# VERSAL<sup>™</sup> XQR PORTFOLIO FOR SPACE APPLICATIONS

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## SPACE-GRADE VERSAL ADAPTIVE SoCs

The AMD Versal<sup>™</sup> Space-Grade (XQR) adaptive SoCs continue the AMD tradition of full radiation tolerant, ultra-high throughput, machine learning capable reconfigurable devices for satellite and space applications. Built on the Versal architecture, this family includes devices with flexible and dynamically reconfigurable high-performance AI/ML compute engines, DSP engines, programmable logic, 26 Gb/s transceivers, dual-core Arm<sup>®</sup> Cortex-A72 and dual-core Arm Cortex-R5 embedded processors.

Versal XQR Adaptive SoCs are targeted for on-board processing payload applications with high levels of compute density for vector-based algorithms, system logic cells, integrated SRAM and multi-gigabit transceivers. The devices offer a processing subsystem, hard-wired peripherals and a platform controller facilitating true unlimited on-orbit reconfiguration and SEU mitigation.

Building on the AMD space heritage and highly successful 20nm and 65nm spacegrade devices, the launch of Versal XQR Adaptive SoCs advances the space industry by multiple process node generations setting a new benchmark for reconfigurable solutions in space.

### 7NM ADAPTIVE SoCs FOR SPACE APPLICATIONS

- Versal AI Core and AI Edge family members with heterogeneous compute resources: - Application and real-time processor cores
  - SIMD/VLIW vector engines
  - Programmable logic, DSP, memory resources
  - High bandwidth serial transceivers
- Innovative silicon design for SEU mitigation
- SEL and TID characteristics suitable for many space environments
- True on-orbit reconfiguration with unlimited programming cycles

#### RUGGEDIZED ORGANIC PACKAGING

- Lidless, ruggedized package with stiffener ring for added thermal mitigation capabilities
- Footprint compatible with commercial packages
- Al Core 45mm x 45mm, Al Edge 23mm x 23mm

#### **PRODUCTION SPACE TEST FLOW**

• Class B screening flow for organic substrates derived from Mil Prf 38535

#### AMD IN SPACE APPLICATIONS

- ML/AI
- Cloud & Object Detection
- Broadband Internet
- High-Speed Networks
- Hyperspectral Imaging
- Synthetic Aperture Radar
- GPS / GNSS
- Instrumentation

### **KEY TAKEAWAYS**

- Radiation tolerant adaptive SoCs targeted for space applications
- True unlimited on-orbit reconfiguration to enable "Upgrade-on-the-Fly" capability
- Configuration SEUs managed by internal scrubbing mechanism
- Heterogeneous solution for realtime on-board processing needs including DSP, machine learning, and artificial intelligence



## **PROCESSING SYSTEM**

Processing systems deliver power-efficient embedded compute with the safety and security required in real-time systems. The dualcore Arm<sup>®</sup> Cortex<sup>®</sup>-A72 application processor is ideal for running Linux-class applications, while the dual-core Arm Cortex-R5F real-time processor runs safety-critical code for the highest levels of functional safety (ASIL and SIL). The platform management controller (PMC) is based on a triple-redundant processor and manages device operation, including platform boot, advanced power and thermal management, security, safety, and reliability across the platform.

## **PROGRAMMABLE LOGIC**

The programmable logic enables the development of custom computational blocks for differentiation, future-proofing, and everchanging algorithms. Loaded with a wide variety of memory elements and tightly coupled with programmable I/O, the programmable logic allows users to create powerful accelerators for any application.

## **COMPUTE AND ACCELERATION ENGINES**

Both AI Engines and DSP Engines support a breadth of workloads common in edge applications including AI inference, image processing, motion control, and signal processing. AI Engines are a breakthrough architecture based on a scalable array of vector processors and distributed memory, delivering breakthrough AI performance/watt. DSP Engines are based on the proven slice architecture in AMD FPGAs and adaptive SoCs, now with integrated floating-point support, and are ideal for wireless and image signal processing, data analytics, motion control, and more.

The space-grade Versal AI Core device includes the AI Engines, optimized for complex matrix multiplications, as required in signal processing applications such as beamforming. The space-grade Versal AI Edge device offers the AI Engine-ML (AIE-ML) tiles, providing enhanced support for data types commonly used in neural network applications, along with increased local memory resources.

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|                                   |                                 | XQRVC1902-1MSBVSRA2197<br>(AI CORE)   | XQRVE2302-1MSBSSRA784<br>(AI EDGE) |
|-----------------------------------|---------------------------------|---|------------------------------------|
| AI ENGINE                         | AI Engine Tiles                 | 400 (AIE)   | 34 (AIE-ML)                        |
|                                   | Al Engine Data Memory (Mb)      | 100   | 17                                 |
|                                   | AIE-ML Shared Memory (Mb)       | -   | 68                                 |
| PROGRAMMABLE LOGIC                | System Logic Cells (K)          | 1,968   | 329                                |
|                                   | LUTs                            | 899,840   | 150,272                            |
|                                   | DSP Engines                     | 1,968   | 464                                |
|                                   | NoC Master/NoC Slave Ports      | 28  | 5                                  |
|                                   | Distributed RAM (Mb)            | 27  | 4.6                                |
| Memory                            | Total Block RAM (Mb)            | 34  | 5.4                                |
|                                   | UltraRAM (Mb)                   | 130   | 43.6                               |
|                                   | Accelerator RAM (Mb)            | -   | 32                                 |
|                                   | Total PL Memory (Mb)            | 191   | 86                                 |
|                                   | DDR Memory Controllers          | 4   | 1                                  |
|                                   | DDR Bus Width                   | 256   | 64                                 |
| PROCESSING SYSTEM                 | Application Processing Unit     | Dual-core Arm* Cortex*-A72, 48KB/32KB L1 Cache w/ECC 1 MB L2 Cache w/ECC      |                                    |
|                                   | Real-time Processing Unit       | Dual-core Arm Cortex-RSF, 32KB/32KB L1 Cache, and 256KB TCM w/ECC             |                                    |
|                                   | Memory                          | 256KB On-Chip Memory w/ECC  |                                    |
|                                   | General Connectivity            | Ethernet (x2); UART (x2); CAN-FD (x2) USB 2.0 (x1); SPI (x2); I2C (x2)        |                                    |
| SERIAL TRANSCEIVERS               | Gigabit Transceivers            | 44 GTY (26.5625 Gb/s)   | 8 GTYP (26.5625 Gb/s)              |
| INTEGRATED PROTOCOL IP            | CCIX & PCIe° w/DMA (CPM)        | 1 x Gen4x8, CCIX  | -                                  |
|                                   | PCI Express                     | 4 x Gen4x8  | 1 x Gen4x8                         |
|                                   | Multirate Ethernet MAC          | 4   | 1                                  |
| PLATFORM MANAGEMENT<br>Controller | Platform Management Controller  | Boot, Security, Safety, Monitoring, High-Speed Debug, SEU Mitigation (XiISEM) |                                    |
| RUGGEDIZED PACKAGE                | Organic BGA, Sn-Pb Solder Balls | VSRA2197, 45mm x 45mm, 0.92mm pitch   | SSRA784, 23mm x 23mm, 0.8mm pitch  |
| I/O                               | 1/0                             | 648 XPIO, 44 HDIO, 78 MIO, 44 GTY   | 216 XPIO, 22 HDIO, 78 MIO, 8 GTYP  |

## TAKE THE NEXT STEPS

Check out all Space-grade offerings from AMD on the web www.amd.com/en/solutions/aerospace-and-defense/space.html

Register for Space Lounge access - Access released documentation & full radiation reports https://account.amd.com/en/member/space.html

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