Family 15h Models 10h - 1Fh AMD A-Series Mobile Accelerated Processor Product Data Sheet
## Revision History

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Description</th>
</tr>
</thead>
</table>
| December 2012 | 3.03     | Third public release.  
  • Product update. |
| October 2012  | 3.02     | Second public release.  
  • Product update. |
| August 2012   | 3.00     | Initial public release.              |
| April 2012    | 1.00     | Initial NDA release.                 |
1 Family 15h Models 10h - 1Fh AMD A-Series Mobile Accelerated Processor Features

1.1 Family 15h Models 10h - 1Fh AMD A-Series Mobile Accelerated Processor Features

This section lists the features and design capabilities of the Family 15h Models 10h - 1Fh AMD A-Series mobile accelerated processor.

- **Compatible with Existing 32-Bit x86 and 64-bit AMD64 Code Base**
  - Including support for SSE, SSE2, SSE3, SSE4a, SSE4.1, SSE4.2, SSSE3, ABM, AVX, AVX1.1, AES, BMI, XSAVE/XRSTOR, XGETBV/XSETBV, PCLMULQDQ, FMA, FMA4, TBM, XOP, MMX™, and legacy x86 instructions
  - Runs existing operating systems and drivers
  - Local APIC on the chip
  - Light Weight Profiling (LWP) support

- **AMD64 Technology**
  - AMD64 technology instruction-set extensions
  - 64-bit integer registers, 48-bit virtual addresses, and 40-bit physical addresses
  - Sixteen 64-bit integer registers
  - Sixteen 128-bit SSE/SSE2/SSE3/SSE4a registers

- **Family 15h Architecture**
  - Dual-core and quad-core options
  - Shared L2 cache architecture storage in addition to exclusive L1 cache

- **Cache Structures**
  - 16-Kbyte 4-Way Associative, Write-through ECC-Protected L1 Data Cache per Core
    - Two 64-bit operations per cycle, 3-cycle latency
  - 64-Kbyte 2-Way Associative Parity-Protected L1 Instruction Cache Shared between Two Cores
    - With advanced branch prediction
  - 2048\(^3\)-Kbyte Maximum 16-Way Associative ECC-Protected L2 Cache Shared between Two Cores
    - 2048 Kbytes of L2 cache per compute unit are available on quad-core options, and 1024 Kbytes of L2 cache per compute unit are available on dual-core options.
    - Exclusive cache architecture storage in addition to L1 caches

- **Floating-Point Unit**
  - 256-bit shared or two dedicated 128-bit floating-point units (FPU)
  - Shared between two cores

- **Management and Virtualization Features**
  - AMD Virtualization™ (AMD-V™) technology
    - SVM pause count capability
    - SVM disable and lock
    - Rapid virtualization indexing (nested paging)
    - Improved world-switch speed
• **Power Management**
  - Multiple low-power states
  - AMD AllDay™ power technology
  - System Management Mode (SMM)
  - ACPI-compliant, including support for processor performance states (P-states)
  - Supports processor power states C0, C1, C1E, C6, and CC6
  - Supports sleep states\(^2\) including S0, S3, S4, and S5
    \(^2\) Model 5000 processors support IOIC with optimized S3 and S4 resume.
  - PCI Express® core power gating
  - PCI speed power policy
  - AMD Turbo CORE technology 3.0 with per core power gating

• **Electrical Interfaces**
  - DDR3 SDRAM: Compliant with JEDEC DDR3 1.5V, LV-DDR3 1.35V, and UL-DDR3 1.25V SDRAM specifications\(^3\)
    \(^3\) UL-DDR3 1.25V SDRAM is available on selected Model 5000 processors.
  - Refer to the Electrical Data Sheet (EDS) for AMD Family 15h Models 10h-1Fh Processors, order# 47080, for electrical details of AMD Family 15h (Models 10h-1Fh) processors.

• **Thermal Controls**
  - Sideband temperature control (SB-TSI)
  - Hardware thermal control (HTC)
  - Local hardware thermal control (LHTC)
  - DRAM thermal protection

• **PCI Express® Technology**
  - PCIe Gen 1.0 and PCIe Gen 2.0\(^4\) technology supported:
    \(^4\) PCIe Gen 2.0 support is available on selected AMD A-Series mobile accelerated processors.
    - Configurable x8 and x16\(^5\) external graphics card expansion PCIe link
    \(^5\) x16 PCIe link support is available on selected AMD A-Series mobile accelerated processors.
  - Configurable x4 General Purpose Ports (GPP) link
  - x4 unified media interface link

• **Integrated Memory Controller**
  - AMD Memory Controller PowerCap
  - Low-latency, high-bandwidth
  - DRAM Prefetcher:
    - Adaptive prefetching support
    - 32-entry DRAM prefetch table
    - Differentiation between core prefetch requests and core demand requests
  - FS1r2 package
    - Two 64-bit DDR3 SDRAM controllers operating at frequencies up to 1866 MT/s (933 MHz)\(^6\)
      \(^6\) 1866 MT/s (933 MHz) is available on selected Model 5000 processors.
    - Supports up to two single-rank SODIMMs or unbuffered DIMMs
  - FP2 package
    - Two 64-bit DDR3 SDRAM controllers operating at frequencies up to 1600 MT/s (800 MHz)\(^7\)
      \(^7\) 1600 MT/s (800 MHz) is available on selected Model 5000 processors.
    - Supports up to two single-rank SODIMMs or unbuffered DIMMs

• **Available Packages**
  - Compliant with RoHS (EU Directive 2002/95/EC), with lead used only in small amounts in specifically exempted applications
  - FS1r2 package
    - Refer to the AMD FS1r2 Processor Functional Data Sheet, order# 48588, for functional and mechanical details of the FS1r2 package processor.
• 722-pin lidless micro PGA
• 1.219-mm pin pitch
• 35 mm x 35 mm
• 28 x 28 row pin array
• Organic C4 die attach

• FP2 package
  • Refer to the AMD FP2 Processor Functional Data Sheet, order# 48589, for functional and mechanical details of the FP2 package processor.
  • 827-pin lidless micro BGA
  • Multi-pitch package with 0.800 mm to 1.2 mm pitches
  • 27 mm x 31 mm
  • 32 x 34 row pin array
  • Organic C4 die attach
1.2 Family 15h Models 10h - 1Fh AMD A-Series Graphics Features

This section lists the graphics features available for the Family 15h Models 10h - 1Fh AMD A-Series mobile accelerated processor when the internal GPU is enabled.

- **Graphics**
  - Discrete-level graphics processor embedded alongside the x86 CPU complex
  - Dedicated graphics memory controller
  - Refer to *AMD Family 15h Models 10h - 1Fh Processor Power and Thermal Data Sheet*, order# 48935, for graphics engine clock speeds.
  - AMD Eyefinity
    - AMD Eyefinity is available on selected AMD A-Series mobile accelerated processors and may support up to four displays, when two displays are operating with DisplayPort 1.2 multi-streaming.
  - AMD Dual Graphics support
    - AMD Dual Graphics support is available on selected AMD A-Series mobile accelerated processors, with limited mobile discrete graphics processors and on the Windows® 7 operating system.

- **Power Management**
  - Frame buffer compression in single memory channel
  - GPU power gating
  - UVD power gating
  - VCE power gating
  - SCLK deep sleep
  - Graphics memory controller (GMC) power gating
  - AMD PowerPlay™ power management technology
  - Vari-Bright™ technology
  - eDP panel self refresh
  - Dynamic refresh rate
  - AMD Dynamic Switchable Graphics (DSG) technology
    - AMD Dynamic Switchable Graphics technology is available on selected AMD A-Series mobile accelerated processors, with limited mobile discrete graphics processors and on the Windows 7 operating system.

- **2D Acceleration Features**
  - Highly-optimized 128-bit engine, capable of processing multiple pixels per clock
  - Hardware acceleration of Bitblt, polygon and rectangle fills, bit masking, monochrome expansion, and scissoring
  - Game acceleration including support for Microsoft® DirectDraw: Double Buffering, Virtual Sprites, Transparent Blt, and Masked Blt
  - 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®: Alpha BLT, Transparent BLT, and Gradient Fill
    - In Windows 7: Alpha BLT, Transparent BLT, Color Fill BLT, and Stretch 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® 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
• 32-bit and 64-bit floating point processing per component
• 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
• High dynamic range rendering with floating point blending, texture filtering, and anti-aliasing support
• 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 4.2

• Anti-Aliasing Filtering:\footnote{11} Support for anti-aliasing filtering is dependent on application.
  • 2x/4x/8x/16x modes
  • Multi- and super-sample algorithm with gamma correction, programmable sample patterns, and centroid sampling
  • Custom filter anti-aliasing with up to 12-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:\footnote{12} 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

• Hardware 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 Comal Platform Minimum System Recommendations for HD Media Content, order# 50767, 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
• Video compression engine:
  • Dedicated hardware (VCE 1.0) assisted encoding of HD video streams to H.264 (baseline + CABAC) compressed 1080p at 60 fps format
  • Real-time transcoding by encoding the output from UVD with reduction of CPU utilization and power
consumption

- Faster than real-time transcoding using VCE and 3D shader pipeline

Motion video decode acceleration technology:
- Dedicated hardware (UVD 3.2) for H.264, MPEG4 Part 2, VC-1 and MPEG2 decode:
  - H.264 implementation based on the ISO/IEC 14496-10 specification
  - MPEG4¹³ Part 2 implementation based on the ISO/IEC 14496-2 specification
- Sprite, global motion compensation, and reversible variable length coding are not supported.
- VC-1 implementation based on the SMPTE 421M specification
- MPEG2 implementation based on the ISO 13811-2 specification
- Simultaneous high-definition and standard definition source decode
- Simultaneous dual high-definition source decode
- 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 enhancement, 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
- AMD SteadyVideo technology

Display Interfaces¹⁴

- Refer to Table 2 on page 12 for maximum resolution, color depth, and audio support per display interface.
- Four independent display controllers¹⁵ supporting DisplayPort 1.2 with a maximum resolution of 4096 × 2160 at 30 Hz and 30 bpp

  See the "Display Interface Design Guidelines" chapter in the FS1r2 Processor Motherboard Design Guide, order# 48890, and in the FP2 Processor Motherboard Design Guide, order# 48892 for simultaneous display combinations and display restrictions.

HDCP¹⁶ (High-bandwidth Digital Content Protection) supported on HDMI™ (High-Definition Multimedia Interface), DVI (Digital Visual Interface), and DisplayPort

- HDCP content protection support is available only to HDCP licensees and can be enabled only when connected to an HDCP-capable receiver.
- Key information stored in the APU
- External ROM not needed
- Protects both audio and video content on all HDMI/DisplayPort outputs

DVI/HDMI Features¹⁷

- Refer to Table 1 on page 11 for HDMI feature table.
- Supports DVI or HDMI 1.4a¹⁸ using TMDS data encoding

  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 and single-link DVI with resolutions of up to 2560 × 1600 at 60 Hz and 24 bpp and 1920 × 1200 at 60 Hz and 24 bpp respectively
• 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
• Supports stereoscopic 3D frame transport, stereoscopic 3D gaming, Blu-ray 3D, and stereoscopic 3D video decoding via HDMI 1.4a\(^{19}\)
  \(^{19}\) Support is available through software, in full-screen and windowed mode.
• Supports Wireless Display 3.0\(^{20}\)
  \(^{20}\) Support is available on selected Model 5000 processors.
• DisplayPort Features
  • Supports all mandatory features of the VESA DisplayPort Standard, Version 1.2, 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
    • ACM packet-type support
    • ISRC packet-type support
• Supports DP++
• DisplayPort audio
  • Linear PCM, Dolby Digital (AC-3), Dolby TrueHD, DTS, and DTS-HD Master Audio to 24.567 Mbps
  • 16-bit samples
  • Supports up to 8 channels
  • Supports a maximum audio rate of 192 KHz
• Supports 4, 2, or 1-lane transmission
• Supports 5.4 Gbps, 2.7 Gbps, and 1.62 Gbps link bit rates
• Supports 1 Mbps Auxiliary Channel (AUX CH)
• Supports DisplayPort multi-streaming for up to four independent video and audio streams on one connector
• Maximum link bit rate of 5.4 Gbps
• Maximum resolution of 4096 x 2160 at 30 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 120-Hz sequential frame internal LCD panels
### Table 1. HDMI™ Features

<table>
<thead>
<tr>
<th>HDMI™ Feature</th>
<th>Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Link Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum HDMI Bandwidth (Gbit/s)</td>
<td>6.6825</td>
</tr>
<tr>
<td>Maximum Effective Data Rate (Gbit/s)</td>
<td>5.56875</td>
</tr>
<tr>
<td><strong>Video Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum Resolution</td>
<td>1920 x 1080p at 60 Hz, 36 bpp(^1)</td>
</tr>
<tr>
<td></td>
<td>1920 x 1200p at 60 Hz, 24 bpp</td>
</tr>
<tr>
<td>RGB</td>
<td>Yes</td>
</tr>
<tr>
<td>YCbCr 4:4:4</td>
<td>Yes</td>
</tr>
<tr>
<td>YCbCr 4:2:2</td>
<td>Yes</td>
</tr>
<tr>
<td>HDMI™ 1.3 xvYCC</td>
<td>Yes</td>
</tr>
<tr>
<td>HDMI 1.3 Deep Color</td>
<td>Yes</td>
</tr>
<tr>
<td>Underscan</td>
<td>Yes</td>
</tr>
<tr>
<td>Maximum 4:4:4 Color Depth (bits per component)</td>
<td>12(^2)</td>
</tr>
<tr>
<td>Maximum 4:2:2 Color Depth (bits per component)</td>
<td>12(^2)</td>
</tr>
<tr>
<td><strong>Audio Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>Auto Lip-Sync</td>
<td>Not in OS or audio drivers (Hardware ready).</td>
</tr>
<tr>
<td><strong>PCM (Pulse-Code Modulation) Audio Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>PCM Audio Rates Supported</td>
<td>192, 176.4, 96, 88.2, 48, 44.1, 32 KHz</td>
</tr>
<tr>
<td>PCM Audio Bits per Sample</td>
<td>24, 20, 16</td>
</tr>
<tr>
<td>PCM Audio Maximum Channels</td>
<td>8</td>
</tr>
<tr>
<td>PCM Audio Maximum Bandwidth (Rate × Bits × Channels)</td>
<td>36.864 Mbps</td>
</tr>
<tr>
<td><strong>Compressed-Audio Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>Compressed-Audio Maximum Bandwidth</td>
<td>24.576 Mbps</td>
</tr>
<tr>
<td><strong>Specific non-PCM Audio-Format Support</strong></td>
<td></td>
</tr>
<tr>
<td>IEC 61937 Compressed-Format support. For example, 5.1-channel Dolby®, DTS and 5.1-channel AC-3.</td>
<td>Yes</td>
</tr>
<tr>
<td>HDMI 1.3 Dolby-TrueHD Bitstream Capable</td>
<td>Yes</td>
</tr>
<tr>
<td>HDMI 1.3 DTS-HD Master-Audio Bitstream Capable</td>
<td>Yes</td>
</tr>
<tr>
<td>DVD-A (DST) Support</td>
<td>No</td>
</tr>
<tr>
<td>SACD (DSD) Support</td>
<td>No</td>
</tr>
<tr>
<td><strong>CEC (consumer electronic control) Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>CEC</td>
<td>No</td>
</tr>
<tr>
<td><strong>HDMI 1.4a 3D Display Capabilities</strong></td>
<td></td>
</tr>
<tr>
<td>Packed Frame Stereo 3D Video Formats</td>
<td>1080p at 24 Hz, 1080 at 30 Hz, 720p at 60 Hz, 720p at 50 Hz</td>
</tr>
</tbody>
</table>

**Notes:**
1. 36-bpp mode uses 30 bpp of meaningfully derived data.
2. 12-bit mode uses 10 bits of meaningfully derived data.
Table 2 shows the maximum resolution for each output configuration.

### Table 2. Display Interface Support

<table>
<thead>
<tr>
<th>Output Configuration</th>
<th>Maximum Resolution</th>
<th>Bit Depth</th>
<th>Audio</th>
</tr>
</thead>
<tbody>
<tr>
<td>DisplayPort / eDP¹</td>
<td>4096 × 2160 at 30 Hz</td>
<td>18, 24, 30 bpp</td>
<td>Supported²</td>
</tr>
<tr>
<td>Single-link DVI</td>
<td>1920 × 1200 at 60 Hz</td>
<td>24 bpp</td>
<td>Not Supported</td>
</tr>
<tr>
<td>Dual-link DVI</td>
<td>2560 × 1600 at 60 Hz 1920 × 1200 at 60 Hz</td>
<td>24 bpp 30 bpp</td>
<td>Not Supported</td>
</tr>
<tr>
<td>Native HDMI™</td>
<td>1920 × 1080 at 60 Hz 1920 × 1200 at 60 Hz</td>
<td>24, 30, 36 bpp 24 bpp</td>
<td>Supported</td>
</tr>
<tr>
<td>Type 1 Dual-mode DisplayPort to HDMI Adaptor</td>
<td>1280 × 720 at 60 Hz 1920 × 1200 at 60 Hz</td>
<td>24, 30, 36 bpp 24 bpp</td>
<td>Supported</td>
</tr>
<tr>
<td>Type 2 Dual-mode DisplayPort to HDMI Adaptor</td>
<td>1920 × 1080 at 60 Hz 1920 × 1200 at 60 Hz</td>
<td>24, 30, 36 bpp 24 bpp</td>
<td>Supported</td>
</tr>
</tbody>
</table>

**Notes:**
1. Internal LCD panel.
2. Audio support is only available for DisplayPort.

For display interface mapping, see the "Display Interface Design Guidelines" chapter in the *FS1r2 Processor Motherboard Design Guide*, order# 48890, and in the *FP2 Processor Motherboard Design Guide*, order# 48892.
2 Compatible Socket Infrastructures

Refer to the *FS1r2 Infrastructure Roadmap*, order# 49452 and *FP2 Infrastructure Roadmap*, order# 49453, for information on platform feature implications of package and infrastructure combinations. Family 15h Models 10h - 1Fh AMD A-Series mobile accelerated processors support the following infrastructures:

- **FS1r2 Infrastructure**
  - Compatible with FS1r2 package processors
  - Refer to the *AMD FS1r2 Processor Functional Data Sheet*, order# 48588, for functional and mechanical details of the FS1r2 package processor.

- **FP2 Infrastructure**
  - Compatible with FP2 package processors
  - Refer to the *AMD FP2 Processor Functional Data Sheet*, order# 48589, for functional and mechanical details of the FP2 package processor.