



# SPEC CPU®2017 Floating Point Speed Result

Copyright 2017-2021 Standard Performance Evaluation Corporation

## Dell Inc.

SPECspeed®2017\_fp\_base = 234

PowerEdge C6525 (AMD EPYC 7713 64-Core Processor)

SPECspeed®2017\_fp\_peak = 238

CPU2017 License: 55

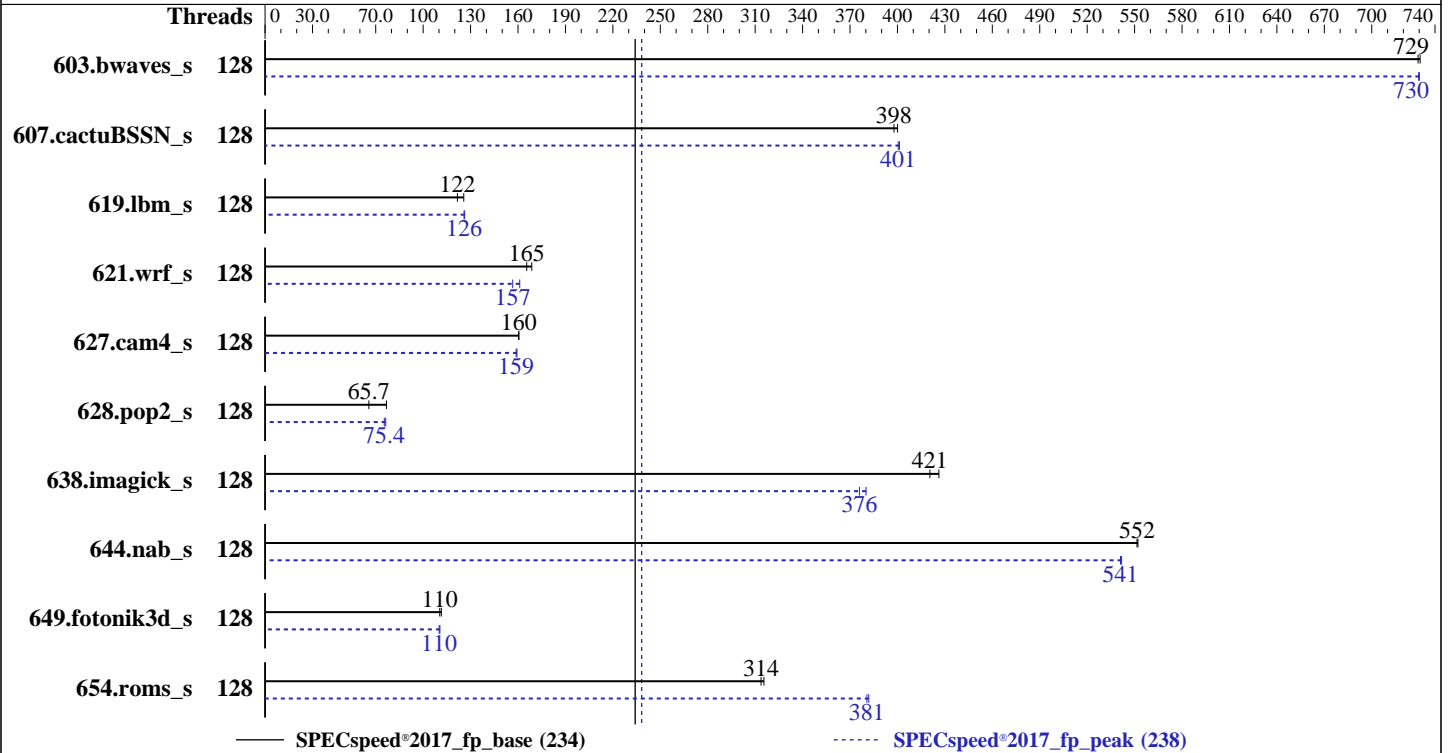
Test Sponsor: Dell Inc.

Tested by: Dell Inc.

Test Date: Feb-2021

Hardware Availability: Mar-2021

Software Availability: Mar-2021



### Hardware

CPU Name: AMD EPYC 7713  
 Max MHz: 3675  
 Nominal: 2000  
 Enabled: 128 cores, 2 chips  
 Orderable: 1,2 chips  
 Cache L1: 32 KB I + 32 KB D on chip per core  
 L2: 512 KB I+D on chip per core  
 L3: 256 MB I+D on chip per chip, 32 MB shared / 8 cores  
 Other: None  
 Memory: 1 TB (16 x 64 GB 2Rx4 PC4-3200AA-R)  
 Storage: 504 GB on tmpfs  
 Other: None

### Software

OS: Red Hat Enterprise Linux 8.3 (Ootpa)  
 4.18.0-240.el8.x86\_64  
 Compiler: C/C++/Fortran: Version 3.0.0 of AOCC  
 Parallel: Yes  
 Firmware: Version 2.1.4 released Feb-2021  
 File System: tmpfs  
 System State: Run level 3 (multi-user)  
 Base Pointers: 64-bit  
 Peak Pointers: 64-bit  
 Other: jemalloc: jemalloc memory allocator library v5.1.0  
 Power Management: BIOS set to prefer performance at the cost of additional power usage



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## Results Table

Benchmark	Base							Peak						
	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Threads	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
603.bwaves_s	128	<b>80.9</b>	<b>729</b>	80.8	731			128	<b>80.9</b>	<b>730</b>	80.8	730		
607.cactuBSSN_s	128	41.7	400	<b>41.9</b>	<b>398</b>			128	<b>41.6</b>	<b>401</b>	41.5	401		
619.lbm_s	128	41.7	126	<b>43.1</b>	<b>122</b>			128	41.5	126	<b>41.6</b>	<b>126</b>		
621.wrf_s	128	<b>79.9</b>	<b>165</b>	78.4	169			128	82.1	161	<b>84.4</b>	<b>157</b>		
627.cam4_s	128	55.2	161	<b>55.2</b>	<b>160</b>			128	55.6	159	<b>55.8</b>	<b>159</b>		
628.pop2_s	128	155	76.8	<b>181</b>	<b>65.7</b>			128	156	76.3	<b>157</b>	<b>75.4</b>		
638.imagick_s	128	33.8	426	<b>34.3</b>	<b>421</b>			128	<b>38.4</b>	<b>376</b>	37.9	380		
644.nab_s	128	<b>31.7</b>	<b>552</b>	31.6	552			128	32.2	542	<b>32.3</b>	<b>541</b>		
649.fotonik3d_s	128	<b>82.5</b>	<b>110</b>	81.8	112			128	<b>82.8</b>	<b>110</b>	82.4	111		
654.roms_s	128	49.9	316	<b>50.2</b>	<b>314</b>			128	41.2	382	<b>41.4</b>	<b>381</b>		

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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
'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>

'echo 8 > /proc/sys/vm/dirty_ratio' run as root to limit dirty cache to 8% of memory.
'echo 1 > /proc/sys/vm/swappiness' run as root to limit swap usage to minimum necessary.
'echo 1 > /proc/sys/vm/zone_reclaim_mode' run as root to free node-local memory and avoid remote memory usage.
'sync; echo 3 > /proc/sys/vm/drop_caches' run as root to reset filesystem caches.
'sysctl -w kernel.randomize_va_space=0' run as root to disable address space layout randomization (ASLR) to reduce run-to-run variability.
```

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## Operating System Notes (Continued)

'echo always > /sys/kernel/mm/transparent\_hugepage/enabled' and  
'echo always > /sys/kernel/mm/transparent\_hugepage/defrag' run as root to enable  
Transparent Hugepages (THP) for this run.  
'echo madvise > /sys/kernel/mm/transparent\_hugepage/enabled' run as root for peak  
runs of 628.pop2\_s and 638.imagick\_s to enable THP only on request.

## Environment Variables Notes

Environment variables set by runcpu before the start of the run:

GOMP\_CPU\_AFFINITY = "0-127"

LD\_LIBRARY\_PATH =

"/dev/shm/cpu2017-1.1.5/amd\_speed\_aocc300\_milan\_B\_lib/64:/dev/shm/cpu2017-1.1.5/amd\_speed\_aocc300\_milan\_B\_lib/32:"

MALLOC\_CONF = "retain:true"

OMP\_DYNAMIC = "false"

OMP\_SCHEDULE = "static"

OMP\_STACKSIZE = "128M"

OMP\_THREAD\_LIMIT = "128"

Environment variables set by runcpu during the 603.bwaves\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 607.cactuBSSN\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 619.lbm\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 621.wrf\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 627.cam4\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 628.pop2\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 638.imagick\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

Environment variables set by runcpu during the 644.nab\_s peak run:

GOMP\_CPU\_AFFINITY = "0 64 1 65 2 66 3 67 4 68 5 69 6 70 7 71 8 72 9 73 10 74  
11 75 12 76 13 77 14 78 15 79 16 80 17 81 18 82 19 83 20 84 21 85 22 86  
23 87 24 88 25 89 26 90 27 91 28 92 29 93 30 94 31 95 32 96 33 97 34 98  
35 99 36 100 37 101 38 102 39 103 40 104 41 105 42 106 43 107 44 108 45  
109 46 110 47 111 48 112 49 113 50 114 51 115 52 116 53 117 54 118 55"

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## Environment Variables Notes (Continued)

119 56 120 57 121 58 122 59 123 60 124 61 125 62 126 63 127"

Environment variables set by runcpu during the 649.fotonik3d\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

PGHHPF\_ZMEM = "yes"

Environment variables set by runcpu during the 654.roms\_s peak run:

GOMP\_CPU\_AFFINITY = "0-127"

## General Notes

Binaries were compiled on a system with 2x AMD EPYC 7742 CPU + 1TiB Memory using openSUSE 15.2  
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.

jemalloc: configured and built with GCC v4.8.2 in RHEL 7.4 (No options specified)

jemalloc 5.1.0 is available here:

<https://github.com/jemalloc/jemalloc/releases/download/5.1.0/jemalloc-5.1.0.tar.bz2>

## Platform Notes

BIOS settings:

Logical processor : Disabled  
L3 Cache as NUMA Domain : Enabled  
Virtualization Technology : Disabled  
DRAM Refresh Delay : Performance  
System Profile : Custom  
CPU Power Management : Maximum Performance  
Memory Patrol Scrub : Disabled  
PCI ASPM L1 Link  
Power Management : Disabled

sysinfo program /dev/shm/cpu2017-1.1.5/bin/sysinfo  
Rev: r6538 of 2020-09-24 e8664e66d2d7080afeaa89d4b38e2f1c  
running on localhost.localdomain Thu Feb 25 17:35:38 2021

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>

From /proc/cpuinfo

model name : AMD EPYC 7713 64-Core Processor

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## Platform Notes (Continued)

```

2 "physical id"s (chips)
128 "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 : 64
siblings : 64
physical 0: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
53 54 55 56 57 58 59 60 61 62 63
physical 1: cores 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52
53 54 55 56 57 58 59 60 61 62 63

```

From lscpu:

```

Architecture: x86_64
CPU op-mode(s): 32-bit, 64-bit
Byte Order: Little Endian
CPU(s): 128
On-line CPU(s) list: 0-127
Thread(s) per core: 1
Core(s) per socket: 64
Socket(s): 2
NUMA node(s): 16
Vendor ID: AuthenticAMD
CPU family: 25
Model: 1
Model name: AMD EPYC 7713 64-Core Processor
Stepping: 1
CPU MHz: 1711.581
BogoMIPS: 3992.70
Virtualization: AMD-V
L1d cache: 32K
L1i cache: 32K
L2 cache: 512K
L3 cache: 32768K
NUMA node0 CPU(s): 0-7
NUMA node1 CPU(s): 8-15
NUMA node2 CPU(s): 16-23
NUMA node3 CPU(s): 24-31
NUMA node4 CPU(s): 32-39
NUMA node5 CPU(s): 40-47
NUMA node6 CPU(s): 48-55
NUMA node7 CPU(s): 56-63
NUMA node8 CPU(s): 64-71
NUMA node9 CPU(s): 72-79
NUMA node10 CPU(s): 80-87
NUMA node11 CPU(s): 88-95

```

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## Platform Notes (Continued)

```

NUMA node12 CPU(s): 96-103
NUMA node13 CPU(s): 104-111
NUMA node14 CPU(s): 112-119
NUMA node15 CPU(s): 120-127
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 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 bpeext perfctr_llc mwaitx cpb
cat_l3 cdp_l3 invpcid_single hw_pstate sme ssbd mba sev ibrs ibpb stibp vmmcall
fsgsbase bmi1 avx2 smep bmi2 invpcid cqm rdt_a rdseed adx smap clflushopt clwb
sha_ni xsaveopt xsavec xgetbv1 xsaves cqm_llc cqm_occup_llc cqm_mbm_total
cqm_mbm_local clzero irperf xsaveerptr wbnoinvd amd_ppin arat npt lbrv svm_lock
nrip_save tsc_scale vmcb_clean flushbyasid decodeassists pausefilter pfthreshold
v_omsave_vmload vgif umip pku ospke vaes vpclmulqdq rdpid overflow_recov succor smca

```

```

/proc/cpuinfo cache data
cache size : 512 KB

```

From numactl --hardware WARNING: a numactl 'node' might or might not correspond to a physical chip.

```

available: 16 nodes (0-15)
node 0 cpus: 0 1 2 3 4 5 6 7
node 0 size: 64074 MB
node 0 free: 63952 MB
node 1 cpus: 8 9 10 11 12 13 14 15
node 1 size: 64507 MB
node 1 free: 64376 MB
node 2 cpus: 16 17 18 19 20 21 22 23
node 2 size: 64507 MB
node 2 free: 61834 MB
node 3 cpus: 24 25 26 27 28 29 30 31
node 3 size: 64509 MB
node 3 free: 63420 MB
node 4 cpus: 32 33 34 35 36 37 38 39
node 4 size: 64507 MB
node 4 free: 63206 MB
node 5 cpus: 40 41 42 43 44 45 46 47
node 5 size: 64509 MB
node 5 free: 63090 MB
node 6 cpus: 48 49 50 51 52 53 54 55
node 6 size: 64503 MB
node 6 free: 64398 MB
node 7 cpus: 56 57 58 59 60 61 62 63
node 7 size: 64491 MB
node 7 free: 64406 MB

```

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## Platform Notes (Continued)

```

node 8 cpus: 64 65 66 67 68 69 70 71
node 8 size: 64509 MB
node 8 free: 64342 MB
node 9 cpus: 72 73 74 75 76 77 78 79
node 9 size: 64507 MB
node 9 free: 64434 MB
node 10 cpus: 80 81 82 83 84 85 86 87
node 10 size: 64462 MB
node 10 free: 64396 MB
node 11 cpus: 88 89 90 91 92 93 94 95
node 11 size: 64503 MB
node 11 free: 64442 MB
node 12 cpus: 96 97 98 99 100 101 102 103
node 12 size: 64509 MB
node 12 free: 64447 MB
node 13 cpus: 104 105 106 107 108 109 110 111
node 13 size: 64507 MB
node 13 free: 64452 MB
node 14 cpus: 112 113 114 115 116 117 118 119
node 14 size: 64509 MB
node 14 free: 64388 MB
node 15 cpus: 120 121 122 123 124 125 126 127
node 15 size: 64503 MB
node 15 free: 64438 MB
node distances:
node  0  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15
  0: 10 11 11 11 11 11 11 11 32 32 32 32 32 32 32 32
  1: 11 10 11 11 11 11 11 11 32 32 32 32 32 32 32 32
  2: 11 11 10 11 11 11 11 11 32 32 32 32 32 32 32 32
  3: 11 11 11 10 11 11 11 11 32 32 32 32 32 32 32 32
  4: 11 11 11 11 10 11 11 11 32 32 32 32 32 32 32 32
  5: 11 11 11 11 11 10 11 11 32 32 32 32 32 32 32 32
  6: 11 11 11 11 11 11 10 11 32 32 32 32 32 32 32 32
  7: 11 11 11 11 11 11 11 10 32 32 32 32 32 32 32 32
  8: 32 32 32 32 32 32 32 32 32 10 11 11 11 11 11 11
  9: 32 32 32 32 32 32 32 32 32 11 10 11 11 11 11 11
10: 32 32 32 32 32 32 32 32 32 11 11 10 11 11 11 11
11: 32 32 32 32 32 32 32 32 32 11 11 11 10 11 11 11
12: 32 32 32 32 32 32 32 32 32 11 11 11 11 10 11 11
13: 32 32 32 32 32 32 32 32 32 11 11 11 11 11 10 11
14: 32 32 32 32 32 32 32 32 32 11 11 11 11 11 11 10
15: 32 32 32 32 32 32 32 32 32 11 11 11 11 11 11 10

```

From /proc/meminfo

MemTotal: 1056423112 kB

HugePages\_Total: 0

Hugepagesize: 2048 kB

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## Platform Notes (Continued)

```

/sbin/tuned-adm active
  Current active profile: throughput-performance

From /etc/*release* /etc/*version*
os-release:
  NAME="Red Hat Enterprise Linux"
  VERSION="8.3 (Ootpa)"
  ID="rhel"
  ID_LIKE="fedora"
  VERSION_ID="8.3"
  PLATFORM_ID="platform:el8"
  PRETTY_NAME="Red Hat Enterprise Linux 8.3 (Ootpa)"
  ANSI_COLOR="0;31"
redhat-release: Red Hat Enterprise Linux release 8.3 (Ootpa)
system-release: Red Hat Enterprise Linux release 8.3 (Ootpa)
system-release-cpe: cpe:/o:redhat:enterprise_linux:8.3:ga

uname -a:
Linux localhost.localdomain 4.18.0-240.el8.x86_64 #1 SMP Wed Sep 23 05:13:10 EDT 2020
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: Full AMD retpoline,
                                           IBPB: conditional, IBRS_FW, STIBP:
                                           disabled, RSB filling
CVE-2020-0543 (Special Register Buffer Data Sampling): Not affected
CVE-2019-11135 (TSX Asynchronous Abort): Not affected

run-level 3 Jan 8 09:48

SPEC is set to: /dev/shm/cpu2017-1.1.5
Filesystem      Type      Size  Used Avail Use% Mounted on
tmpfs           tmpfs    504G   5.7G 499G   2% /dev/shm

From /sys/devices/virtual/dmi/id

```

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## Platform Notes (Continued)

Vendor: Dell Inc.  
Product: PowerEdge C6525  
Product Family: PowerEdge

Additional information from dmidecode 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:  
11x 802C8632802C 36ASF8G72PZ-3G2B2 64 GB 2 rank 3200  
5x 802C869D802C 36ASF8G72PZ-3G2B2 64 GB 2 rank 3200

BIOS:  
BIOS Vendor: Dell Inc.  
BIOS Version: 2.1.4  
BIOS Date: 02/17/2021  
BIOS Revision: 2.1

(End of data from sysinfo program)

## Compiler Version Notes

=====  
C | 619.lbm\_s(base, peak) 638.imagick\_s(base, peak)  
644.nab\_s(base, peak)

AMD clang version 12.0.0 (CLANG: AOCC\_3.0.0-Build#78 2020\_12\_10) (based on LLVM Mirror.Version.12.0.0)  
Target: x86\_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin  
-----

=====  
C++, C, Fortran | 607.cactuBSSN\_s(base, peak)  
-----

AMD clang version 12.0.0 (CLANG: AOCC\_3.0.0-Build#78 2020\_12\_10) (based on LLVM Mirror.Version.12.0.0)  
Target: x86\_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin  
AMD clang version 12.0.0 (CLANG: AOCC\_3.0.0-Build#78 2020\_12\_10) (based on LLVM Mirror.Version.12.0.0)  
Target: x86\_64-unknown-linux-gnu  
Thread model: posix  
InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

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Target: x86\_64-unknown-linux-gnu

Thread model: posix

InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

Fortran | 603.bwaves\_s(base, peak) 649.fotonik3d\_s(base, peak)  
| 654.roms\_s(base, peak)

AMD clang version 12.0.0 (CLANG: AOCC\_3.0.0-Build#78 2020\_12\_10) (based on LLVM Mirror.Version.12.0.0)

Target: x86\_64-unknown-linux-gnu

Thread model: posix

InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

Fortran, C | 621.wrf\_s(base, peak) 627.cam4\_s(base, peak)  
| 628.pop2\_s(base, peak)

AMD clang version 12.0.0 (CLANG: AOCC\_3.0.0-Build#78 2020\_12\_10) (based on LLVM Mirror.Version.12.0.0)

Target: x86\_64-unknown-linux-gnu

Thread model: posix

InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

AMD clang version 12.0.0 (CLANG: AOCC\_3.0.0-Build#78 2020\_12\_10) (based on LLVM Mirror.Version.12.0.0)

Target: x86\_64-unknown-linux-gnu

Thread model: posix

InstalledDir: /opt/AMD/aocc-compiler-3.0.0/bin

## Base Compiler Invocation

C benchmarks:

clang

Fortran benchmarks:

flang

Benchmarks using both Fortran and C:

flang clang

(Continued on next page)



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CPU2017 License: 55

Test Date: Feb-2021

Test Sponsor: Dell Inc.

Hardware Availability: Mar-2021

Tested by: Dell Inc.

Software Availability: Mar-2021

## Base Compiler Invocation (Continued)

Benchmarks using Fortran, C, and C++:

clang++ clang flang

## Base Portability Flags

```

603.bwaves_s: -DSPEC_LP64
607.cactuBSSN_s: -DSPEC_LP64
619.lbm_s: -DSPEC_LP64
621.wrf_s: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
627.cam4_s: -DSPEC_CASE_FLAG -DSPEC_LP64
628.pop2_s: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
638.imagick_s: -DSPEC_LP64
644.nab_s: -DSPEC_LP64
649.fotonik3d_s: -DSPEC_LP64
654.roms_s: -DSPEC_LP64

```

## Base Optimization Flags

C benchmarks:

```

-m64 -mno-adx -mno-sse4a -Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -march=znver3
-fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000
-freemap-arrays -mllvm -function-specialize -flv-function-specialization
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3 -z muldefs
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm -ljemalloc
-lflang -lflangrti

```

Fortran benchmarks:

```

-m64 -mno-adx -mno-sse4a -Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp -Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Hz,1,0x1 -O3
-march=znver3 -fveclib=AMDLIBM -ffast-math -Mrecursive
-mllvm -fuse-tile-inner-loop -funroll-loops
-mllvm -extra-vectorizer-passes -mllvm -lsr-in-nested-loop
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -z muldefs -DSPEC_OPENMP -fopenmp

```

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## Base Optimization Flags (Continued)

Fortran benchmarks (continued):

-fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang -lflangrti

Benchmarks using both Fortran and C:

-m64 -mno-adx -mno-sse4a -Wl,-mllvm -Wl,-enable-X86-prefetching  
-Wl,-mllvm -Wl,-enable-licm-vrp -Wl,-mllvm -Wl,-region-vectorize  
-Wl,-mllvm -Wl,-function-specialize  
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6  
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -march=znver3  
-fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5  
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000  
-fremap-arrays -mllvm -function-specialize -flv-function-specialization  
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true  
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3 -Hz,1,0x1  
-Mrecursive -mllvm -fuse-tile-inner-loop -funroll-loops  
-mllvm -extra-vectorizer-passes -mllvm -lsr-in-nested-loop -z muldefs  
-DSPEC\_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm -ljemalloc  
-lflang -lflangrti

Benchmarks using Fortran, C, and C++:

-m64 -mno-adx -mno-sse4a -std=c++98  
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false  
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-function-specialize  
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6  
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -march=znver3  
-fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5  
-mllvm -unroll-threshold=50 -mllvm -inline-threshold=1000  
-fremap-arrays -mllvm -function-specialize -flv-function-specialization  
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true  
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3  
-mllvm -enable-partial-unswitch -mllvm -unroll-threshold=100  
-finline-aggressive -mllvm -loop-unswitch-threshold=200000  
-mllvm -reroll-loops -mllvm -aggressive-loop-unswitch  
-mllvm -extra-vectorizer-passes -mllvm -convert-pow-exp-to-int=false  
-Hz,1,0x1 -Mrecursive -mllvm -fuse-tile-inner-loop -funroll-loops  
-mllvm -lsr-in-nested-loop -z muldefs -DSPEC\_OPENMP -fopenmp  
-fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang -lflangrti

## Base Other Flags

C benchmarks:

-Wno-unused-command-line-argument -Wno-return-type

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## Base Other Flags (Continued)

Fortran benchmarks:

-Wno-unused-command-line-argument -Wno-return-type

Benchmarks using both Fortran and C:

-Wno-unused-command-line-argument -Wno-return-type

Benchmarks using Fortran, C, and C++:

-Wno-unused-command-line-argument -Wno-return-type

## Peak Compiler Invocation

C benchmarks:

clang

Fortran benchmarks:

flang

Benchmarks using both Fortran and C:

flang clang

Benchmarks using Fortran, C, and C++:

clang++ clang flang

## Peak Portability Flags

Same as Base Portability Flags

## Peak Optimization Flags

C benchmarks:

```
619.lbm_s: -m64 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -flto
-fstruct-layout=5 -mllvm -unroll-threshold=50
-fremap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-mllvm -global-vectorize-slp=true
```

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## Peak Optimization Flags (Continued)

619.lbm\_s (continued):

```
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -DSPEC_OPENMP -fopenmp
-fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang
```

638.imagick\_s: Same as 619.lbm\_s

```
644.nab_s: -m64 -mno-adx -mno-sse4a -Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-function-specialize -Ofast -march=znver3
-fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5
-mllvm -unroll-threshold=50 -fremap-arrays
-flv-function-specialization -mllvm -inline-threshold=1000
-mllvm -enable-gvn-hoist -mllvm -global-vectorize-slp=true
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -DSPEC_OPENMP -fopenmp
-fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang
```

Fortran benchmarks:

```
603.bwaves_s: -m64 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -Mrecursive
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -enable-licm-vrp
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm
-ljemalloc -lflang
```

```
649.fotonik3d_s: -m64 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -flto
-Mrecursive -mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp=true -mllvm -enable-licm-vrp
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm
-ljemalloc -lflang
```

654.roms\_s: Same as 603.bwaves\_s

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## Peak Optimization Flags (Continued)

Benchmarks using both Fortran and C:

```
621.wrf_s: -m64 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -flto
-fstruct-layout=5 -mllvm -unroll-threshold=50
-freemap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-mllvm -global-vectorize-slp=true
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -Hz,1,0x1 -O3
-Mrecursive -mllvm -fuse-tile-inner-loop -funroll-loops
-mllvm -extra-vectorizer-passes -mllvm -lsr-in-nested-loop
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm
-ljemalloc -lflang
```

```
627.cam4_s: -m64 -mno-adx -mno-sse4a
-Wl,-mllvm -Wl,-enable-X86-prefetching
-Wl,-mllvm -Wl,-enable-licm-vrp
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver3 -fveclib=AMDLIBM -ffast-math -flto
-fstruct-layout=5 -mllvm -unroll-threshold=50
-freemap-arrays -flv-function-specialization
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist
-mllvm -global-vectorize-slp=true
-mllvm -function-specialize -mllvm -enable-licm-vrp
-mllvm -reduce-array-computations=3 -Mrecursive
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lamdlibm
-ljemalloc -lflang
```

628.pop2\_s: Same as 627.cam4\_s

Benchmarks using Fortran, C, and C++:

```
-m64 -mno-adx -mno-sse4a -std=c++98
-Wl,-mllvm -Wl,-x86-use-vzeroupper=false -Wl,-mllvm -Wl,-enable-licm-vrp
-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-align-all-nofallthru-blocks=6
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast -march=znver3
-fveclib=AMDLIBM -ffast-math -flto -fstruct-layout=5
-mllvm -unroll-threshold=50 -freemap-arrays -flv-function-specialization
```

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## Peak Optimization Flags (Continued)

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

```
-mllvm -inline-threshold=1000 -mllvm -enable-gvn-hoist  
-mllvm -global-vectorize-slp=true -mllvm -function-specialize  
-mllvm -enable-licm-vrp -mllvm -reduce-array-computations=3  
-finline-aggressive -mllvm -unroll-threshold=100 -mllvm -reroll-loops  
-mllvm -aggressive-loop-unswitch -Mrecursive -DSPEC_OPENMP -fopenmp  
-fopenmp=libomp -lomp -lamdlibm -ljemalloc -lflang
```

## Peak Other Flags

C benchmarks:

```
-Wno-unused-command-line-argument -Wno-return-type
```

Fortran benchmarks:

```
-Wno-unused-command-line-argument -Wno-return-type
```

Benchmarks using both Fortran and C:

```
-Wno-unused-command-line-argument -Wno-return-type
```

Benchmarks using Fortran, C, and C++:

```
-Wno-unused-command-line-argument -Wno-return-type
```

The flags files that were used to format this result can be browsed at

<http://www.spec.org/cpu2017/flags/aocc300-flags-A1.html>

<http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-AMD-Milan-rev1.0.html>

You can also download the XML flags sources by saving the following links:

<http://www.spec.org/cpu2017/flags/aocc300-flags-A1.xml>

<http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-AMD-Milan-rev1.0.xml>

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