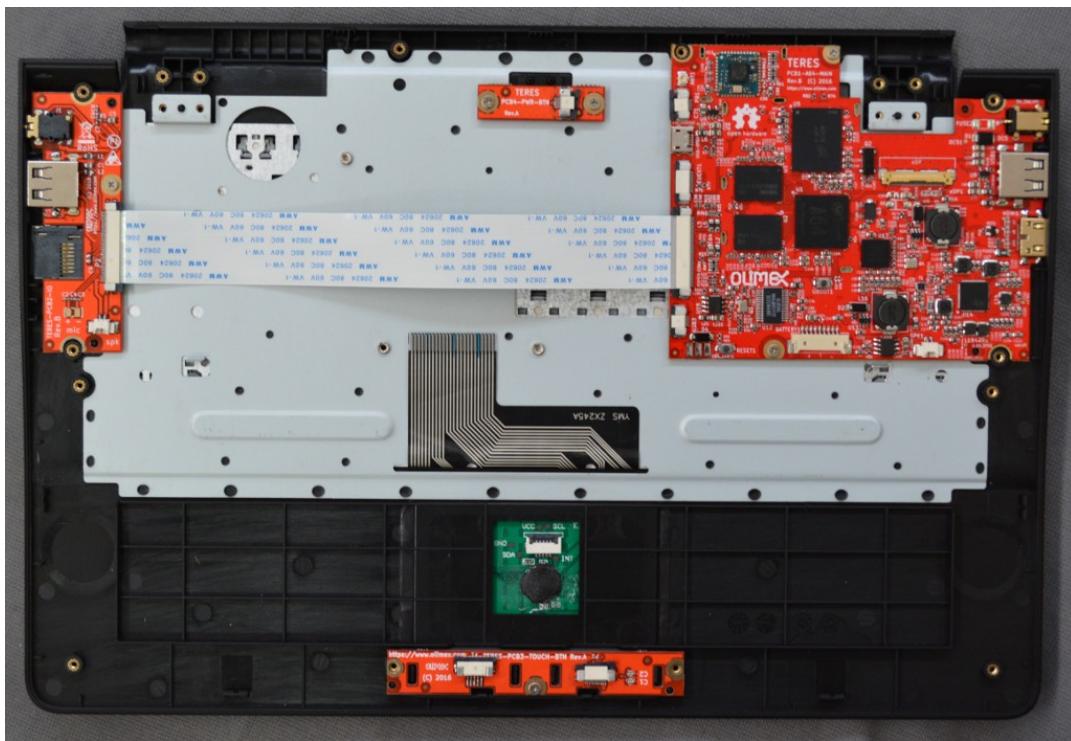
There are two 40-pin connectors on **TERES-PCB2-IO** and **TERES-PCB1-A64**. You have to pull the dark plastic of the connector up and insert the FPC cable above it with the contacts up:

After you insert the cable push the dark plastic back so it holds tight the cable to the connector:

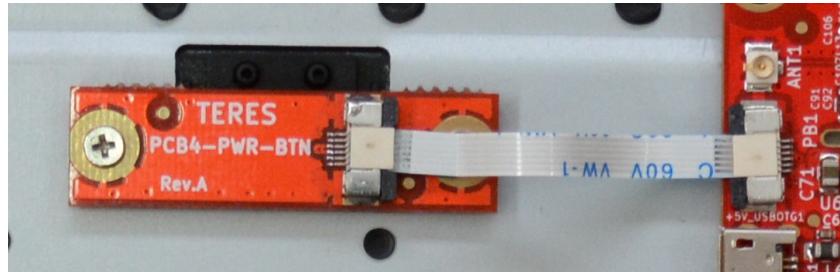


Repeat the same with the **TERES-PCB1-A64**.

Now **TERES-PCB2-IO** and **TERES-PCB1-A64** are connected together:



Let's do the same for **TERES-PCB4-Btn** and **TERES-PCB1-A64**. For this purpose we use the small flat cable **TERES-028-FPC-Pwr-Main**. These connectors are of the same type. You should pull the dark plastic up and insert the flat cable with the contacts UP between the white and dark plastic then push the dark plastic back. Here is the flat cable connected to both connectors:



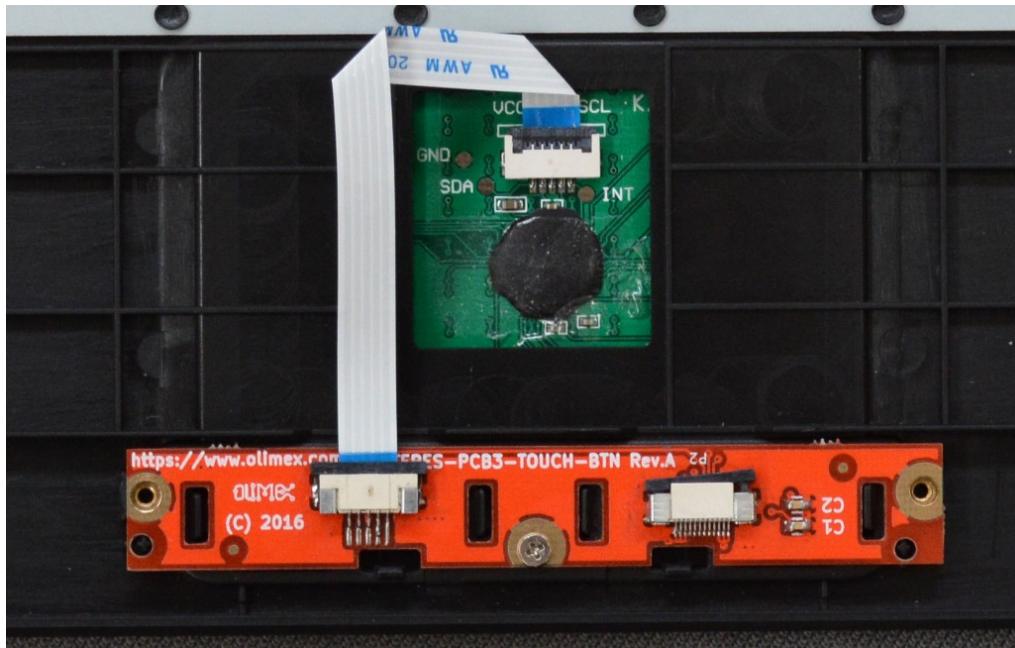
The next step is to connect the touch panel **TERES-023-Touch** to the board with touch buttons **TERES-PCB3-TOUCH**. We will do this with the flat cable **TERES-029-FPC-Touch-Btn**. Note that these connectors are different, the touch panel connector has a hinge and the dark plastic is opening upside as on this picture:



The flat cable is also inserted with the contacts pointing down and blue back up:

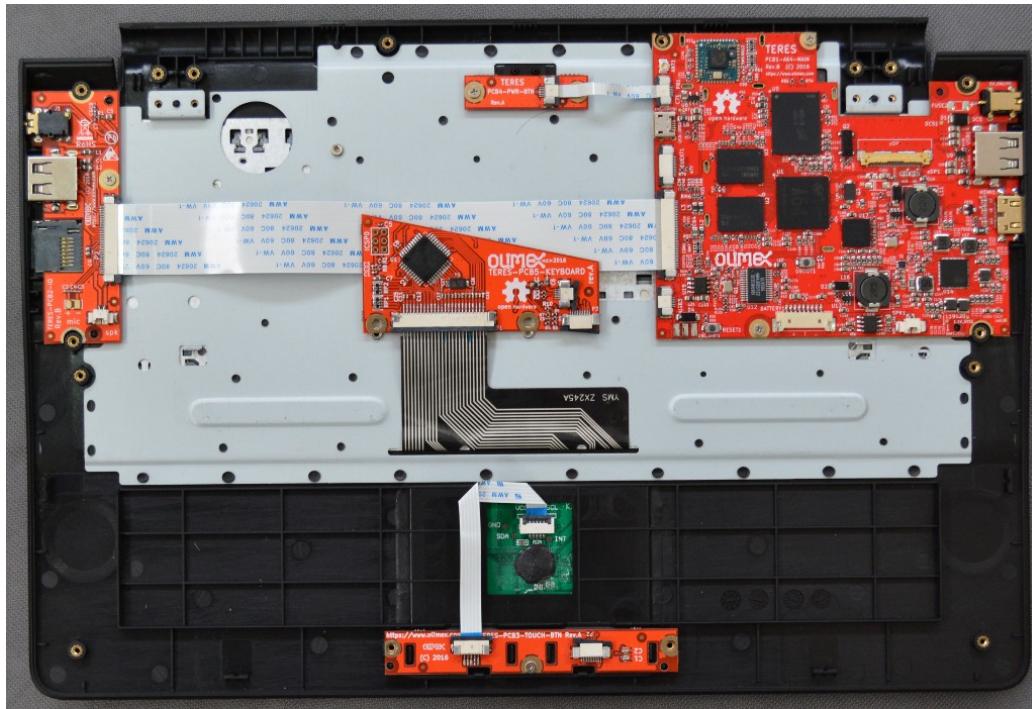


The connector on **TERES-PCB3-TOUCH** is also different so the cable is inserted **below** the dark plastic again with blue back pointing up:



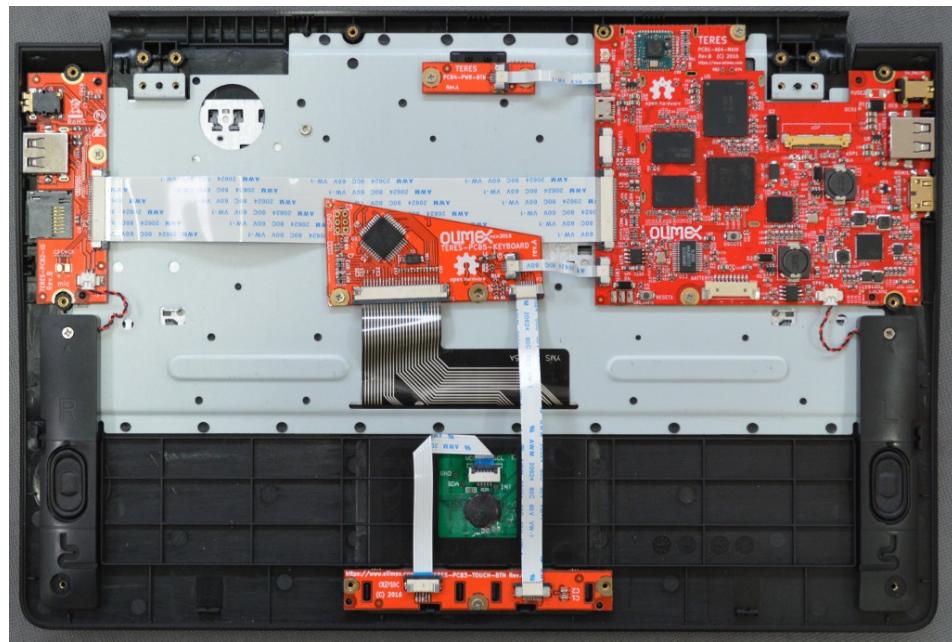
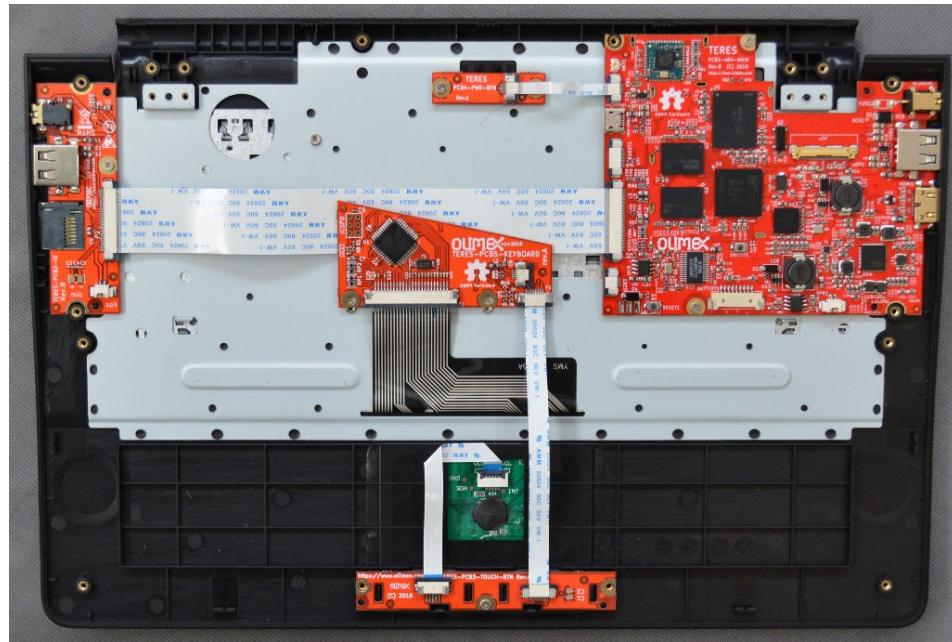
You have to bend the cable twice. Do not bend at too sharp an angle or too hard so as not to break it!

The next step is to attach the **TERES-PCB5-KEYBOARD** to the keyboard flat cable as shown on the picture below. Note that the cable is put under the black sliding plastic of the connector:



Do not assemble the keyboard PCB to the plastic base yet.

The next step is to connect **TERES-PCB5-KEYBOARD** with **TERES-PCB3-TOUCH**. We will use **TERES-031-FPC-Kbd-Btn** flat cable for this purpose. This cable is inserted with contacts up above the black plastic of the connector, the same as the power button and main board cables:



Next we connect **TERES-PCB5-KEYBOARD** with **TERES-PCB1-A64** and with one M2 x 3 screw attach **TERES-PCB5-KEYBOARD** to the plastic body. Note that only the left screw is placed. The right screw will be inserted from the bottom plastic.

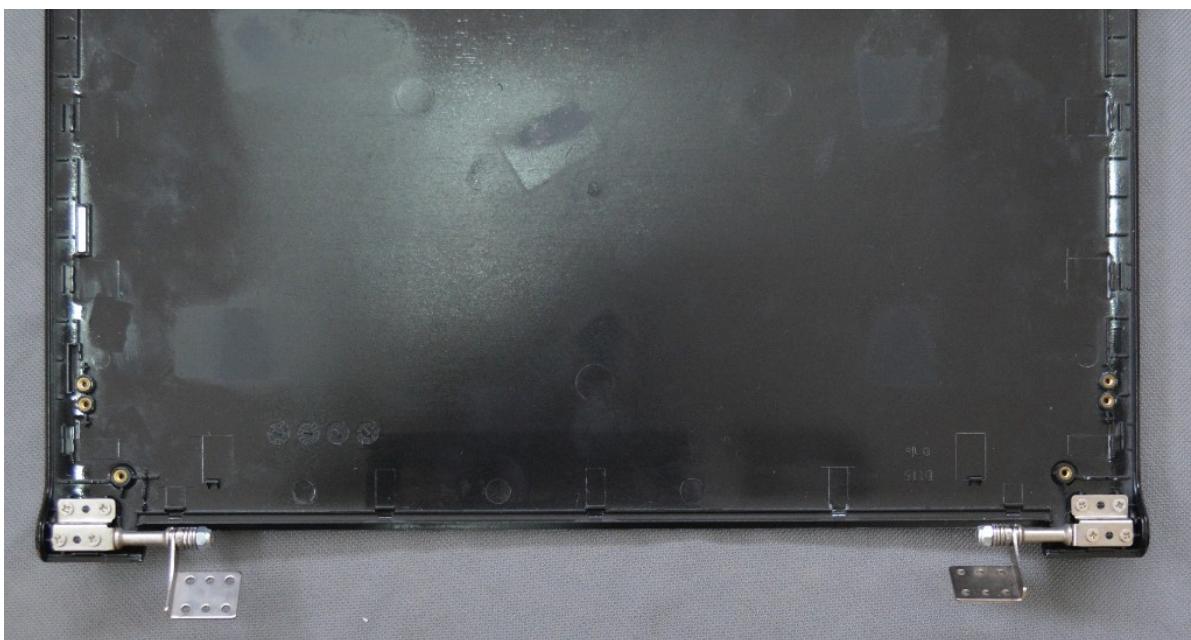
The final assembly step is to attach the left and right speakers. As we look now on bottom side you will notice that Right speaker is assembled on the left hand side, and Left speaker on the right hand side.

For this purpose we use M2 x 4 screws and only the upper one is screwed. The speaker connectors should be inserted in **TERES-PCB2-IO** and **TERES-PCB1-A64** boards.

Now let's continue with LCD frame assembly using as base the **TERES-008-LCD-Back**:



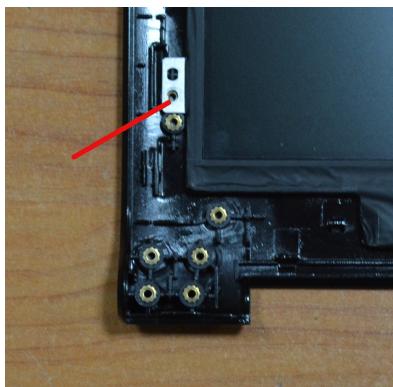
First let's attach the metal hinges to the **TERES-016-Hinge-Set** using 8 pcs M2 x 4 screws:



Next attach **TERES-026-LCD-cable** to **TERES-015-LCD11.6"** LCD panel:



With M2 x 1.5 screws assemble the LCD to the plastic. Note that only 4 screws are used!



Connect the **TERES-019-Camera** to the four pin connector of the **TERES-026-LCD-cable**. There are two holes in the camera board which attach to two pins on the plastic body.



On the other side attach **TERES-025-WiFi-Antenna** with double sided adhesive tape to the plastic body:



Follow this wiring for where the LCD and WiFi cables go through. Pay attention to how the cables go out around the hinges!

The **018-Magnet** is placed in special place on the left hand of the LCD:



The LCD cable wiring is probably most difficult part of the whole assembly. If you do not do it correctly the LCD frame will not snap tight. If you did everything correctly you will have something like this:



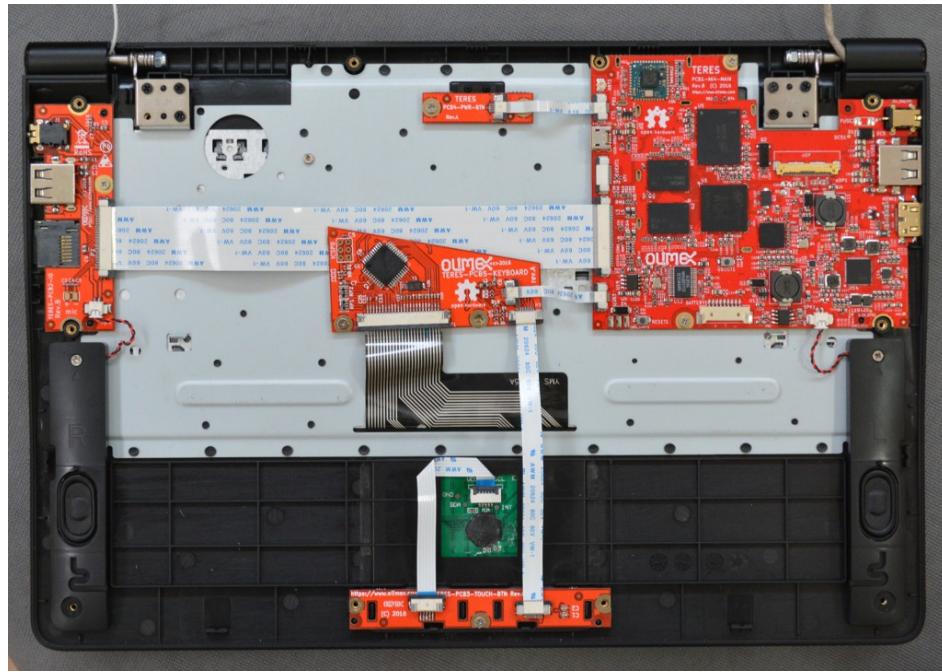
Then fix the upper corners with M2x3 mm screws like this:



Then place the [**TERES-020-Camera-Lens**](#) above the camera sensor and rubber mats over the two screws:

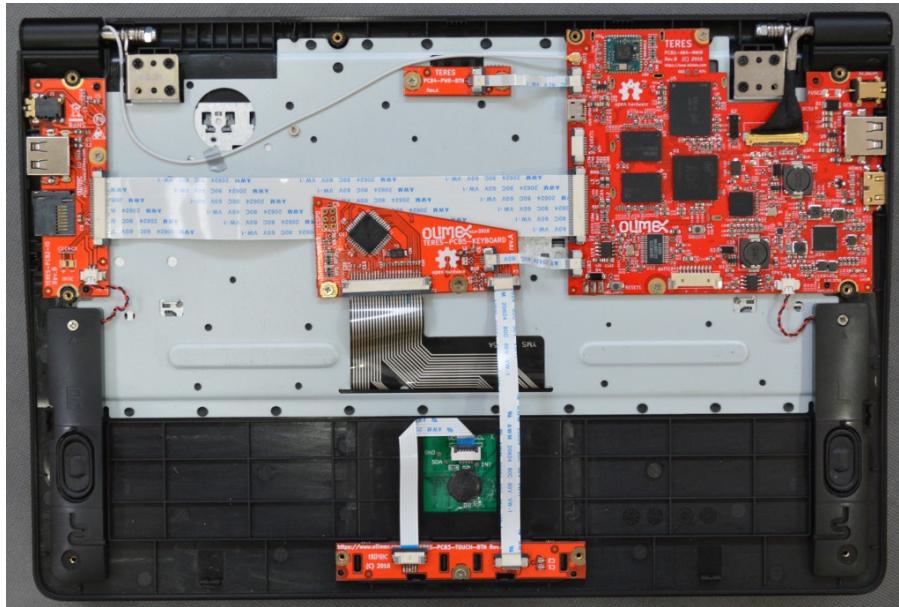


Now we are ready to assemble the LCD part with the keyboard body. We will use 6 screws M2x4 mm for this purpose:

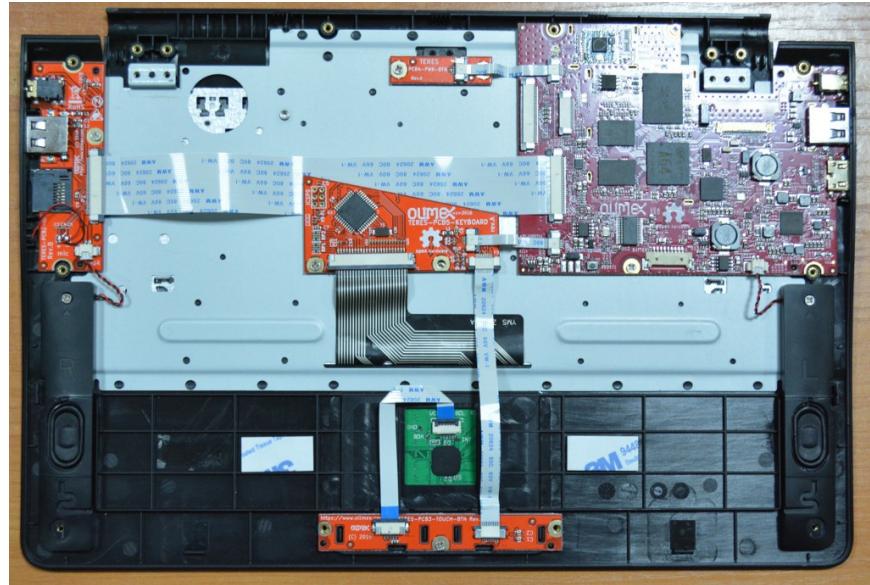


Note that there are four places on the hinges but only three are assembled with screws. The fourth screw will be from the bottom plastic body attachment. The places where you have to put screws are stamped at the metal hinges with arrows.

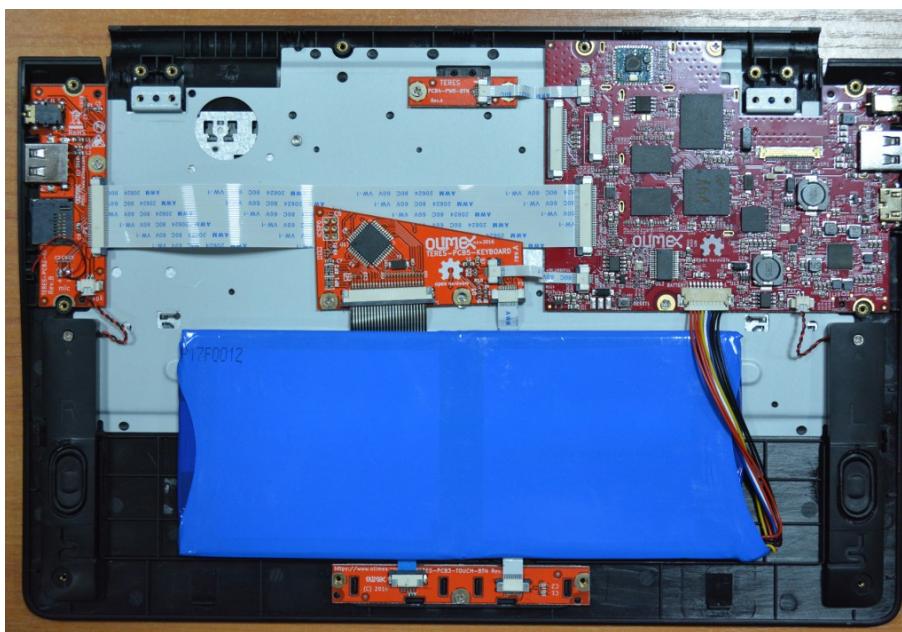
Next let's connect the WiFi antenna cable and LCD cable to **TERES-PCB1-A64**:



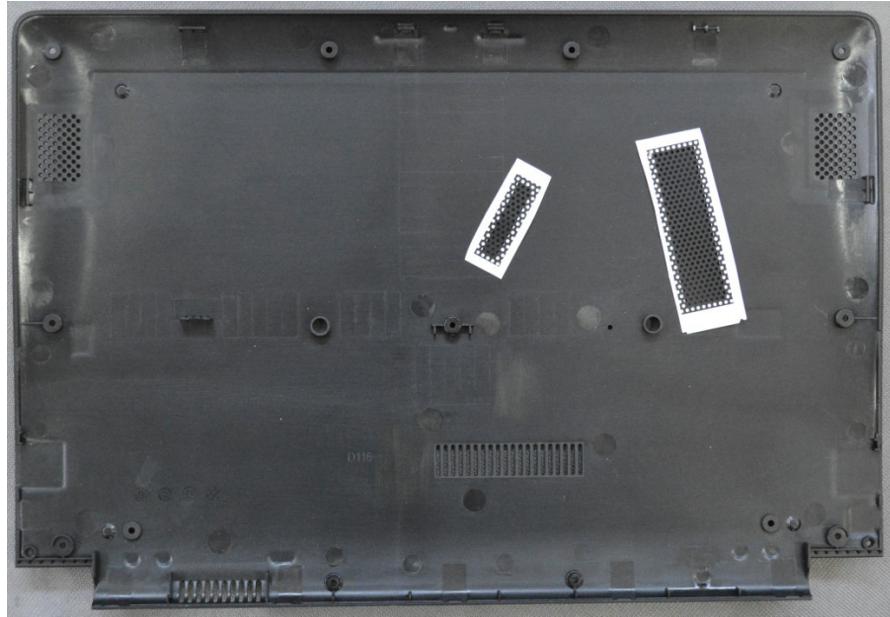
The next step is to attach four double adhesive mats to which we will snap the LiPo battery:



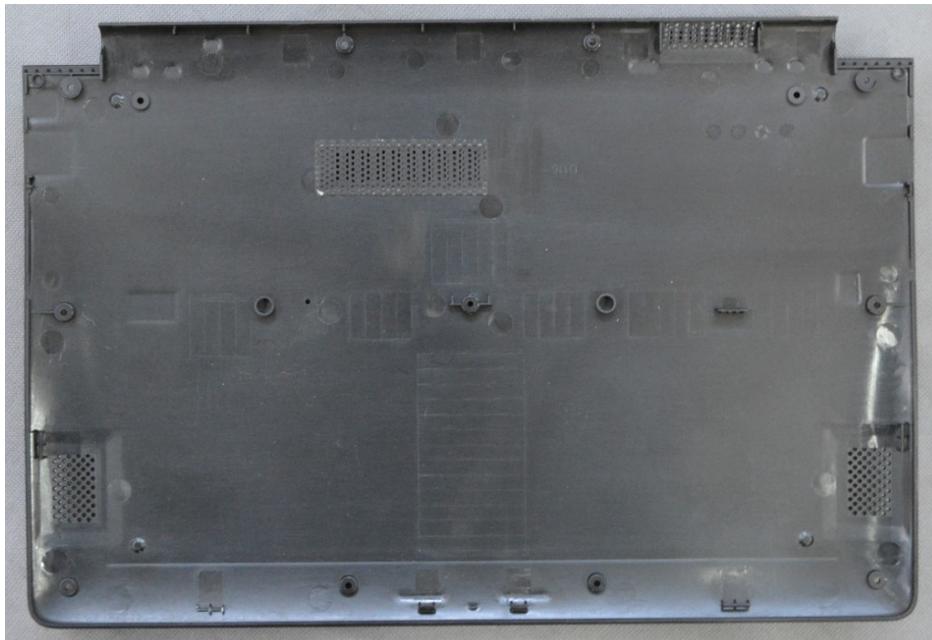
Snap the battery and plug the battery connector to the PCB1. Mind the polarity! Red cables are on the left side.



Now let's prepare the bottom plastic **TERES-005-Bottom** with the **TERES-021-Dust-Protectors**:



Here they are placed on the two openings:



Next we assemble the bottom plastic with 12 M2 x 5 screws:



The final step is to attach the rubber mats to the four places:



The assembly is complete. Now press the PWR button and the laptop will boot:



Congratulations! You assembled your own TERES I Laptop!

10. What's next?

TERES-I is a work in progress. We are now working on the next boards which will turn it into portable lab – a digital storage oscilloscope and logic analyzer.

There will be new main boards with newer and more powerful processors with more RAM and Flash (this of course will trade-off the battery life).

Being OSHW we expect community members to release their own stuff compatible with the TERES-I modular concept.

11. Community links

