



**Family 12h AMD A-Series Accelerated  
Processor  
Product Data Sheet**

Publication # **49894**  
Revision: **3.01**  
Issue Date: **October 2011**

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## Revision History

Date	Revision	Description
October 2011	3.01	Second Public Release. <ul style="list-style-type: none"><li>• Removed Digital Rights Management (DRM) from “Display Interfaces” on page 8.</li><li>• Updated HDMI pixel rate and deep color in “Display Interfaces” on page 8.</li><li>• Removed Digital Rights Management (DRM) Audio protection from Table 1 on page 10.</li><li>• Added notes to Table 1 on page 10.</li><li>• Updated Table 1 on page 10.</li><li>• Updated Table 2 on page 11.</li></ul>
July 2011	3.00	First Public Release.

# 1 Family 12h AMD A-Series Accelerated Processor Features

## 1.1 Family 12h AMD A-Series Accelerated Processor Features

This section lists the features and capabilities of the Family 12h AMD A-Series accelerated processor.

- **Compatible with Existing 32-Bit x86 and 64-bit AMD64 Code Base**
  - Including support for SSE, SSE2, SSE3, SSE4A, 3DNow!™, MMX™, and legacy x86 instructions
  - Runs existing operating systems and drivers
  - Local APIC on the chip
- **AMD64 Technology**
  - AMD64 technology instruction set extensions
  - 64-bit integer registers, 48-bit virtual addresses, and 48-bit physical addresses
  - Eight 64-bit integer registers
  - Eight 128-bit SSE registers
- **Multi-Core Architecture**
  - Dual-core, triple-core, and quad-core options
  - Discrete L1 and L2 cache structures for each core
- **Cache Structures**
  - **64-Kbyte 2-Way Associative ECC-Protected L1 Data Cache**
    - Two 64-bit operations per cycle, 3-cycle latency
  - **64-Kbyte 2-Way Associative Parity-Protected L1 Instruction Cache**
    - With advanced branch prediction
  - **1024-Kbyte, 16-Way Associative L2 Cache**
    - Exclusive cache architecture storage in addition to L1 caches
- **Floating-Point Unit**
  - AMD floating-point accelerator
    - 128-bit floating-point unit (FPU)
- **Management and Virtualization Features**
  - Temperature Sensor Interface (SB-TSI)
    - Provides access to temperature sensor and temperature threshold registers
  - AMD Virtualization™ technology (AMD-V™)
    - SVM lock and unlock
    - Nested paging
    - Nested paging performance counter event selects
    - Next RIP
    - LBR virtualization
    - 64 address space identifiers
    - Performance counter guest/host bit
    - Improved nested page table fault info
- **Power Management**
  - Multiple low-power states
  - 32-nm process for decreased power consumption
  - AMD PowerNow!™ technology
  - System Management Mode (SMM)
  - ACPI-compliant, including support for processor performance states (P-states), processor power states (C-states), and sleep states including S0, S3, S4, and S5
  - Per-core power gating (CC6)

- PCIe® core power gating
- PCIe power-down for unused lanes
- AMD Turbo Core technology<sup>†</sup>

<sup>†</sup> This feature is available on selected AMD A-Series Processor.

- **Electrical Interfaces**

- DDR3 SDRAM: Compliant with JEDEC DDR3 1.5V SDRAM specifications
- Refer to the *AMD Family 12h Processor Electrical Data Sheet* order# 41609, for electrical details of AMD Family 12h processors.

- **Thermal Controls**

- Sideband temperature control
- Hardware thermal control (HTC)
- Local hardware thermal control (LHTC)
- DRAM thermal protection

- **PCIe Technology**

- PCIe Gen 1.0 and PCIe Gen 2.0 technology supported:
  - Configurable x8 and x16 external discrete graphics card expansion PCIe link<sup>†</sup>
    - <sup>†</sup> Supports only single discrete graphics card.
  - Configurable x4 General Purpose Ports (GPP) link
  - x4 unified media interface link

- **Integrated Memory Controller**

- Low-latency, high-bandwidth
- Socket FM1 package
  - Two 64-bit DDR3 SDRAM controllers operating at frequencies up to 1866 MT/s (933 MHz)
  - Supports up to two dual-rank SODIMMs or unbuffered DIMMs per channel

- **Available Packages**

- Compliant with RoHS (EU Directive 2002/95/EC), with lead used only in small amounts in specifically exempted applications
- Socket FM1 package
  - Refer to the *AMD Socket FM1 Processor Functional Data Sheet*, order# 44085, for functional and mechanical details of the socket FM1 package processor.
  - 905-pin lidded micro PGA
  - 1.27-mm pin pitch
  - 40 mm x 40 mm
  - 31 x 31 row pin array
  - Organic C4 die attach

## 1.2 Family 12h AMD A-Series Graphics Features

This section lists the graphics features available for the Family 12h AMD A-Series accelerated processor when the internal GPU is enabled.

### • Integrated Graphics

- Discrete-class graphics processor embedded alongside the x86 CPU complex
- Dedicated graphics memory controller
- Refer to *AMD Family 12h Processor Power and Thermal Data Sheet*, order# 47952, for graphics engine clock speeds.
- AMD Dual Graphics support<sup>†</sup>

<sup>†</sup> AMD Dual Graphics support is available with limited discrete graphics processors and on the Windows<sup>®</sup> 7 operating system.

### • Power Management

- Frame buffer compression
- GPU power gating
- UVD power gating
- Graphics memory controller (GMC) power gating
- AMD PowerPlay™ power management technology

### • 2D Acceleration Features

- Highly-optimized 128-bit engine, capable of processing multiple pixels per clock
- Hardware acceleration of Bitblt, line drawing, polygon and rectangle fills, bit masking, monochrome expansion, panning and scrolling, scissoring, and full ROP support (including ROP3)
- Optimized handling of fonts and text using AMD proprietary techniques
- Game acceleration including support for Microsoft<sup>®</sup> DirectDraw: Double Buffering, Virtual Sprites, Transparent Blit, and Masked Blit
- Acceleration in 1/8/15/16/32-bpp modes:
  - Pseudocolor mode for 8 bpp
  - ARGB1555 and RGB565 modes for 16 bpp
  - ARGB8888 mode for 32 bpp
- Setup of 2D polygons and lines
- Support for GDI extensions:
  - In Windows XP and Windows Vista<sup>®</sup>: Alpha BLT, Transparent BLT, and Gradient Fill
  - In Windows 7: Alpha BLT, Transparent BLT, Color Fill BLT, Stretch BLT, and Clear Type BLT
- Hardware cursor (up to 64 bpp × 64 bpp × 32 bpp), with alpha channel for direct support of Windows XP, Windows Vista and Windows 7 alpha cursor

### • 3D Acceleration Features

- DirectX<sup>®</sup> 11 compliant, including full speed 32-bit floating point per component operations
  - Shader Model 5 geometry and pixel support in a unified shader architecture:
    - Vertex, pixel, geometry, compute, domain, and hull shaders
    - Full speed 32-bit and 64-bit floating point processing per component
    - High dynamic range rendering with floating point blending, texture filtering and anti-aliasing support
    - High performance dynamic branching and flow control
    - Shader instruction store, using an advance caching system
    - Advanced shader design, with ultra-threading sequencer for high efficiency operations
    - Advanced, high performance branching support, including static and dynamic branching
    - 16-bit and 32-bit floating point components for high dynamic range computations
    - Full anti-aliasing on render surfaces up to and including 128-bit floating point formats
- Support for OpenCL™ 1.1
- Support for OpenGL 3.2 and 2.1

- Anti-Aliasing Filtering:<sup>†</sup>
  - † Support for anti-aliasing filtering is dependent on application.
  - 2x/4x/8x modes
  - Multi- and super-sample algorithm with gamma correction, programmable sample patterns, and centroid sampling
  - Custom filter anti-aliasing with up to 24-samples per pixel
  - Adaptive anti-aliasing mode
  - Lossless color compression (up to 8:1) at all resolutions, up to and including widescreen HDTV
- Anisotropic Filtering:<sup>†</sup>
  - † Support for anisotropic filtering is dependent on application.
  - 2x/4x/8x/16x modes
  - Up to 128-tap texture filtering
  - Anisotropic biasing to allow trading quality for performance
  - Improved quality mode due to improved sub-pixel precision, and higher precision LOD computations
  - Advanced texture compression (3Dc+)
  - High quality 4:1 compression for normal maps and luminance maps
  - Angle-invariant algorithm for improved quality
  - Works with single-channel or two-channel data format
- HW support to overcome "Small batch" issues in CPU limited applications
- 3D resources virtualized to a 32-bit addressing space, for support of large numbers of render targets and textures
- Support for up to 16k x 16k textures, including 128-bit/pixel textures
- Software-upgradeable, programmable arbitration logic maximizing memory efficiency
- Fully associative texture, color, and Z cache design
- Hierarchical Z and stencil buffers with early Z Test
- Lossless Z-buffer compression for both Z and stencil
- Fast Z-buffer clear
- Fast color-buffer clear
- Z cache optimized for real-time shadow rendering
- Z and color compression resources virtualized to a 32-bit addressing space, for simultaneous support of multiple render targets and textures
- **Motion Video Acceleration Features**
  - Refer to *Sabine Platform Minimum System Recommendations for HD Video Playback*, order# 48827, to view the minimum system configurations required to enable HD playback and the maximum resolution supported for each advanced video quality feature.
  - Supports DVD, Blu-ray, and SDTV/HDTV content playback with low CPU usage
  - Supports stereoscopic 3D Blu-ray
  - Motion video decode acceleration technology:
    - Dedicated hardware (UVD 3) for H.264, MPEG4 Part 2, VC-1 and MPEG2 decode:
      - H.264 implementation based on the ISO/IEC 14496-10 specification
      - MPEG4 Part 2 implementation based on the ISO/IEC 14496-2 specification
      - VC-1 implementation based on the SMPTE 421M specification
      - MPEG2 implementation based on the IOS 13811-2 specification
    - Simultaneous high-definition and standard-definition source decode
    - Dual high-definition source decode<sup>†</sup>
      - † Dual high-definition source decode is available on systems configured with adequate clock speeds.
  - Microsoft DirectX video acceleration (DXVA) API (application programming interface) for Windows operating system

- **Motion Video Process Acceleration:**

- Video scaling and YCrCb to RGB color space conversion for video playback and fully adjustable color controls
- Motion adaptive and vector based de-interlacing filter eliminates video artifacts caused by displaying interlaced video on non-interlaced displays, and by analyzing image and using optimal de-interlacing functions on a per-pixel basis
- HD HQV and SD HQV support: noise removal, detail enchantment, color enhancement, cadence detection, sharpness, and advanced de-interlacing
- Super up-conversion for SD to HD resolutions
- Multi-plane compositing engine for Blu-ray player applications

- **Display Interfaces<sup>†</sup>**

<sup>†</sup> Refer to Table 2 on page 11 for maximum resolution, color depth, and audio support per display interface and Table 3 on page 11 for dual simultaneous display combinations.

- HDCP<sup>†</sup> (High-bandwidth Digital Content Protection) supported on HDMI™ (High-Definition Multimedia Interface), DVI (Digital Visual Interface), and DisplayPort

<sup>†</sup> HDCP content protection support is available only to HDCP licensees and can be enabled only when connected to an HDCP-capable receiver.

- Key information is stored in the APU
- External ROM not needed
- Protects both audio and video content on all HDMI/DisplayPort outputs
- Two independent display controllers with a maximum resolution of 2560 × 1600 at 60 Hz per display output

- **DVI/HDMI Features<sup>†</sup>**

<sup>†</sup> Refer to Table 1 on page 10 for HDMI feature table.

- Supports DVI or HDMI 1.4a<sup>†</sup>, using TMDS data encoding

<sup>†</sup> HDMI 1.4a version number is equivalent to highest version of the HDMI specification for which an optional HDMI feature is listed and does not imply that all features in HDMI 1.4a are supported.

- Supports industry-standard CEA-861-B video modes including 480p, 720p, 1080i, and 1080p
- Advanced DVI capability supporting 10-bit HDR (High Dynamic Range) output in Dual-Link DVI mode with 162 MP/s (megapixels per second) maximum
- Supports dual-link DVI with a resolution of up to 2560 × 1600 at 60 Hz and 24 bpp
- Maximum pixel clock rate of 162 MHz for Single-Link DVI, 268.5 MHz for Dual-Link DVI, and 148.5 MHz for HDMI
- HDMI deep color support with 30 bpp and 36 bpp for up to 1920 × 1080 with up to 225 MHz HDMI link rates
- Dolby® Digital, Dolby Digital Plus, DTS Digital, DTS-HD High Res, Dolby TrueHD and DTS-HD Master Audio to 24.576 Mbps
- Supports stereoscopic 3D frame transport, stereoscopic 3D gaming, Blu-ray 3D, and stereoscopic 3D video decoding via HDMI 1.4a<sup>†</sup>

<sup>†</sup> Support is available through software, in full-screen mode only.

- **DisplayPort Features**

- Supports all mandatory features of the VESA DisplayPort Standard, Version 1.1a, plus the following optional features:
  - 30-bit support
  - YCbCr 4:4:4 and 4:2:2 support
  - HDCP support
  - DisplayPort extension for test- automation features, including test pattern generation
  - DisplayPort Audio
- Supports DP++
- Supports 4, 2, or 1-lane transmission
- Supports both the 2.7 Gbps and 1.62 Gbps link bit rates
- Supports 1 Mbps Auxiliary Channel (AUX CH)



- Supports a maximum resolution of 2560 x 1600 at 60 Hz and 30 bpp
- Supports Embedded DisplayPort (eDP) features as described in the VESA eDP Standard, Version 1
- Supports stereoscopic 3D frame transport, stereoscopic 3D gaming, Blu-ray 3D, and stereoscopic 3D video decoding via eDP for 120Hz sequential frame internal LCD panels

**Table 1. HDMI™ Features**

HDMI™ Feature	Compatibility
<b>Link Capabilities</b>	
Maximum TMDS Bandwidth (Gbit/s)	3 x 1.5 x 1.485 = 6.6825
Maximum Effective Data Rate (Gbit/s)	3 x 1.25 x 1.485 = 5.56875
<b>Video Capabilities</b>	
Maximum Resolution	1920 x 1080p at 60 Hz, 36 bpp <sup>†</sup> 1920 x 1200p at 60 Hz, 24 bpp
RGB	Yes
YCbCr 4:4:4	Yes
YCbCr 4:2:2	Yes
HDMI™ 1.3 xvYCC	Yes
HDMI 1.3 Deep Color	Yes
Underscan	Yes
Maximum 4:4:4 Color Depth (bits per component)	12 <sup>‡</sup>
Maximum 4:2:2 Color Depth (bits per component)	12 <sup>‡</sup>
<b>Audio Capabilities</b>	
Auto Lip-Sync	Not in OS or audio drivers (Hardware ready.)
<b>PCM (Pulse-Code Modulation) Audio Capabilities</b>	
PCM Audio Rates Supported	192, 176.4, 96, 88.2, 48, 44.1, 32 kHz
PCM Audio Bits per Sample	24, 20, 16
PCM Audio Maximum Channels	8
PCM Audio Maximum Bandwidth (Rate × Bits × Channels)	36.864 Mbps
<b>Compressed-Audio Capabilities</b>	
Compressed-Audio Maximum Bandwidth	24.576 Mbps
<b>Specific non-PCM Audio-Format Support</b>	
IEC 61937 Compressed-Format support. For example, 5.1-channel Dolby® DTS and 5.1-channel AC-3.	Yes
HDMI 1.3 Dolby-TrueHD Bitstream Capable	Yes
HDMI 1.3 DTS-HD Master-Audio Bitstream Capable	Yes
DVD-A (DST) Support	No
SACD (DSD) Support	No
<b>CEC (consumer electronic control) Capabilities</b>	
CEC	No
<b>HDMI 1.4a 3D Display Capabilities</b>	
Packed Frame Stereo 3D Video Formats	1080p at 24 Hz, 1080 at 30 Hz, 720p at 60 Hz, 720p at 50 Hz

**Notes:**

<sup>†</sup> 36 bpp mode uses 30 bpp of meaningfully derived data.

<sup>‡</sup> 12 bit mode uses 10 bits of meaning fully derived data.

Table 2 shows the maximum resolution for each output configuration.

**Table 2. Display Interface Support**

Output Configuration	Maximum Resolution	Bit Depth	Audio
DisplayPort / eDP	2560 × 1600	18, 24, 30 bpp	Supported <sup>1</sup>
Dual-link	2560 × 1600 1920 × 1200	24 bpp 30 bpp	Not Supported
Single-link	1920 × 1200	24 bpp	Not Supported
HDMI™	1920 × 1200	24, 30, 36 <sup>2</sup> bpp	Supported

**Notes:**

1. Audio support is only available for DisplayPort.
2. HDMI deep color (36 bpp) is not supported through the use of a dongle adaptor.

Table 3 shows the possible dual simultaneous display combinations according to output configuration.

**Table 3. Dual Simultaneous Display**

Display One	Extended Display
DisplayPort / eDP <sup>†</sup>	DisplayPort
	HDMI™
	Single-link DVI
Single-link DVI	DisplayPort
	HDMI
	Single-link DVI

**Notes:**

- † Internal LCD panel.

## 2 Compatible Socket Infrastructures

Refer to the *AMD Infrastructure Roadmap*, order# 41842, for information on platform feature implications of package and infrastructure combinations. Family 12h AMD A-Series processors support the following infrastructure:

- **FM1 Infrastructure**
  - Compatible with FM1 package processors
  - Refer to the *AMD Socket FM1 Processor Functional Data Sheet*, order# 44085, for functional and mechanical details of the socket FM1 package processor.