



THINKPAD X220/X230 FHD MOD

Overview and installation guide

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Document version: 0.2

Jun. 13, 2018

Hardware revision: 5



RECORD OF REVISIONS

Revision No	Revision Date	Page	Description
0.1	Apr. 30, 2018	-	First edition
0.2	Jun. 13, 2018	6	Fixed typo in "Removing R318" section

OVERVIEW

The kit contains 5 items as shown in the figure 1:

1. Adapter board
2. LVDS cable
3. Auxiliary power wire
4. Sense wire
5. eDP cable

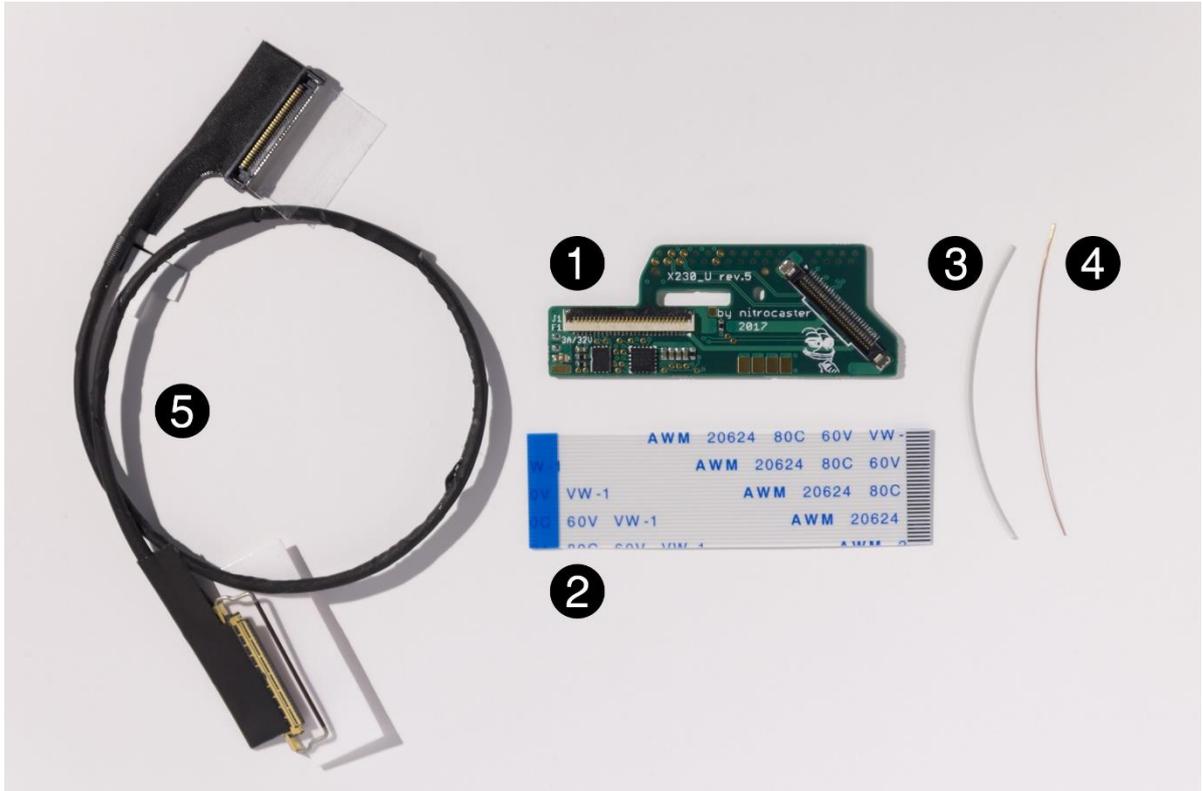


Figure 1. The kit

The adapter board uses 2 DisplayPort lanes from the docking connector, providing enough bandwidth for Full HD display.



DANGER

Turn off the computer, disconnect the power cord and remove the battery pack before proceeding with the installation. To prevent permanent hardware damage, do not plug or unplug any internal cables unless the power cord is disconnected and battery pack is removed.



Note:

All HMM references contained herein apply to *ThinkPad X230 and X230i Hardware Maintenance Manual*, which is available on Lenovo website: <https://support.lenovo.com/docs/um014928>

ADAPTER BOARD

1. PREPARING THE MOTHERBOARD

The adapter board has to be soldered on the back side of the docking connector. For access, do the following:

1. Power off the computer and unplug the AC power adapter from it.
2. Remove the battery pack ("1010 Battery pack", HMM page 56).
3. Remove the keyboard ("1040 Keyboard", HMM page 60).
4. Remove the palm rest ("1050 Palm rest", HMM page 63).
5. Remove the keyboard bezel ("1110 Keyboard bezel", HMM page 75).

The motherboard is covered with black protective film, which has to be removed in the areas around solder points. Figure 2 shows these areas for X220 and X230 motherboards.



Figure 2. Solder points for X220 (on the left) and for X230 (on the right)

Do not try to save time by ripping a big piece. Instead, remove the least required pieces using X-ACTO knife. Carefully puncture the film and cut from the inside to avoid cutting PCB traces.



Figure 3. Removing the protective film (cutting edge points up)

Figure 4 shows **Area ❶** which covers docking connector pins with nearby components after the protective film is removed.

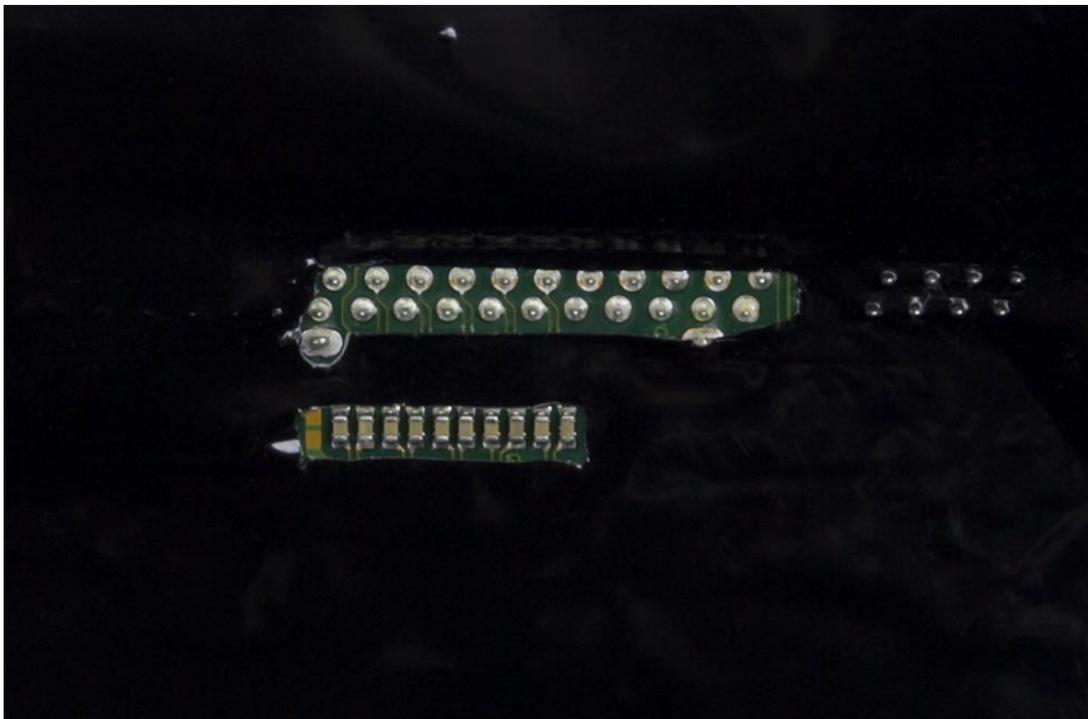


Figure 4. Docking connector area prepared for adapter board installation

Figure 5 shows **Area 2** which covers pads for auxiliary power wire.



Figure 5. Auxiliary power pads of X220 (on the left) and X230 (on the right)

2. REMOVING R318

Figure 6 shows resistor R318 which is installed on X220 motherboard with Core i7 CPU. If this is not your case, skip this step. Otherwise, remove R318 before proceeding with the next step. Remove only a small piece of protective film which covers the resistor, do not remove more than actually required like in the picture below – it is only to show where the resistor is located.

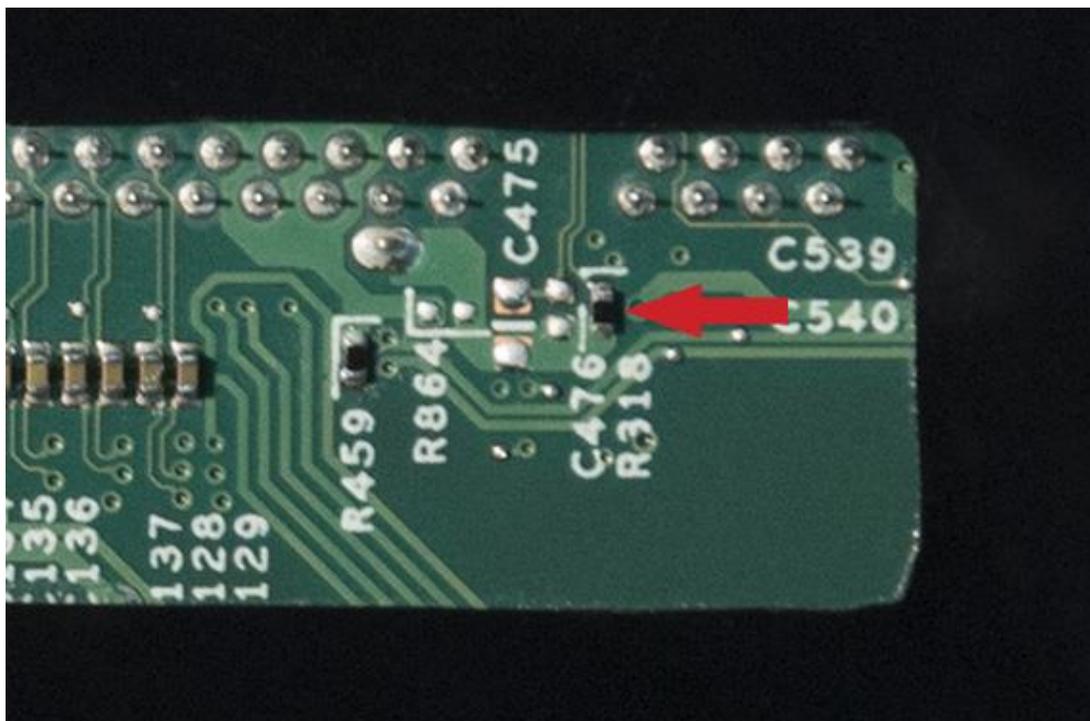


Figure 6. R318 resistor on X220 motherboard with Core i7 CPU

3. SOLDERING THE SENSE WIRE

The sense wire has to be soldered before the adapter board. Figures 7 and 8 show the pad which the sense wire is soldered to. Note that the wire which comes with the kit is enameled, so you have to remove the enamel from one end of the wire before soldering. Be careful not to bridge adjacent capacitors.

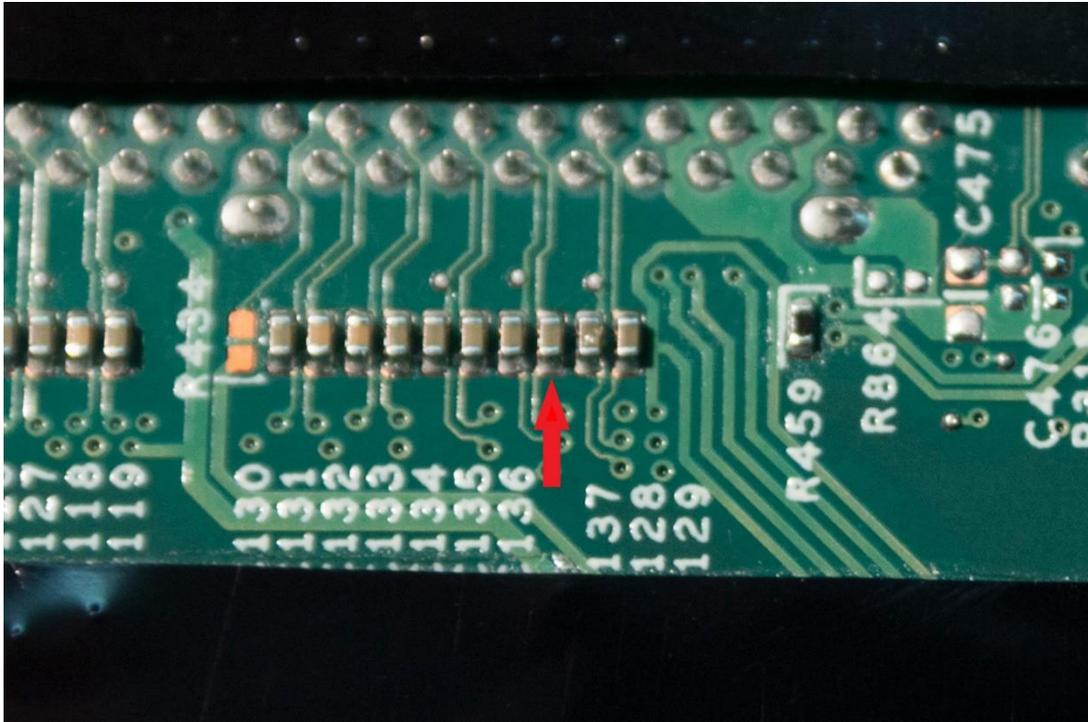


Figure 7. The pad for the sense wire

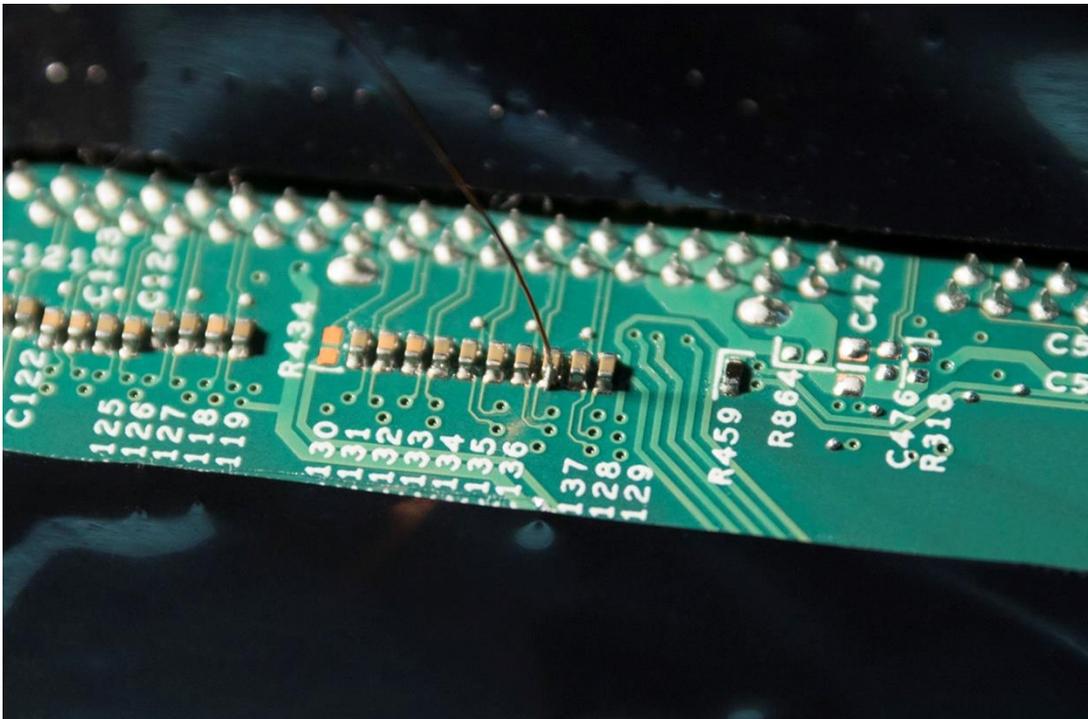


Figure 8. The sense wire soldered to the capacitor's pad

4. SOLDERING THE ADAPTER BOARD

The adapter board attaches to the motherboard (specifically, to the docking connector pins) by 7 plated-through holes, as shown in figure 9. Each PTH must be soldered to the docking connector pin.

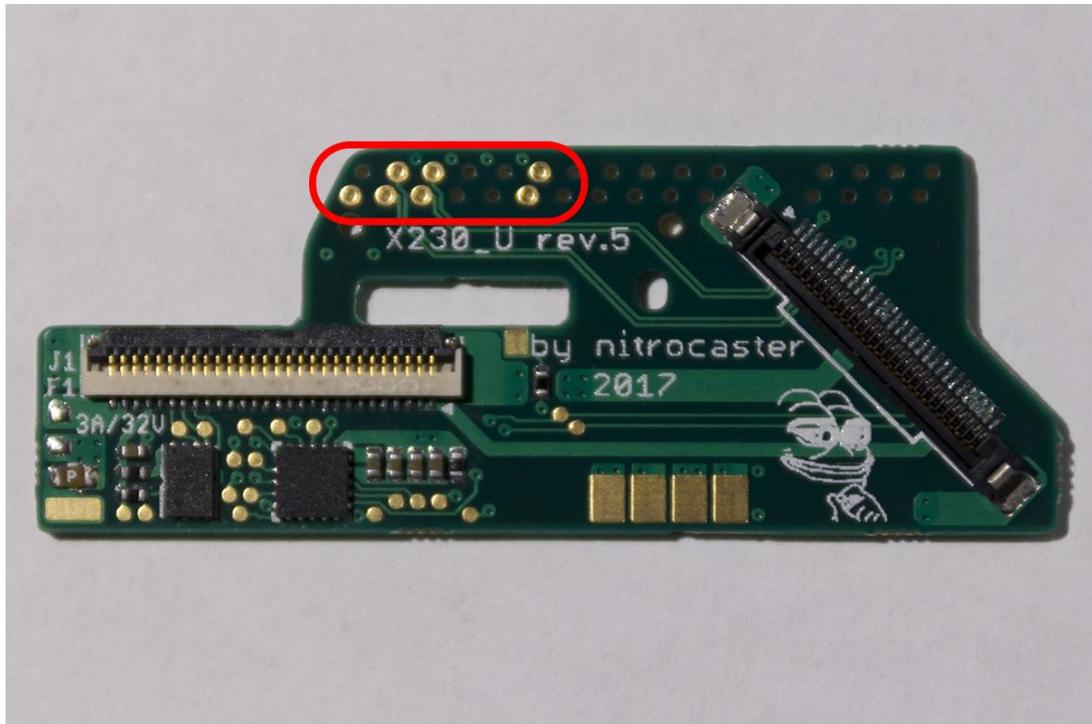


Figure 9. Plated-through holes

Do the following:

1. Place the adapter board on the motherboard, pulling the sense wire through the slot in the adapter board, and make sure it locks in position where docking connector pins are inserted in the mating holes. Check that the adapter board lies flat on the motherboard;
2. Set the temperature to 300 C;
3. Put some flux on each PTH (see figure 10);
4. Heat each PTH by touching it with a tip. Avoid applying any pressure to PTHs as it may damage them while not helping to heat the joint. As soon as the flux melts and flows down the hole, slowly feed a solder wire to the pad, allowing it to gradually fill the PTH;
5. Add more flux and reheat each PTH for at least 6 seconds to make sure there is no air trapped inside. The result is shown in figure 11;
6. Put some flux on the sense wire pad, then add some solder and push the sense wire against the pad with a tip to remove the enamel (see figure 12);
7. Once the sense wire is soldered, remove the remaining piece and clean the area from flux (figure 13).

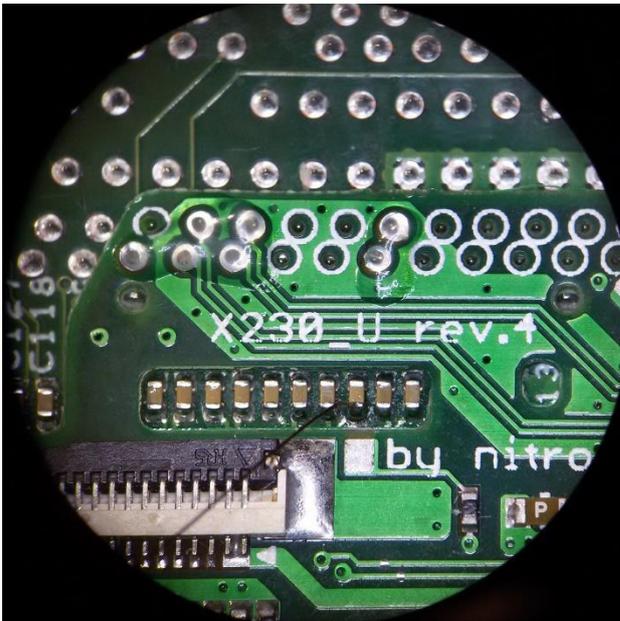


Figure 10. Putting the flux

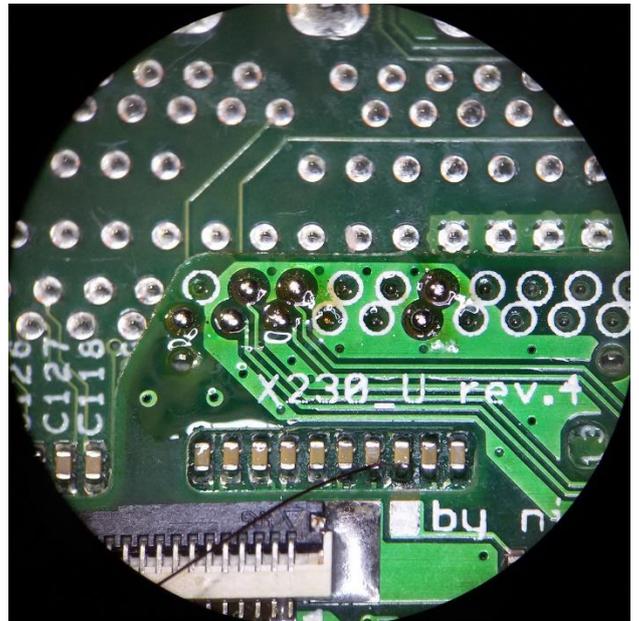


Figure 11. Soldering PTHs

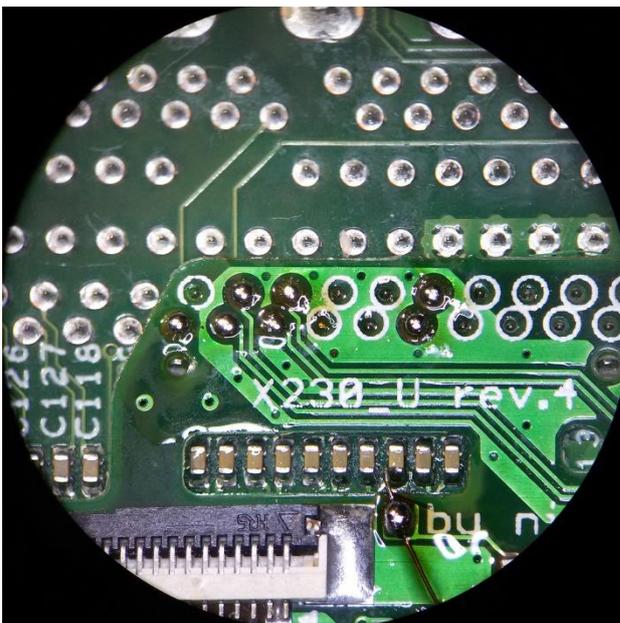


Figure 12. Soldering the sense wire

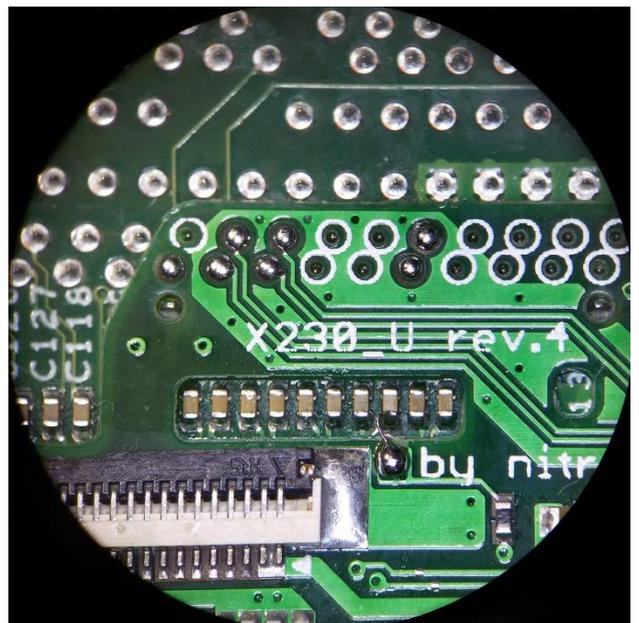


Figure 13. Cleaning the area

5. SOLDERING THE AUXILIARY POWER WIRE

The auxiliary power wire provides power for the display logic board. Do the following:

1. Find the corresponding pad on the motherboard (see figure 14);
2. Put some lead solder to the pad on the motherboard before attaching the wire to reduce soldering time and prevent wire insulation from excessive deforming;
3. Once one end of the wire is soldered to the motherboard, cut it to the length enough to attach the other end to the pad on the adapter board (figure 15);
4. Solder the wire to the pad on the adapter board;
5. Clean the area from flux.

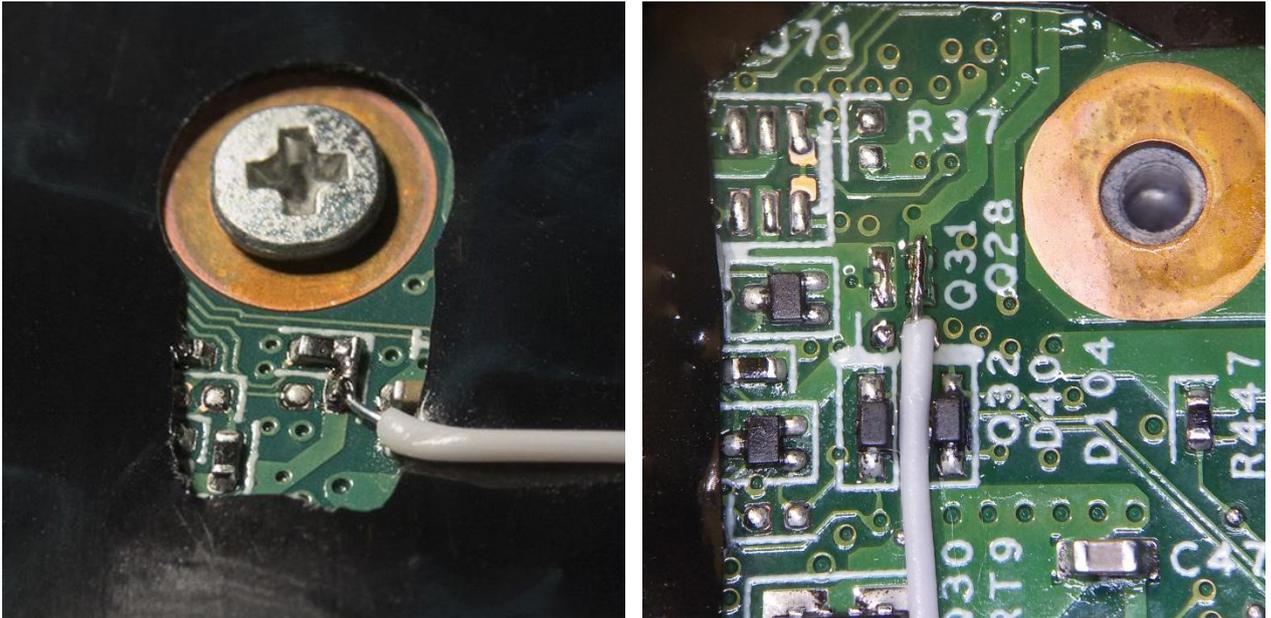


Figure 14. Auxiliary power wire soldered to X220 (on the left) and X230 motherboard (on the right)

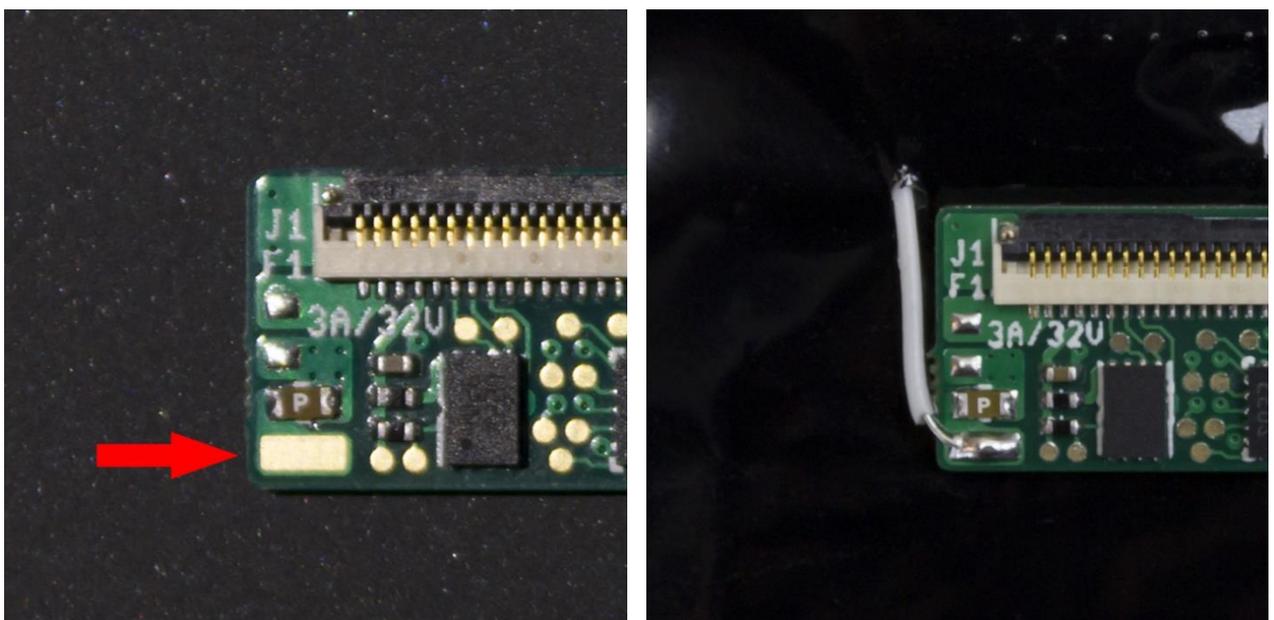


Figure 15. Auxiliary power wire pad on the adapter board

LID

Because the logic board of a new panel is wider, some parts of the lid have to be removed. For access to the LCD panel, refer to page 87 of the HMM ("2030 LCD panel"). Once the stock panel is removed, do the following:

1. Remove the hinges;
2. Remove and disconnect the status LED board;
3. Cover the power status indicator area with a tape to avoid debris sticking to the inner surface of the icon plate (see figure 16);

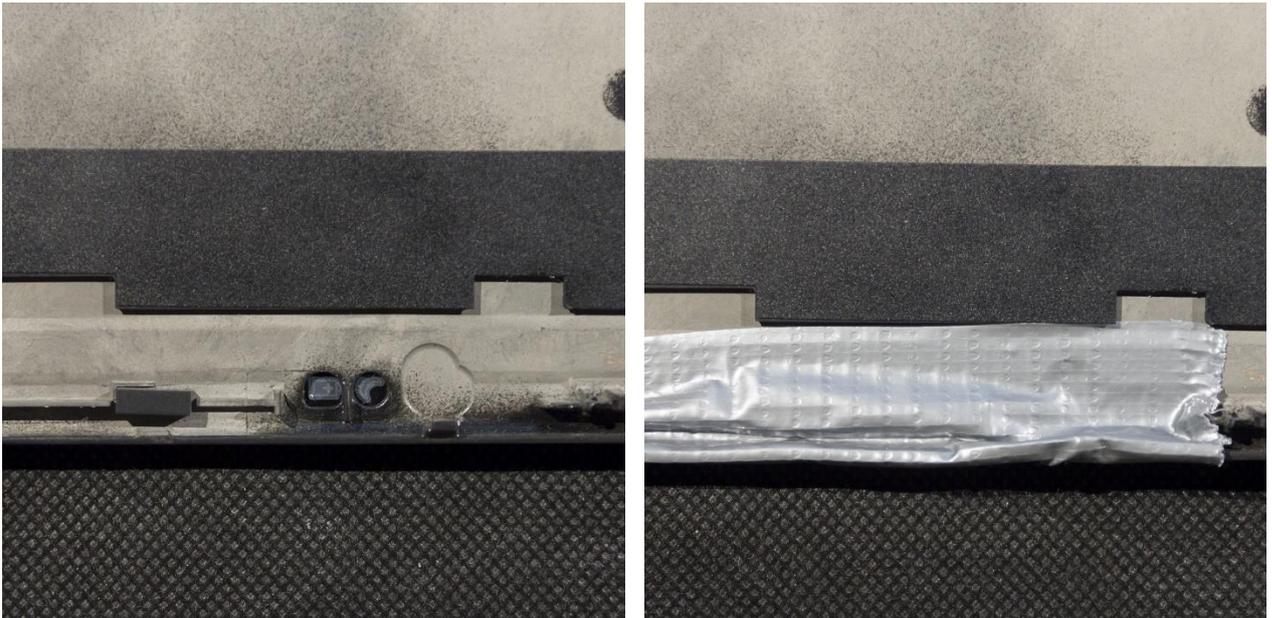


Figure 16. Power status indicator area

4. Remove the spacers and cable guides near the hinges as shown in figure 17. The best results are achieved using a mill, but you can also use Dremel or a similar tool, or a pair of pliers;

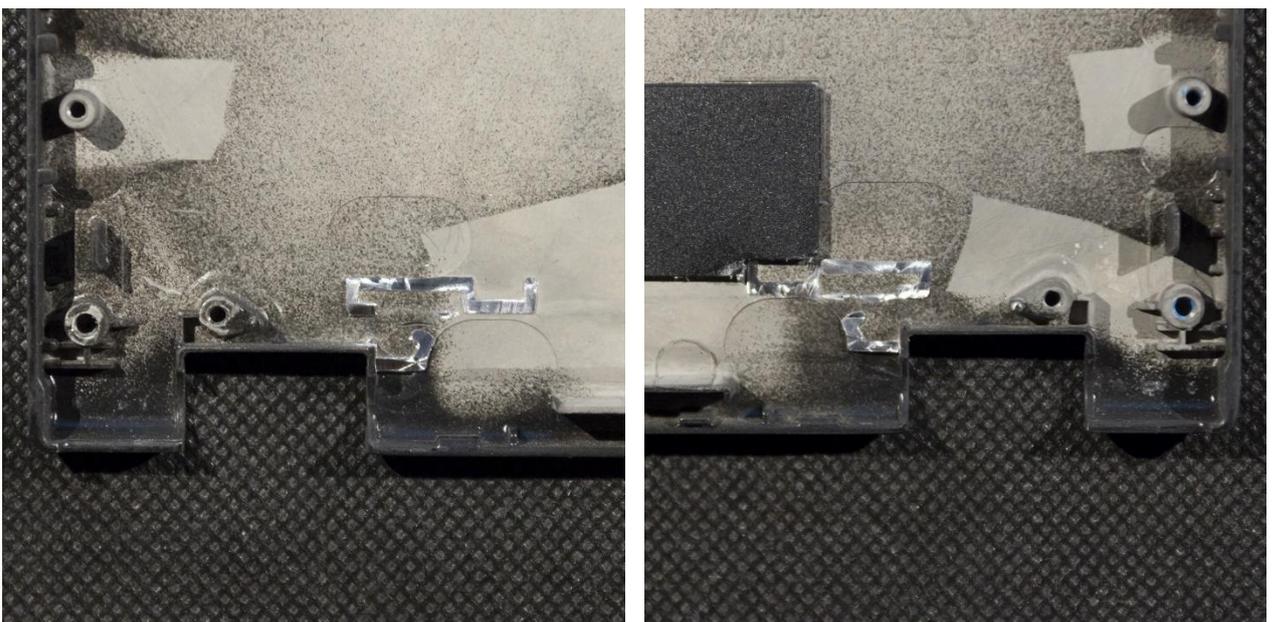


Figure 17. Removed spacers and cable guides

5. Remove two inner clips on the LCD bezel (see figure 18);

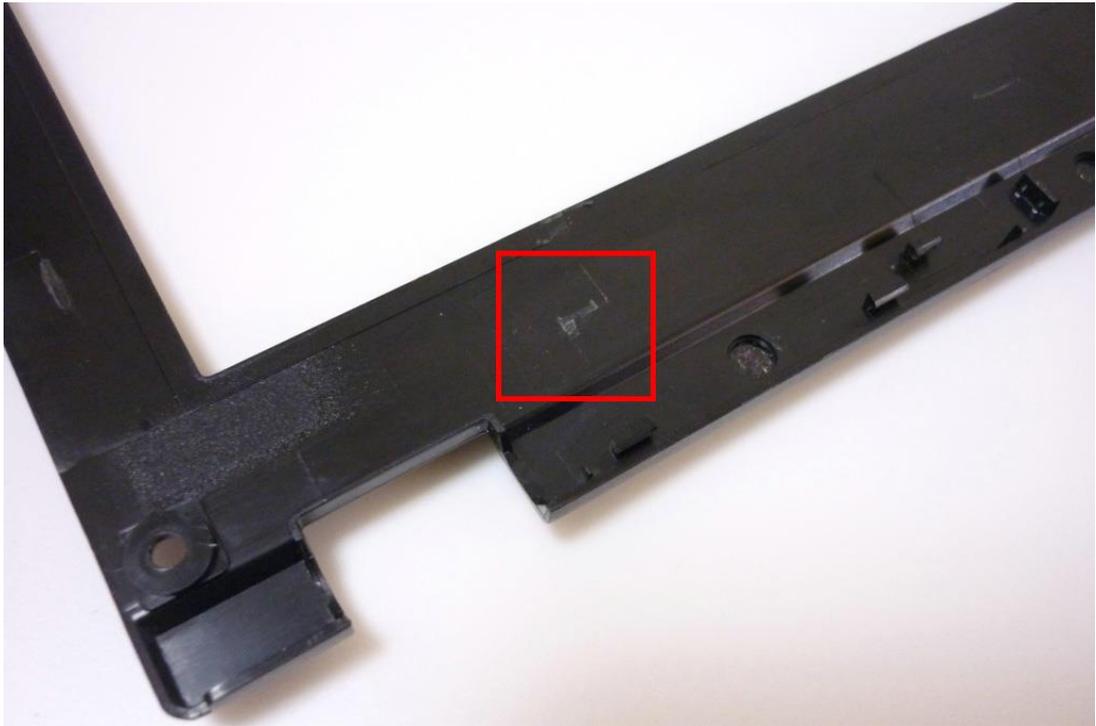


Figure 18. Right inner LCD bezel clip is removed (the left one looks similar)

6. Clean the inner surface of the lid and make sure there is no magnesium debris left inside;
7. Connect and install the status LED board;
8. Route the camera and antenna cables as shown in figure 19;

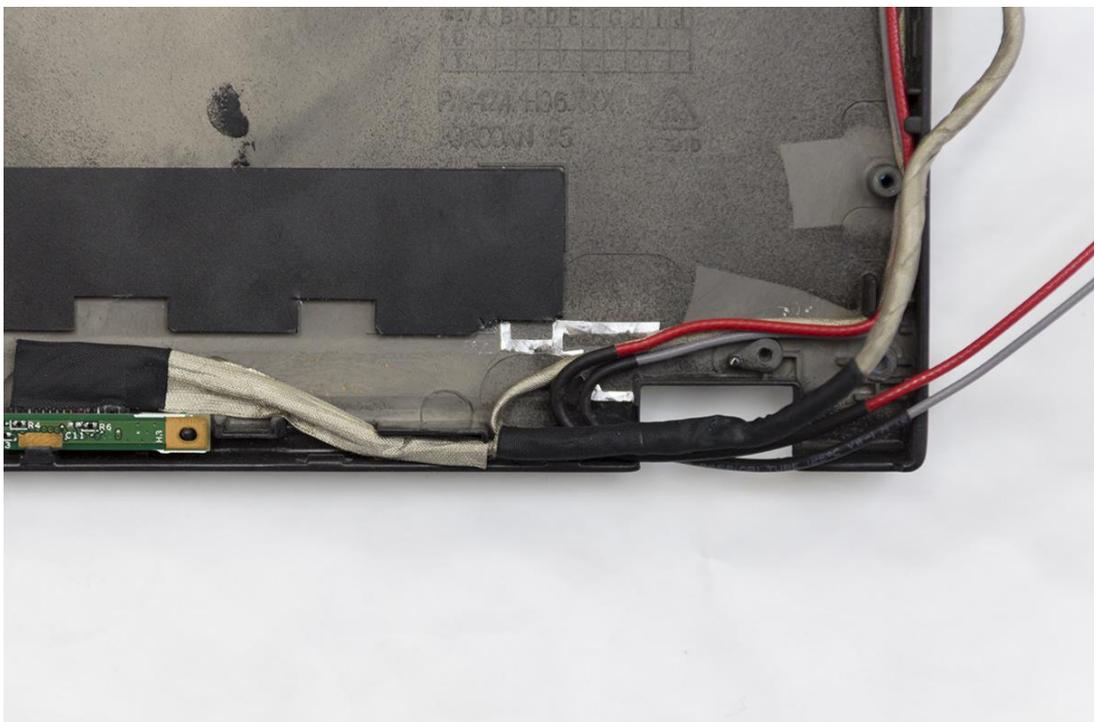


Figure 19. Camera and antenna cables

9. Install the hinges (see figures 20 and 21).

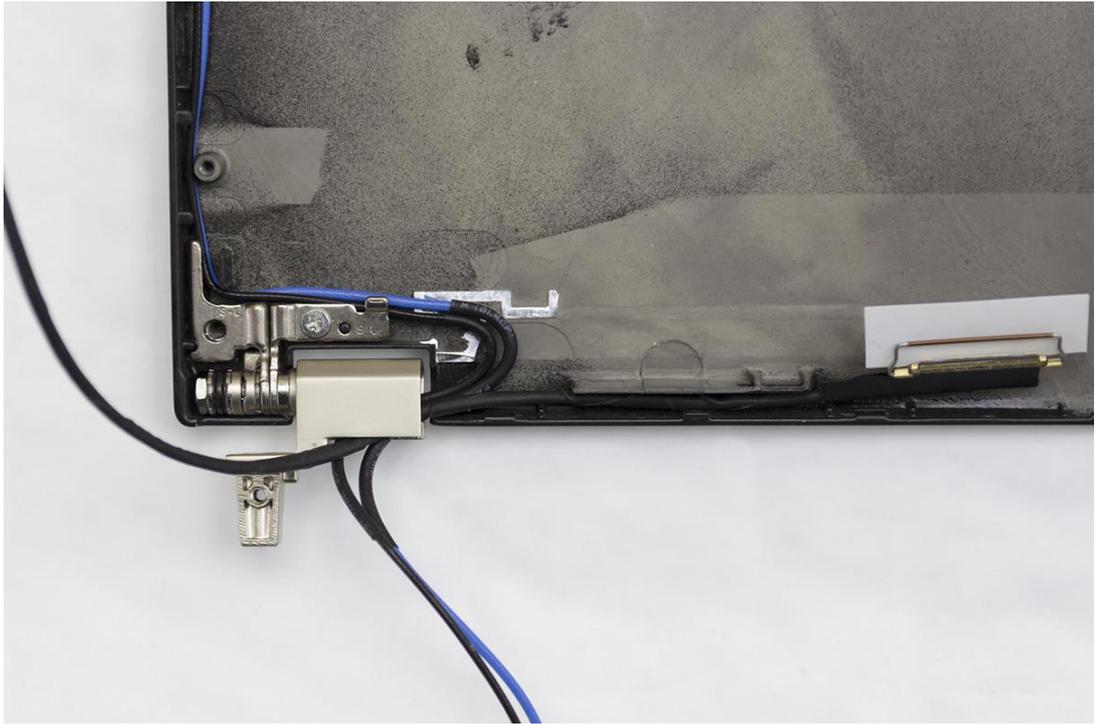


Figure 20. Left hinge

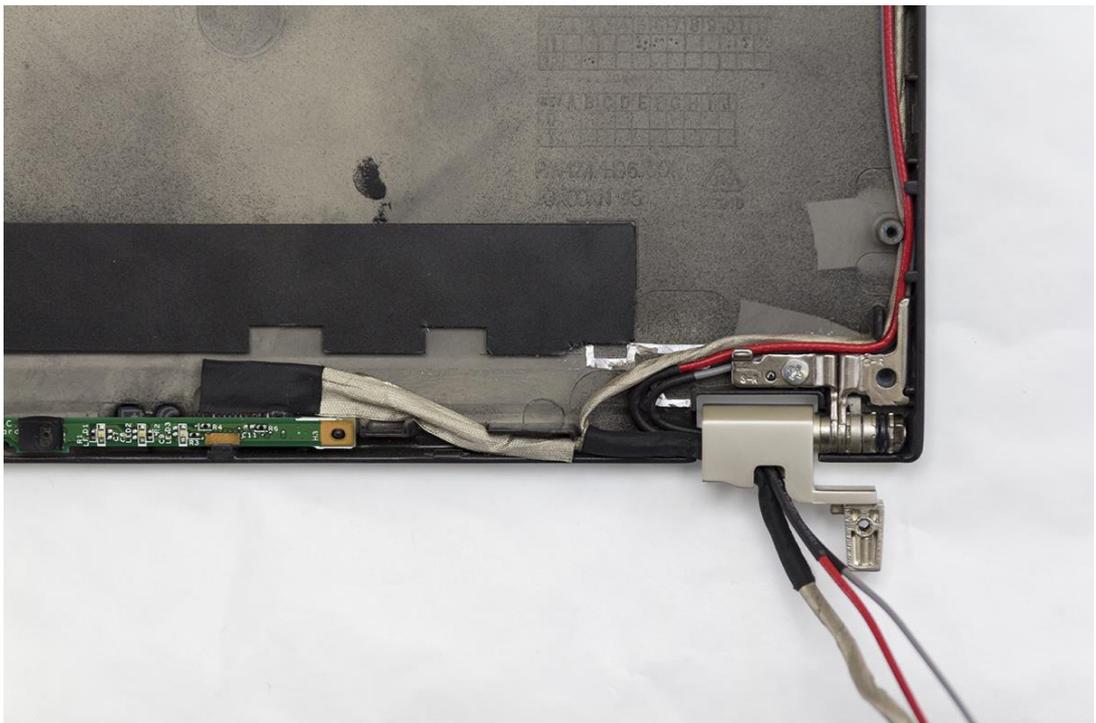


Figure 21. Right hinge

FULL HD PANEL

The logic board of a new Full HD panel may be too wide to fit in between the hinge cutouts. In that case 2 corners of the logic board have to be carefully trimmed. Figure 22 shows the corner of LP125WF2-SPB4.



Figure 22. The logic board (dark line on the protective cover shows the required corner shape)

Trimming is done using a pair of snips. Avoid grinding or sanding the corners because small particles of the board can get in between the LCD layers, resulting in small dark or light spots.



Figure 23. Cutting the corner of the logic board

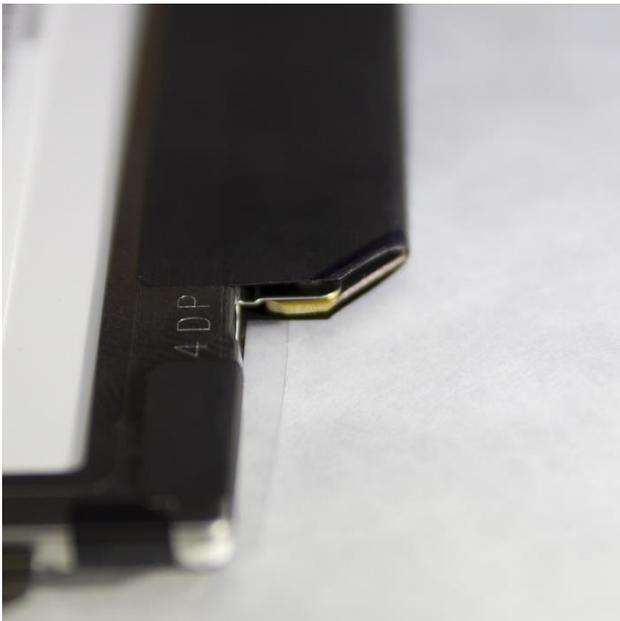


Figure 24. Trimmed corners

Note that the cut goes next to the metal bracket which holds the board, not through it. It's recommended to trim each corner with a single cut to minimize the risk of damage.

Once the trimming is done, the panel should perfectly fit in the lid.

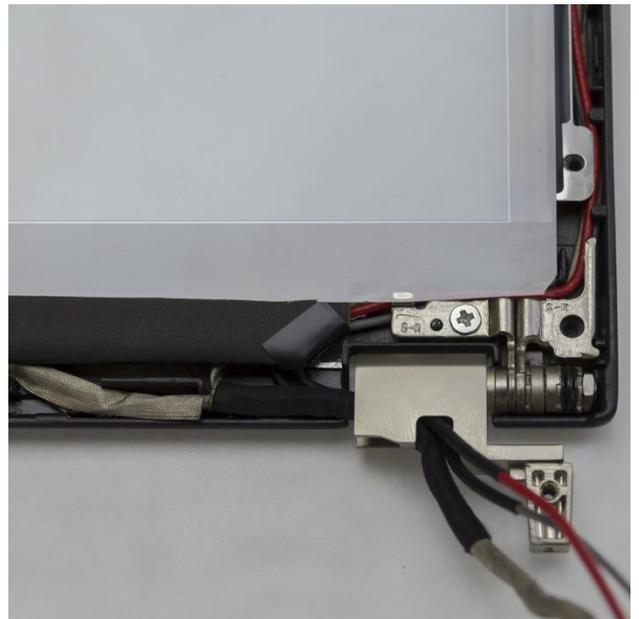
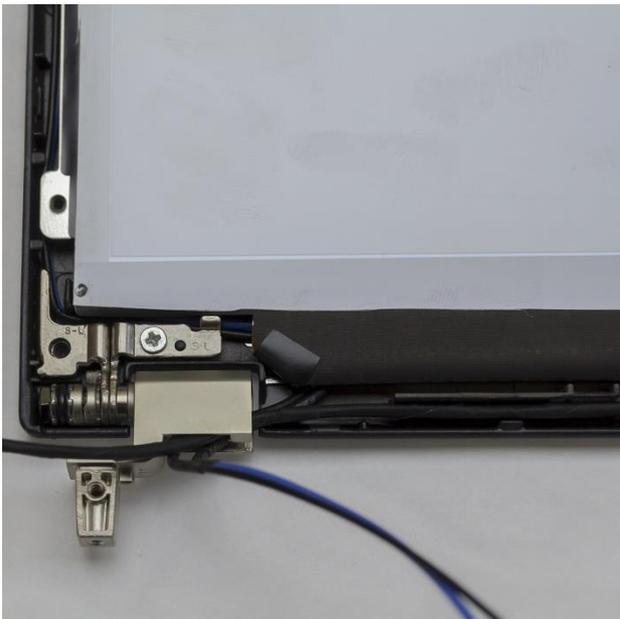


Figure 25. Full HD panel placed inside the lid

KEYBOARD BEZEL

To allow the eDP cable to pass under the keyboard bezel, a small piece of plastic has to be removed (see figure 26).

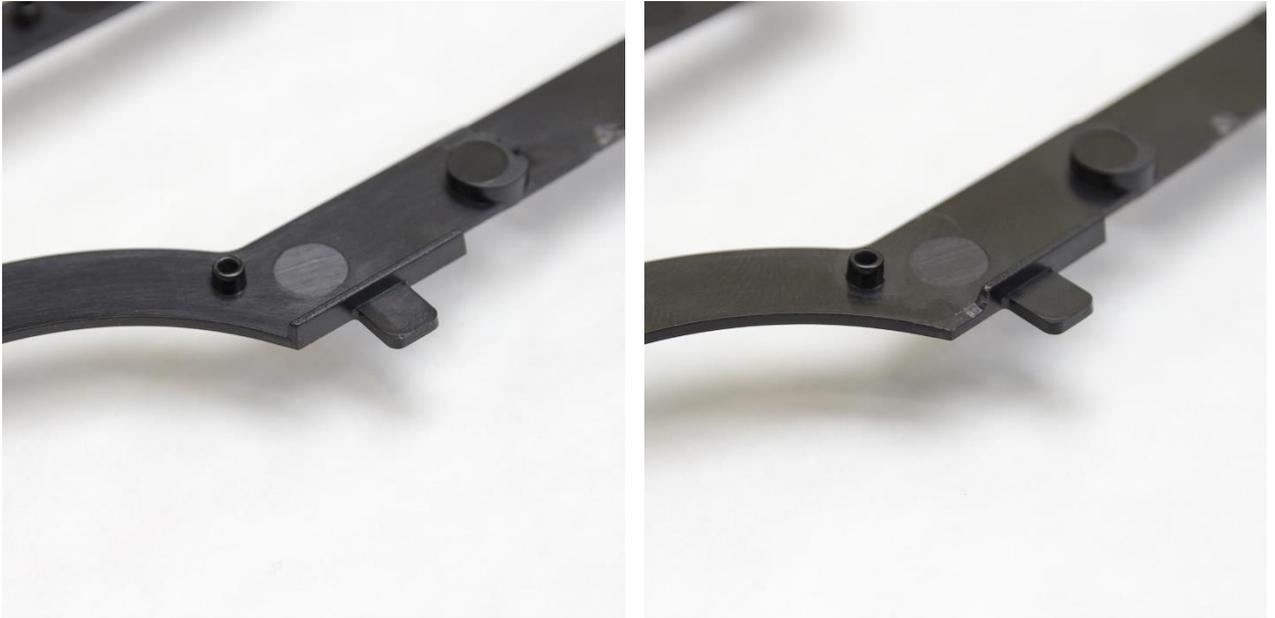


Figure 26. Cutout for eDP cable in the keyboard bezel

Another cutout is required for X230 bezel only (see figure 27).

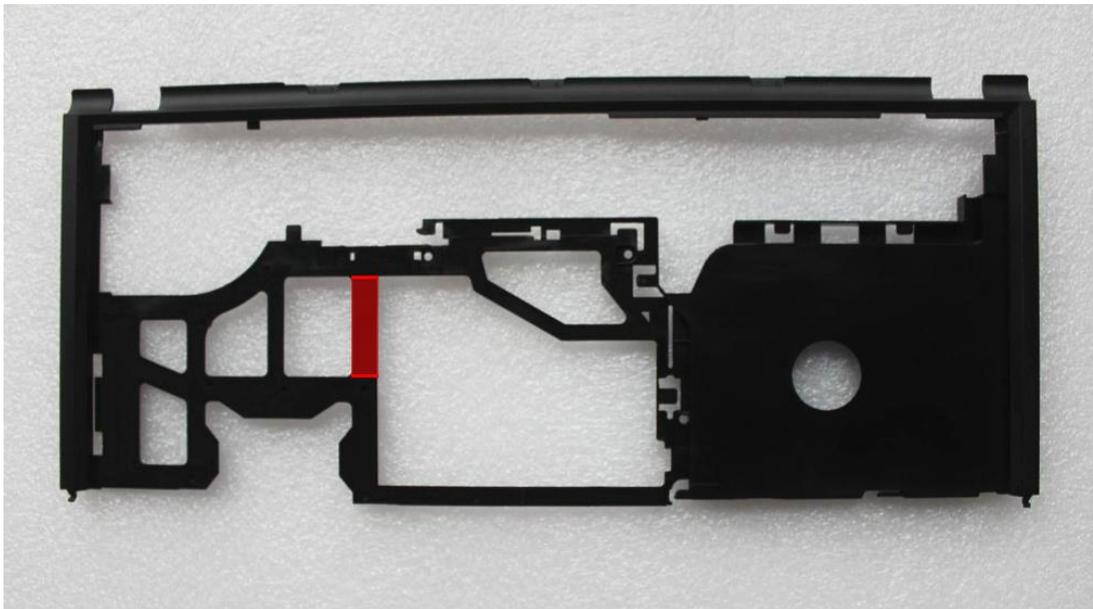


Figure 27. The second cutout in the keyboard bezel of X230

LVDS AND EDP CABLES

The LVDS cable connects the adapter board to the motherboard, and the eDP cable connects the display to the adapter board. These cables are connected and routed as shown in figure 28.

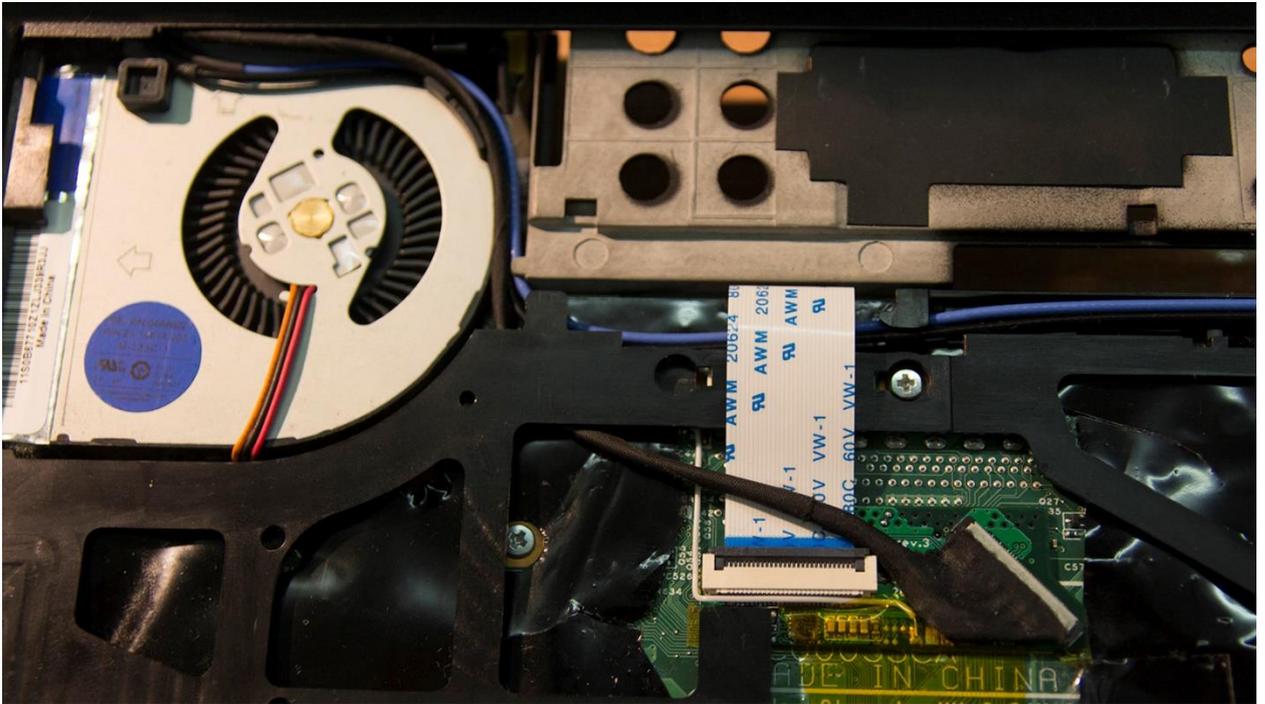


Figure 28. LVDS and eDP cable routing

Note that the LVDS cable must be inserted with the blue substrate facing up and the contacts facing the board.

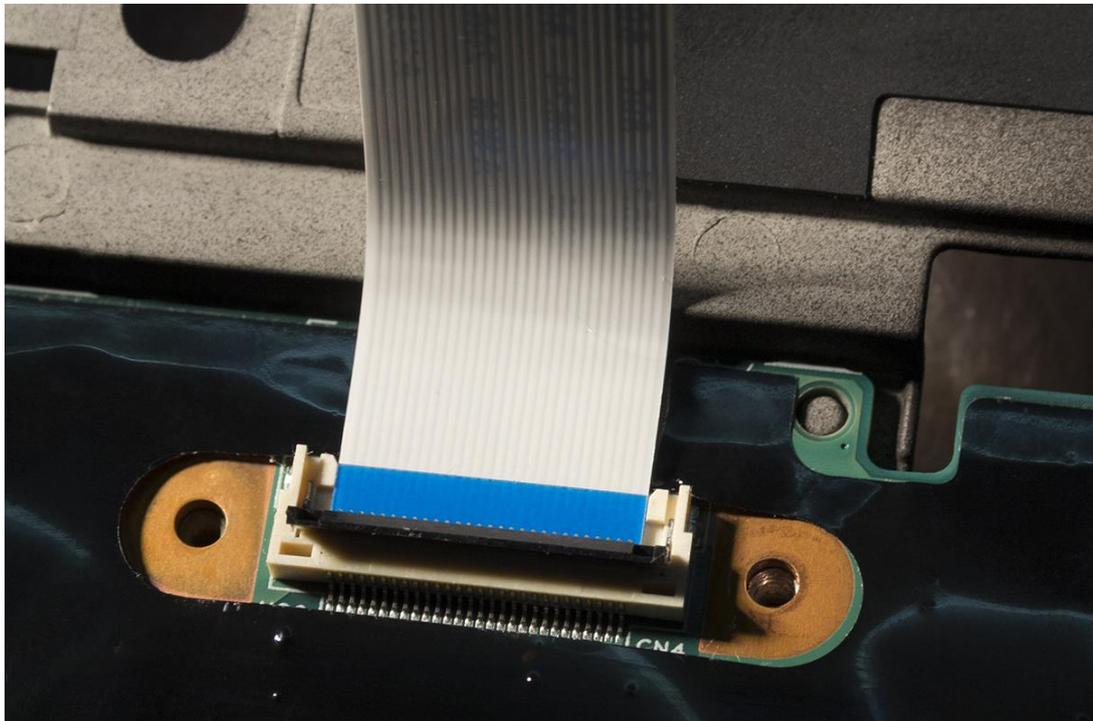


Figure 29. LVDS and eDP cable routing

APPLICATION NOTES

COMPATIBLE LCD PANELS

The panel must meet the following mechanical requirements:

1. 12.5" diagonal;
2. 6 screw holes;
3. 30-pin eDP connector (the required position is shown in figure 30).

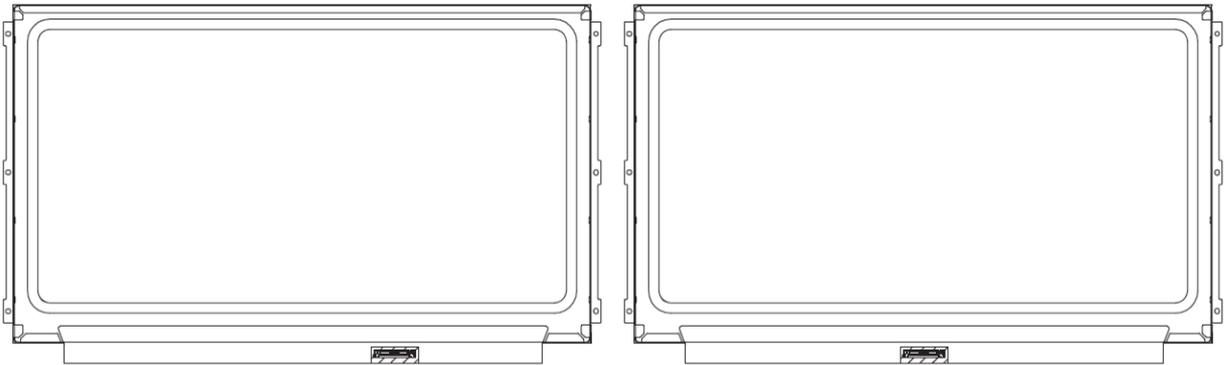


Figure 30. Offset (on the left) and centered (on the right) eDP connector

Tested panels:

- LG LP125WF2-SPB3
- LG LP125WF2-SPB4
- AUO B125HAN02.0
- BOE NV125FHM-N62

Unsupported panels:

- Samsung LTN125HL02-301

BANDING ARTIFACTS

Due to a bug in the Intel display driver, dithering is not enabled for DisplayPort displays with 6 bpc color capability and lower, which results in banding artifacts (see figure 31).

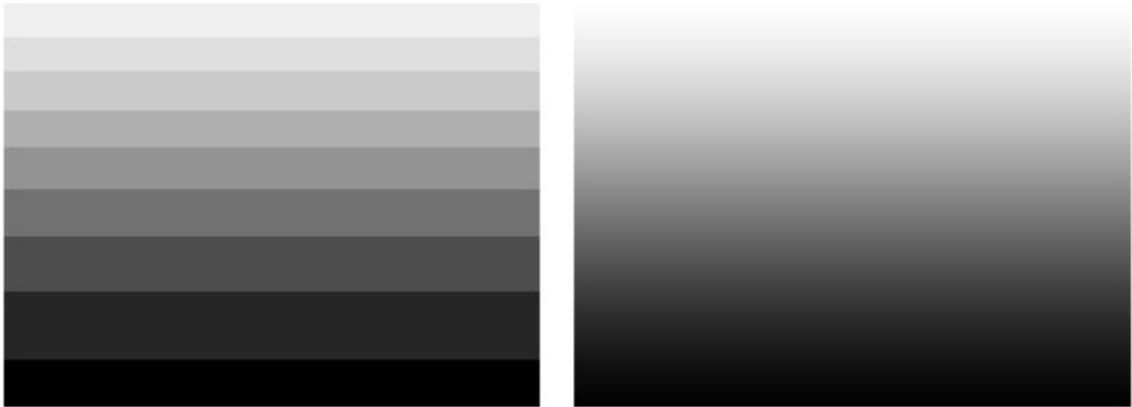


Figure 31. Banded gradient (on the left) and dithered gradient (on the right)

Linux users are not affected by this issue.

Windows users should use *Dithering Settings for Intel Graphics* utility which can be found on Suguru Kawamoto's website: http://kawamoto.no-ip.org/henteko/myapp_en.html

This utility can work on ThinkPad X230 out of the box, but additional setup has to be done to make it run on X220:

1. In the utility directory, navigate to `ditherig\x86\` (if using 32-bit Windows) or `ditherig\amd64\` (if using 64-bit Windows);
2. Open `database.csv`, find the device list and insert new row in the beginning (see figure 32);

43		Vendor ID	Device ID	Type	
44	2	0x8086	0x0126	1	Intel(R) HD Graphics (Sandy Bridge)
45	2	0x8086	0x0152	1	Intel(R) HD Graphics (Ivy Bridge)
46	2	0x8086	0x0156	1	Intel(R) HD Graphics (Ivy Bridge)
47	2	0x8086	0x015a	1	Intel(R) HD Graphics (Ivy Bridge)
48	2	0x8086	0x0162	1	Intel(R) HD Graphics 4000 (Ivy Bridge)
49	2	0x8086	0x0166	1	Intel(R) HD Graphics (Ivy Bridge)
50	2	0x8086	0x016a	1	Intel(R) HD Graphics (Ivy Bridge)

Figure 32. New entry in the device list

3. Save and close `database.csv`.