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 new 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.

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. APU configurations are available with single or dual x86 cores, at 5.5W, 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 Embedded A50M controller hub with support for advanced interfaces such as 6Gb/s SATA, Generation 2 PCI Express®, and HD Audio, the AMD G-Series platform delivers a low power, value-oriented solution for applications requiring a better balance of CPU and multimedia performance. For high-end, full-featured platforms, the AMD A55E controller hub is an alternative pairing choice with added features of Gigabit Ethernet MAC, RAID (0/1/5/10) support with FIS-based switching, and PCI local bus support.

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 system.

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 through 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 footprint and low power solution reduces overall system costs.

> The integration of the APU reduces the footprint 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, 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.

1. 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).
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 Direct3D® 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 architect 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 RIIP
- LBR virtualization
- I 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 A55E

PACKAGE
- APU
  - 413-pin idless micro BGA
  - 19mm x 19mm
  - Controller Hub
  - 605-pin lidless FCBGA
  - 23mm x 23mm

AMD Embedded G-Series APU Models and Key Features

<table>
<thead>
<tr>
<th>Model</th>
<th>Graphics</th>
<th>Clock Speed</th>
<th>Cores</th>
<th>Cache</th>
<th>DDR3 Speed</th>
<th>Max TDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>T56N</td>
<td>AMD Radeon™ HD 6320</td>
<td>1.65GHz</td>
<td>2 L1: 64KB L2: 512KB x2</td>
<td>DDR3-1333</td>
<td>18W</td>
<td></td>
</tr>
<tr>
<td>T52R</td>
<td>AMD Radeon™ HD 6310</td>
<td>1.5GHz</td>
<td>1 L1: 64KB L2: 512KB</td>
<td>DDR3-1333</td>
<td>18W</td>
<td></td>
</tr>
<tr>
<td>T48N</td>
<td>AMD Radeon™ HD 6310</td>
<td>1.4GHz</td>
<td>2 L1: 64KB L2: 512KB x2</td>
<td>DDR3-1066</td>
<td>18W</td>
<td></td>
</tr>
<tr>
<td>T40N</td>
<td>AMD Radeon™ HD 6290</td>
<td>1.0GHz</td>
<td>2 L1: 64KB L2: 512KB x2</td>
<td>LVDDR3-1066</td>
<td>9W</td>
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<tr>
<td>T44R</td>
<td>AMD Radeon™ HD 6250</td>
<td>1.2GHz</td>
<td>1 L1: 64KB L2: 512KB</td>
<td>LVDDR3-1066</td>
<td>9W</td>
<td></td>
</tr>
<tr>
<td>T40E</td>
<td>AMD Radeon™ HD 6250</td>
<td>1.0GHz</td>
<td>2 L1: 64KB L2: 512KB x2</td>
<td>LVDDR3-1066</td>
<td>6.4W</td>
<td></td>
</tr>
<tr>
<td>T40R</td>
<td>AMD Radeon™ HD 6250</td>
<td>1.0GHz</td>
<td>1 L1: 64KB L2: 512KB</td>
<td>LVDDR3-1066</td>
<td>5.5W</td>
<td></td>
</tr>
<tr>
<td>T48L</td>
<td>N/A</td>
<td>1.4GHz</td>
<td>2 L1: 64KB L2: 512KB x2</td>
<td>DDR3-1066</td>
<td>18W</td>
<td></td>
</tr>
<tr>
<td>T30L</td>
<td>N/A</td>
<td>1.4GHz</td>
<td>1 L1: 64KB L2: 512KB</td>
<td>DDR3-1066</td>
<td>18W</td>
<td></td>
</tr>
<tr>
<td>T24L</td>
<td>N/A</td>
<td>1.0GHz</td>
<td>1 L1: 64KB L2: 512KB</td>
<td>LVDDR3-1066</td>
<td>5W</td>
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</table>

AMD Embedded G-Series Platform Controller Hubs

<table>
<thead>
<tr>
<th>Model</th>
<th>PCI Express®</th>
<th>PCI</th>
<th>Gigabit Ethernet MAC</th>
<th>RAID</th>
<th>SATA</th>
<th>USB</th>
<th>Additional Interfaces/Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>A55E</td>
<td>4x1 or 1x4 PCIe® Generation 2 UMI connection to APU</td>
<td>33MHz with support for 4 masters</td>
<td>Yes</td>
<td>0/1/5/10 support with FIS-based switching</td>
<td>6x 6Gb/s ports</td>
<td>14x v2.0 ports</td>
<td>SPI, LPC, SMBus, CIR, HD audio, up to 102 GPIO, Fan control, Integrated Clock Generation, pin compatible for A50M and A55E</td>
</tr>
<tr>
<td>A50M</td>
<td>4x1 or 1x4</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

2. Low voltage (1.35V) DDR3 is assumed for the 1W TDP processors. The use of 1.5V DDR3 will incur a power adder. Always refer to the processor/chipset data sheets for technical specifications. Feature information in this document is provided for reference only.
3. 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.
Dual Independent Display with HD Video and Graphics

The AMD Embedded G-Series APU family supports dual independent display with different display technologies and is ideal for Thin Client, Digital Signage, Smart Kiosk/Point-of-Sales, Casino Gaming, Internet Ready IP-TV and Set-Top-Box. Depending on the model and the respective thermal TDP, the GPU is capable of different resolution support.

The following two tables list the supported configurations of AMD Embedded G-Series platform with dual display options.

**Table 1: AMD Embedded G-Series APU with AMD Radeon™ HD 6320 and AMD Radeon™ HD 6310 Dual Independent Display combinations**

<table>
<thead>
<tr>
<th>Display One</th>
<th>Resolution</th>
<th>Extended Display</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>DisplayPort / eDP</td>
<td>2560 x 1600 at 60Hz</td>
<td>DisplayPort</td>
<td>2560 x 1600 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>2048 x 1536 at 60Hz</td>
</tr>
<tr>
<td>Single-link LVDS</td>
<td>1440 x 900 or 1400 x 1050 at 60Hz</td>
<td>DisplayPort</td>
<td>2560 x 1600 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>2048 x 1536 at 60Hz</td>
</tr>
<tr>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>2048 x 1536 at 60Hz</td>
</tr>
<tr>
<td>VGA</td>
<td>2048 x 1536 at 60Hz</td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
</tbody>
</table>

**Table 2: AMD Embedded G-Series APU with AMD Radeon™ HD 6290 and AMD Radeon™ HD 6250 Dual Independent Display combinations**

<table>
<thead>
<tr>
<th>Display One</th>
<th>Resolution</th>
<th>Extended Display</th>
<th>Resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>DisplayPort / eDP</td>
<td>1920 x 1200 at 60Hz</td>
<td>DisplayPort</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td>Single-link LVDS</td>
<td>1024 x 600 at 60Hz</td>
<td>DisplayPort</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Single-link DVI</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VGA</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
<tr>
<td>VGA</td>
<td>1920 x 1200 at 60Hz</td>
<td>HDMI™</td>
<td>1920 x 1200 at 60Hz</td>
</tr>
</tbody>
</table>

**Notes:**
1. AMD Embedded G-Series processor, Rev C and later, support a maximum display resolution for both display one and the extended display of 2560 x 1600.
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 on the AMD Embedded Developers Web Site.

**Notes:**
1. Both displays can have a maximum display resolution of 1920 x 1200.
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 on the AMD Embedded Developers Web Site.