OLIMEX LTD presents:

TERES I

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

rev. 1.1
November 2017
Plovdiv, Bulgaria

Content

1. What is TERES I ?

TERES I is Open Source Hardware and Software Do It Yourself Laptop running Linux on Quad core 64-bit ARM processor. It’s very light, less 1 kg and convenient to carry with when travel. TERES I is with stylish and elegant shape and 11.6” LCD. You can play video, browse Internet, write programs. The laptop main board has eMMC Flash with Ubuntu Mate and basic programs for Internet browsing, Open Office packet, Arduino, IceStorm FPGA verilog tools, video player and so on, you can add software from Ubuntu repositories.

2. Where this name comes from?

Teres I was the first king of the Odrysian state of Thrace where Plovdiv – the city where this Laptop was designed. The Odrysian state was the first Thracian kingdom that acquired power in the region, by the unification of more than 40 Thracian tribes under a single ruler. The King's Teres I golden mask was discovered in year 2004 in the Valley of the Thracian Rulers near city of Kazanlak.

3. What makes this laptop different than others?

This Laptop is Open Source Hardware and Software, so people can learn and study how it's done. The CAD files and source code is on GitHub and everybody (who has knowledge or wants to learn how it's done) can download and modify and use for their own need.

This gives incredible power and flexibility in the user hands. If you want to implement new features nothing stops you. If you need another processor, more power, more memory, 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! Android SDK is also available by Allwinner and we will make Android image to run on TERES I.

The Laptop is Modular which means that there is number of possibilities to expand it. We have several ideas in hand – to add FPGA and add to the Laptop capabilities for Digital Storage Oscilloscope, Logic Analyzer and make it this way powerful portable laboratory. These expansion modules are work in progress and you can see the development on our FPGA page at www.olimex.com

Another advantage is that this Laptop has all it's components 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 the electronics waste.

There is big educational benefit to have TERES I, as you can build it with your kid and to teach it what is inside the computers. Your kid will learn the basic computer components, how they are assembled and in case of trouble can repair it, so this may spark the interest in electronics and programming. To assembly the Laptop is very easy and even small kid will be able to do it under adult supervision and control :)

4. Why Open Source matters 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.

The 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.

The proprietary products do not come with sources files, 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

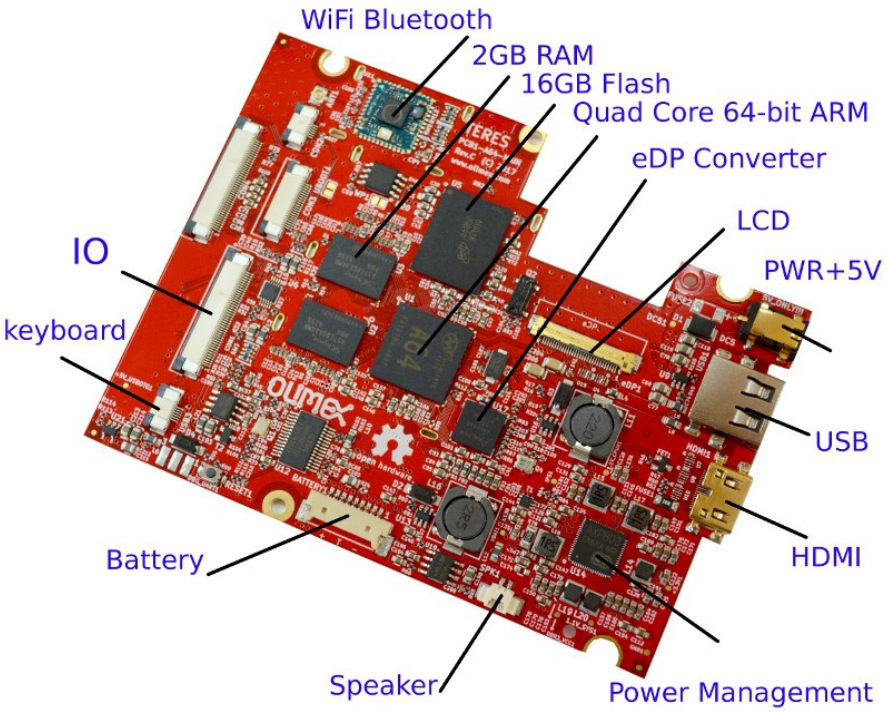
The Hardware and Software are in separate folders, as there will be other versions of the PCBs with other processors, the current Hardware files are in A64 folder. More to come in future.

The Software has building scripts for Linux, for Android will be add when available.

6. Introduction to TERES laptop Hardware

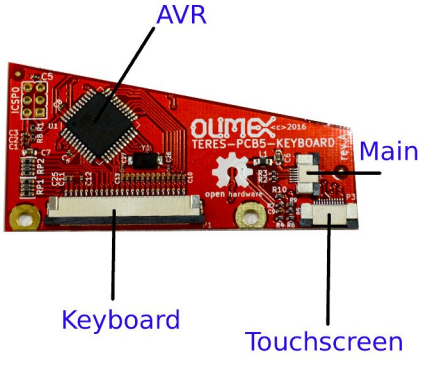
TERES I electronic part has 5 boards. All of them are designed with KiCAD (http://kicad-pcb.org/) Open Source Software. You can download KiCAD and open and edit all PCBs.

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



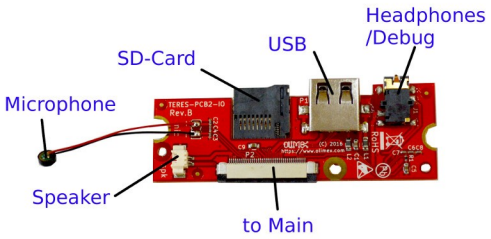
More main boards with different processors and memory configurations will come, they will work with all other existing boards and will just change the laptop speed and memory performance.

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

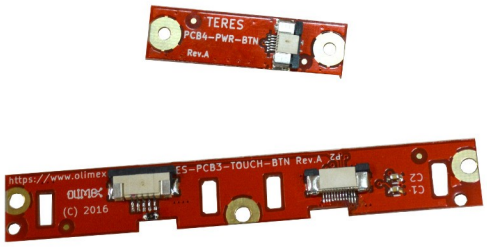


The source of AVR firmware is on the GitHub, this Keyboard controller board allow you to completely reprogram the keyboard mapping and response up to your taste. The Touch screen parameters also can be changed, you can upload new firmware in the keyboard controller while working with the laptop.

The **IO board** contains 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 key which power on and off the laptop:



7. Building the software

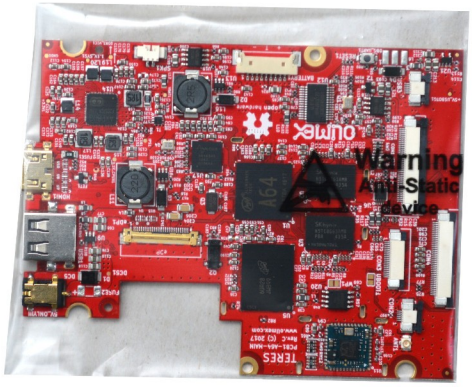
Follow the building scripts instructions from GitHub.

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

8. What I 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 ESD protective bag, handle with care.



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

- PCB3-TOUCH two button PCB

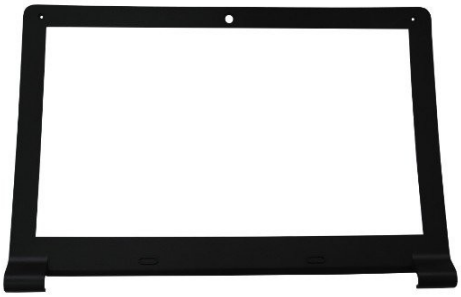
- PCB4-PWR PCB with button for power on/off

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

- #005 bottom body plastic part, it’s packed in bubble foil 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 LEDs pipe

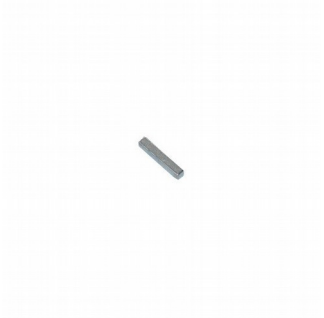
- 014 set of screws: M2x1.5 mm - 4 pcs; M2x3 - 9 pcs; M2x4 – 17 pcs; M2x5 – 12 pcs;

- 015 LCD 11.6” it has protective foil on top

- 016 Left and Right hinge set

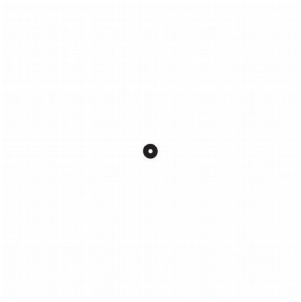
- 017 mats set, these have four rubber pads for the bottom of the laptop, two circular pads for LCD frame screws cover and four self adhesive mats for holding the battery

- 018 magnet for cover close sensor



- 019 camera

- 020 camera lens



- 021 small and big dust protectors

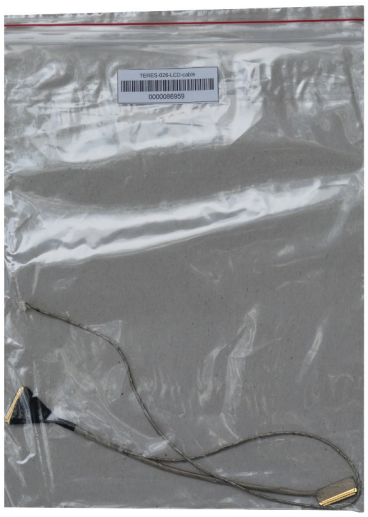
- 022 Touch cover

- 023 Touch pad

- 024 LiPo battery 9500 mAh

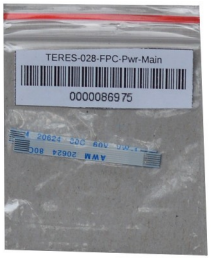
- 025 WiFi/Bluetooth antenna

- 026 LCD/camera cable



- 027 Flat cable Main-IO

- 028 Flat cable Power-Main, Flat cable Main-Keyboard



- 029 Flat cable Touchpad-TouchButtons

- 031 Flat cable Keyboard-TouchButtons

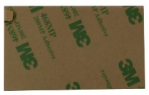
- 032 Power adapter EU Style 5V 3A with 3 meter cable and LED status GREEN/RED indicator with sockets for UK and US

9. How do I assembly my TERES-I?

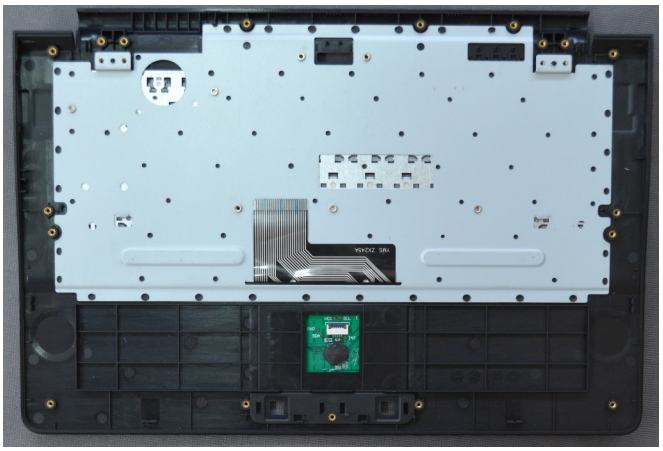
Before you start the assembly please prepare your place, cover your desk with soft textile which prevent scratching the laptop plastic parts.

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

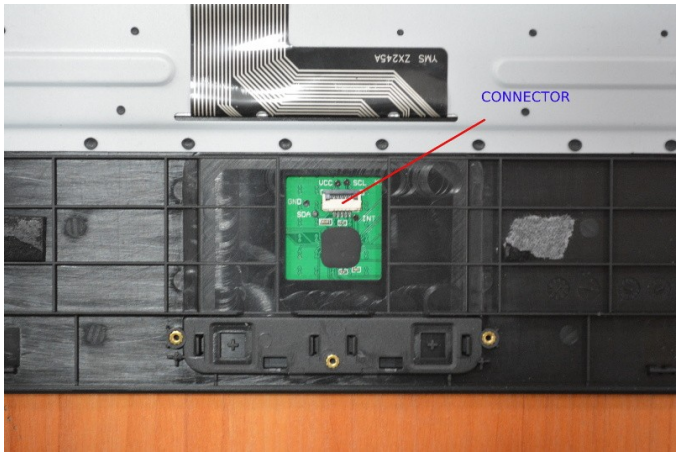
First let’s attach to the keyboard body the touch panel **TERES-023-Touch**:



The touch panel has double adhesive tape on both sides. Please remove the protective foil and place it on top side of the Keyboard body like this:



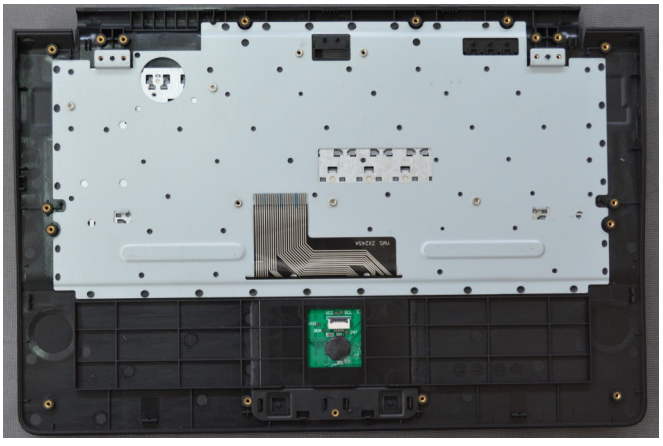
You must be careful about the touch panel connector orientation. The connector must be pointing UP.



Touch panel fits very tight on the upper plastic you should place it with 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 looks like this picture:



Next step is to attach the TERES printed circuit boards to the keyboard body.

We will use for this purpose **TERES-014-Screw-Set**. Note that in this set there are 42 pcs different kind of screws:

- M2x1.5 mm 4 pcs
- M2x3 mm 9 pcs
- M2x4 mm 17 pcs
- M2x5 mm 12 pcs

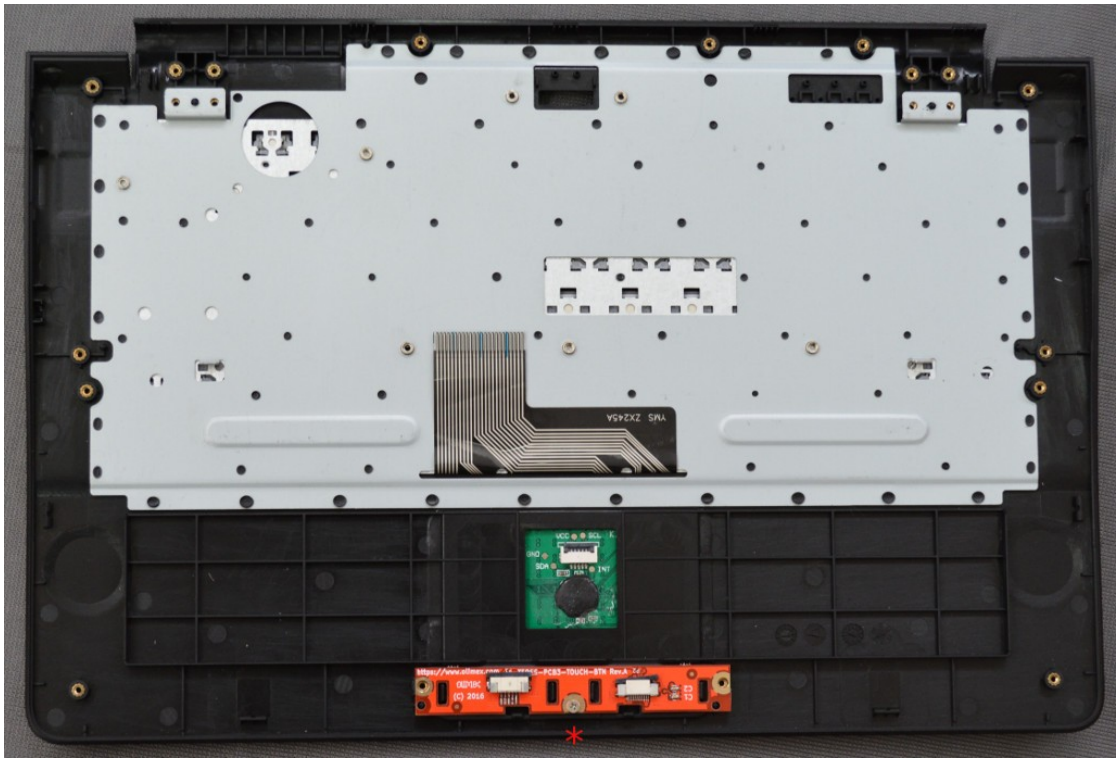
every screw has his destination and you should put it to the exact place without mixing screws with different lengths as this may damage the plastic parts if wrong screw is used.

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

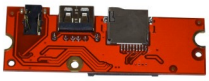
For the PCBs the M2x3 mm screws must be used.

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

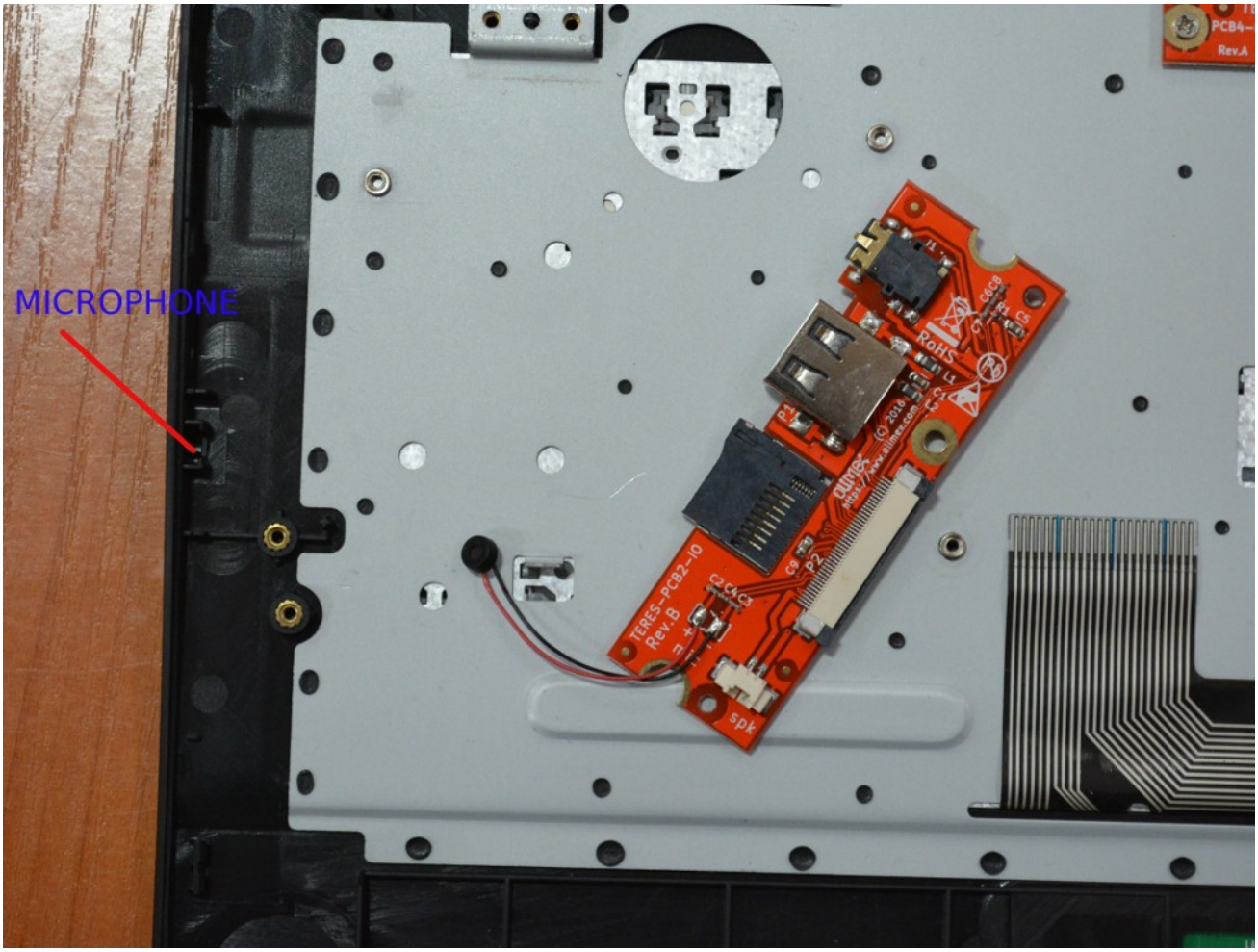
Here it is attached to the keyboard body, note that only the middle screw is used, the other two will be screwed with the bottom cover plastic:



Next PCB to attach **TERES-PCB2-IO**:

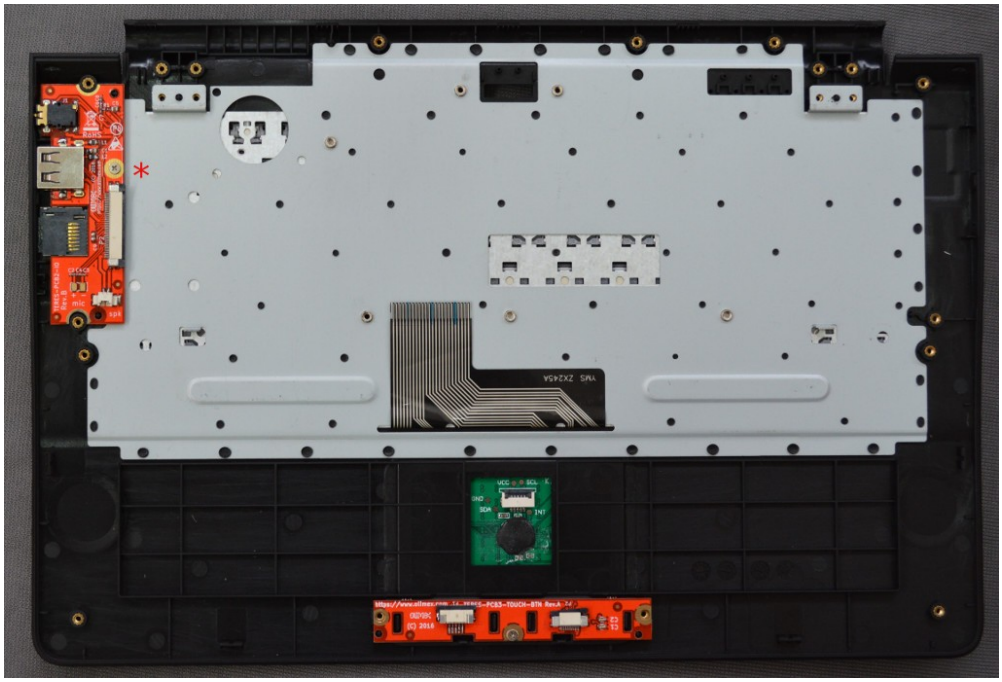


This board has microphone which has first to be placed in the side pocket specially designated for it.



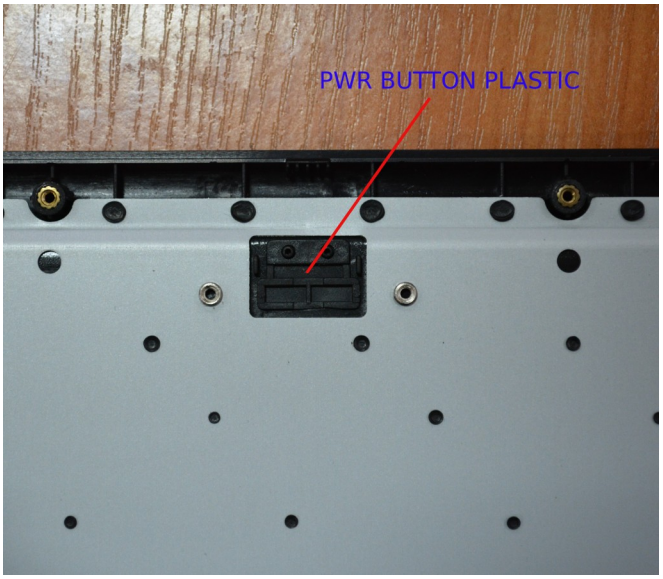
After the microphone is put in place, slip the board at angle to the side openings for the SD card, USB and Audio connector and then place down.

Then use one M2x3 mm screw to fix the board:

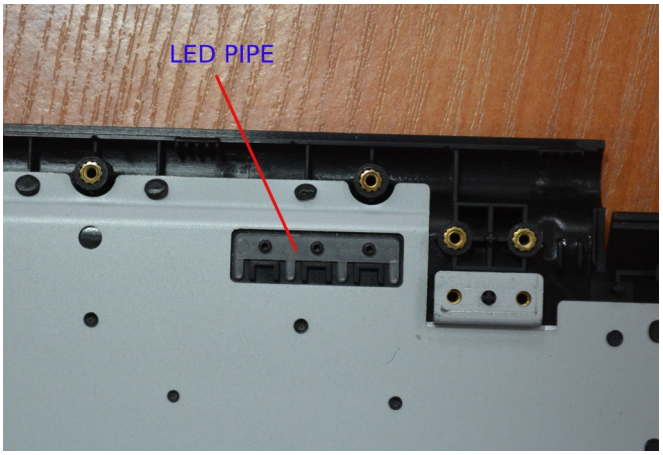


Please make sure that the side connectors are well aligned:

Next you put the PWR button plasstic:

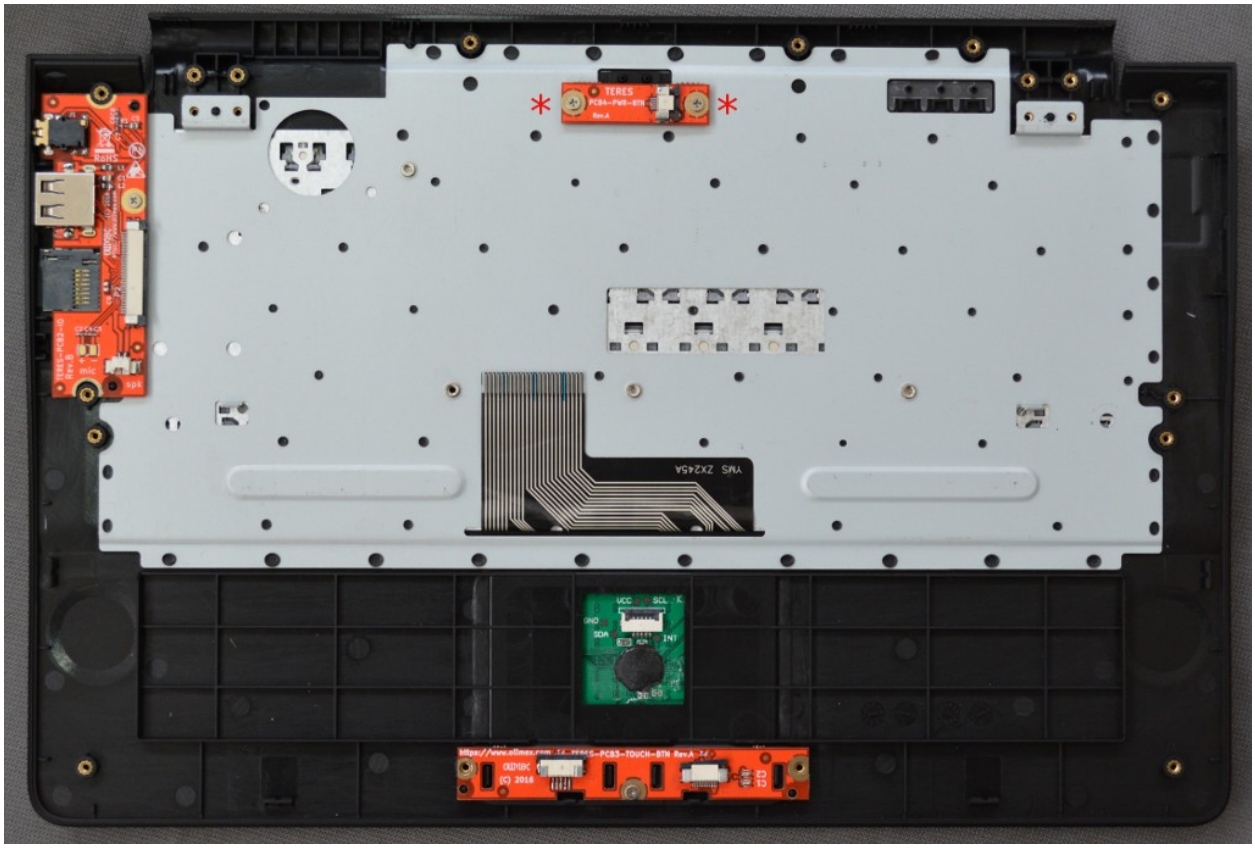


Then the LED pipe:



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

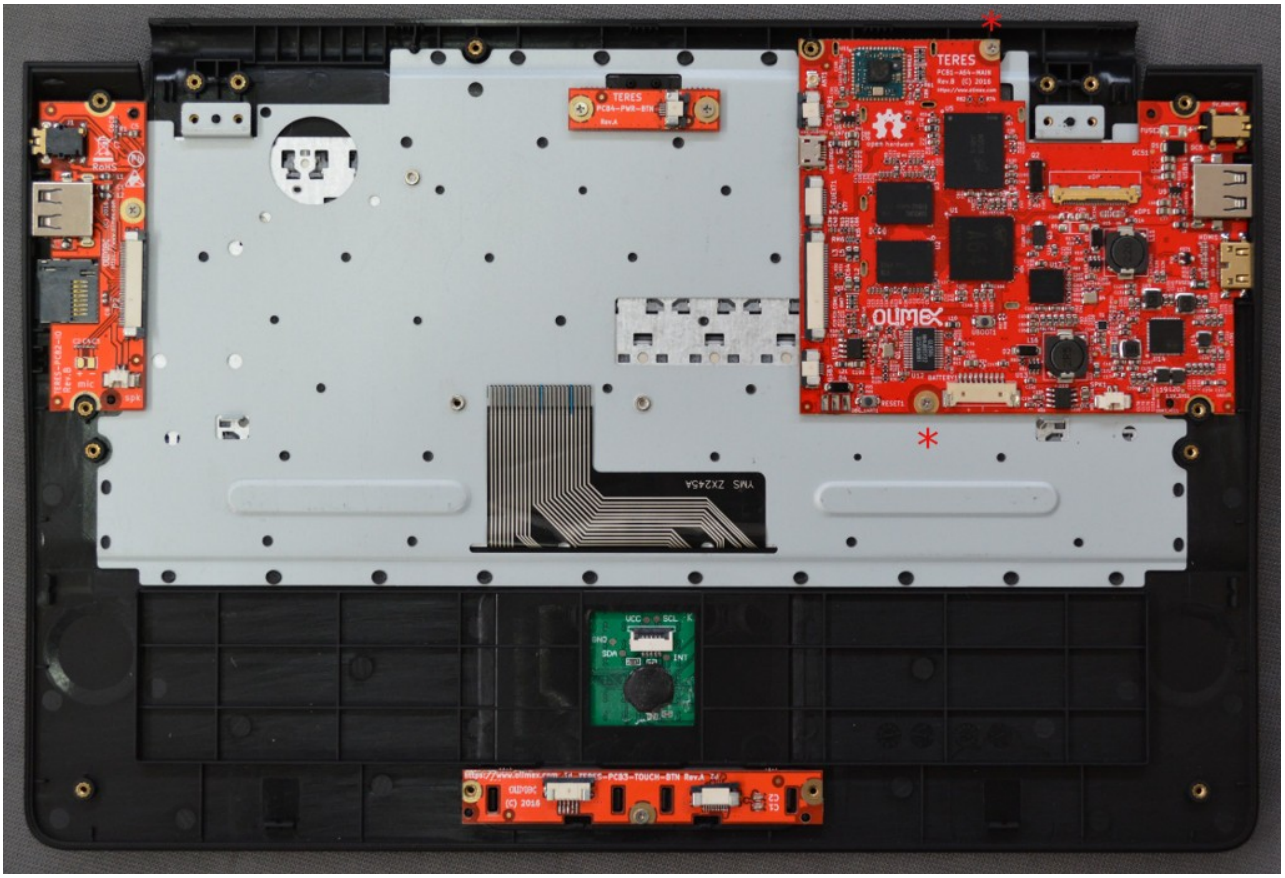
TERES-PCB4-Btn is attached with two screws M2x3 mm, connector on right side:



Next step is to assembly the big **TERES-PCB1-A64**:

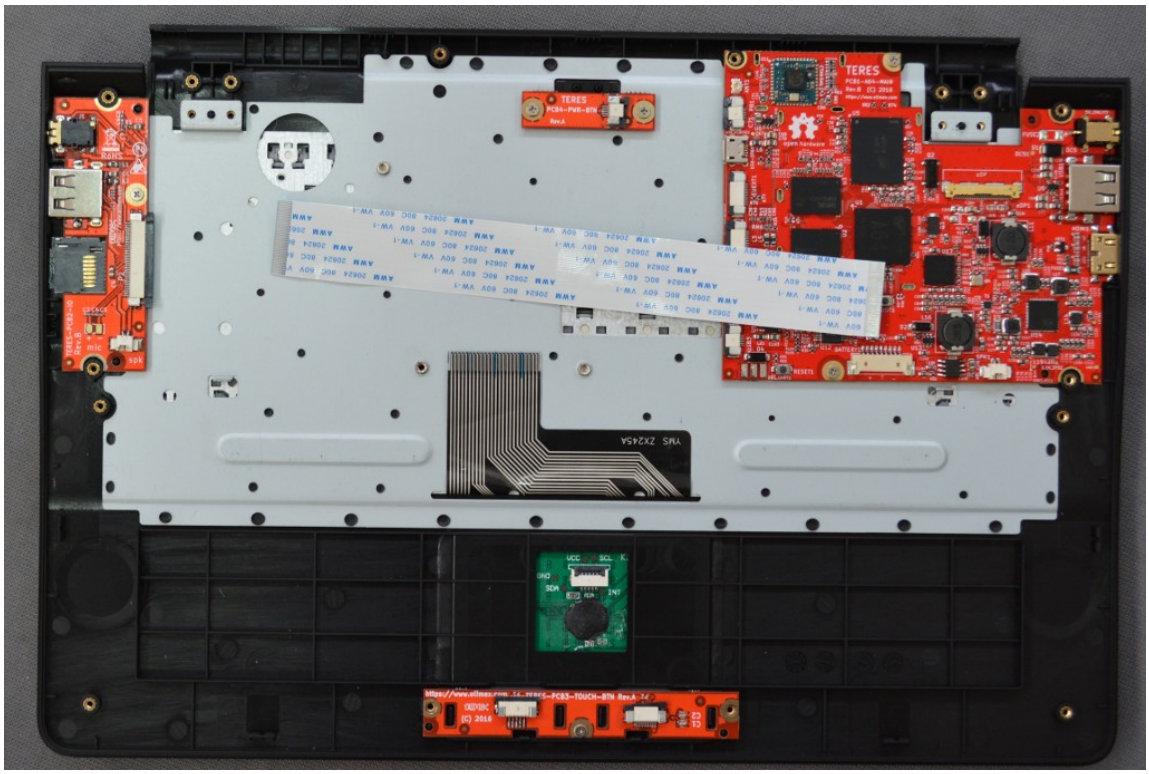
This is the main board and you should handle it very carefully without bending, drop it etc. This board is also very sensitive to static electricity.

It’s a bit tricky to put it on 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 PCB support nuts from the keyboard body pass exactly the openings of the PCB, you need just two screws M2x3 to attach:

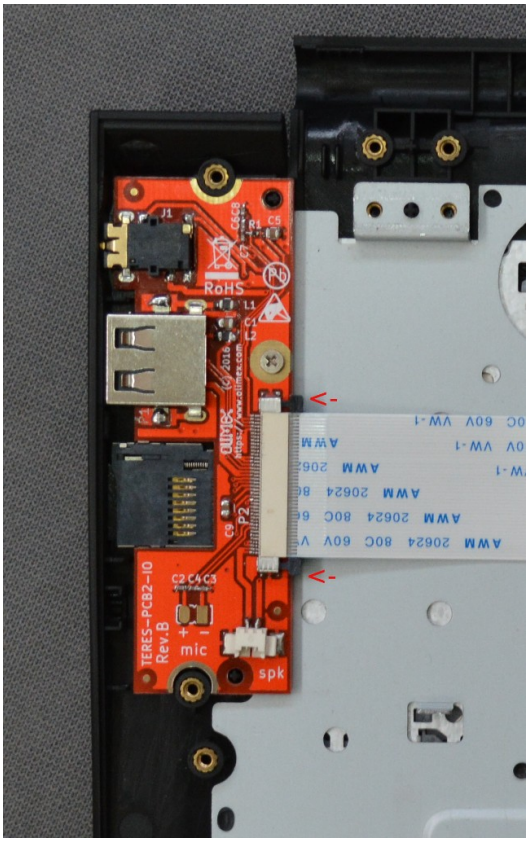


Again you must check if the side connectors are aligned:

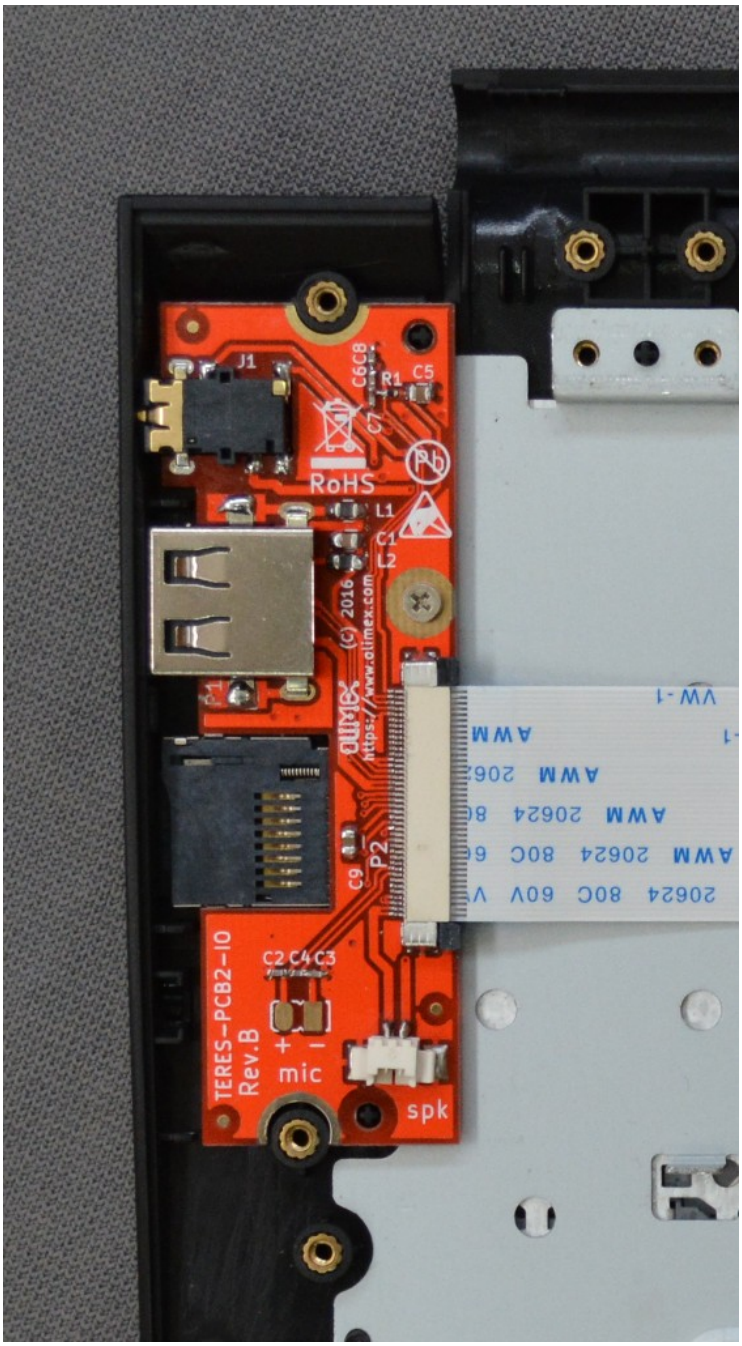
Now we have to connect **TERES-PCB2-IO** with **TERES-PCB1-A64**. For this purpose we use Flat Cable **TERES-027-FPC-IO-Main**.



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

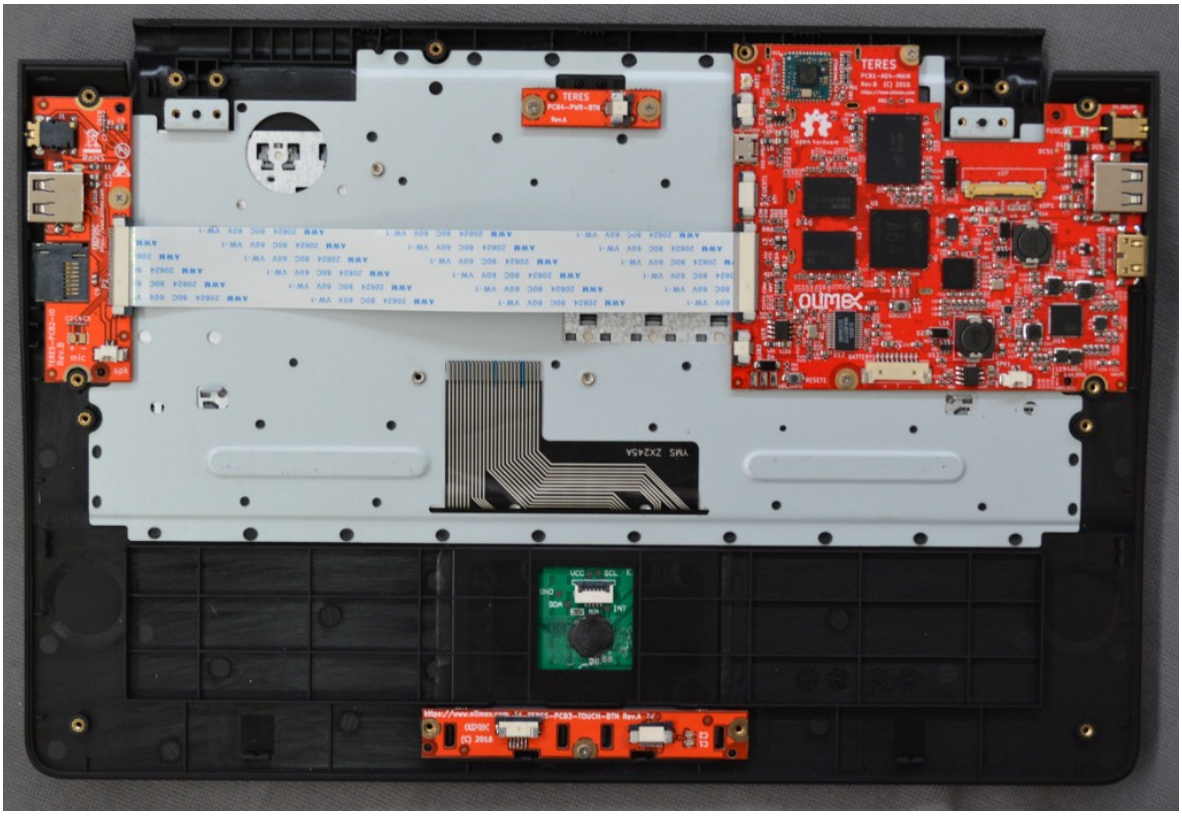


After you insert the cable push the dark plastic back so it holds tight the cable to the connector:

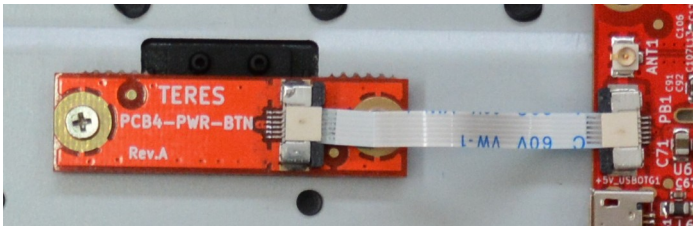


repeat the same with the **TERES-PCB1-A64**.

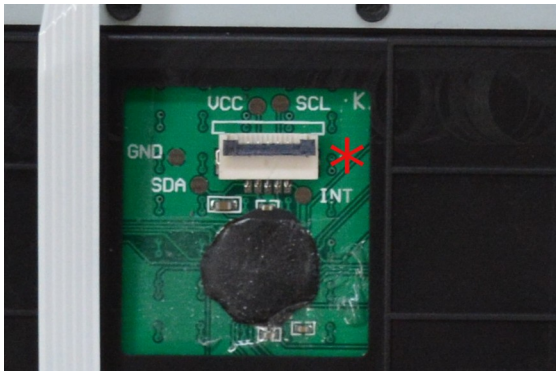
Now **TERES-PCB2-IO** and **TERES-PCB1-A64** are connected together:



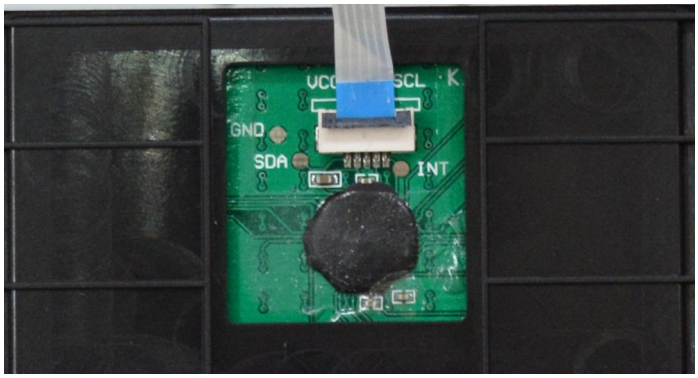
Let’s do the same for **TERES-PCB4-Btn** and **TERES-PCB1-A64**, for this purpose we use the small flat cable **TERES-028-FPC-Pwr-Main**. These connectors are of the same type you should pull the dark plastic and insert the flat cable with the contacts UP between the white and dark plastic then push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



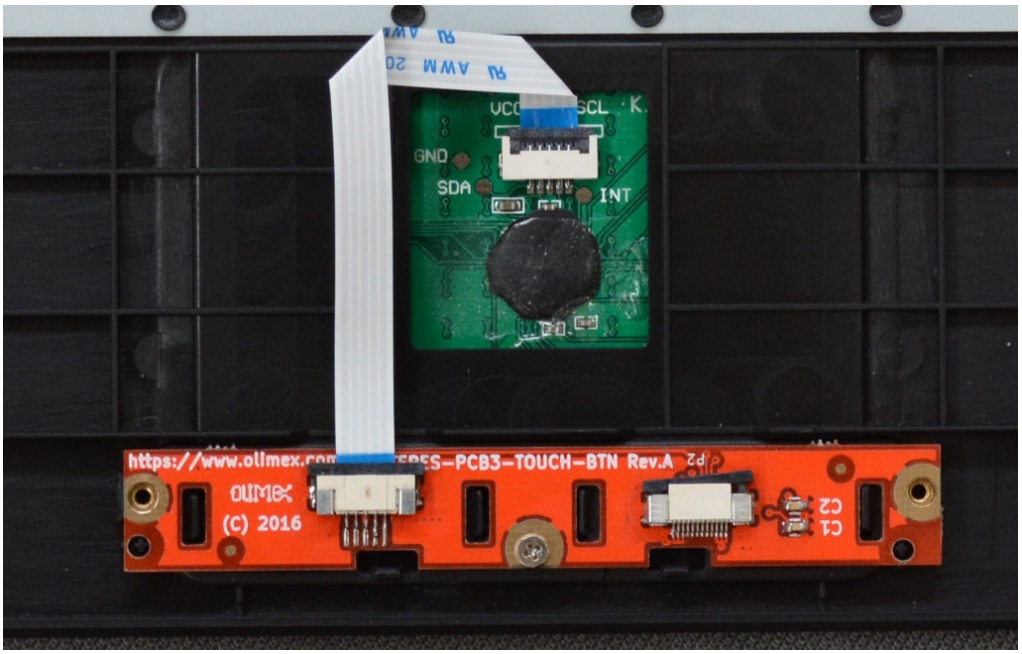
Next step is to connect the touch panel **TERES-023-Touch** to the board with touch buttons **TERES-PCB3-TOUCH** we will do this with flat cable **TERES-029-FPC-Touch-Btn**. Note that these connectors are different, the touch panel connector has hunge and the dark plastic is opening upside as on this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



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

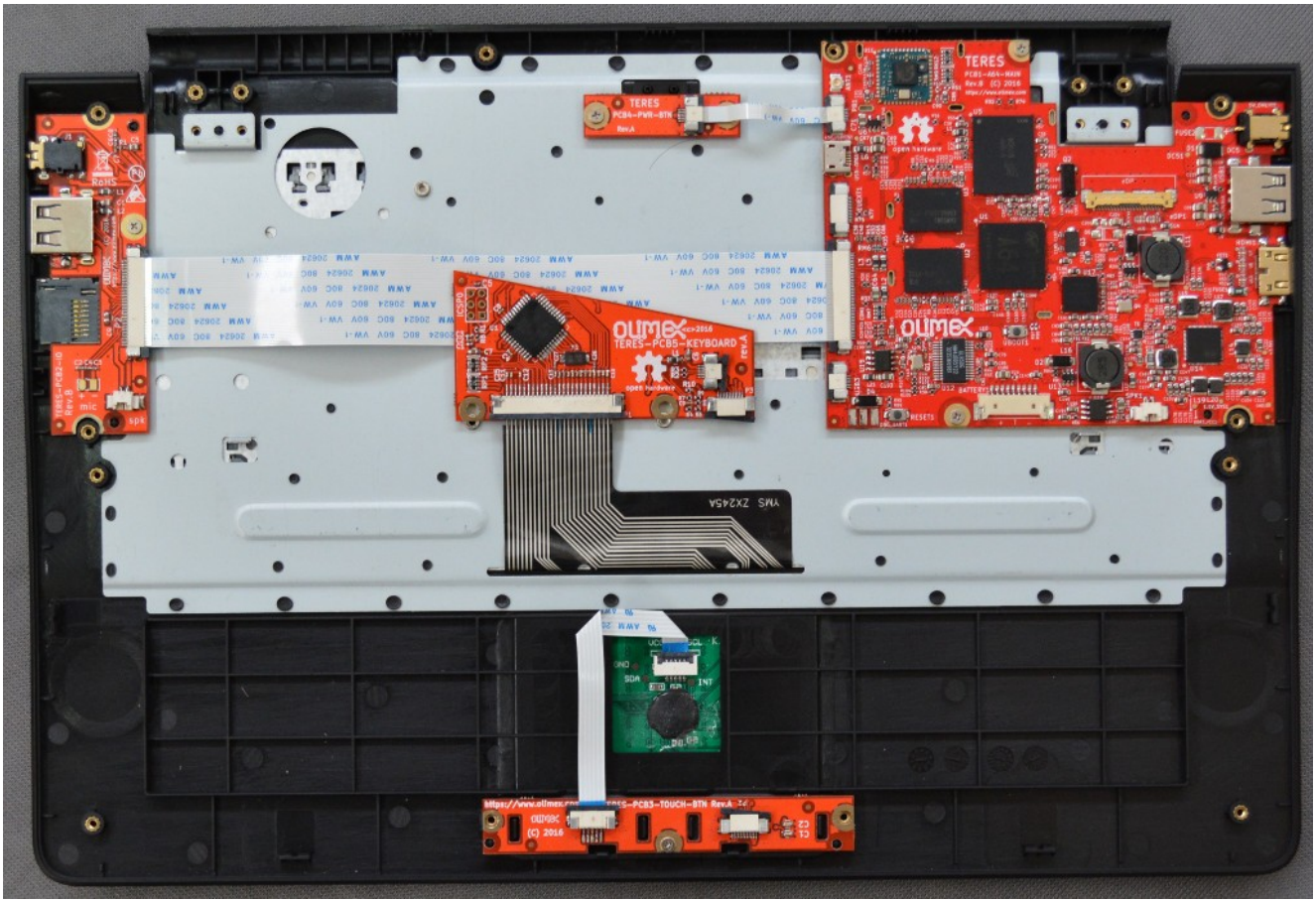


The connector on **TERES-PCB3-TOUCH** is also different so the cable is inserted **below** the dark plastic again with blue back pointing up:



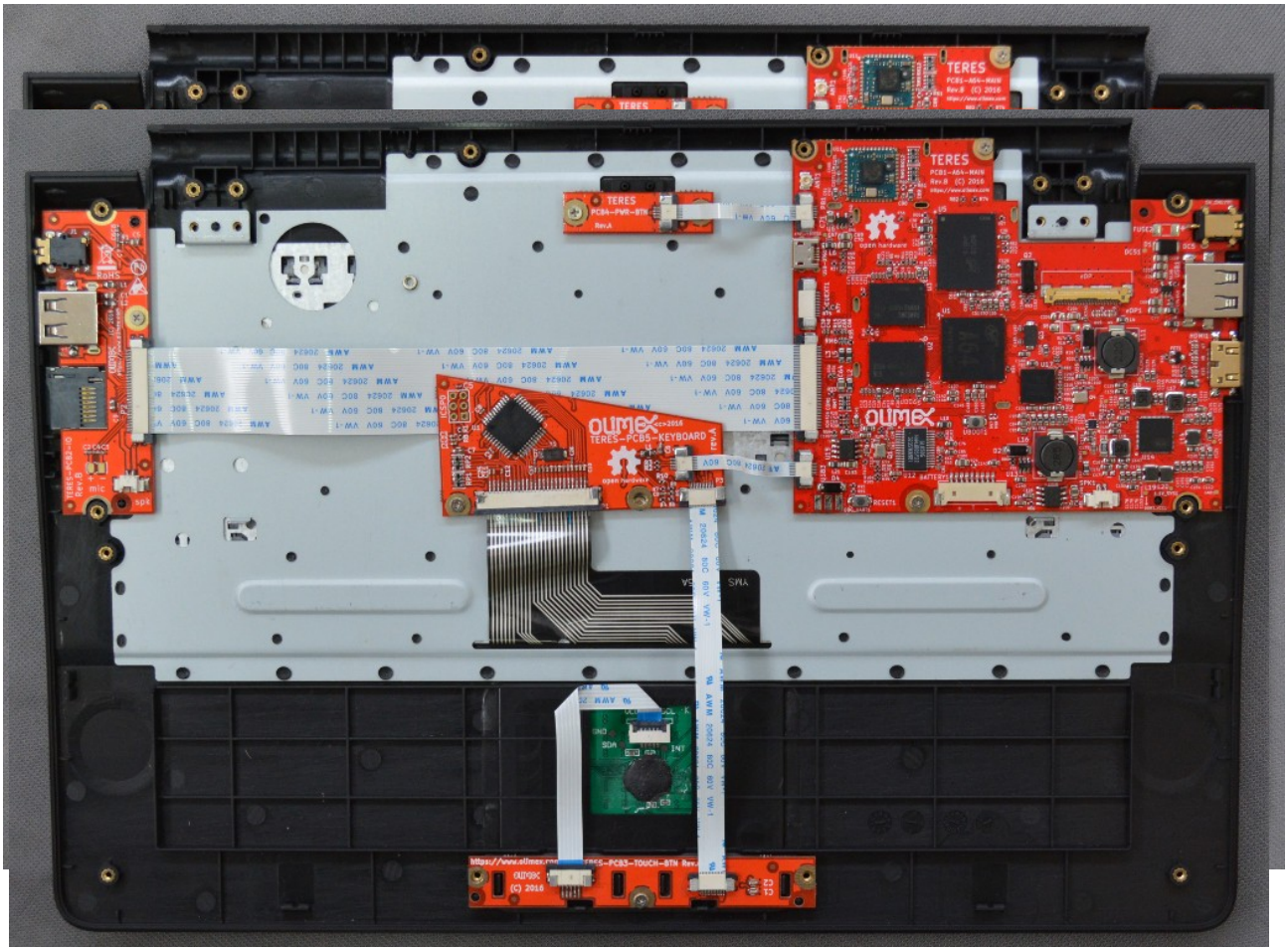
You have to bend the cable twice, do not bend at too sharp angle and too hard to not break it!

Next step is to attach **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:

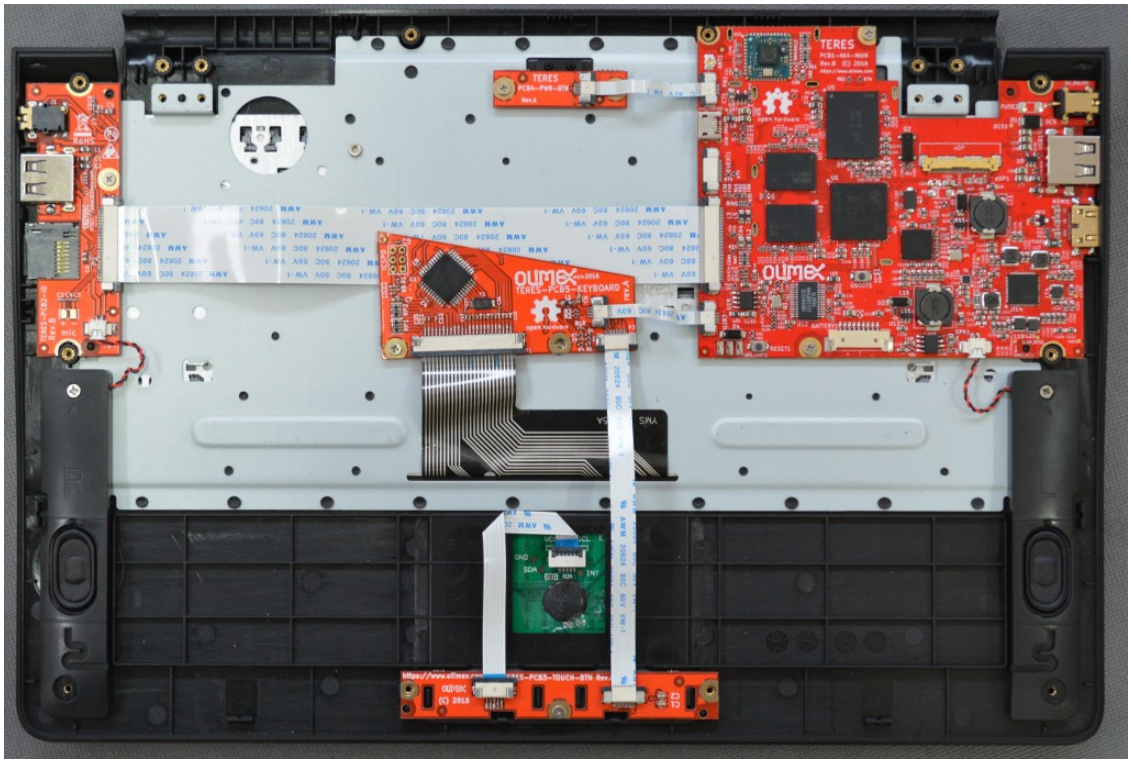


Do not assembly the keyboard PCB to the plastic base yet.

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 inserting with contacts up above the black plastic of the connector same as power button and main board cables:



Next we connect **TERES-PCB5-KEYBOARD** with **TERES-PCB1-A64** and with one screw M2x3 attach **TERES-PCB5-KEYBOARD** to plastic body, note that only the left screw is placed, the right screw will be inserted from the bottom plastic.



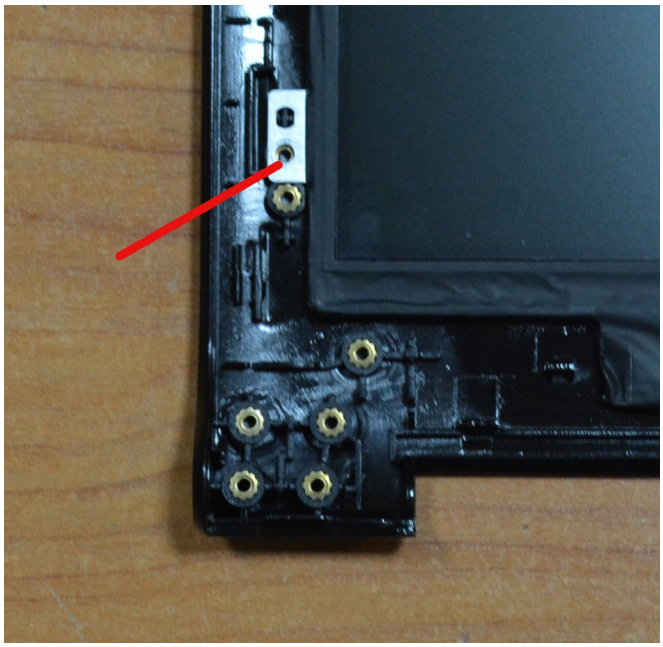
The final assembly step is to attach the left and right speakers, as we look now on bottom side you will notice that Right speaker is assembled at left hand side, and Left speaker at the right hand side. For this purpose we use M2x4 screws and only upper one is screwed, the speakers connectors should be inserted in **TERES-PCB2-IO** and **TERES-PCB1-A64** boards.

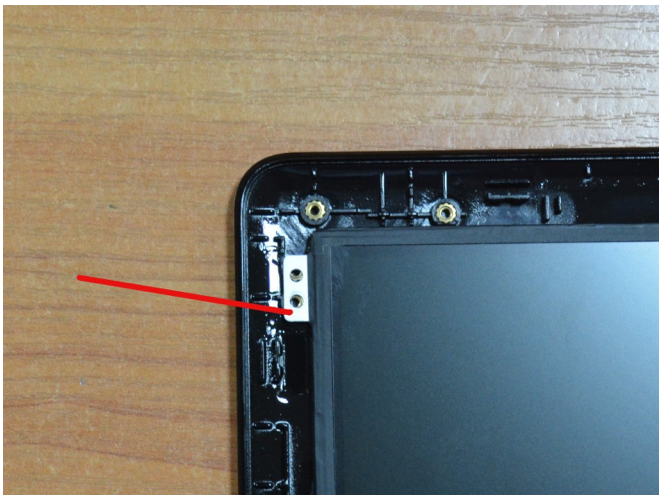
Now lets' continue with LCD frame assembly using as base **TERES-008-LCD-Back**:

First lets attach the metal hinges to it **TERES-016-Hinge-Set** using 8 pcs M2x4 mm screws:

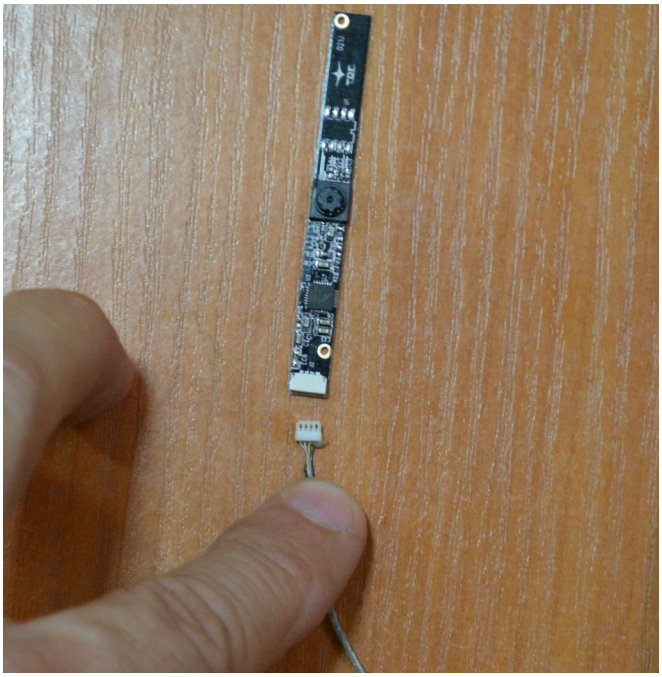
Next attach **TERES-026-LCD-cable** to **TERES-015-LCD11.6"** LCD panel:

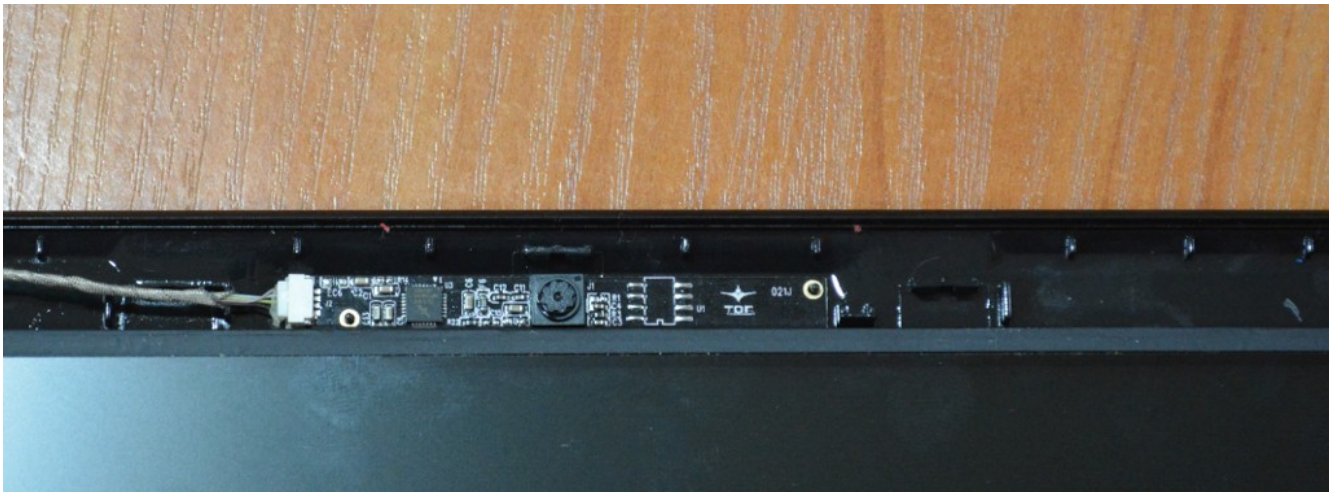
With screws M2x1.5 assembly the LCD to the plastic, note that only 4 screws are used!



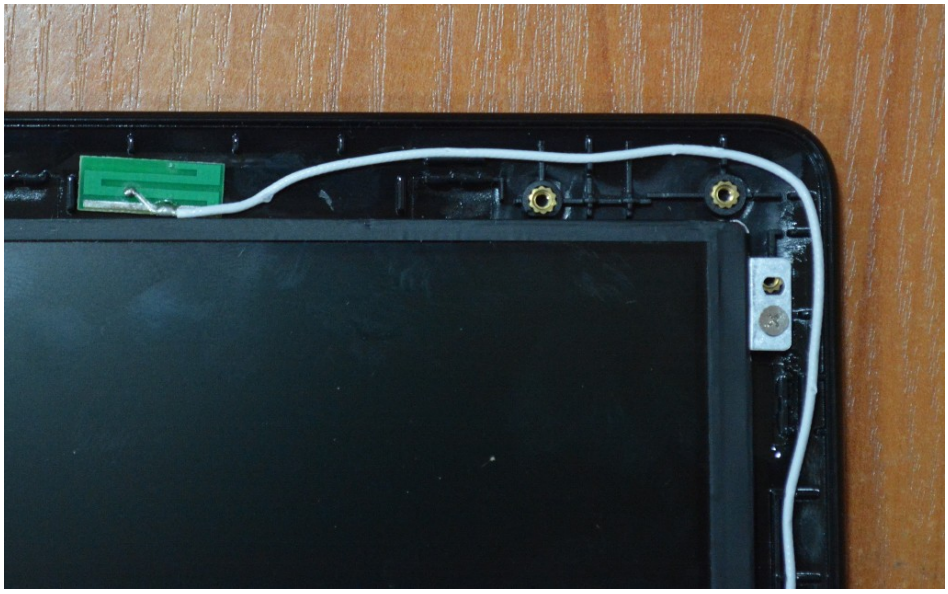


Connect the **TERES-019-Camera** to the four pin connector of the **TERES-026-LCD-cable**, there are two holes in the camera board which stick to two pins on the plastic body.





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



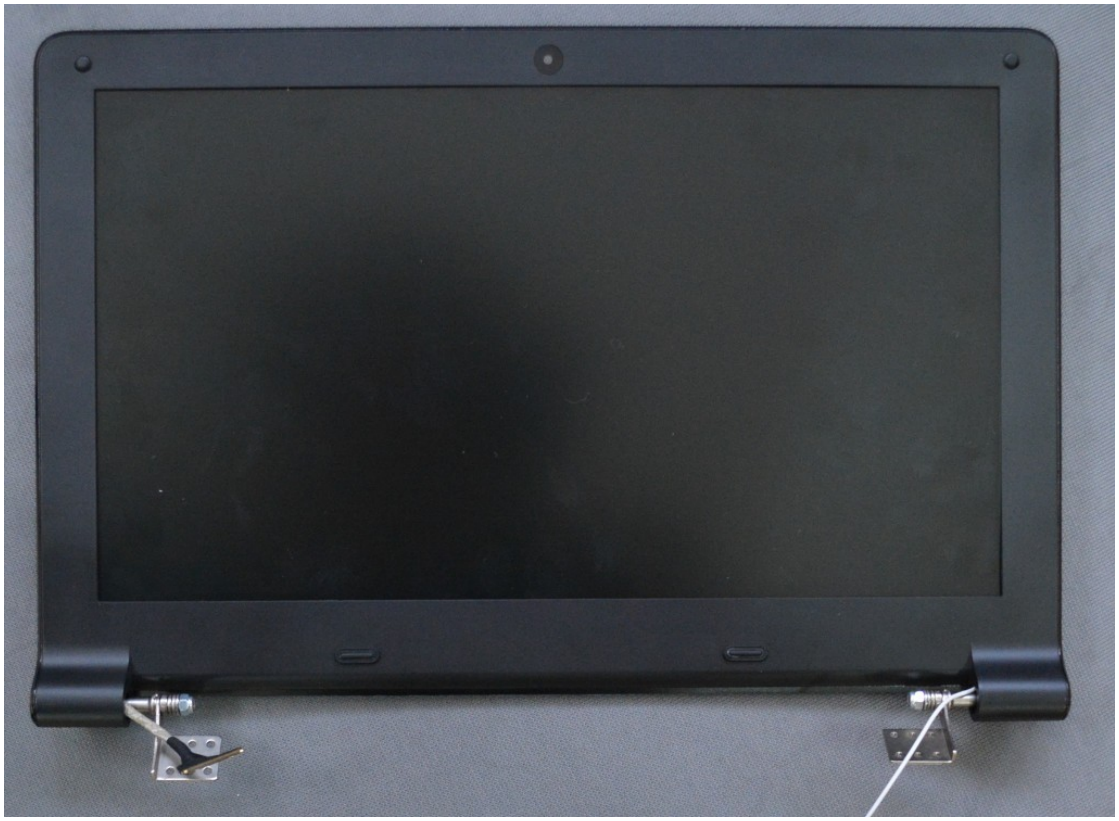
Follow this wiring for where the LCD and WiFi cables go through. Pay attention how the cables go out around the hinges!

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

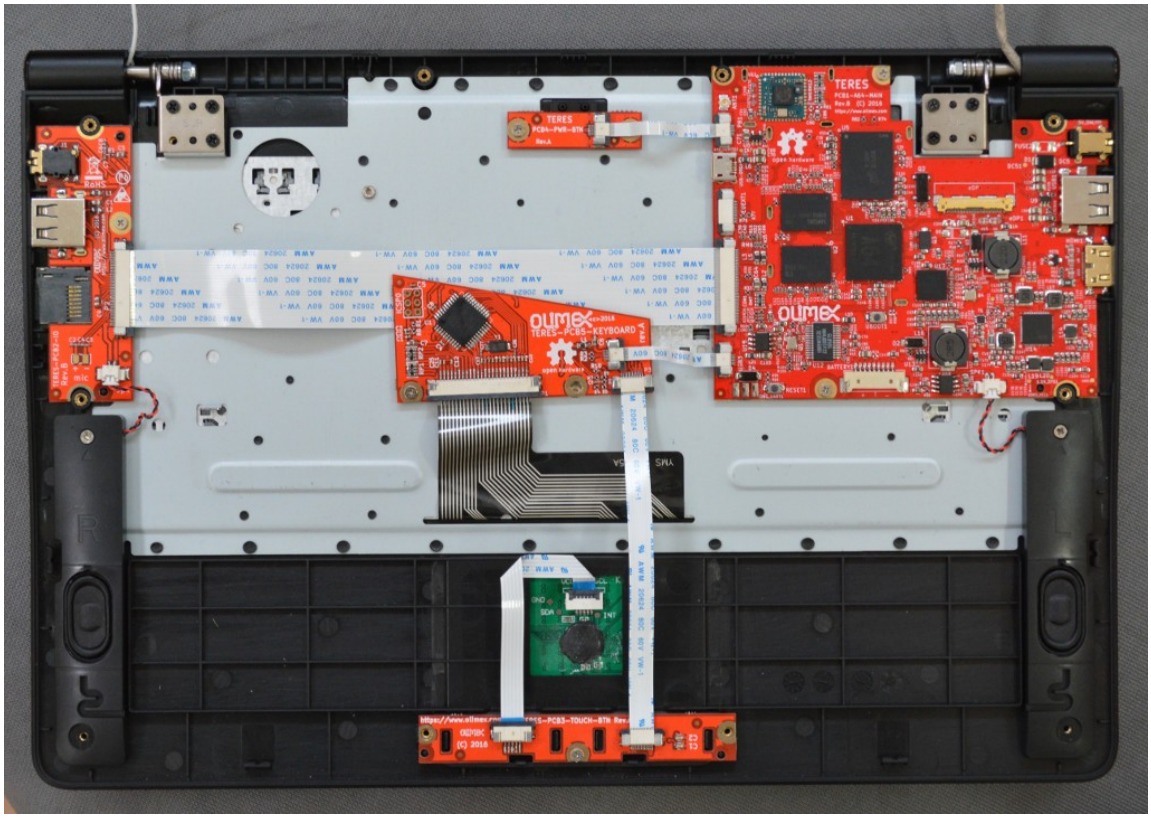
The LCD cable wiring is probably most difficult part of the whole assembly, if you do not do correctly the LCD frame will not snap tight. If you did everything correctly you will have something like this:

then fix the upper corners with M2x3 mm like this:

Then place the **TERES-020-Camera-Lens** above the camera sensor and rubber mats over the two screws:

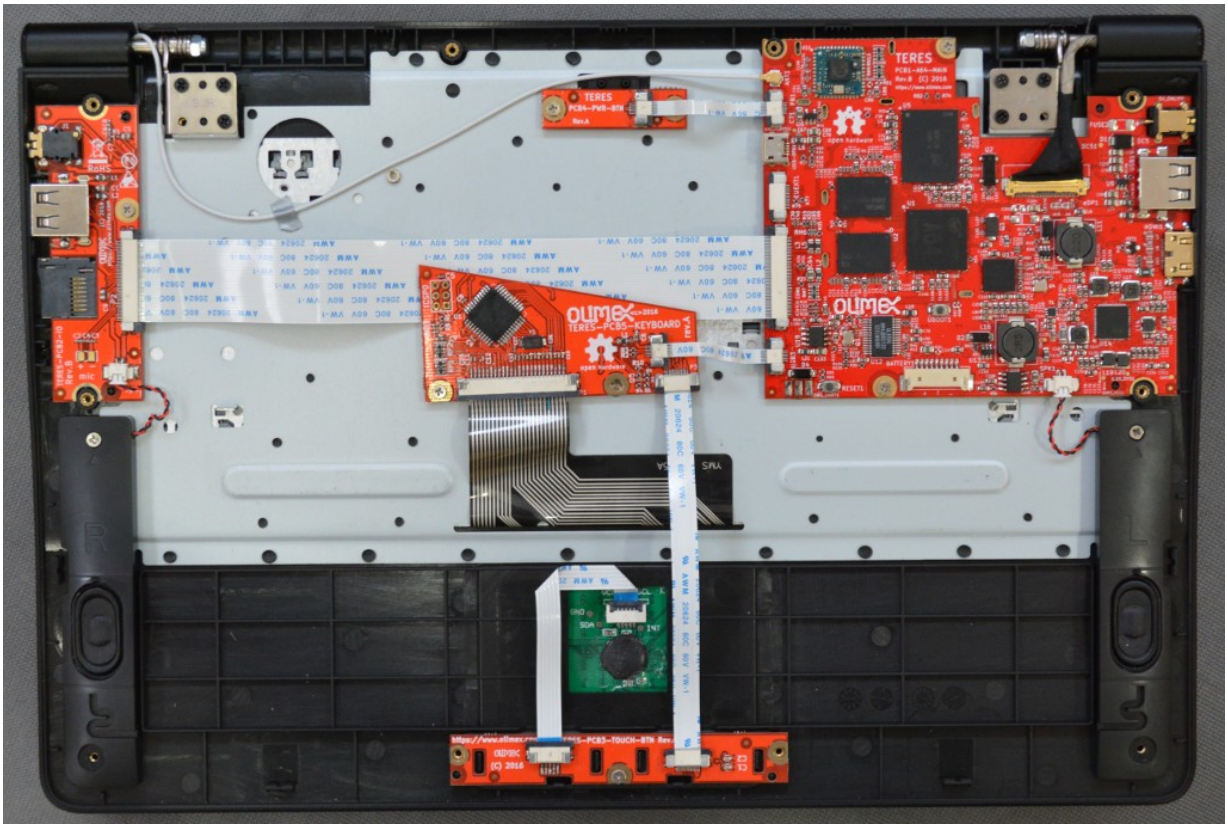


Now we are ready to assemble the LCD part with the keyboard body. We will use 6 screws M2x4 for this purpose:

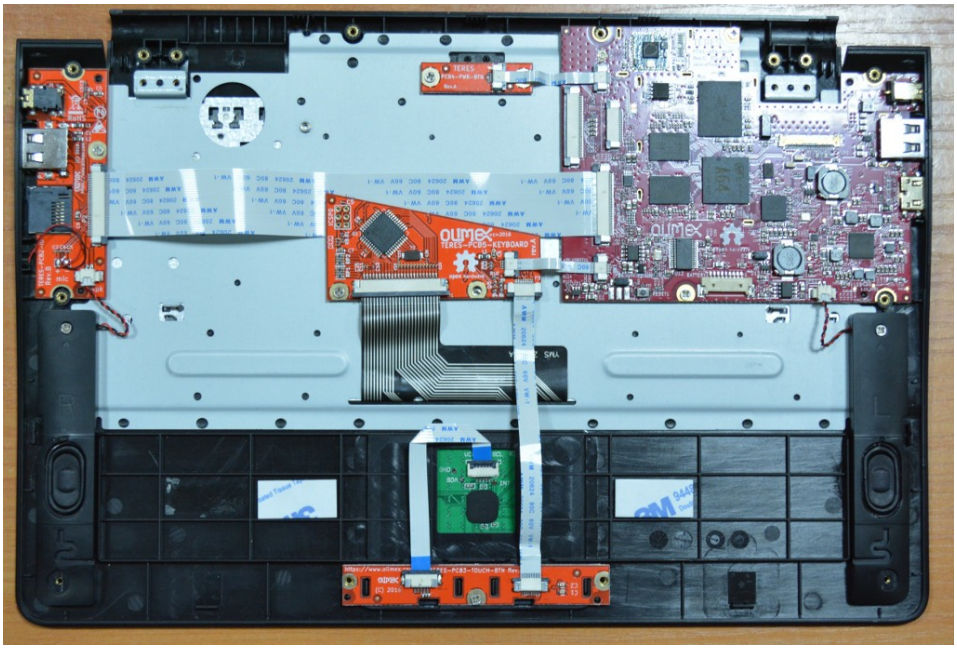


Note that there are four places on the hinges but only 3 are assembled with screws, the fourth screw will be from the bottom plastic body attachment. The places where you have to put screws are stamped at the metal hinges with arrows.

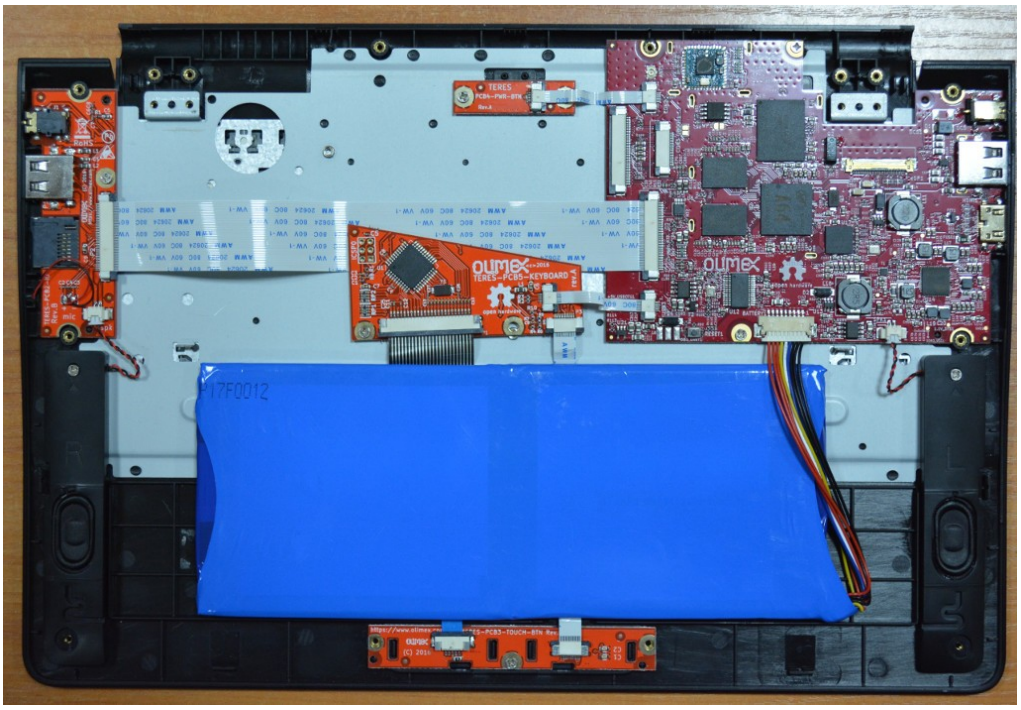
Next let’s connect WiFi antenna cable and LCD cable to **TERES-PCB1-A64**:



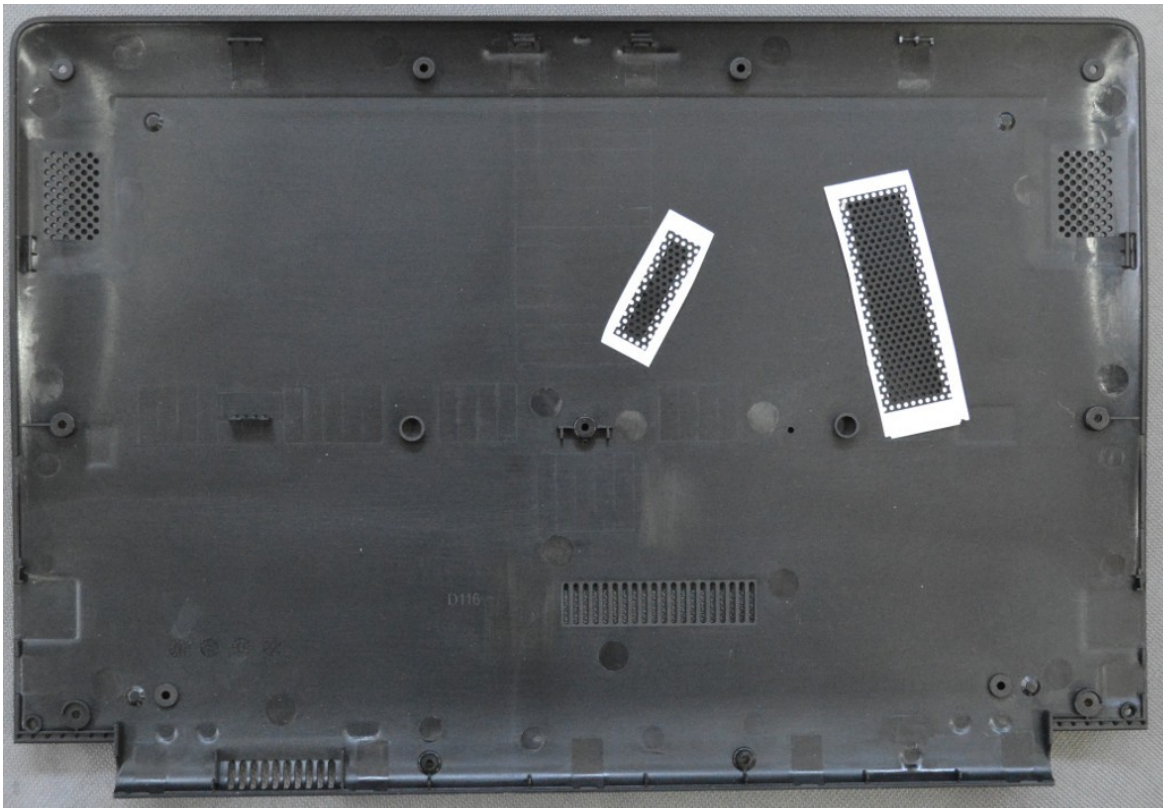
Next step is to attach four double adhesive mats to which we will snap the LiPo battery:



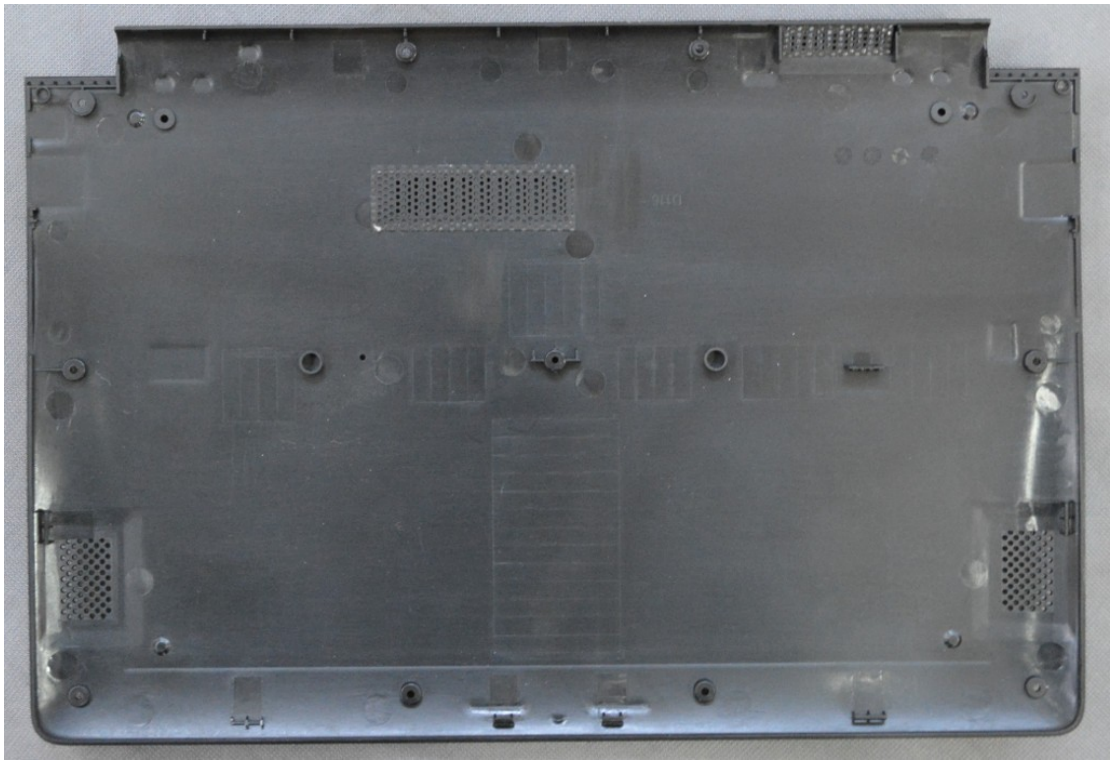
and of course to snap the battery and plug the battery connector to the PCB1. Mind the polarity! Red cables are on the left side.



Now let’s prepare the bottom plastic TERES-005-Bottm with the TERES-021-Dust-Protectors:



here they are placed on the two openings:



Next we assembly the bottom plastic with 12 screws M2x5 mm:

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

The assembly is complete, now press the PWR button and laptop will boot:

Congratulations you assembled your TERES I Laptop!

10. What’s Next?

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

There will be new Main board 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 TERES-I modular concept.

11. Community links: