ATI Takes 3D Lead With Rage 128

New Chip Combines Performance, Features, and Flexibility With Low Cost

by Peter N. Glaskowsky

One of the last mainstream 3D accelerators to be introduced this year looks to be the best of the bunch. ATI's new Rage 128 has more consumer-oriented features than any other chip announced to date and it provides excellent performance at a price that should put it into the most popular system configurations from many leading PC OEMs.

If the Rage 128 delivers on its performance promise in real-world 3D applications, it should become the preferred choice for 3D games as well as low-cost professional 3D CAD systems. Assuming ATI can deliver production quantities of the new chip to OEMs in time for 4Q98 system shipments, the new product will increase ATI's success in the highly competitive 3D-chip industry.

In the Rage 128, ATI has created the most complex chip ever offered as a mainstream graphics controller. The device contains more than eight million transistors, more than are found in Intel's Pentium II processor. As Figure 1 shows, ATI designed two 8K caches into the new part, one for texture data and one to cache pixel data from the frame buffer. ATI says 200 person-years of engineering effort went into the Rage 128, which will be built by TSMC on its 0.25-micron process.

Rage 128 Offers Unmatched Performance

The Rage 128 features two rendering pipelines, each able to render one pixel per cycle at the chip's 100-MHz core clock rate. The aggregate 200-Mpixel/s throughput makes the Rage 128 faster than any other single-chip 3D engine on the market. (Nvidia's RIVA TNT takes second-place honors with a 190-Mpixel/s rating.)

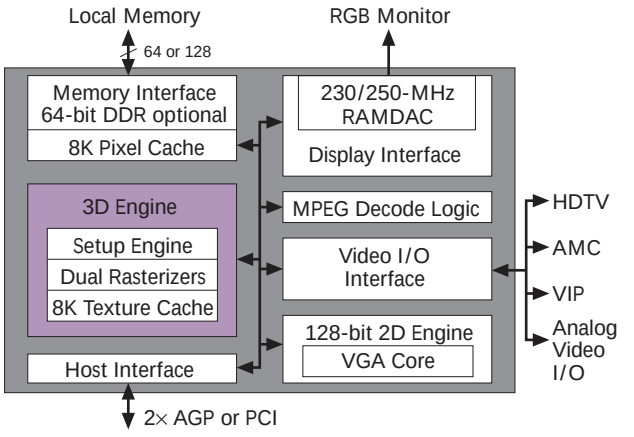

Figure 1. The Rage 128 uses eight million transistors to implement every important feature for mainstream PC graphics applications. The chip is the first to include an 8K pixel cache.

The Rage 128 can assign both pipelines to the same pixel, applying two bilinear-sampled textures (four texel samples each) or one trilinear-sampled texture (eight texel samples) in a single clock period. At 100 Mpixel/s in these modes, the Rage 128 is slower than 3Dlabs' 125-Mpixels/s Permedia 3. S3's Savage3D can also perform trilinear filtering at 125 Mpixels/s, but its dual-texturing throughput is just half that rate.

ATI's Rage Pro (see MPR 3/31/97, p. 4) was the first announced mainstream single-chip 3D engine to include a full floating-point setup engine. The Rage 128 includes a significantly enhanced setup unit capable of processing up to 3.2 million polygons per second or 2.8 million lines per second for CAD applications. The chip can process triangle strips and quadrilaterals directly, reducing host CPU loading for format translation. This CPU overhead can have a substantial impact on application-level performance.

More RAM Is Mo Betta

With support for up to 32M of local memory, the Rage 128 can be configured to suit almost any expansion-card or motherboard design. Today, even entry-level systems are moving from 4M to 8M local-memory arrays, with 16M add-in cards becoming common. During the life of the Rage 128, we expect to see 32M cards become the preferred choice of performance-hungry 3D gamers—the extra 16M of SDRAM will add less than $15 in parts cost but may justify a $50 boost to a card's retail price. Most of the Rage 128's competitors, particularly the TNT, Permedia 3, and 3Dfx's Voodoo Banshee, support only 16M of local memory. S3's Savage3D handles only 8M of 64-bit memory, a limitation that is already causing trouble for S3 at major graphics-card OEMs.

While 32M of graphics memory may seem like a large amount (even Windows 98 needs only 32M of system memory for efficient operation), today's high-resolution monitors and high-quality rendering can easily require this much storage. The Rage 128 supports up to 1,920 × 1,200-pixel displays with 32-bit front and back buffers and a 32-bit Z buffer—a total of over 26M of local storage, the balance being used for local texture storage. Even with 32M, the Rage 128 can't handle triple-buffered rendering (an increasingly popular technique to produce smoother screen updates) at this resolution, though triple-buffered rendering is supported at 1,600 × 1,200 pixels—enough for almost anyone.

As its name suggests, the Rage 128 has a 128-bit local-memory interface. Uniquely, this interface can also be configured for 64-bit operation, a feature that should help win motherboard designs for the new chip. SDRAM and SGRAM

memory are supported at speeds up to 125 MHz on a 128-bit bus, or up to 143 MHz for 64-bit operation. Double-data-rate (DDR) SDRAM and SGRAM may also be used at speeds up to 125 MHz in the 64-bit bus mode.

The Rage 128 is the first mainstream 3D chip to include a frame-buffer cache, 8K of SRAM integrated into the memory controller that stores color and Z values to reduce memory-bus traffic during 3D rendering. ATI plans to stick with SDRAM for its own Rage 128-based graphics cards; ATI's board division believes SGRAM and especially DDR SGRAM add significant cost but little extra performance.

Motherboard OEMs that need only the 64-bit memory interface can purchase a special small-footprint 256-contact BGA package called the Rage 128 VR. This package is pin-compatible with some versions of ATI's Rage Pro, easing the transition to the newer part for some customers. Buyers needing the full flexibility of the 128-bit interface may select a 312-contact BGA-packaged chip called the Rage 128 GL. The wide-bus packaging option is likely to be used mostly by ATI's own board group, since ATI doesn't sell its chips to outside expansion-card OEMs. ATI offers several PCI and AGP configurations for its popular Rage Pro 3D chip; the Rage 128 should enable an even broader range of expansion cards.

Rendering Quality Is Excellent

Like other 3D chips announced this year, the Rage 128 supports 32-bit color rendering and a 32-bit Z-buffer format in addition to the 16-bit formats commonly used in today's 3D games. The increased precision improves visual realism and reduces the chance of depth-sorting errors (is the paper on top of the desk or the desk on top of the paper?), though 32-bit rendering is slower than 16-bit rendering.

Greater color precision doesn't help much without accurate texture filtering. Compared with its predecessor, the Rage 128 offers improved texture filtering, and the new chip's greatly improved throughput on trilinear-filtered textures make the use of this mode much more practical. The Rage 128 does not, however, support anisotropic texture filtering, which is found on Nvidia's RIVA TNT. Anisotropic filtering would have provided even better results than trilinear filtering on some types of textures—particularly text—though at the cost of a 50% drop in fill rate. ATI's development team ran out of time to include this feature and hopes to add it to a midlife-kicker product already being designed.

Consumer Multimedia Support Is Best in Class

The Rage 128 fulfills ATI's promise earlier this year to include support for HD0-class digital-TV in its next graphics-chip architecture. HD0 is an intermediate level of the Advanced Television Systems Committee (ATSC; *www.atsc.org*) digital-TV standard, defining a 1,280 × 720-pixel, 24-frame-per-second format plus a 720 × 480-pixel, 60-fps format with the same effective data rate.

The Rage 128 includes an enhanced version of the Rage Pro's MPEG-2 motion-compensation engine, along with a completely new inverse discrete-cosine transform (iDCT) unit. These elements allow the Rage 128 to decode DVD or HD0 content with only moderate CPU overhead. High-definition television (HDTV) content (1,920 × 1,080 pixels interlaced at 60 Hz) can be subsampled to HD0 by the host, allowing playback with some reduction in quality. When full HDTV support is required, the Rage 128 can connect to a separate HDTV decoder IC over an upgraded 16-bit, 75-MHz ATI Multimedia Channel (AMC) interface.

Combined with a PCI television-tuner card for ATSC broadcasts, the Rage 128 should provide an affordable way to view these broadcasts when they begin later this year. We expect such tuner cards to be priced below $200, while complete ATSC-compatible televisions may cost $2,000 or more.

Pricing and Availability

ATI's Rage 128 began sampling to selected OEM customers in August and will enter volume production in October. In a 256-contact BGA package, the Rage 128 VR sells for $30; the Rage 128 GL in a 312-contact BGA is available for $40. Both prices are for 10,000-unit quantities. ATI (*www.atitech.com*) sells its chips only to motherboard vendors. The company will offer its own selection of Rage 128–based add-in cards for OEM and retail customers beginning in October.

Timing Isn't Everything

ATI announced the Rage 128 long after most of its competitors revealed their new chips. The late announcement allowed ATI to refine its marketing message and kept its competitors guessing until the last minute.

Despite the risk of missing critical OEM deadlines, there are potential benefits to this strategy. Nvidia announced its RIVA TNT in March, promising a 125-MHz clock rate, but yield problems slowed TNT to just 95 MHz by the time it entered production in August. This situation reduced the pressure on ATI to debut the Rage 128 at 125 MHz, which might have reduced production yields.

ATI has matured into a true leader of the PC 3D industry, able to develop and deliver market-leading 3D chips in extremely high volumes. In conjunction with the Rage 128 announcement, the company revealed it has shipped over 10 million AGP graphics chips. According to research by Mercury Research (*www.mercury.org*), ATI recently surpassed S3 as the sales-volume leader in the PC graphics market. The Rage 128 is an impressive product for the price, and its core technology is sure to be used in a variety of derivative products for mobile and low-cost systems over the next year. M

Peter N. Glaskowsky has just completed The MDR Guide to 3D Accelerators: Chips and Companies. *For more information, please see* www.MDRonline.com/tl/3d-chips.