SPEC CPU®2017 Floating Point Rate Result

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Lenovo Global Technology

ThinkSystem SD665 V3
(4.10 GHz, AMD EPYC 9174F)

SPECrate®2017_fp_base = 598
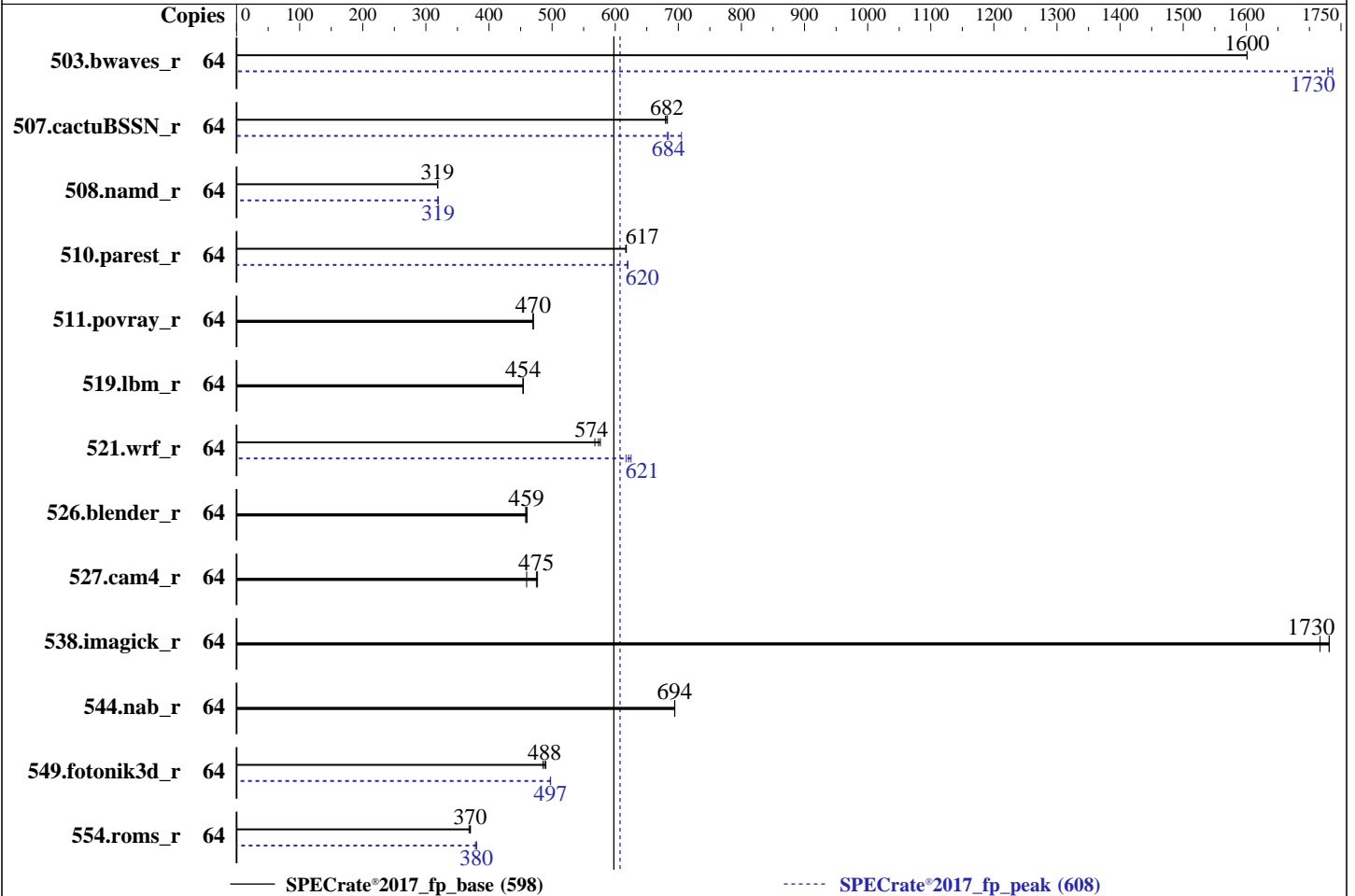
SPECrate®2017_fp_peak = 608

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

Test Date: Jan-2023
Hardware Availability: Dec-2022
Software Availability: Nov-2022

Benchmark	Copies	base	peak
503.bwaves_r	64	1600	1730
507.cactuBSSN_r	64	682	684
508.namd_r	64	319	319
510.parest_r	64	617	620
511.povray_r	64	470	
519.lbm_r	64	454	
521.wrf_r	64	574	621
526.blender_r	64	459	
527.cam4_r	64	475	
538.imagick_r	64	1730	
544.nab_r	64	694	
549.fotonik3d_r	64	488	497
554.roms_r	64	370	380

SPECrate®2017_fp_base (598)
SPECrate®2017_fp_peak (608)

Hardware

CPU Name: AMD EPYC 9174F
 Max MHz: 4400
 Nominal: 4100
Enabled: 32 cores, 2 chips, 2 threads/core
Orderable: 2 chips
Cache L1: 32 KB I + 32 KB D on chip per core
 L2: 1 MB I+D on chip per core
 L3: 256 MB I+D on chip per chip,
 32 MB shared / 2 cores
 Other: None
Memory: 768 GB (24 x 32 GB 2Rx8 PC5-4800B-R)
Storage: 1 x 3.84 TB NVME SSD
Other: None

Software

OS: SUSE Linux Enterprise Server 15 SP4 (x86_64)
 Kernel 5.14.21-150400.22-default
Compiler: C/C++/Fortran: Version 4.0.0 of AOCC
Parallel: No
Firmware: Lenovo BIOS Version QGE105O 1.10 released Dec-2022
File System: xfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: 64-bit
Other: None
Power Management: BIOS and OS set to prefer performance at the cost
 of additional power usage

Standard Performance Evaluation Corporation (info@spec.org)

https://www.spec.org/

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Results Table

Benchmark	Base						Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
503.bwaves_r	64	401	1600	**401**	**1600**	401	1600	64	370	1740	371	1730	**371**	**1730**
507.cactuBSSN_r	64	119	680	**119**	**682**	119	683	64	115	705	119	683	**118**	**684**
508.namd_r	64	**191**	**319**	191	319	191	319	64	190	319	**190**	**319**	190	319
510.parest_r	64	271	618	**271**	**617**	271	617	64	270	620	**270**	**620**	270	619
511.povray_r	64	318	470	318	470	**318**	**470**	64	318	470	318	470	**318**	**470**
519.lbm_r	64	149	454	**149**	**454**	148	454	64	149	454	**149**	**454**	148	454
521.wrf_r	64	249	576	252	568	**250**	**574**	64	232	617	229	625	**231**	**621**
526.blender_r	64	212	460	213	458	**212**	**459**	64	212	460	213	458	**212**	**459**
527.cam4_r	64	235	477	244	460	**236**	**475**	64	235	477	244	460	**236**	**475**
538.imagick_r	64	91.9	1730	**91.9**	**1730**	92.7	1720	64	91.9	1730	**91.9**	**1730**	92.7	1720
544.nab_r	64	155	694	**155**	**694**	155	694	64	155	694	**155**	**694**	155	694
549.fotonik3d_r	64	509	490	514	485	**511**	**488**	64	**501**	**497**	502	497	501	498
554.roms_r	64	274	371	276	368	**275**	**370**	64	269	379	**268**	**380**	267	380

SPECrate®2017_fp_base =		**598**
SPECrate®2017_fp_peak =		**608**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Compiler Notes

```
The AMD64 AOCC Compiler Suite is available at
http://developer.amd.com/amd-aocc/
```

Submit Notes

```
The config file option 'submit' was used.
'numactl' was used to bind copies to the cores.
See the configuration file for details.
```

Operating System Notes

```
'ulimit -s unlimited' was used to set environment stack size limit
'ulimit -l 2097152' was used to set environment locked pages in memory limit

runcpu command invoked through numactl i.e.:
numactl --interleave=all runcpu <etc>

To limit dirty cache to 8% of memory, 'sysctl -w vm.dirty_ratio=8' run as root.
To limit swap usage to minimum necessary, 'sysctl -w vm.swappiness=1' run as root.
To free node-local memory and avoid remote memory usage,
'sysctl -w vm.zone_reclaim_mode=1' run as root.
```

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Operating System Notes (Continued)

```
To clear filesystem caches, 'sync; sysctl -w vm.drop_caches=3' run as root.
To disable address space layout randomization (ASLR) to reduce run-to-run
variability, 'sysctl -w kernel.randomize_va_space=0' run as root.

To enable Transparent Hugepages (THP) for all allocations,
'echo always > /sys/kernel/mm/transparent_hugepage/enabled' and
'echo always > /sys/kernel/mm/transparent_hugepage/defrag' run as root.
```

Environment Variables Notes

```
Environment variables set by runcpu before the start of the run:
LD_LIBRARY_PATH =
     "/home/cpu2017-1.1.8-amd-aocc400-genoa-B1b/amd_rate_aocc400_genoa_B_lib/
     lib:/home/cpu2017-1.1.8-amd-aocc400-genoa-B1b/amd_rate_aocc400_genoa_B_l
     ib/lib32:"
MALLOC_CONF = "retain:true"
```

General Notes

```
Binaries were compiled on a system with 2x AMD EPYC 9174F CPU + 1.5TiB Memory using RHEL 8.6

NA: The test sponsor attests, as of date of publication, that CVE-2017-5754 (Meltdown)
is mitigated in the system as tested and documented.
Yes: The test sponsor attests, as of date of publication, that CVE-2017-5753 (Spectre variant 1)
is mitigated in the system as tested and documented.
Yes: The test sponsor attests, as of date of publication, that CVE-2017-5715 (Spectre variant 2)
is mitigated in the system as tested and documented.
```

Platform Notes

```
BIOS configuration:
Operating Mode set to Maximum Performance and then set it to Custom Mode
NUMA Nodes per Socket set to NPS4

 Sysinfo program /home/cpu2017-1.1.8-amd-aocc400-genoa-B1b/bin/sysinfo
 Rev: r6622 of 2021-04-07 982a61ec0915b55891ef0e16acafc64d
 running on localhost Fri Jan 20 23:52:37 2023

 SUT (System Under Test) info as seen by some common utilities.
 For more information on this section, see
    https://www.spec.org/cpu2017/Docs/config.html#sysinfo
```

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Lenovo Global Technology

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Platform Notes (Continued)

```
From /proc/cpuinfo
   model name : AMD EPYC 9174F 16-Core Processor
      2  "physical id"s (chips)
      64 "processors"
   cores, siblings (Caution: counting these is hw and system dependent. The following
   excerpts from /proc/cpuinfo might not be reliable.  Use with caution.)
      cpu cores : 16
      siblings  : 32
      physical 0: cores 0 1 16 17 24 25 32 33 40 41 48 49 56 57
      physical 1: cores 0 1 16 17 24 25 32 33 40 41 48 49 56 57

From lscpu from util-linux 2.37.2:
      Architecture:              x86_64
      CPU op-mode(s):            32-bit, 64-bit
      Address sizes:             52 bits physical, 57 bits virtual
      Byte Order:                Little Endian
      CPU(s):                    64
      On-line CPU(s) list:       0-63
      Vendor ID:                 AuthenticAMD
      Model name:                AMD EPYC 9174F 16-Core Processor
      CPU family:                25
      Model:                     17
      Thread(s) per core:        2
      Core(s) per socket:        16
      Socket(s):                 2
      Stepping:                  1
      Frequency boost:           enabled
      CPU max MHz:               4408.2998
      CPU min MHz:               1500.0000
      BogoMIPS:                  8200.00
      Flags:                     fpu vme de pse tsc msr pae mce cx8 apic sep mtrr
   pge mca cmov pat pse36 clflush mmx fxsr sse sse2 ht syscall nx mmxext fxsr_opt
   pdpe1gb rdtscp lm constant_tsc rep_good nopl nonstop_tsc cpuid extd_apicid
   aperfmperf rapl pni pclmulqdq monitor ssse3 fma cx16 pcid sse4_1 sse4_2 x2apic movbe
   popcnt aes xsave avx f16c rdrand lahf_lm cmp_legacy svm extapic cr8_legacy abm sse4a
   misalignsse 3dnowprefetch osvw ibs skinit wdt tce topoext perfctr_core perfctr_nb
   bpext perfctr_llc mwaitx cpb cat_l3 cdp_l3 invpcid_single hw_pstate ssbd mba ibrs
   ibpb stibp vmmcall fsgsbase bmi1 avx2 smep bmi2 erms invpcid cqm rdt_a avx512f
   avx512dq rdseed adx smap avx512ifma clflushopt clwb avx512cd sha_ni avx512bw
   avx512vl xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
   cqm_mbm_local avx512_bf16 clzero irperf xsaveerptr rdpru wbnoinvd amd_ppin arat npt
   lbrv svm_lock nrip_save tsc_scale vmcb_clean flushbyasid decodeassists pausefilter
   pfthreshold avic v_vmsave_vmload vgif v_spec_ctrl avx512vbmi umip pku ospke
   avx512_vbmi2 gfni vaes vpclmulqdq avx512_vnni avx512_bitalg avx512_vpopcntdq la57
   rdpid overflow_recov succor smca fsrm flush_l1d
      Virtualization:            AMD-V
      L1d cache:                 1 MiB (32 instances)
```

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Platform Notes (Continued)

```
     L1i cache:                        1 MiB (32 instances)
     L2 cache:                         32 MiB (32 instances)
     L3 cache:                         512 MiB (16 instances)
     NUMA node(s):                     8
     NUMA node0 CPU(s):                0-3,32-35
     NUMA node1 CPU(s):                4-7,36-39
     NUMA node2 CPU(s):                8-11,40-43
     NUMA node3 CPU(s):                12-15,44-47
     NUMA node4 CPU(s):                16-19,48-51
     NUMA node5 CPU(s):                20-23,52-55
     NUMA node6 CPU(s):                24-27,56-59
     NUMA node7 CPU(s):                28-31,60-63
     Vulnerability Itlb multihit:      Not affected
     Vulnerability L1tf:               Not affected
     Vulnerability Mds:                Not affected
     Vulnerability Meltdown:           Not affected
     Vulnerability Spec store bypass: Mitigation; Speculative Store Bypass disabled via
     prctl and seccomp
     Vulnerability Spectre v1:         Mitigation; usercopy/swapgs barriers and __user
     pointer sanitization
     Vulnerability Spectre v2:         Mitigation; Retpolines, IBPB conditional, IBRS_FW,
     STIBP always-on, RSB filling
     Vulnerability Srbds:              Not affected
     Vulnerability Tsx async abort:    Not affected

  From lscpu --cache:
     NAME ONE-SIZE ALL-SIZE WAYS TYPE          LEVEL   SETS PHY-LINE COHERENCY-SIZE
     L1d       32K       1M    8 Data            1     64      1               64
     L1i       32K       1M    8 Instruction     1     64      1               64
     L2         1M      32M    8 Unified         2   2048      1               64
     L3        32M     512M   16 Unified         3  32768      1               64

  /proc/cpuinfo cache data
     cache size : 1024 KB

  From numactl --hardware
  WARNING: a numactl 'node' might or might not correspond to a physical chip.
    available: 8 nodes (0-7)
    node 0 cpus: 0 1 2 3 32 33 34 35
    node 0 size: 96345 MB
    node 0 free: 95294 MB
    node 1 cpus: 4 5 6 7 36 37 38 39
    node 1 size: 96752 MB
    node 1 free: 96101 MB
    node 2 cpus: 8 9 10 11 40 41 42 43
    node 2 size: 96752 MB
    node 2 free: 96356 MB
```

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Platform Notes (Continued)

```
   node 3 cpus: 12 13 14 15 44 45 46 47
   node 3 size: 96752 MB
   node 3 free: 96446 MB
   node 4 cpus: 16 17 18 19 48 49 50 51
   node 4 size: 96752 MB
   node 4 free: 96426 MB
   node 5 cpus: 20 21 22 23 52 53 54 55
   node 5 size: 96752 MB
   node 5 free: 96413 MB
   node 6 cpus: 24 25 26 27 56 57 58 59
   node 6 size: 96752 MB
   node 6 free: 96394 MB
   node 7 cpus: 28 29 30 31 60 61 62 63
   node 7 size: 96553 MB
   node 7 free: 96219 MB
   node distances:
   node   0   1   2   3   4   5   6   7
     0:  10  12  12  12  32  32  32  32
     1:  12  10  12  12  32  32  32  32
     2:  12  12  10  12  32  32  32  32
     3:  12  12  12  10  32  32  32  32
     4:  32  32  32  32  10  12  12  12
     5:  32  32  32  32  12  10  12  12
     6:  32  32  32  32  12  12  10  12
     7:  32  32  32  32  12  12  12  10

 From /proc/meminfo
    MemTotal:       791972980 kB
    HugePages_Total:        0
    Hugepagesize:        2048 kB

 /sys/devices/system/cpu/cpu*/cpufreq/scaling_governor has
    performance

 From /etc/*release* /etc/*version*
    os-release:
       NAME="SLES"
       VERSION="15-SP4"
       VERSION_ID="15.4"
       PRETTY_NAME="SUSE Linux Enterprise Server 15 SP4"
       ID="sles"
       ID_LIKE="suse"
       ANSI_COLOR="0;32"
       CPE_NAME="cpe:/o:suse:sles:15:sp4"

 uname -a:
    Linux localhost 5.14.21-150400.22-default #1 SMP PREEMPT_DYNAMIC Wed May 11 06:57:18
```

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Platform Notes (Continued)

```
    UTC 2022 (49db222) x86_64 x86_64 x86_64 GNU/Linux

  Kernel self-reported vulnerability status:

  CVE-2018-12207 (iTLB Multihit):             Not affected
  CVE-2018-3620 (L1 Terminal Fault):          Not affected
  Microarchitectural Data Sampling:           Not affected
  CVE-2017-5754 (Meltdown):                   Not affected
  CVE-2018-3639 (Speculative Store Bypass):   Mitigation: Speculative Store
                                              Bypass disabled via prctl and
                                              seccomp
  CVE-2017-5753 (Spectre variant 1):          Mitigation: usercopy/swapgs
                                              barriers and __user pointer
                                              sanitization
  CVE-2017-5715 (Spectre variant 2):          Mitigation: Retpolines, IBPB:
                                              conditional, IBRS_FW, STIBP:
                                              always-on, RSB filling
  CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
  CVE-2019-11135 (TSX Asynchronous Abort):    Not affected

  run-level 3 Jan 20 08:58

  SPEC is set to: /home/cpu2017-1.1.8-amd-aocc400-genoa-B1b
     Filesystem      Type  Size  Used Avail Use% Mounted on
     /dev/nvme0n1p3 xfs    3.5T   27G  3.5T   1% /

  From /sys/devices/virtual/dmi/id
     Vendor:          Lenovo
     Product:         ThinkSystem SD665 V3
     Product Family:  ThinkSystem
     Serial:          1234567890

  Additional information from dmidecode 3.2 follows.  WARNING: Use caution when you
  interpret this section. The 'dmidecode' program reads system data which is "intended to
  allow hardware to be accurately determined", but the intent may not be met, as there are
  frequent changes to hardware, firmware, and the "DMTF SMBIOS" standard.
    Memory:
      3x Samsung M321R4GA3BB0-CQKMG 32 GB 2 rank 4800
      4x Samsung M321R4GA3BB0-CQKVG 32 GB 2 rank 4800
      17x Samsung M321R4GA3BB6-CQKVG 32 GB 2 rank 4800

  BIOS:
     BIOS Vendor:       Lenovo
     BIOS Version:      QGE105O-1.10
     BIOS Date:         12/19/2022
     BIOS Revision:     1.10
     Firmware Revision: 0.90
```

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Platform Notes (Continued)

```
  (End of data from sysinfo program)
```

Compiler Version Notes

```
==============================================================================
C                     | 519.lbm_r(base, peak) 538.imagick_r(base, peak)
                      | 544.nab_r(base, peak)
------------------------------------------------------------------------------
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
------------------------------------------------------------------------------


==============================================================================
C++                   | 508.namd_r(base, peak) 510.parest_r(base, peak)
------------------------------------------------------------------------------
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
------------------------------------------------------------------------------


==============================================================================
C++, C                | 511.povray_r(base, peak) 526.blender_r(base, peak)
------------------------------------------------------------------------------
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
------------------------------------------------------------------------------


==============================================================================
C++, C, Fortran | 507.cactuBSSN_r(base, peak)
------------------------------------------------------------------------------
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
```

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Compiler Version Notes (Continued)

```
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
--------------------------------------------------------------------------


================================================================================
Fortran           | 503.bwaves_r(base, peak) 549.fotonik3d_r(base, peak)
                  | 554.roms_r(base, peak)
--------------------------------------------------------------------------
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
--------------------------------------------------------------------------


================================================================================
Fortran, C        | 521.wrf_r(base, peak) 527.cam4_r(base, peak)
--------------------------------------------------------------------------
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
AMD clang version 14.0.6 (CLANG: AOCC_4.0.0-Build#389 2022_10_07) (based on
  LLVM Mirror.Version.14.0.6)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /opt/AMD/aocc/aocc-compiler-rel-4.0-3206-389/bin
--------------------------------------------------------------------------
```

Base Compiler Invocation

C benchmarks:
```
clang
```

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Base Compiler Invocation (Continued)

C++ benchmarks:
```
clang++
```

Fortran benchmarks:
```
flang
```

Benchmarks using both Fortran and C:
```
flang clang
```

Benchmarks using both C and C++:
```
clang++ clang
```

Benchmarks using Fortran, C, and C++:
```
clang++ clang flang
```

Base Portability Flags

503.bwaves_r: `-DSPEC_LP64`
507.cactuBSSN_r: `-DSPEC_LP64`
508.namd_r: `-DSPEC_LP64`
510.parest_r: `-DSPEC_LP64`
511.povray_r: `-DSPEC_LP64`
519.lbm_r: `-DSPEC_LP64`
521.wrf_r: `-DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64`
526.blender_r: `-funsigned-char -DSPEC_LP64`
527.cam4_r: `-DSPEC_CASE_FLAG -DSPEC_LP64`
538.imagick_r: `-DSPEC_LP64`
544.nab_r: `-DSPEC_LP64`
549.fotonik3d_r: `-DSPEC_LP64`
554.roms_r: `-DSPEC_LP64`

Base Optimization Flags

C benchmarks:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-ldist-scalar-expand -fenable-aggressive-gather -O3
-march=znver4 -fveclib=AMDLIBM -ffast-math -fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-zopt -lamdlibm -lamdalloc -lflang
```

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Lenovo Global Technology

SPECrate®2017_fp_base = 598

ThinkSystem SD665 V3
(4.10 GHz,AMD EPYC 9174F)

SPECrate®2017_fp_peak = 608

CPU2017 License:	9017	**Test Date:**	Jan-2023
Test Sponsor:	Lenovo Global Technology	**Hardware Availability:**	Dec-2022
Tested by:	Lenovo Global Technology	**Software Availability:**	Nov-2022

Base Optimization Flags (Continued)

C++ benchmarks:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -O3 -march=znver4
-fveclib=AMDLIBM -ffast-math -mllvm -unroll-threshold=100
-finline-aggressive -mllvm -loop-unswitch-threshold=200000
-mllvm -reduce-array-computations=3 -zopt -lamdlibm -lamdalloc
-lflang
```

Fortran benchmarks:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -O3 -march=znver4
-fveclib=AMDLIBM -ffast-math -Kieee -Mrecursive -funroll-loops
-mllvm -lsr-in-nested-loop -mllvm -reduce-array-computations=3
-fepilog-vectorization-of-inductions -zopt -lamdlibm -lamdalloc
-lflang
```

Benchmarks using both Fortran and C:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -O3 -march=znver4
-fveclib=AMDLIBM -ffast-math -fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-zopt -Kieee -Mrecursive -funroll-loops -mllvm -lsr-in-nested-loop
-fepilog-vectorization-of-inductions -lamdlibm -lamdalloc -lflang
```

Benchmarks using both C and C++:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -O3 -march=znver4
-fveclib=AMDLIBM -ffast-math -fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-zopt -mllvm -unroll-threshold=100 -finline-aggressive
-mllvm -loop-unswitch-threshold=200000 -lamdlibm -lamdalloc -lflang
```

Benchmarks using Fortran, C, and C++:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -O3 -march=znver4
-fveclib=AMDLIBM -ffast-math -fstruct-layout=7
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-fremap-arrays -fstrip-mining -mllvm -reduce-array-computations=3
-zopt -mllvm -unroll-threshold=100 -finline-aggressive
```

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Lenovo Global Technology

ThinkSystem SD665 V3
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Test Date: Jan-2023
Hardware Availability: Dec-2022
Software Availability: Nov-2022

Base Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++ (continued):

```
-mllvm -loop-unswitch-threshold=200000 -Kieee -Mrecursive
-funroll-loops -mllvm -lsr-in-nested-loop
-fepilog-vectorization-of-inductions -lamdlibm -lamdalloc -lflang
```

Base Other Flags

C benchmarks:
```
-Wno-unused-command-line-argument
```

C++ benchmarks:
```
-Wno-unused-command-line-argument
```

Fortran benchmarks:
```
-Wno-unused-command-line-argument
```

Benchmarks using both Fortran and C:
```
-Wno-unused-command-line-argument
```

Benchmarks using both C and C++:
```
-Wno-unused-command-line-argument
```

Benchmarks using Fortran, C, and C++:
```
-Wno-unused-command-line-argument
```

Peak Compiler Invocation

C benchmarks:
```
clang
```

C++ benchmarks:
```
clang++
```

Fortran benchmarks:
```
flang
```

Benchmarks using both Fortran and C:
```
flang clang
```

Benchmarks using both C and C++:
```
clang++ clang
```

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Lenovo Global Technology

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Peak Compiler Invocation (Continued)

Benchmarks using Fortran, C, and C++:
```
clang++ clang flang
```

Peak Portability Flags

```
Same as Base Portability Flags
```

Peak Optimization Flags

C benchmarks:

519.lbm_r: `basepeak = yes`

538.imagick_r: `basepeak = yes`

544.nab_r: `basepeak = yes`

C++ benchmarks:

508.namd_r: `-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6`
`-Wl,-mllvm -Wl,-reduce-array-computations=3`
`-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -Ofast`
`-march=znver4 -fveclib=AMDLIBM -ffast-math`
`-finline-aggressive -mllvm -unroll-threshold=100`
`-mllvm -reduce-array-computations=3 -zopt -lamdlibm`
`-lamdalloc`

510.parest_r: `-m64 -flto -Wl,-mllvm -Wl,-suppress-fmas`
`-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -Ofast`
`-march=znver4 -fveclib=AMDLIBM -ffast-math`
`-finline-aggressive -mllvm -unroll-threshold=100`
`-mllvm -reduce-array-computations=3 -zopt -lamdlibm`
`-lamdalloc`

Fortran benchmarks:

503.bwaves_r: `-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6`
`-Wl,-mllvm -Wl,-reduce-array-computations=3`
`-Wl,-mllvm -Wl,-enable-X86-prefetching -Ofast`
`-march=znver4 -fveclib=AMDLIBM -ffast-math -Mrecursive`
`-mllvm -reduce-array-computations=3`
`-fepilog-vectorization-of-inductions -zopt -lamdlibm`

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Peak Optimization Flags (Continued)

503.bwaves_r (continued):
```
-lamdalloc -lflang
```

549.fotonik3d_r: `-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6`
```
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -Ofast
-march=znver4 -fveclib=AMDLIBM -ffast-math -Kieee
-Mrecursive -mllvm -reduce-array-computations=3
-fepilog-vectorization-of-inductions -fvector-transform
-fscalar-transform -lamdlibm -lamdalloc -lflang
```

554.roms_r: `Same as 503.bwaves_r`

Benchmarks using both Fortran and C:

521.wrf_r: `-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6`
```
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-enable-X86-prefetching -Ofast
-march=znver4 -fveclib=AMDLIBM -ffast-math
-fstruct-layout=7 -mllvm -unroll-threshold=50
-fremap-arrays -fstrip-mining
-mllvm -inline-threshold=1000
-mllvm -reduce-array-computations=3 -zopt -Mrecursive
-fepilog-vectorization-of-inductions -lamdlibm -lamdalloc
-lflang
```

527.cam4_r: `basepeak = yes`

Benchmarks using both C and C++:

511.povray_r: `basepeak = yes`

526.blender_r: `basepeak = yes`

Benchmarks using Fortran, C, and C++:
```
-m64 -flto -Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -Ofast -march=znver4
-fveclib=AMDLIBM -ffast-math -fstruct-layout=7
-mllvm -unroll-threshold=50 -fremap-arrays -fstrip-mining
-mllvm -inline-threshold=1000 -mllvm -reduce-array-computations=3 -zopt
-mllvm -unroll-threshold=100 -mllvm -loop-unswitch-threshold=200000
-finline-aggressive -faggressive-loop-transform -fvector-transform
-fscalar-transform -Mrecursive -fepilog-vectorization-of-inductions
-lamdlibm -lamdalloc -lflang
```

SPEC CPU®2017 Floating Point Rate Result

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Lenovo Global Technology

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Peak Other Flags

C benchmarks:
```
-Wno-unused-command-line-argument
```

C++ benchmarks:
```
-Wno-unused-command-line-argument
```

Fortran benchmarks:
```
-Wno-unused-command-line-argument
```

Benchmarks using both Fortran and C:
```
-Wno-unused-command-line-argument
```

Benchmarks using both C and C++:
```
-Wno-unused-command-line-argument
```

Benchmarks using Fortran, C, and C++:
```
-Wno-unused-command-line-argument
```

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Genoa-Q.html
http://www.spec.org/cpu2017/flags/aocc400-flags.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-Genoa-Q.xml
http://www.spec.org/cpu2017/flags/aocc400-flags.xml

For questions about this result, please contact the tester. For other inquiries, please contact info@spec.org.

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