Transplanting the HP 100LX/200LX screen polarizer

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The polarizer sheet on the exterior of my HP 200LX screen suffered from the dread 'screen rot disease' – the screen blackened and emit a sour odour, presumably due to prolonged exposure to humidity and heat.

Wee Meng solved this vexing problem by swapping the damaged polarizer layer with a replacement polarizer sheet from 3M and shared his findings at http://leewm.freeshell.org/200lx/Replacing%20polarizer%20of%20200lx.pdf. The replaced screen with 3M polarizer is reported to be darker and highly glossy compared to the original matted screen on the HPLX.

Drawing on Wee Meng's experience, I sought to rebuild the excellent HPLX screen by transplanting the polarizer sheet from a defective HPLX display screen. Michel Bel made this operation possible with his generous donation of spare screen parts for my experimenting and gave a second life to my long suffering 200LX. Thanks, Michel !

My transplant attempt is not entirely successful in that the restored screen is still darker than the original because in the process, I damaged a peculiar 'transparent layer' in the polarizer sheet. If that was not so, which seemed entirely possible in retrospect, I believe there is a very good chance that the restored screen will look as good as the original HPLX screen. But I'm getting ahead of myself ...


Transplanting the HPLX screen polarizer

Step 1 Checking the compatibility of the donor and recipient screen polarizers

The polarizer sheet is the tough surface layer of the HPLX screen. It's the gray piece of film in the middle of the photo below. This polarizer sheet has an orientation which has to match the orientation of a second polarizer embedded within the LCD screen. What is not obvious (to me) is that polarizer sheets of both type of orientations are in use in the manufacturing of the HPLXes.

In the photo above, the HPLX unit on the left has already been stripped off its spoilt polarizer sheet. The polarizer sheet from the donor screen unit [right middle] appeared very dark when placed over this HPLX screen because they, unsuspectingly, turned out to be incompatible in polarizer orientation.

I did further checks on more HPLX screen units. On the right, the same polarizer sheet, salvaged from the middle screen, is turned 90% over the 3 screen units. It appeared dark over the middle and bottom screens because they have the same orientation (and the polarizer sheet is now out of phase with them) but appeared light over the top screen. This top screen unit has a different orientation from the other two and would be a compatible donor for my HPLX in the previous photo.
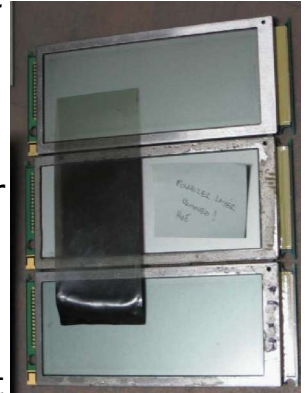
On closer examination, the top screen unit is identical to the middle screen unit, with the same circuitry layout and chips except for their batch serial number and polarizer orientation. It appeared that there are identical HPLX display screens in circulation with both type of polarizer orientations. As such, we should test for compatibility of orientation before attempting polarizer transplant.

How to test ? If both units can be brought together, it's easy to look at them through a polarizing sunglasses and ensuring that they are of the same shade of gray in both orientations.

What if the donor and recipient units cannot be brought together, such as when exploring a potential donor screen from oversea ? I do not have an answer. Perhaps there is an objective way to determine the orientation of the polarizer separately without special and expensive optical equipment ? Or perhaps it's easier to just send potential polarizer sheets, which are light and sturdy, to and fro via regular air mail ?

Step 2 Preserving the 'transparent layer'

Beneath the HPLX polarizer sheet is a very clear, brittle glue-like layer that adhered very strongly to the glass screen panel below. I do not know its proper name and purpose so I will just call it the 'transparent layer'. This layer is probably a component of the polarizer as it somehow changed the display screen from a greenish sheen to a clear HPLX screen. So we do not want to damage this layer on the recipient screen if possible.

Which is exactly what I did in my first botched operation to remove the polarizer sheet.
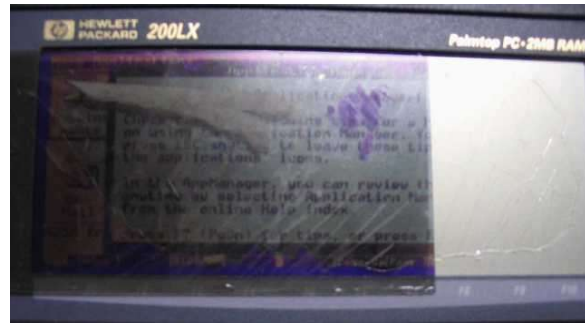
Above left is the ruins of the 'transparent layer' after I ripped off the spoilt, blackened polarizer sheet. Note the outline of this residual 'transparent layer'. The effect of the 'transparent layer' is visible when a freshly harvest polarizer sheet is overlaid [above right] . Those areas outside the 'transparent layer' appeared bright blueish while the transparent areas seemed normal (mmm, this polarizer sheet has a different orientation from the screen so it appeared blueish rather than greenish, and the video display is actually <ON></> reversed to counter the difference in orientations).

Now, in the photo above, the remnants of the 'transparent layer' on the HPLX screen have been scrapped off entirely. Overlaid on the left is a polarizer with the correct orientation (again, this same polarizer from my first attempt has the wrong orientation for the display but is now rotated 90 degrees to correct it). This is how a normal HPLX screen looked like without this curious 'transparent layer'. Notice the greenish sheen.

Overlaid on the right is a second polarizer with the correct orientation and with my replacement 'transparent layer', repurposed from a transparent document pocket which is the best I could find at the moment. This screen with the substituted 'transparent layer' is not as clear as the original so it's far better to preserve the original 'transparent layer' in the first place.

Thankfully, having removed 3 polarizer sheets and with hindsight, it seemed possible not to damage the 'transparent layer when stripping the polarizer. The 'transparent layer' looked like a transparent foil over the glass screen [right, only an edge is shown]. It adhered very strongly to the glass surface and actually have to be scrapped off to be removed. Just remember to watch out for it during the removal and not to scratch or to exert too much force on this layer beneath the polarizer sheet and it should be fine.

Step 3 Removing the damaged polarizer sheet

First, pry off the bezel which is lightly glued to the screen casing.

The actual steps to remove the damaged polarizer are the same as the removal of the polarizer sheet from the donor unit [refer to step 4]. Just be wary of damaging the 'transparent layer' during the process.

After removal of the damaged polarizer, clean up the LCD screen and keep it free of dust so it's ready to receive the donor polarizer sheet.

## Step 4 Removing the polarizer sheet from the donor unit

What you need:

- ◆ a sharp pen knife

- Glue remover – "Goo Gone" worked very well. "Ronsonal" lighter fluid worked also and is cheaper

- An eye dropper or bulb to apply the glue remover solution with some precision

- A thin strip of plastic, longer than the height of the screen and with a non-sticking surface for separating the polarizer sheet from the screen. A non-sticking surface is important because the underside of the polarizer sheet is very sticky. I used a piece of leftover plastic, cut out from a file folder, in another project where I tried in vain to glue it to another surface. It's the perfect tool for this job.

  Note: The peel-off polarizer sheet is similar to those sticky screen protector sheets. Specks of dusts find their ways onto it and are impossible to remove. Do not use paper tissue, wooden tooth picks, or anything that will leave bits behind on its sticky underside. Always handle it using only the edges. You may even want to standby a piece of waxed paper, like those yellow backing paper from a large sticker, to preserve a freshly harvest polarizer sheet till it's ready to be applied.
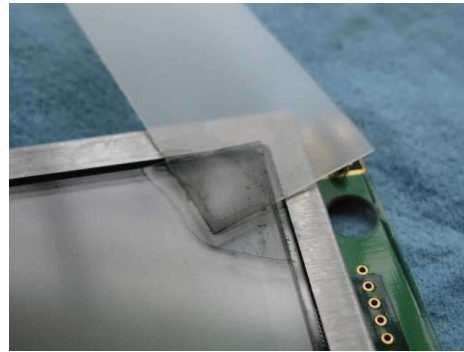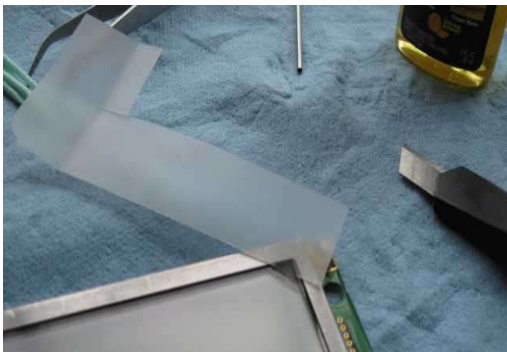
To remove the polarizer sheet :

  Use a pen knife to lift one corner of the polarizer sheet. Underneath, you should see the edge of the 'transparent layer' on the glass. Gently tuck in the strip of plastic and use it as a wedge to separate the polarizer from the 'transparent layer'.

  Drip in the glue remover under the polarizer sheet so it looked wet. Allow a little time for the glue to be dissolved and use both hands to slowly move the plastic strip forward. Repeat till you have work through the length of the screen.
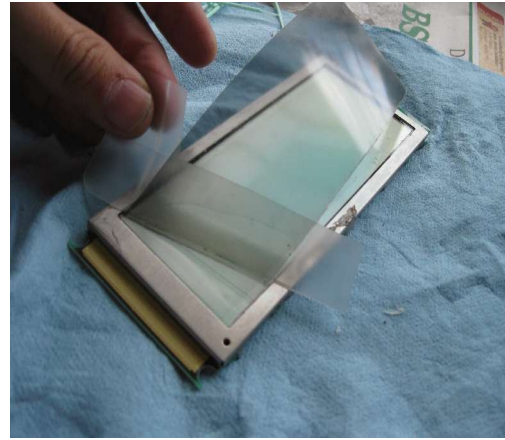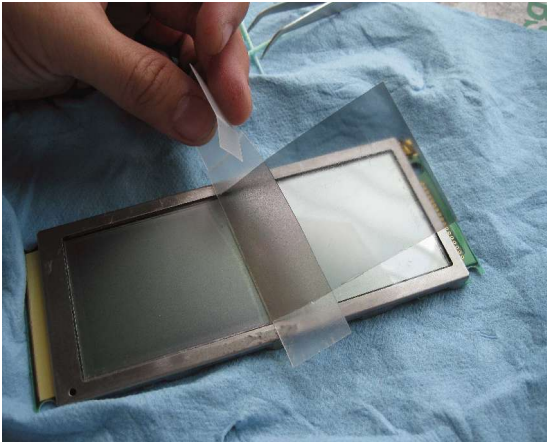
The polarizer sheet should come off cleanly and leave the entire 'transparent layer' beneath intact. Ideally.

My second and third operations to liberate the polarizer sheets occurred as described above. Applying enough glue remover such that the separating surfaces are always wet helped. Not touching the sticky underside of the polarizer sheet keep it clean and free of marks and fingerprints.

In contrast, my first removal operation was botched, leaving pieces of tissues, toothpicks and ugly scratch marks on the sticky side of the polarizer sheet [right].

If the removal went smoothly and newly peel-off polarizer sheet is clean, it should be applied immediately to the recipient HPLX screen [step 7] before it picked up more dusts with its sticky bottom.

Step 5 Cleaning up residual glue on the polarizer sheet

If the polarizer sheet is messed up, you need to clean up the residual glue and all the debris before it can be deployed.

Ronsonol, otherwise an excellent glue remover, is no help here. I found this China manufactured glue remover spray, a BiaoBang car care product [right], from a neighbourhood store that did the trick. It smelled real nasty and still it was a messy job to remove those stubborn goo. I didn't have my bottle of "Goo Gone" then to prove its namestake.

Belatedly, I came across this writeup on the HPLX Backlight project

[http://www.hermocom.com/knowledgebase/hplx/backlight/install] on cleaning up a second polarizer within the LCD screen that seemed applicable here :

''*If some glue remains on the reflection layer, and as a result the glue surface on the polarizing layer looks ugly (tracks, stripes, holes) .... you will have to remove all the glue from the polarizing layer using petroleum and a piece of tissue paper. It needs some minutes of scrubbing. Scrub until the surface looks perfectly clean and consistent! ... Then clean everything (also all the contacts) with ethyl alcohol. Now you should have a clean polarizing layer surface, which doesn't feel sticky anymore.*"*.

Step 6 Replacing the 'transparent layer'

This step is necessary only if the 'transparent layer' on the recipient HPLX is somehow damaged. First, scrapped off the 'transparent layer' with glue remover, plastic ruler and a big dose of patience as per the cleanup instructions in Wee Meng's PDF.

I have not found the perfect replacement material for this intriguing 'transparent layer'. I tested various transparent materials around the house and finally settled on this transparent document pocket from Daiso (a Japanese thrift chain store and hobbyists' toolbox) that provides the clearest screen. Transparent cellophane wrapping foil is another option and doesn't need a plane trip to purchase.

You may also wish to experiment on your own. Try placing various transparent materials between the polarizer sheet and the switched-on HPLX without its polarizer layer. You need to rotate the material to find the best orientation and screen clarity. I'm not sure exactly how it worked but some transparent materials can produce a luminous rainbow range of screen hue through the polarizer sheet while other transparent materials are just transparent.

If you do find something suitable (do let me know), remember the orientation and cut out a piece of the same size as the polarizer sheet in the orientation with that best view.

In my case, the harvested polarizer sheet still retained its sticky side so I simply sticked the transparent cutout onto the polarizer sheet without having to apply any glue. However, I was hasty and left air bubbles all over the sheet. The polarizer sheet was very sticky. Rather than redo it and probably have to remove and replace the glue as well, not to mention researching for the most transparent glue that doesn't interfere with the polarizer, I decided to live with the squashed air bubbles, until I can find a better transparent material that is worth redoing it.

With hindsight, I should apply the transparent cutout slowly and take care to remove air bubbles, just like applying a sticky screen protector sheet.

If you removed the glue on the polarizer sheet [step 5] and now need to glue on the transparent cutout, then I'm afraid you are on your own. I have no actual experience yet to share but would love to hear about yours.

Step 7 Grafting the polarizer sheet onto the HPLX

This is simple. Position the harvested polarizer sheet over the HPLX and slap on the bezel. The glue on the bezel should still be sticky and will hold it in place.

End result
My 200LX with the grafted polarizer sheet and substituted 'transparent layer' is on the right below. On the left is an unaltered 100LX screen for comparison [This 100LX has its own LCD problem. The black spot at the centre is caused by an over-energetic thumb on the top casing. I will have to look into this next. Sigh].

It's difficult to photograph the LCD screen contrasts clearly and accurately. The 200LX screen with the transplanted polarizer sheet is actually darker, greener, less clear and blemished with squashed bubbles but just about usable at the moment. This 200LX screen is not as clear and contrasty as the 100LX to begin with.

But had the 'transparent layer' on the 200LX been intact and didn't have to be substituted, I would imagine that the restored screen would be almost, if not, as good as its original screen. Unfortunately, having grind the 'transparent layer' to obliteration, I'm not able to verify my imagining and will have to leave it to another HPLXer with an afflicted HPLX to perform a proper polarizer transplant and confirm.

The replacement 'transparent layer' is not ideal. I will continue to test and look out for better alternative materials. If you know something about the nature of the 'transparent layer' or have suggestions on suitable replacement for the 'transparent layer', I would love to hear from you on the HPLX-L mailing list !

*** THE END ***