Macintosh Display Cards Overview (2 of 3)

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(This is a continuation of, "Macintosh Display Cards Overview (1 of 3)")

- Convolution

The 8/24 Macintosh video cards address interlaced display flicker by running every pixel through a formula that averages the pixel with its individual neighboring pixels above and below. This technique is called convolution and it is part of the function of the CLUT/DAC chip. Convolution causes an averaging effect between scan lines so that a horizontal line includes at least a portion of the scan lines above and below its own scan line. A portion of the horizontal line remains visible during display of both the odd and even fields to avoid flicker. The convolution formula follows a 1:2:1 ratio where the current pixel value is given twice the weight of its neighbors above and below.

The 4/8 does not support convolution; the 8/24 supports convolution at up to 8-bits per pixel automatically turning it on where appropriate. If a Display Card 8/24 is driving an interlace display in 24-bit mode, convolution is disabled. If the card is driving an interlace display in 8-bit, or a lesser pixel depth, convolution is enabled.

- Underscan and Overscan

The full 640 x 480 active video display is visible on an interlaced monitor if the monitor operates in underscan mode. (Underscan means that the monitor screen is larger than the active video display.)

Many monitors do not show the full active video display area much because the picture extends beyond the edges of the screen. This mode is called overscan because the scanned image is larger than the display area. (Television sets use overscan.)

To guarantee that the whole image is visible on an overscan monitor, all three new display cards can be switched to overscan mode, which produces a smaller display with only 512 x 384 pixels.

The new display cards can support both overscan and underscan monitors.

- Memory Organization

The frame buffer controller is a custom gate array that serves as the controller for the 4/8 and 8/24 display cards. The frame buffer implements an address translation scheme that allows the cards to use only 1MB to support 24-bit graphics even though a 640 x 480 monitor displaying 24-bit graphics would normally require 1.2MB of VRAM. The 8 bits of data in each pixel that do not convey any color (or gray-scale) information are ignored. Such compaction allows 24-bit data for a 640 x 480 monitor to fit in just over 900K of VRAM. The eight bits that are ignored are defined as the alpha channel and, when maintained, can be used for special effects.

Macintosh Display Card 8/24 GC

The Macintosh Display Card 8/24 GC has the entire feature set of the Display Card 8/24, with rapid drawing of 24-bit images. Display Card 8/24 GC is a stand-alone display card that extends the 8/24 to include dramatic performance acceleration. Unaccelerated 24-bit imaging can be slow, but Macintosh Display Card 8/24 GC uses several methods to provide a thorough and integrated solution. Macintosh Display Card 8/24 GC accelerates the drawing of images by 5 to 30 times, with greatest acceleration when drawing very complex images. (Users of applications that circumvent QuickDraw will see very little acceleration.)

The 8/24 GC supports convolution for interlaced displays at up to 8 bits per pixel. 8/24 GC resident video RAM is not compressed the way it is on the 4/8 and 8/24 cards, which means the the extra alpha channel byte is maintained.

- Accelerating Graphics

One effective method for accelerating graphic imaging is the use of a co-processor dedicated to drawing images. This frees the 680x0 to continue program execution without having to wait for the time-consuming imaging of 8 to 24-bit pixel images. The Macintosh Display Card 8/24 GC card uses the Am29000 RISC-based microprocessor to relieve the 680x0 of the imaging process. The AM29000 was chosen instead of a graphics processor because specialized graphics processors are inadequate for Display Card 8/24 GC; they are unable to handle complex QuickDraw operations and setup code.

- Inter-Process Communication

Display Card 8/24 GC uses a unique Inter-Process Communication (IPC), streamlined for low overhead and fast response time. The Display Card 8/24 GC resident IPC intercepts QuickDraw calls on the Macintosh and passes them and their parameters to the special version of 32-bit QuickDraw that resides on Macintosh Display Card 8/24 GC. The IPC also makes it possible for the customized Macintosh Display Card 8/24 GC QuickDraw to call specific routines running on the Macintosh.

- NuBus Data Transfer

Transferring large and deep bitmaps across the NuBus is the slowest part of the drawing process. Typical reads and writes, from the Macintosh to the display cards, are performed in 1000 and 500 nanoseconds respectively. NuBus data

transfer time is affected by the need to re-arbitrate for control of the bus after each 32-bit word is transferred.

The Display Card 8/24 GC optimizes NuBus data transfer by reading only QuickDraw variables and small portions of data structures across NuBus. The bit maps are then created locally in the Macintosh Display Card 8/24 GC's VRAM. The Display Card 8/24 GC reads and writes to its frame buffer memory at a rate of 66 to 132 nanoseconds, and up to 2MB of DRAM on the card holds offscreen bitmaps.

- 32-bit QuickDraw Optimized For the Am29000

The Display Card 8/24 GC 32-bit QuickDraw produces the same graphic output as standard 32-bit QuickDraw. However, several algorithms have been modified, and internal organization has been altered to fit into the graphics accelerator architecture.

Macintosh Display Card 8/24 GC provides transparent acceleration of any Macintosh application. No extra work need be done by an application to take advantage of Macintosh Display Card 8/24 GC optimized 32-bit QuickDraw.

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