



### 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



### 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.

### 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<sup>1</sup> 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 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 systems.

## 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<sup>2</sup>.
- 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 foot print 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 A55E
- 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 (51762)

**Package**

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

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

Display One	Resolution	Extended Display	Resolution <sup>1</sup>
DisplayPort / eDP <sup>2</sup>	2560 x 1600 at 60Hz (1920 x 1200 at 60Hz)	DisplayPort	2560 x 1600 at 60Hz (1900 x 1200 at 60Hz)
		HDMI™	1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)
		Single-link DVI	1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)
		VGA	2048 x 1536 at 60Hz (1900 x 1200 at 60Hz)
Single-link LVDS <sup>3,4</sup>	1440 x 900 or 1400 x 1050 at 60Hz (1024 x 600 at 60Hz)	DisplayPort	2560 x 1600 at 60Hz (1900 x 1200 at 60Hz)
		HDMI™	1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)
		Single-link DVI	1920 x 1200 at 60Hz (1900 x 1200 at 60Hz)
		VGA	2048 x 1536 at 60Hz (1900 x 1200 at 60Hz)
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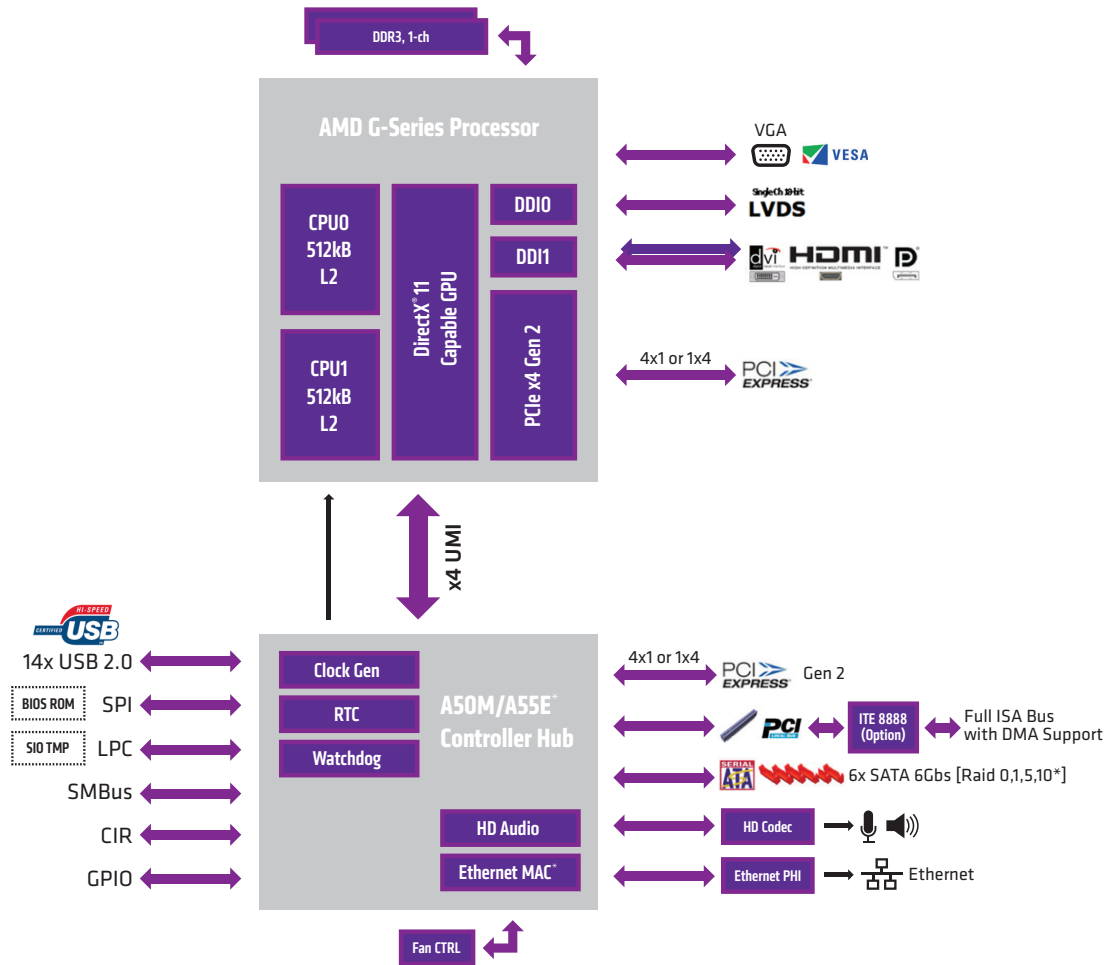
### AMD G-Series Accelerated Processing Units

Model	OPN	Pckg	CPU Cores	L2 Cache /Core	Memory Interface	CPU Core Frequency	Discrete Class Graphics	CPU Core Frequency	Hardware Video Acceleration <sup>12</sup>	Graphics	Display Outputs <sup>13</sup>	Display Resolutions	Thermal Design Power	Tdie	Product Release			
T56N	GET56NGBB22GVE	FT1 413-pin, µBGA, 19mm <sup>2</sup>	2	512KB	DDR3-1333, Unbuffered	1.65GHz <sup>17</sup>	AMD Radeon™ HD 6320	500MHz	UVD 3 for H.264, VC-1 and MPEG2 with Blu-ray support	DirectX® 11 Shader Model 5 OpenCL™ 1.1 OpenCL 4.0	Dual independent display controllers 2 active outputs from: 1x VGA 2x single link DVI 1x single link LVDS 2x DisplayPort 1.1a 1x HDMI 1x DVO	VGA: 2560x1600 (HD 6320, HD 6310) or 1920x1200 (HD 6290, HD 6250) 30 bpp Single link DVI: 1920x1200 24 bpp HDMI: 1920x1080p 36 bpp Single link LVDS <sup>14</sup> : 1400x1050 18 bpp DisplayPort 1.1a: 2560x1600 (HD 6310) or 1920x1200 (HD 6250) @ 30 bpp	18W	90°C	Q2-11			
T56E	GET56EGBB22GVE		2	512KB	DDR3-1333, Unbuffered	1.65GHz <sup>17</sup>	AMD Radeon™ HD 6250	275MHz	UVD 3 for H.264, VC-1 and MPEG2				18W	90°C	Q2-12			
T52R	GET52RGBB12GVE		1	512KB	DDR3-1333, Unbuffered	1.5GHz	AMD Radeon™ HD 6310	500MHz	UVD 3 for H.264, VC-1 and MPEG2 with Blu-ray support				18W	90°C	Q2-11			
T48E	GET48EGBB22GVE		2	512KB	DDR3-1066, Unbuffered	1.4GHz	AMD Radeon™ HD 6250	280MHz	UVD 3 for H.264, VC-1 and MPEG2				18W	90°C	Q2-12			
T44R	GET44RFPB12GVE		1	512KB	DDR3-1066, <sup>15</sup> Unbuffered	1.2GHz	AMD Radeon™ HD 6250	280MHz	UVD 3 for H.264, VC-1 and MPEG2				9W	90°C	Q2-11			
T40N	GET40NFPB22GVE		2	512KB	DDR3-1066, <sup>15</sup> Unbuffered	1.0GHz <sup>17</sup>	AMD Radeon™ HD 6290	280MHz					9W	90°C	Q2-11			
T48N	GET48NGBB22GVE		2	512KB	DDR3-1066, Unbuffered	1.4GHz	AMD Radeon™ HD 6310	520MHz					18W	90°C	Q2-11			
T40E	GET40EFSB22GVE		2	512KB	DDR3-1066, <sup>15</sup> Unbuffered	1.0GHz	AMD Radeon™ HD 6250	280MHz					6.4W	90°C	Q2-11			
T40R	GET40RFSB12GVE		1	512KB	DDR3-1066, <sup>15</sup> Unbuffered	1.0GHz	AMD Radeon™ HD 6250	280MHz					5.5W	90°C	Q2-11			
T16R	GET16RFWB12GVE		1	512KB	LVDDR3-1066	615MHz	AMD Radeon™ HD 6250	276MHz					VGA: 1920x1200 (HD 6290, HD 6250) 30 bpp Single link DVI: 1920x1200 24 bpp DisplayPort 1.1a: 1920 x 1200 (HD 6250) @ 30 bpp	4.5W	90°C	Q2-12		
T48L	GET48LGBB22GVE		2	512KB	DDR3-1066, Unbuffered	1.4GHz	N/A	N/A					N/A	N/A	N/A	18W	90°C	Q2-11
T30L	GET30LGBB12GVE		1	512KB	DDR3-1066, Unbuffered	1.4GHz	N/A	N/A					N/A	N/A	N/A	18W	90°C	Q2-11
T24L	GET24LFQB12GVE		1	512KB	DDR3-1066, <sup>15</sup> Unbuffered	1.0GHz	N/A	N/A					N/A	N/A	N/A	5W	90°C	Q2-11

### AMD G-Series Platform Controller Hubs

Model	OPN	CPU Interface	Package	PCI Express <sup>5</sup>	PCI	SATA	FIS-Based Switching	Ethernet MAC	USB	HD Audio	LPC SPI SMBus	Max GPIOs	APU Fan Control	APU Clock Gen	Power <sup>16</sup>
A50M	100-CC2198	1x4 Gen 1	FCBGA 605-pin lidless µBGA 2mm <sup>2</sup>	4x1 Gen 2	No	6x 6Gb/s	No	No	14 v2.0 2 v1.1	Up to 4-channels	Yes	102	Yes	Yes	2.7W-5.9W
A55E	100-CG2293	1x4 Gen 2	FCBGA 605-pin lidless µBGA 2mm <sup>2</sup>	4x1 Gen 2	33MHz 4 Slots	6x 6Gb/s with RAID 0,1,5,10	Yes	Yes (non-EEE PHY only)	14 v2.0 2 v1.1	Up to 4-channels	Yes	102	Yes	Yes	2.7W-5.9W

## AMD G-Series Platform Block Diagram



[www.amd.com/embedded](http://www.amd.com/embedded)

**Notes:**

- Extended displays connected to any interface of the AMD Radeon™ HD 6290/6250 graphics support a maximum resolution of 1920 x 1200 at 60Hz.
- Internal LCD panel.
- Internal LCD panel, DPO only.
- 24-bit, dual-channel, LVDS support option available. See the AMD FT1 Processor Display Option Schematic (PID 486D01) on the AMD Embedded Developer Support Web Site ([www.amd.com/dev](http://www.amd.com/dev)).
- 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).
- 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 I/OCH of .965W during a run of 3DMark 06. System Configuration: AMD G-T16R APU (DVT) at 30°C, "Inagua" Development Board, 4GB 1.35V DDR3, Windows 7 Ultimate, EMB-26
- Low voltage (1.35V) DDR3 is assumed for the 9W 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.
- 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.
- 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.
- Other resolutions available that do not oversubscribe link bandwidth. Display resolutions limited by available memory bandwidth.
- eDP translator option supporting 2048x1536 (HD 6310) or 1920x1200 (HD 6250) at 18 or 24 bpp.
- Low voltage (1.35V) DDR3 is assumed for the 9W TDP processors. The use of 1.5V DDR3 will incur a power adder.
- Configuration dependent. See product databook for configurations.
- 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.

