

HEXAGON MSC NASTRAN® MULTIDISCIPLINARY STRUCTURAL ANALYSIS

Powered by 4th Gen AMD EPYC™ Processors
March 2024

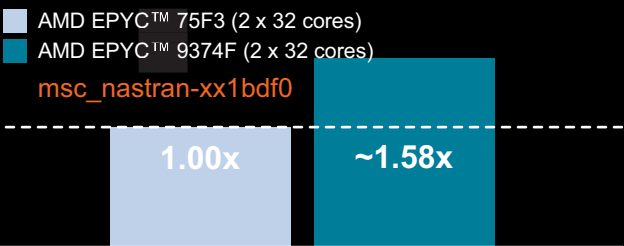
AT A GLANCE

2P systems powered by 4th Generation AMD EPYC™ processors demonstrate outstanding generational and intra-generational performance uplifts on Hexagon MSC Nastran®.

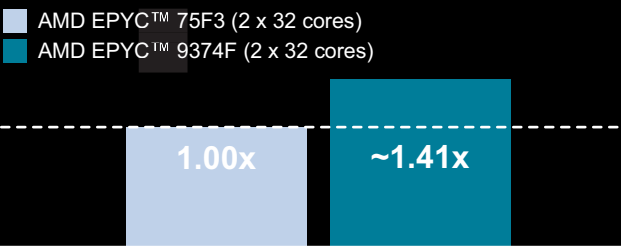
PERFORMANCE HIGHLIGHTS

A 2P system powered by 32-core 4th Gen AMD EPYC 9374F processors delivered a composite average 41% higher Hexagon MSC Nastran performance across five workloads, with a peak of ~58% better performance for the msc_nastran-xx1bdf0 workload vs. a 2P system powered by 32-core 3rd Gen AMD EPYC 75F3 processors.

MAX 4TH GEN AMD EPYC 9374F PERFORMANCE UPLIFT
VS. AMD EPYC 75F3
(MSC_NASTRAN-XX1BDF0 BENCHMARK)



COMPOSITE AVERAGE 4TH GEN AMD EPYC 9374F PERFORMANCE
UPLIFT VS. AMD EPYC 75F3
(FIVE WORKLOADS)



KEY TAKEAWAYS

Hexagon MSC Nastran users can see significant generational AMD EPYC processor performance uplifts on MSC Nastran when choosing high frequency 32-core 4th Gen AMD EPYC 9374F processors compared to the previous generation. The maximum uplift is ~1.58x for the msc_nastran-xx1bdf0 workload with a composite average uplift of ~1.41x across all five MSC Nastran workloads tested.

General purpose and high frequency 4th Gen AMD EPYC 9004 processors are available in 1P and 2P configurations and feature:

- Up to 384MB of L3 cache in standard 4th Gen AMD EPYC processors.
- Up to 4 links of Gen 3 Infinity Fabric™ at up to 32 Gbps.
- 12 memory channels that support up to 6TB of DDR5-4800 memory.
- Support for PCIe® Gen 5 at up to 32 Gbps.
- AVX-512 instruction support for enhanced HPC and ML performance.
- AMD Infinity Guard technology to defend your data.¹

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HEXAGON MSC NASTRAN

Engineers use MSC Nastran to perform both linear and nonlinear static, dynamic, and thermal analysis augmented by automated structural optimization and fatigue analysis. These analyses help determine that structures have the necessary specifications to withstand required conditions without failure, such as stress, resonance, or buckling that could compromise safety. MSC Nastran also helps engineers improve economy and passenger comfort. Analysis can be performed at various points in the design cycle starting with virtual prototyping that can reduce costs associated with physical prototypes. This can help identify and remediate structural issues that may be present, thereby optimizing downtime and costs. It can also help improve existing designs and contribute to designing new products.²

Hexagon is consistently upgrading and improving the capabilities of MSC Nastran, including architecture-independent enhancements optimized for both current and future architectures. This means that MSC Nastran automatically maintains high-performance computing capabilities when architectures are updated.

AMD EPYC 9004 SERIES PROCESSORS

AMD EPYC 9004 Series Processors continue to redefine the standards for modern datacenters. 4th Gen AMD EPYC processors are built on the innovative x86 architecture and “Zen 4” core. 4th Gen AMD EPYC processors deliver efficient, optimized performance by combining high frequencies, the largest-available L3 cache, 128 lanes of PCIe® 5 I/O (1P), and synchronized fabric and memory clock speeds, plus support for up to 6 TB of DDR5-4800 memory. Built-in security features, such as Secure Memory Encryption (SME) and Secure Encrypted Virtualization (SEV-SNP), collectively known as AMD Infinity Guard, help protect data while it is in use.¹

TEST METHODOLOGY

AMD engineers ran the Hexagon MSC Nastran benchmarks and obtained the results listed in Table 1 on systems configured as shown in Table 2. These benchmark cases represent typical usage and cover a range of sizes. The uplift is calculated as the ratio of the systems under test (*sut*) to the reference system (*ref*). In this Performance Brief, the 3rd Gen AMD EPYC 75F3 system is the *ref* for the generational performance uplift calculations, and the 4th Gen AMD EPYC 9374F system is the *sut*. Each benchmark was run three times, and the variability between runs was <1%. The average for each set of three runs was then calculated. The composite average for each system was calculated as the average across all of the per-benchmark averages.

The per-workload and composite average uplifts for the 4th Gen AMD EPYC 9374F vs. the 3rd Gen AMD EPYC 75F3 were:

WORKLOAD	AMD EPYC 9374F
msc_nastran-xx2fmf0	~1.30x
msc_nastran-xx1gmd0	~1.26x
msc_nastran-xx1en40	~1.45x
msc_nastran-xx1cmd0	~1.48x
msc_nastran-xx1bdf0	~1.58x
Composite Average:	~1.41x

Table 1: Per-benchmark and composite average uplifts normalized to the 3rd Gen AMD EPYC 75F3

SYSTEM CONFIGURATION

AMD SYSTEM CONFIGURATION		
CPU	2x AMD EPYC 75F3	2x AMD EPYC 9374F
Frequency: Base Boost ³	2.95 GHz 4.00 GHz (up to)	3.85 GHz 4.30 GHz (up to)
Cores	32 cores/socket	32 cores/socket
L3 Cache	256 MB/CPU	256 MB/CPU
Memory	2.0 TB (32x) DDR4 3200 64 GB DIMMs	1.5 TB (24x) DDR5 4800 64 GB DIMMs
Ethernet	Mellanox Technologies MT27800 Family [ConnectX-5]	
Infiniband	Mellanox Technologies MT28908 Family [ConnectX-6]	
Storage	2.9TB Samsung NVMe SSD Controller 172Xa/172Xb (rev 01)	1.8 TB Samsung NVMe SSD Controller PM9A1/PM9A3/980PRO
BIOS Version	2.13.3	RTI1009C
BIOS Settings	SMT=OFF; NPS=4; Determinism=Power	
OS	RHEL 9.3 (Plow), 5.14.0-362.8.1.el9_3.x86_64	
Kernel CMDLINE	amd_iommu=on, iommu=pt, mitigations=off	
OS Settings	clear caches, NUMA balancing 0, randomize_va_space 0, C2 states disabled, THP ON, governor=performance	

Table 2: AMD system configurations

FOR ADDITIONAL INFORMATION

Please see the following additional resources for more information about 4th Gen AMD EPYC features, architecture, and available models:

- [AMD EPYC™ 9004 Series Processors](#)
- [AMD EPYC™ Products](#)
- [AMD EPYC™ Tuning Guides](#)

REFERENCES

1. AMD Infinity Guard features vary by EPYC™ Processor generations. Infinity Guard security features must be enabled by server OEMs and/or Cloud Service Providers to operate. Check with your OEM or provider to confirm support of these features. Learn more about Infinity Guard at <https://www.amd.com/en/technologies/infinity-guard>. GD-183
2. Please see <https://hexagon.com/products/product-groups/computer-aided-engineering-software/msc-nastran>*for detailed information about Hexagon MSC Nastran.
3. Maximum boost for AMD EPYC processors is the maximum frequency achievable by any single core on the processor under normal operating conditions for server systems. EPYC-18

AUTHORS

Mary Bass, Olivier Schreiber, and Anthony Hernandez contributed to this Performance Brief.

RELATED LINKS

- [MSC Nastran*](#)
- [AMD EPYC Processors](#)
- [AMD EPYC Technical Briefs](#)

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AMD EPYC 9004 FOR HPC

4th Gen AMD EPYC CPUs deliver excellent per-core performance by taking advantage of fast CPU frequencies, low latency memory, and a unified cache structure. Design engineers can use AMD EPYC processors to perform complex structural analysis tasks with ground-breaking high-performance computing and robust security features to deliver excellent results.

“ZEN 4” CORE & SECURITY FEATURES

General purpose and high frequency AMD EPYC processors support

- 96 physical cores, 192 threads
- Up to 1152 MB of L3 cache per CPU
- 96 MB of L3 cache per CCD
- 6 TB of DDR5-4800 memory
- 128 1P, up to 160 2P PCIe® Gen 5 lanes

Infinity Guard security features¹

- Secure Boot
- Encrypted memory with SME

HEXAGON®

Hexagon is a leader in digital reality solutions, combining sensor, software and autonomous technologies. Their solutions free our customers to harness the rapidly-increasing amounts of data, putting it to work to boost efficiency, productivity, quality and safety across industrial, manufacturing, infrastructure, public sector and mobility applications.

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