Designers of medical imaging systems play an invaluable role in improving healthcare, leveraging every available technology advantage to ensure that medical practitioners can assess patients’ medical imagery with the highest possible resolution and accuracy. From diagnostic imaging to imaging-assisted medical procedures, the ability to maximize visual clarity and fidelity is vitally important.

Simultaneously, designers are under increasing pressure to expand advanced visualization features to lower-end products while reducing overall system costs throughout their portfolios. Design agility is another key consideration, particularly for designers migrating to software-defined architectures that support sophisticated, next-generation product features.

**AMD-POWERED MEDICAL IMAGING SOLUTIONS**

AMD provides a scalable portfolio of x86 processors and Discrete Graphics Processing Units (dGPUs) that can provide performance optimized solutions for a wide range of medical imaging applications.

AMD’s processor portfolio for medical imaging includes:

- AMD Embedded G-Series optimized for power efficiency
- AMD Embedded R-Series optimized for performance
- AMD Radeon™ Pro GPUs and AMD Embedded Radeon™ for enhanced visualization and compute

**4 Key Medical Imaging Applications:**
- Ultrasound systems
- Endoscopes
- X-ray and CT equipment
- MRI machines

**Additional Medical Imaging Applications:**
- Medical Monitors
- Patient Monitoring systems
- Anesthesia systems
- Bedside terminals

**Medical Imaging Application Brief**

High-Performance Solutions Deliver Superior Performance, Visualization, and Design Versatility for Medical Imaging Applications

Designers of medical imaging systems play an invaluable role in improving healthcare, leveraging every available technology advantage to ensure that medical practitioners can assess patients’ medical imagery with the highest possible resolution and accuracy. From diagnostic imaging to imaging-assisted medical procedures, the ability to maximize visual clarity and fidelity is vitally important.

Simultaneously, designers are under increasing pressure to expand advanced visualization features to lower-end products while reducing overall system costs throughout their portfolios. Design agility is another key consideration, particularly for designers migrating to software-defined architectures that support sophisticated, next-generation product features.
**Application Brief: MEDICAL IMAGING**

The AMD Embedded G-Series is ideal for small form factor applications, providing clinicians and medical emergency response teams with portable yet advanced medical imaging capabilities. The exceptional compute performance of AMD Embedded R-Series processors can deliver high image transformation speeds, and helps reconstruct images from sparse data. This can make low-dose X-ray imaging feasible, an attractive option for those medical practitioners and patients concerned with the possibility of increased cancer risk associated with exposure to certain types of radiation. AMD Embedded R-Series and AMD Embedded Radeon™ GPUs can enable high resolution, multi-display visualization, thereby helping increase efficiency and reduce the fatigue surgical staff using imaging-assisted systems.

### THE BENEFITS OF GPU ACCELERATION

All of the medical imaging application modalities highlighted above involve image reconstruction from sound, radio, or X-ray waves. The figure below shows a typical ultrasound imaging pipeline, and the large amount of signal and image processing that’s required.

All of this processing is parallelizable and therefore well suited for GPU acceleration. The combination of GPU and CPU can be an ideal fit to process such a pipeline. Even though this pipeline is representative of an ultrasound device, the underlying principles are applicable to other modalities as well. Endoscope, CT, MRI, and X-ray imaging all contain similar levels of signal and image processing, thus making GPU compute an ideal fit for medical imaging applications.

### HIGHER PERFORMANCE AT LOWER COSTS

GPU compute – which can address both the need for increased processing power and the need for system cost reduction – can enable dramatic evolutions in algorithm complexity and image quality. GPU processing, using either the GPU onboard an AMD Embedded Processor or a discrete AMD Embedded Radeon™ GPU, and significantly impact performance of image processing algorithms relative to CPU-only processing.

This increased performance can translate to improved image fidelity, enhanced accuracy, and ultimately more accurate diagnoses for patients. GPU compute can help medical equipment manufacturers deliver superior performance at cost-effective price points and achieve solid return on investment.

<table>
<thead>
<tr>
<th>HAND HELD</th>
<th>PORTABLE</th>
<th>CART BASED</th>
<th>HIGH END IMAGING</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Hand Held" /></td>
<td><img src="image2.png" alt="Portable" /></td>
<td><img src="image3.png" alt="Cart Based" /></td>
<td><img src="image4.png" alt="High End Imaging" /></td>
</tr>
</tbody>
</table>

- **Low power requirements**
- **Minimal image processing requirements**
- **Low resolution recording requirements**

- **Modest data rate and compute**
- **Modest image processing requirements**
- **FHD@60fps recording**
- **1+ Displays**

- **High data rate and compute**
- **High image processing requirements**
- **FHD/4K@60fps recording**
- **2+ Displays**

- **Extreme data rate and compute**
- **High image processing and display requirements**
- **Server class CPU with GPU – box configuration**
DESIGN AGILITY FOR SOFTWARE-DEFINED SOLUTIONS

Medical equipment designers are increasingly interested in migrating to a software-defined architecture. The diagrams below show how customers can implement software beamforming using Direct GPU Memory Access (dGMA) technology from AMD combined with GPU compute. dGMA technology can enable external acquisition devices to transfer data to GPU memory at more than 10 GB/s, and the GPU can process this data without intervention from the CPU. This capability allows a system to collect data from ultrasound transducers in parallel, transfer this data to GPU memory, and use GPU compute to coherently combine the data to generate an image. GPU compute can enable plane wave imaging and the combining of data in the frequency domain, yielding better image quality. Technology advancements such as software beamforming will trigger the next level of innovation in the medical equipment industry, and AMD Embedded processing solutions can accelerate customers’ transition through this inflection point.

AMD provides software development kits and tools to help OEMs make the transition to software-defined architecture and free them from a single vendor solution. OpenCL™ – the royalty-free open standard for parallel processing software development – can help to reduce system costs through compatibility with CPUs, GPUs, and some DSPs and FPGAs from a variety of vendors. OpenCL compatibility across AMD Embedded G-Series, AMD Embedded R-Series, and AMD Embedded Radeon™ discrete graphics platforms enables software-defined solutions that can leverage a single code base to scale across a portfolio of products, which can help reduce software development costs.
Application Brief: MEDICAL IMAGING

AMD Discrete
GPU
FPGA
Convert JESD-204b to PCIe
GPU
Memory
VCE
PCIe Switch (Gen 3)
CPU
MXM or PCIe®
ComE Module
Memory
Beamforming and Pre-processing
High End Ultrasound (>128 channels)

FPGA
Convert JESD-204b to PCIe
e.g. Stratix V®
Memory
Post-processing and Rendering
ComE Module
CPU
x8 PCIe Gen3
AMD APU
Beamforming, Pre/Post-processing, and Rendering
Low-Mid End Ultrasound (<128 channels)

HDMI™
DP
eDP
SATA
AMD APU
FPGA
Convert JESD-204b to PCIe®
e.g. Stratix 10®
Memory
Beamforming, Pre/Post-processing, and Rendering
ComE Module
CPU
x8 PCIe
x16 PCIe

The information contained herein is for informational purposes only, and is subject to change without notice. While every precaution has been taken in the preparation of this document, it may contain technical inaccuracies, omissions and typographical errors, and AMD is under no obligation to update or otherwise correct this information. Advanced Micro Devices, Inc. makes no representations or warranties with respect to the accuracy or completeness of the contents of this document, and assumes no liability of any kind, including the implied warranties of noninfringement, merchantability or fitness for particular purposes, with respect to the operation or use of AMD hardware, software or other products described herein. No license, including implied or arising by estoppel, to any intellectual property rights is granted by this document. Terms and limitations applicable to the purchase or use of AMD’s products are as set forth in a signed agreement between the parties or in AMD’s Standard Terms and Conditions of Sale. GD-18

©2017 Advanced Micro Devices, Inc. All rights reserved. AMD, the AMD Arrow logo, Radeon, and combinations thereof are trademarks of Advanced Micro Devices, Inc. PCIe is a registered trademark of PCI-SIG Corporation. HDMI, the HDMI logo and High-Definition Multimedia Interface are trademarks or registered trademarks of HDMI Licensing, LLC in the United States and other countries. Stratix is a trademark of Altera Corporation. AMD and other product names used in this publication are for identification purposes only and may be trademarks of their respective companies. PIB #T08388-A

www.amd.com/r-series

www.amd.com/medicalembedded

www.amd.com/medicalimaging

www.amd.com/resources