Low Power, Exceptional Performance
The AMD G-Series platform is a flexible solution that in the same package offers scalable choices for the level of CPU performance, power efficiency, and visual experience. The AMD G-T16R APU with an average power of only 2.3 Watts enables very small form factor, fan-less and portable applications. APU configurations are available with single or dual x86 cores, at 4.5W, 9W or 18W thermal design power (TDP), and two levels of graphics and video performance. Each APU supports single or dual-independent high resolution displays and exceptional multi-media capability with hardware decode support for H.264, VC-1, MPEG2, WMV, DivX and Adobe® Flash. When paired with the AMD A50M controller hub with support for advanced interfaces such as 6Gb/s SATA, Generation 2 PCI Express®, and HD Audio, the AMD Embedded G-Series platform delivers a low power, value-oriented solution for applications requiring a better balance of CPU and multimedia performance.

Headless Embedded Systems
For deeply embedded headless systems, the AMD Embedded G-Series CPU models T48L and T30L enable whisper-quiet media servers and model T24L enables fanless design for factory control systems.

Product Overview
The AMD Embedded G-Series processor is the world’s first integrated circuit to combine a low-power CPU and a discrete-level GPU into a single embedded Accelerated Processing Unit (APU). This unprecedented level of graphics integration builds a new foundation for high performance multi-media content delivery in a small form factor and power efficient platform for a broad range of embedded designs. Based on a power-optimized core, the AMD Embedded G-Series platform delivers levels of performance in a compact BGA package that is ideal for low power designs in embedded applications such as Digital Signage, x86 Set-Top Box (xSTB), IP-TV, Thin Client, Information Kiosk, Point-of-Sale, Casino Gaming, Media Servers, and Industrial Control Systems.

Product Brief
AMD Embedded G-Series APU Platform
The world’s first combination of low-power CPU and advanced GPU integrated into a single embedded device
**Features and Benefits**

A flexible platform that in one package offers many choices for power efficiency, visual experience with high resolution, and fully connected Internet experience with maximum multi-media capability. Delivering unprecedented high definition visual experience while still maintaining a low power design.

- DirectX® 11 support lets you enjoy awesome graphics performance, stunning 3D visual effects and dynamic interactivity.
- Advanced discrete-level GPU with OpenGL 4.0 and OpenCL™ 1.1 support in an integrated device provides support to build the designs of tomorrow, today.
- Unprecedented graphics performance/per watt thru advanced graphics and hardware acceleration delivering over 3X performance per watt of previous generation.
- Selective models, T56N and T40N, have additional boost capability enabled by AMD Turbo CORE technology without additional power draw.
- Enabling Innovative Small Form Factor Designs - Smaller foot print and low power solution reduces overall system costs.
- The integration of the APU reduces the foot print of a traditional three-chip platform to two chips, the APU and its companion controller hub. This simplifies the design, requiring fewer board layers and a smaller power supply, thereby driving down system costs.
- Reduced Costs over the Product Life Cycle - A single, scalable platform design that allows OEMs to reduce development costs, optimize solutions and increase product stability.
- A single APU architecture with an array of performance options, the AMD Embedded G-Series platform lets OEMs utilize a single board design to enable solutions that span from entry level to high end. The commonality of the scalable platform design across multiple product variants can help reduce development costs, simplify the supply chain and reduce operational complexity.
- AMD’s embedded lifecycle, with planned availability of at least 5 years, helps to ensure a long life for an OEM design.

**Key Architecture Benefits**

**APU Features**
- High speed device interconnect
- High performance integrated x86 core(s)
- Integrated cutting edge graphics processor
- High-bandwidth, low-latency integrated memory controller
- Low-latency platform interface

**x86 Core Architecture**
- Single or dual x86 Processor
- Advanced Branch Prediction
- Out-of-Order Instruction Execution
  - Full OOO Instruction Execution
  - Full OOO Load/Store Engine
- High Performance Floating Point
- AMD64 64-bit ISA
- SSE1,2,3, SSSE3 ISA, SSE4A, MMX™
- Secure Advanced Virtualization

**GPU Core Architecture**
- Dedicated graphics memory controller
  - High efficiency ring bus memory controller
  - Direct connection to memory
- 2D Acceleration
  - Highly-optimized 128-bit engine, capable of processing multiple pixels per clock
- 3D Acceleration
  - Full DirectX® 11 support, including full speed 32-bit floating point per component operations
  - Shader Model 5
  - OpenCL™ 1.1 support
  - OpenGL 4.0 support
- Motion Video Acceleration
  - Dedicated hardware (UVD 3) for H.264, VC-1 and MPEG2 decode
  - HD HQV and SD HQV support: noise removal, detail enhancement, color enhancement, cadence detection, sharpness, and advanced de-interlacing
  - Super up-conversion for SD to HD resolutions
Integrated DDR3 Memory Controller
- Support for solder-down, SODIMM and DIMM memory, two slots, non-ECC type
- 64-bit DDR3 SDRAM controller operating at frequencies up to 1333MT/s (667MHz)

Large High-Performance On-Chip Cache
- 32KB I-Cache, 32KB D-Cache
- 512KB L2 per core

Enabling Fan-Less, High Reliability, Low Cost Solutions
- The two low power models, dual-core T40E and single-core T40R, deliver up to 40% power savings compared to the other models in the AMD Embedded G-Series product family. They expand the fanless design options for system architects and design engineers who want to build a more reliable, lower cost solution with smaller footprint without compromising on features for video, graphics and support for multiple displays.

AMD Virtualization™ Technology (AMD-V™)
- SVM lock and unlock
- Nested paging
- Next RIP
- LBR virtualization
- 8 Address space identifiers
- Performance counter guest/host bit
- Nested page table fault info

I/O
- 4x1 or 1x4 PCI Express® interface on APU
- See controller hub table for detail I/O features of A50M and A5SE
- Full ISA bus support available, please see Delivering Full ISA Support with the AMD Embedded G-Series Platform and the ITE Tech, ITE888 PCI to ISA Bridge posted on the AMD Embedded Developers Web site PID (S1762)

Package
- APU
  - 413-pin lidless micro BGA
  - 19mm x 19mm
- Controller Hub
  - 605-pin lidless

### AMD Embedded G-Series platform with dual display options

<table>
<thead>
<tr>
<th>Display One</th>
<th>Resolution</th>
<th>Extended Display</th>
<th>Resolution¹</th>
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</thead>
<tbody>
<tr>
<td>DisplayPort / eDP²</td>
<td>2560 x 1600 at 60Hz (1920 x 1200 at 60Hz)</td>
<td>DisplayPort</td>
<td>2560 x 1600 at 60Hz (1900 x 1200 at 60Hz)</td>
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<td></td>
<td></td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>2048 x 1536 at 60Hz (1900 x 1200 at 60Hz)</td>
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<tr>
<td>Single-link LVDS³,⁴</td>
<td>1440 x 900 or 1400 x 1050 at 60Hz (1024 x 600 at 60Hz)</td>
<td>DisplayPort</td>
<td>2560 x 1600 at 60Hz (1900 x 1200 at 60Hz)</td>
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<td>HDMI™</td>
<td>1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)</td>
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### AMD G-Series Accelerated Processing Units

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<th>Model</th>
<th>DPN</th>
<th>Poly</th>
<th>CPU Cores</th>
<th>L2 Cache/ Core</th>
<th>Memory Interface</th>
<th>CPU Core Frequency</th>
<th>CPU Core Frequency</th>
<th>Discrete Class Graphics</th>
<th>GPU Core Frequency</th>
<th>Graphic Acceleration</th>
<th>Display Outputs</th>
<th>Display Resolutions</th>
<th>Thermal Design Power</th>
<th>Tdie</th>
<th>Product Release</th>
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<td>AMD Radeon™ HD 6320</td>
<td>260MHz</td>
<td>UVD 3 for H.264, VC.1 and MPEG2</td>
<td>90°C</td>
<td>5.9W</td>
<td>VGA: 1280x1024 (HD 6290), HDMI 1.4a, and 30bps GbE</td>
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<td>5.9W</td>
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<td>5.9W</td>
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### AMD G-Series Platform Controller Hubs

<table>
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<tr>
<th>Model</th>
<th>DPN</th>
<th>CPU Interface</th>
<th>Package</th>
<th>PCI Express*</th>
<th>PCI</th>
<th>SATA</th>
<th>FIFS-Based Switching</th>
<th>Ethernet MAC</th>
<th>USB</th>
<th>HD Audio</th>
<th>LPC SPI</th>
<th>Max Gbps</th>
<th>APU Fan Control</th>
<th>APU Clock Gen</th>
<th>PowerW</th>
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<td>T001-C12</td>
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<td>4x PCIe x1</td>
<td>0x PCIe x1</td>
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<td>2x1000</td>
<td>1MB</td>
<td>8 Gbps</td>
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<td>Yes</td>
<td>4.25W</td>
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<td>1x4 Gen 2</td>
<td>FIBCA</td>
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<td>4x PCIe x1</td>
<td>0x PCIe x1</td>
<td>14 x 1.0 Gbps</td>
<td>2x1000</td>
<td>2x1000</td>
<td>1MB</td>
<td>8 Gbps</td>
<td>No (non-EEE PHY only)</td>
<td>Yes</td>
<td>4.25W</td>
</tr>
</tbody>
</table>
Product Brief: AMD Embedded G-Series APU Platform

AMD G-Series Platform Block Diagram

Notes:
1. Extended displays connected to any interface of the AMD Radeon™ HD 6290/6250 graphics support a maximum resolution of 1920 x 1200 at 60Hz.
2. Internal LCD panel.
3. Internal LCD panel, DP0 only.
4. 24-bit, dual-channel, LVDS support option available. See the AMD FT1 Processor Display Option Schematic (PID 48601) on the AMD Embedded Developer Support Web Site (www.d.amd.com/dev).
5. When comparing the AMD Embedded G-Series T44R platform to the AMD Sempron™ 210U/780E platform running 3DMark™ 06. Internal testing of current vs. previous generation AMD processor-based embedded systems as of October 13, 2010 showed more than 3X graphics performance-per-watt advantage for the current generation. Current system: AMD G-T44R APU (9W TDP), Inagua development platform, 2 GB RAM, Windows® 7. Previous generation: AMD Sempron™ 2010U processor (15W TDP), MSI 9858 motherboard, 2 GB RAM, Windows 7. Graphics performance-per-watt calculated based on 3DMark™ 06 benchmark divided by solution thermal design power (TDP).
6. While running a Winbench 99 business graphics benchmark the AMD G-T16R APU consumed an average of 2.284W. I/O Controller Hub power is estimated based on the measured average power drawn by the ICHR of 61968 during a run of 3DMark OE. System Configuration: AMD G-T16R APU (DVT) at 30°C, “Inagua” Development Board, 4GB 1.35V DDR3, Windows 7 Ultimate. EMB-26
7. 14x USB 2.0
8. SPI
9. SPI
10. LPC
11. SMBus
12. CIR
13. GPIO
14. 4x1 or 4x1
15. 4x1 or 4x1
16. Gen 2
17. Full ISA Bus with DMA Support
18. 6x SATA 6Gb/s (Raid 0,1,5,10*)
19. 6x SATA 6Gb/s (Raid 0,1,5,10*)
20. Low voltage (1.35V) DDR3 is assumed for the 9W TDP processors. The use of 1.5V DDR3 will incur a power adder.
22. Models enabled by AMD Turbo CORE technology, up to 10% clock speed increase is planned. For CPU boost, only one processor core of a dual-core has boost enabled.
23. Refer to the Brazos Platform Minimum System Recommendations for HD Video Playback, order# 48826 to view the minimum system configurations required to enable HD playback and the maximum resolution supported for each advanced video quality feature.
24. Refer to the Bronton Platform Minimum System Recommendations for HD Video Playback, order# 48836 to view the minimum system configurations required to enable HD playback and the maximum resolution supported for each advanced video quality feature.
25. 128MB/ROM
26. SIO TMP
27. Fan CTRL
28. HD Audio
29. Ethernet MAC
30. HDMI
31. PCIe Gen 2
32. Full ISA Bus
33. with DMA Support
34. Intel 8888 (Option)
35. Ethernet PHI
36. AMD Turbo CORE Technology, up to 10% clock speed increase is planned. For CPU boost, only one processor core of a dual-core has boost enabled.
37. AMD Turbo CORE Technology, up to 10% clock speed increase is planned. For CPU boost, only one processor core of a dual-core has boost enabled.
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