



# AMD Embedded G-Series System-on-Chip (SOC)

THE EMBEDDED EVOLUTION CONTINUES WITH X86 CPU, INTEGRATED DISCRETE-CLASS GPU AND I/O CONTROLLER ON THE SAME DIE

## PRODUCT OVERVIEW

The AMD Embedded G-Series SOC platform is a high-performance, low-power System-on-Chip (SOC) design, featured with enterprise-class error-correction code (ECC) memory support, dual and quad-core variants, integrated discrete-class GPU and I/O controller on the same die.

The AMD G-Series SOC achieves superior performance per watt in the low-power x86 microprocessor class of products when running multiple industry standard benchmarks.<sup>1</sup> This helps enable the delivery of an exceptional HD multimedia experience and provides a heterogeneous computing platform for parallel processing. The small-footprint, ECC-capable SOC sets the new foundation for a power-efficient platform for content-rich multimedia processing and workload processing that is well-suited for a broad variety of embedded applications.

## SUPERIOR PERFORMANCE PER WATT

The AMD Embedded G-Series SOC platform delivers an exceptionally high-definition visual experience and the ability to take advantage of heterogeneous computing while maintaining a low-power design.

- > AMD G-Series SOC's next-generation "Jaguar" based CPU offers 113% improved CPU performance vs. AMD G-Series APU and greater than a 2x (125%) advantage vs. Intel Atom when running multiple industry-standard compute-intensive benchmarks.<sup>2</sup>
- > AMD G-Series SOC's advanced GPU, supporting DirectX® 11.1, OpenGL 4.2 and OpenCL™ 1.2<sup>9</sup>, enables parallel processing and high-performance graphics processing that provides up to 20% improvement vs. AMD G-Series APU and a 5x (430%) advantage vs. Intel Atom when running multiple industry-standard graphics-intensive benchmarks.<sup>3</sup>
- > Excellent compute and graphics performance with enhanced hardware acceleration delivers up to 70% overall improvement vs. AMD G-Series APU and over 3x (218%) the overall performance advantage vs. Intel Atom in embedded applications when running multiple industry-standard compute- and graphics-intensive benchmarks.<sup>4</sup>

## ENABLING LOW-POWER, INNOVATIVE SMALL FORM FACTOR DESIGNS

The AMD G-Series SOC is a small footprint and low-power solution that reduces overall system costs.

- > The SOC design offers 33% footprint reduction compared to AMD G-Series APU two-chip platform<sup>5</sup>, simplifying design with fewer board layers and simplified power supply.
- > AMD G-Series SOC enables fan-less design that further helps drive down system cost and enhance system reliability by eliminating moving parts.
- > With an array of performance options, the AMD G-Series SOC platform allows OEMs to utilize a single board design to enable solutions from entry-level to high-end.
- > The SOC design enables new levels of performance in small SBC (single board computer) and COMs (computer-on-modules) form factors.

## OPTIMIZING BUSINESS VALUE

The AMD Embedded G-Series SOC platform brings performance and efficiency with desirable features, delivering lower TCO and higher ROI.

- > Supporting ECC memory, AMD G-Series SOC platforms will help to penetrate markets previously inaccessible to x86 products in these power envelopes, at this price point.
- > The AMD G-Series SOC helps achieve higher system quality, reliability, and energy efficiency, which contribute to overall lower TCO.
- > Multiple performance levels offer upgrade paths to protect software and hardware ecosystem costs.
- > AMD's standard embedded 5 year availability and support (additional 2 years under contract possible) maximizes ROI.
- > The AMD G-Series SOC platform is well-suited for low-power and high-performance designs in a broad range of markets including Industrial Control & Automation, Digital Signage, Thin Client, Electronic Gaming Machines, and SMB storage appliances.

## KEY ARCHITECTURE BENEFITS

### FIRST GENERATION SOC DESIGN

- > Delivers up to 70% overall improvement over AMD G-Series APU<sup>6</sup>
- > Integrates Controller Hub functional block as well as CPU+GPU+NB
- > 28nm process technology, 24.5mm x 24.5mm BGA package

### "JAGUAR" CPU CORE WITH PERFORMANCE INCREASES

- > Dual-core and quad-core, up to 2MB shared L2
- > 113% CPU performance improvement over AMD G-Series APU<sup>7</sup>

### NEXT GENERATION GRAPHICS CORE WITH PERFORMANCE INCREASE OVER PREVIOUS GENERATIONS

- > 20% compute performance improvement over AMD G-Series APU when running multiple industry-standard graphics-intensive benchmark
- > DirectX<sup>®</sup> 11.1 graphics support

### IMPROVED POWER SAVING FEATURES

- > Power gating added to Multimedia Engine, Display Controller & NB
- > DDR P-states for reduced power consumption

### MEMORY SUPPORT: SINGLE-CHANNEL DDR3

- > Up to DDR3-1600 – 1.35V and 1.25V voltage levels supported
- > Up to 2 UDIMMs or 2 SO-DIMMs
- > ECC support

### INTEGRATED DISPLAY OUTPUTS

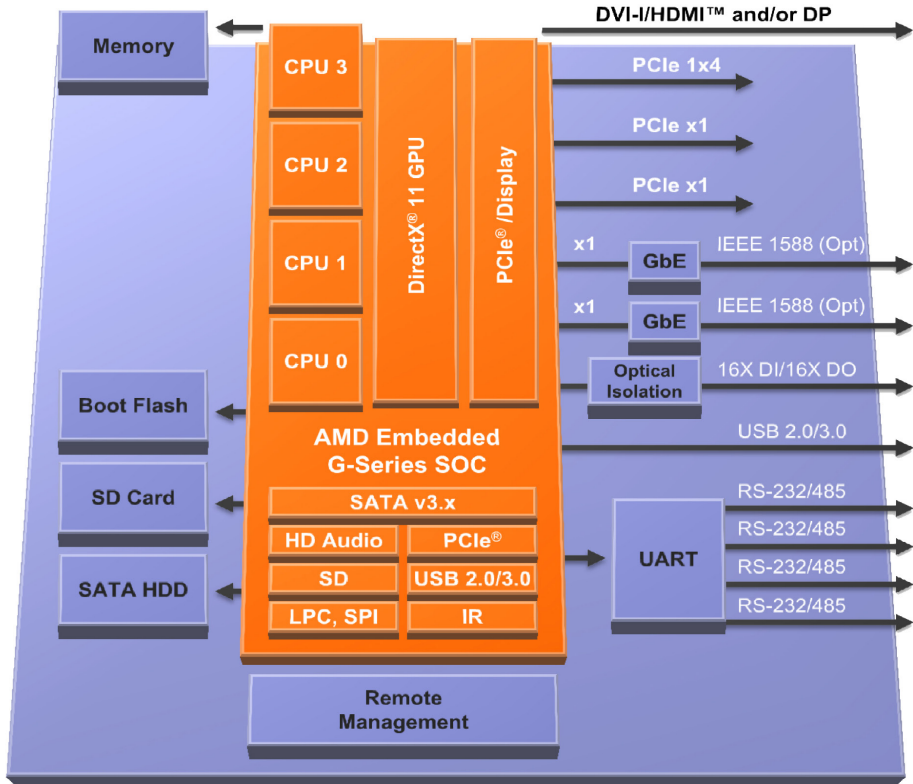
- > Supports two simultaneous displays
- > Supports 4-lane DisplayPort 1.2, DVI, HDMI™ 1.4a
- > Integrated VGA
- > Integrated eDP or 18bpp single channel LVDS

### UPDATED I/O (FEATURES MAY BE SKU DEPENDENT)

- > Four x1 links of PCIe<sup>®</sup> Gen 2 for GPPs
- > One x4 link of PCIe Gen 2 for discrete GPU
- > 8 USB 2.0 + 2 USB 3.0
- > 2 SATA 2.x/3.x (up to 6Gb/s)
- > SD Card Reader v3.0 or SDIO controller

MODEL	OPN	# OF x86 CORES	TDP (CPU, GPU, & SB)	SHARED L2 CACHE	CPU FREQ.	GPU FREQ. (GRAPHICS)	DDR SPEED	USB 3.0	TjC
<b>w/GPU</b>									
GX-420CA	GE420CIAJ44HM	4	25W	2MB	2.0GHz	600MHz (HD 8400E)	DDR3-1600	Yes	90°C
GX-415GA	GE415GIBJ44HM	4	15W	2MB	1.5GHz	500MHz (HD 8330E)	DDR3-1600	Yes	90°C
GX-217GA	GE217GIBJ23HM	2	15W	1MB	1.65GHz	450MHz (HD 8280E)	DDR3-1600	Yes	90°C
GX-210HA	GE210HICJ23HM	2	9W	1MB	1.0GHz	300MHz (HD 8210E)	DDR3-1333	Yes	90°C
<b>w/o GPU</b>									
GX-416RA	GE416RIBJ44HM	4	15W	2MB	1.6GHz	N/A	DDR3-1600	N/A	90°C

# ARCHITECTURAL OVERVIEW OF THE AMD G-SERIES SOC



HIGH PERFORMANCE BOX PC WITH AMD G-SERIES SOC

\*Compared to AMD Embedded G-Series APU

## 1ST GENERATION APU SOC DESIGN

- > Integrates Controller Hub functional block as well as CPU+GPU+NB
- > 28nm process technology, FT3 BGA package, 24.5mm x 24.5mm
- > Dual- or Quad-“Jaguar” CPU cores with 2MB shared L2 cache

## NEXT GENERATION GRAPHICS CORE

- > Compute performance (GFLOP) improvement
- > DirectX® 11.1 graphics support

## MEMORY SUPPORT: SINGLE-CHANNEL DDR3

- > Up to 2 UDIMMs or 2 SO-DIMM DDR3-1600 @ 1.35V & 1.25V
- > Support for ECC DIMMs

## INTEGRATED DISPLAY OUTPUTS

- > Supports two simultaneous displays
- > Supports 4-lane DisplayPort 1.2, DVI, HDMI™ 1.4a, Integrated VGA and Integrated eDP or 18bpp single channel LVDS

## UPDATED I/O

- > Four x1 links of PCIe® Gen 2 for GPPs
- > One x4 link of PCIe Gen 2 for discrete GPU (not on lower TDPs)
- > 8 USB 2.0 + 2 USB 3.0
- > 2 SATA 2.x/3.x (up to 6Gb/s)
- > SD Card Reader v3.0 or SDIO controller

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

1 The low-power x86 microprocessor class includes: GX-420CA @ 25W TDP (scored 19); GX-415GA @ 15W (25), GX-217GA @ 15W (17), GX-210HA @ 9W (20), G-T56N @ 18W (12), G-T52R @ 18W (7), G-T40N @ 9W (14), G-T16R @ 4.5W (19), Intel Atom N270 @ 2.5W (20), Intel Atom D525 @ 13W (9), Intel Atom D2700 @ 10W (12) & Intel Celeron G440 @ 35W (5). Performance score based on an average of scores from the following benchmarks: Sandra Engineering 2011 Dhrystone ALU, Sandra Engineering 2011 Whetstone iSSE3, 3DMark® 06 (1280 x 1024), PassMark Performance Test 7.0 2D Graphics Mark, and EEMBC CoreMark Multi-thread. All systems running Windows® 7 Ultimate for Sandra Engineering, 3DMark® 06 and PassMark. All systems running Ubuntu version 11.10 for EEMBC CoreMark. All configurations used DirectX 11.0. AMD G-Series APU system configurations used iBase MI958 motherboards with 4GB DDR3 and integrated graphics. All AMD G-Series SOC systems used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D2700 configuration used Jetway NC9KDL-2700 motherboard, 4GB DDR3 and integrated graphics. Intel Celeron system configuration used MSI H61M-P23 motherboard with 4GB DDR3 and integrated graphics. Intel Atom N270 system configuration used MSI MS-9830 motherboard with maximum supported configuration of 1GB DDR2 (per <http://download.intel.com/design/intarch/manuals/320436.pdf>), and Intel GM945 Intel Atom D525 used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics.

2 AMD GX-415GA scored 209, AMD G-T56N scored 98, and Intel Atom D525 scored 93, based on an average of Sandra Engineering 2011 Dhrystone, Sandra Engineering 2011 Whetstone and EEMBC CoreMark Multi-thread benchmark results. AMD G-T56N system configuration used iBase MI958 motherboard with 4GB DDR3 and integrated graphics. AMD GX-415GA system configuration used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D525 system configuration used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics. All systems running Windows® 7 Ultimate for Sandra Engineering and Ubuntu version 11.10 for EEMBC CoreMark.

3 AMD GX-415GA scored 864, AMD G-T56N scored 724, and Intel Atom D525 scored 162, based on an average of 3DMark® 06 1280x1024 and PassMark Performance Test 7.0 2D Graphics Suite benchmark results. AMD G-T56N system configuration used iBase MI958 motherboard with 4GB DDR3 and integrated graphics. AMD GX-415GA system configuration used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D525 system configuration used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics. All systems running Windows® 7 Ultimate with DirectX 11.0.

4 AMD GX-415GA scored 369, AMD G-T56N scored 218, and Intel Atom D525 scored 116, based on an average of Sandra Engineering 2011 Dhrystone ALU, Sandra Engineering 2011 Whetstone iSSE3, 3DMark® 06 (1280 x 1024), PassMark Performance Test 7.0 2D Graphics Mark, and EEMBC CoreMark Multi-thread. AMD G-T56N system configuration used iBase MI958 motherboard with 4GB DDR3 and integrated graphics. AMD GX-415GA system configuration used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D525 system configuration used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics. All systems running Windows® 7 Ultimate for Sandra Engineering, 3DMark® 06 and PassMark. All systems running Ubuntu version 11.10 for EEMBC CoreMark. All configurations used DirectX 11.0.

5 AMD G-Series SOC FT3 BGA package dimension 24.5mm x 24.5mm = 600.25 mm<sup>2</sup> SOC; AMD G-Series APU FT1 and Controller Hub two-chip platform: 19mm x 19mm + 23mm x 23mm = 890 mm<sup>2</sup>; 33% improvement based on an average of Sandra Engineering 2011 Dhrystone ALU, Sandra Engineering 2011 Whetstone iSSE3, 3DMark® 06 (1280 x 1024), PassMark Performance Test 7.0 2D Graphics Mark, and EEMBC CoreMark Multi-thread. AMD G-T56N system configuration used iBase MI958 motherboard with 4GB DDR3 and integrated graphics. AMD GX-415GA system configuration used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. All systems running Windows® 7 Ultimate for Sandra Engineering, 3DMark® 06 and PassMark. All systems running Ubuntu version 11.10 for EEMBC CoreMark. All configurations used DirectX 11.0.

6 Based on an average of Sandra Engineering 2011 Dhrystone, Sandra Engineering 2011 Whetstone and EEMBC CoreMark Multi-thread benchmark results. AMD G-T56N system configuration used iBase MI958 motherboard with 4GB DDR3 and integrated graphics. AMD GX-415GA system configuration used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D525 system configuration used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics. All systems running Windows® 7 Ultimate for Sandra Engineering and Ubuntu version 11.10 for EEMBC CoreMark.

8 AMD GX-415GA scored 864, AMD G-T56N scored 724, and Intel Atom D525 scored 162, based on an average of 3DMark® 06 1280x1024 and PassMark Performance Test 7.0 2D Graphics Suite benchmark results. AMD G-T56N system configuration used iBase MI958 motherboard with 4GB DDR3 and integrated graphics. AMD GX-415GA system configuration used AMD "Larne" Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D525 system configuration used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics. All systems running Windows® 7 Ultimate with DirectX 11.0.

9 OpenCL 1.2 currently supported in the following operating systems: Microsoft Windows 7; Microsoft Windows Embedded Standard 7; Microsoft Windows 8; Microsoft Windows Embedded Standard 8; Linux (Catalyst drivers). OpenCL 4.2 currently supported in the following operating systems: Microsoft Windows 7; Microsoft Windows Embedded Standard 7; Microsoft Windows 8; Microsoft Windows Embedded Standard 8; Linux (Catalyst drivers). Ongoing support options TBA.

