

Product Brief

# 1st and 2nd Generation 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 1st 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>
- 1st Generation AMD G-Series SOC's advanced GPU, supporting DirectX<sup>®</sup> 11.1, OpenGL 4.2, and OpenCL<sup>™</sup> 1.2<sup>3</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>4</sup>
- 1st Generation AMD G-Series SOC's advanced GPU 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>5</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>6</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 and universal pin compatibility across the AMD G-Series SOC portfolio, 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.
- AMD G-Series SOC's support Thermal Design Profiles (TDPs) from 5W to 25W and offer dynamically configurable TDP capabilities.

## Optimizing Business Value

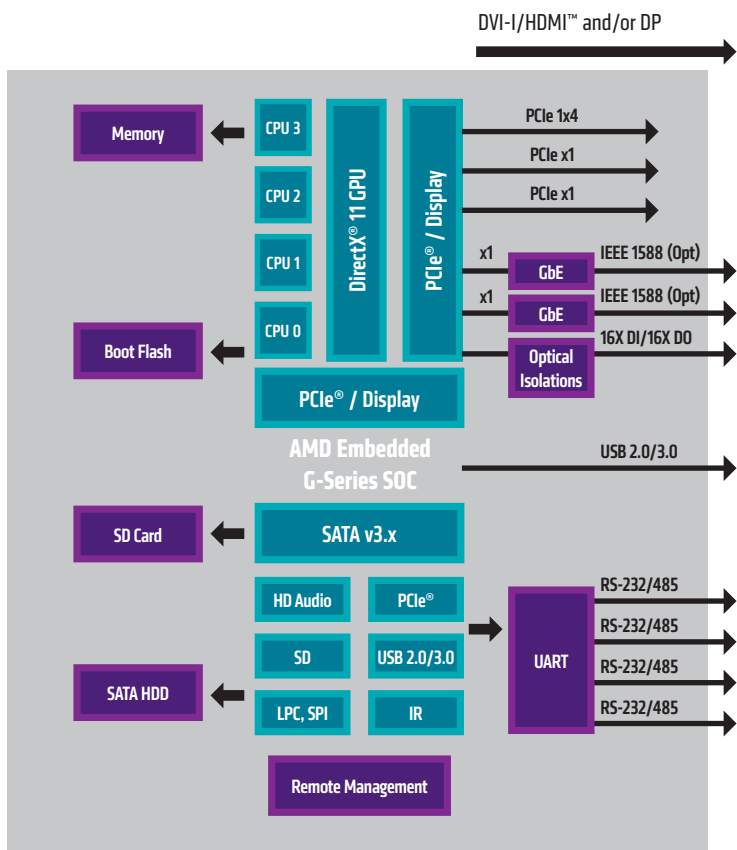
The AMD Embedded G-Series SOC platform brings performance and efficiency with desirable features, delivering lower TCO and higher ROI.

- Supporting ECC memory and providing a dedicated Platform Security Processor (PSP) compatible with ARM<sup>®</sup> TrustZone, 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 commitment to long-term availability and support (5-10 years) maximizes ROI.<sup>7</sup>
- 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, and Electronic Gaming Machines.
- 1st Generation – 33% more performance per dollar than competing Intel solutions – for cost-optimized storage controllers and Network Attached Storage systems.<sup>8</sup>

MODEL NUMBER	OPN	NO. OF CORES	TDP	SHARED L2 CACHE	CPU FREQUENCY	GPU CUS	GPU FREQUENCY	DDR FREQUENCY	OPERATING TEMP RANGE Tj °C
<b>1st Generation G-Series SOCs</b>									
GX-210UA	GE210UIGJ23HM	2	8.50W	1MB	1.0GHZ	N/A	N/A	1333	0-90°C
GX-416RA	GE416RIBJ44HM	4	15.00W	2MB	1.6GHZ	N/A	N/A	1600	0-90°C
GX-209HA	GE209HISJ23HM	2	9.00W	1MB	1.0GHZ	2	225	1066	-40-105°C
GX-210HA	GE210HICJ23HM	2	9.00W	1MB	1.0GHZ	2	300	1333	0-90°C
GX-210JA	GE210JIHJ23HM	2	6.00W	1MB	1.0GHZ	2	225	1066	0-90°C
GX-217GA	GE217GIBJ23HM	2	15.00W	1MB	1.65GHZ	2	450	1600	0-90°C
GX-411GA	GE411GIRJ44HM	4	15.00W	2MB	1.1GHZ	2	300	1066	-40-105°C
GX-415GA	GE415GIBJ44HM	4	15.00	2MB	1.5GHZ	2	500	1600	0-90°C
GX-420CA	GE420CIAJ44HM	4	25.00	2MB	2.0GHZ	2	600	1600	0-90°C
<b>2nd Generation G-Series SOCs</b>									
GX-424CC	GE424HIYJ44JB	4	25W	2MB	2.4GHz	2CU	655MHz/ 800MHz	DDR3-1866	0-90°C
GX-420MC	GE420MIXJ44JB	4	17.5W	2MB	2.0GHz	N/A	N/A	DDR-1600	0-90°C
GX-412TC	GE412TIYJ44JB	4	6W	2MB	1.0GHz/ 1.4GHz	N/A	N/A	DDR-1333	0-90°C
GX-412HC	GE412HIYJ44JB	4	7W	2MB	1.2GHz/ 1.6GHz	2CU	267MHz/ 350MHz	DDR3-1333	0-90°C
GX-410VC	GE410VIZJ44JB	4	7W	2MB	1.0GHz	N/A	N/A	DDR3-1066	-40-105°C
GX-224PC	GE224PIXJ23JB	2	25W	1MB	2.4GHz	N/A	N/A	DDR3-1866	0-90°C
GX-222GC	GE222GITJ23JB	2	15W	1MB	2.2GHz/ 2.4GHz	2CU	655MHz/ 800MHz	DDR3-1600	0-90°C
GX-216HC	GE216HHBJ23JB	2	10W	1MB	1.6GHz	2CU	300MHz	DDR3-1066	-40-105°C
GX-212JC	GE212JIYJ23JB	2	6W	1MB	1.2GHz/ 1.4GHz	2CU	267MHz/ 300MHz	DDR3-1333	0-90°C
GX-210JC	GE210JIZJ23JB	2	7W	1MB	1.0Ghz	2CU	267Mhz	DDR3-1066	-40-105°C



HIGH-PERFORMANCE BOX PC WITH AMD G-SERIES SOC

### 1st-generation APU SOC design

- Integrates Controller Hub functional block as well as CPU+GPU+NB
- 28nm process technology, FT3, and FT3b BGA packages, 24.5mm x 24.5mm
- Dual- or Quad-“Jaguar” or “Jaguar+” CPU cores with 2MB shared L2 cache

### 2nd-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

### Improved power-saving features

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

### 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

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1 The low-power x86 microprocessor class includes: CX-420CA @ 25W TDP (scored 19); CX-415GA @ 15W (25); CX-217GA @ 15W (17); CX-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, 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 M958 motherboards with 4GB DDR3 and integrated graphics. All AMD G-Series SOC systems used AMD “Lame” Reference Design Board with 4GB DDR3 and integrated graphics. Intel Atom D2700 was tested with 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 CM945 Intel Atom D525 used MSI MS-A923 motherboard with platform integrated 1GB DDR3 and integrated graphics.

2 AMD CX-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 M958 motherboard with 4GB DDR3 and integrated graphics. AMD CX-415GA system configuration used AMD “Lame” 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 OpenGL 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). OpenGL 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.

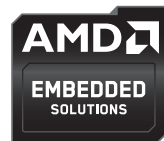
4 AMD CX-415GA scored 864, AMD G-T56N scored 724, and Intel Atom D525 scored 162, based on an average of 3DMark® 06 1280x1024 and PassMark Performance Test 7.0 2D Graphics Suite benchmark results. AMD G-T56N system configuration used iBase M958 motherboard with 4GB DDR3 and integrated graphics. AMD CX-415GA system configuration used AMD “Lame” 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.

5 AMD CX-415GA scored 369, AMD G-T56N scored 218, and Intel Atom D525 scored 116, based on an average of Sandra Engineering 2011 Dhrystone ALL, 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 M958 motherboard with 4GB DDR3 and integrated graphics. AMD CX-415GA system configuration used AMD “Lame” 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 configurations used DirectX 11.0.

6 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

7 5-year, 7-year, and 10-year support offered, depending upon the AMD product. Please contact your AMD representative for more details.

8 Performance comparison is based on the EEMBC CoreMark v1.0 benchmark. The kit price of CX-416RA is \$25, and the kit price of Celeron 1037U is \$25. The performance delta of 34% was calculated based on CX-416RA's CoreMark score of 24699 and Celeron 1037U's CoreMark score of 18461. The performance-per-\$ delta of 34% was calculated based on the CX-416RA's performance-per-\$ ratio of 987/96 and 1037U's performance-per-\$ ratio of 738/44. The AMD Stepple Eagle CX-416RA used an AMD Lame development board with 4GB DDR3-1600 memory and 80GB Hitachi HDD. The Intel Celeron 1037U used a Toshiba Satellite C55-A5220 motherboard with 8GB DDR3-1600 memory and 256GB Sandisk HDD. Both systems ran Ubuntu Linux 11.1. EMB-105



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