PowerBook Screens: Active vs. Passive Matrix Comparison (12/95)

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TOPIC -----

I noticed that there are several types of PowerBook screens. How do they differ?

DISCUSSION -----

Comparison of Active vs. Passive Matrix Displays

All PowerBook screens employ LCD (liquid crystal display) technology. Liquid crystals are electrically polarized - one end is more positive than the other, and thus the crystals tend to orient themselves along the lines of an electric field. When no such field is present, they orient themselves randomly.

Liquid crystals are transparent to light, but they also polarize the light, constraining the vibrations of the light to a single orientation.

An LCD uses a combination of a fixed polarizing screen, and an electrically controlled liquid-crystal polarizer to make light and dark areas. When the liquid crystals are subjected to an electric field, all of the light passing through them becomes polarized with the same orientation.

The orientation of the fixed polarizing screen is exactly 90 degrees off, which effectively blocks the passage of any light. So when a liquid crystal display region or pixel is on, it appears to be dark.

When an LCD pixel is off, quite a bit of the randomly polarized light from the crystals is able to make it through the fixed polarizing screen, so the pixel appears to be light.

Passive matrix screens apply the electric field voltages along the edges of the screen, so that pixels appear light and dark at the intersection of rows and columns. Each pixel is passively responding to voltage differences applied along the horizontal and vertical edges of the screen. It is difficult to get a large number of crystals to line up quickly, and completely. So passive matrix screens are relatively slow and provide less precise definition.

Active matrix screens use a single transistor at every single pixel location. This provides a good strong source of electric field, and it only has to act on

a very tiny region of liquid crystals. So they are quite fast and every crystal in a pixel is lined up perfectly.

The merits of the passive screen are lower cost and lower power usage. But the angle at which you can view the screen undistorted is smaller than for an active-matrix screen. Also, a passive-matrix screen is not as bright as its active-matrix counterpart.

You may experience submarining on a passive-matrix screen, meaning the pointer tends to disappear momentarily when you move it quickly across the screen until it catches up with the trackball. You may also notice speed trails, or shadowy, comet-like trails following the pointer or other objects you drag around the screen. They disappear as quickly as they appear, but some users find them distracting.

An active-matrix screen is brighter and provides better definition. The screen is also less likely to distort when viewed at more extreme angles.

The following charts which PowerBook models have Active or Passive Matrix Displays:

Begin_Table

PB Model	B&W/Color/Grayscale	Active/Passive Matrix
100	B&W	Passive
140	B&W	Passive
145	B&W	Passive
145B	B&W	Passive
150	Grayscale (4 Grays)	Passive
160	Grayscale (16 Grays)	Passive
165c	Color (256 Colors)	Passive
170	B&W	Active
180	Grayscale (16 Grays)	Active
180c	Color (256 Colors)	Active
190	Grayscale (16 Grays)	Passive
190cs	Color (256 Colors)	Passive
520	Grayscale (16 Grays)	Passive
520c	Color (256 Colors)	Passive
540	Grayscale (64 Grays)	Active
540c	Color (256 Colors*)	Active
5300	Grayscale (16 Grays)	Passive
5300c/100 8/500	Color (256 Colors**)	Active
5300c/100 16/750	Color (thousands of colors**)	Active
5300cs	Color (256 Colors)	Passive
5300ce	Color (thousands of colors)	Active
Duo 210	Grayscale (16 Grays)	Passive
Duo 230	Grayscale (16 Grays)	Passive
Duo 250	Grayscale (16 Grays)	Active
Duo 270c	Color (256 Colors*)	Active
Duo 280	Grayscale (16 Grays)	Active
Duo 280c	Color (256 Colors*)	Active

Duo 2300c Color (256 Colors*) Active

* Thousands of colors in 640 by 400 mode
** The PowerBook 5300c computer is available in two configuartions.
One model has 512K of built-in VRAM, while the other has 1 MB.

End_Table

NOTE:
The descriptions in this table apply only to models sold in the United States. Europe and Asia have models that differ slightly from these configurations.

For more information and details about the amount of internal VRAM, number of colors available, and specific model numbers of the PowerBook 190 and 5300 series computers see the TIL article titled "PowerBook 5300 & 190 Series: Internal & External Video".

Article Change History:
12 Dec 1995 - Added PowerBook 190, 5300 series, and 2300.
15 Feb 1995 - Reviewed for technical accuracy, revised format.
13 Oct 1994 - Added PowerBook 150.

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