SPEC CPU®2017 Floating Point Speed Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Dell Inc.

PowerEdge R7515 (AMD EPYC 7662, 2.00 GHz)

$SPECspeed^{®}2017\_fp\_base = 119$

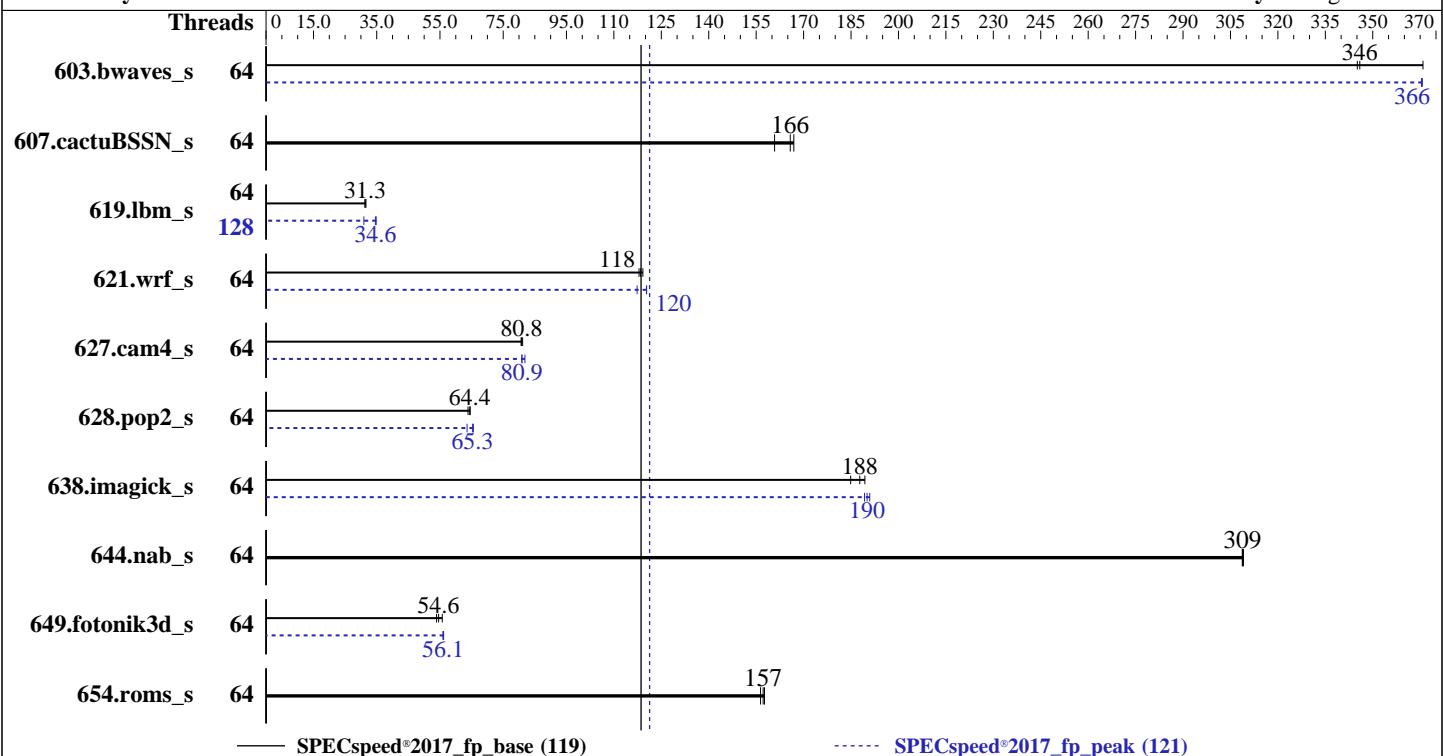$SPECspeed^{®}2017\_fp\_peak = 121$

CPU2017 License: 55
Test Sponsor: Dell Inc.
Tested by: Dell Inc.

Test Date: Jan-2020
Hardware Availability: Apr-2020
Software Availability: Aug-2019

Threads

Benchmark	Threads	Base	Peak
603.bwaves_s	64	346	366
607.cactuBSSN_s	64	166	
619.lbm_s	64 / 128	31.3	34.6
621.wrf_s	64	118	120
627.cam4_s	64	80.8	80.9
628.pop2_s	64	64.4	65.3
638.imagick_s	64	188	190
644.nab_s	64	309	
649.fotonik3d_s	64	54.6	56.1
654.roms_s	64	157	

SPECspeed®2017_fp_base (119) ──── SPECspeed®2017_fp_peak (121) ┄┄┄┄

Hardware

CPU Name: AMD EPYC 7662
 Max MHz: 3300
 Nominal: 2000
Enabled: 64 cores, 1 chip, 2 threads/core
Orderable: 1 chip
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, 16 MB shared / 4 cores
 Other: None
Memory: 256 GB (8 x 32 GB 2Rx4 PC4-3200AA-R)
Storage: 1 x 960 GB SATA SSD
Other: None

Software

OS: SUSE Linux Enterprise Server 15 SP1 kernel 4.12.14-195-default
Compiler: C/C++/Fortran: Version 2.0.0 of AOCC
Parallel: Yes
Firmware: Version 1.3.0 released Jan-2020
File System: xfs
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.

Standard Performance Evaluation Corporation (info@spec.org)

https://www.spec.org/

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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	64	161	366	**171**	**346**	171	345	64	**161**	**366**	161	365	161	366
607.cactuBSSN_s	64	104	161	99.9	167	**101**	**166**	64	104	161	99.9	167	**101**	**166**
619.lbm_s	64	**167**	**31.3**	166	31.6	167	31.3	128	169	30.9	**151**	**34.6**	150	34.8
621.wrf_s	64	**112**	**118**	112	118	111	119	64	113	117	110	120	**110**	**120**
627.cam4_s	64	110	80.7	109	81.1	**110**	**80.8**	64	108	81.9	110	80.9	**110**	**80.9**
628.pop2_s	64	184	64.6	186	63.9	**184**	**64.4**	64	181	65.6	**182**	**65.3**	187	63.6
638.imagick_s	64	**76.8**	**188**	78.0	185	76.2	189	64	**75.9**	**190**	75.6	191	76.2	189
644.nab_s	64	56.5	309	56.6	309	**56.6**	**309**	64	56.5	309	56.6	309	**56.6**	**309**
649.fotonik3d_s	64	164	55.7	**167**	**54.6**	169	53.9	64	162	56.2	**163**	**56.1**	163	56.0
654.roms_s	64	**100**	**157**	101	156	99.9	158	64	**100**	**157**	101	156	99.9	158
SPECspeed®2017_fp_base =		**119**												
SPECspeed®2017_fp_peak =		**121**												

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>

Set dirty_ratio=8 to limit dirty cache to 8% of memory
Set swappiness=1 to swap only if necessary
Set zone_reclaim_mode=1 to free local node memory and avoid remote memory
sync then drop_caches=3 to reset caches before invoking runcpu

dirty_ratio, swappiness, zone_reclaim_mode and drop_caches were
all set using privileged echo (e.g. echo 1 > /proc/sys/vm/swappiness).

Transparent huge pages set to 'always' for this run (OS default)
```

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Environment Variables Notes

```
Environment variables set by runcpu before the start of the run:
GOMP_CPU_AFFINITY = "0-127"
LD_LIBRARY_PATH =
     "/root/cpu2017-1.1.0/amd_speed_aocc200_rome_C_lib/64;/root/cpu2017-1.1.0
     /amd_speed_aocc200_rome_C_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 = "0-63"

Environment variables set by runcpu during the 619.lbm_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
     119 56 120 57 121 58 122 59 123 60 124 61 125 62 126 63 127"

Environment variables set by runcpu during the 621.wrf_s peak run:
GOMP_CPU_AFFINITY = "0-63"

Environment variables set by runcpu during the 627.cam4_s peak run:
GOMP_CPU_AFFINITY = "0-63"

Environment variables set by runcpu during the 628.pop2_s peak run:
GOMP_CPU_AFFINITY = "0-63"

Environment variables set by runcpu during the 638.imagick_s peak run:
GOMP_CPU_AFFINITY = "0-63"

Environment variables set by runcpu during the 649.fotonik3d_s peak run:
GOMP_CPU_AFFINITY = "0-63"
```

General Notes

```
Binaries were compiled on a system with 2x AMD EPYC 7601 CPU + 512GB Memory using Fedora 26

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.
```

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Dell Inc.

PowerEdge R7515 (AMD EPYC 7662, 2.00 GHz)

$SPECspeed®2017\_fp\_base = 119$

$SPECspeed®2017\_fp\_peak = 121$

General Notes (Continued)

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 v9.1.0 in Ubuntu 19.04 with -O3 -znver2 -flto
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:
 NUMA Nodes Per Socket set to 4
 CCX as NUMA Domain set to Enabled
 System Profile set to Custom
 CPU Power Management set to Maximum Performance
 Memory Frequency set to Maximum Performance
 Turbo Boost Enabled
 Cstates set to Enabled
 Memory Patrol Scrub Disabled
 Memory Refresh Rate set to 1x
 PCI ASPM L1 Link Power Management Disabled
 Determinism Slider set to Power Determinism
 Efficiency Optimized Mode Disabled
 Memory Interleaving set to Disabled
 Memory Freq set to 3200
 Fan Speed = Maximum

 Sysinfo program /root/cpu2017-1.1.0/bin/sysinfo
 Rev: r6365 of 2019-08-21 295195f888a3d7edb1e6e46a485a0011
 running on linux-g3ob Thu Jan 23 09:26:08 2020

 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 7662 64-Core Processor
       1  "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  : 128
       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
```

(Continued on next page)

Dell Inc.

PowerEdge R7515 (AMD EPYC 7662, 2.00 GHz)

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CPU2017 License: 55

Test Sponsor: Dell Inc.

Tested by: Dell Inc.

Test Date: Jan-2020

Hardware Availability: Apr-2020

Software Availability: Aug-2019

Platform Notes (Continued)

```
From lscpu:
     Architecture:          x86_64
     CPU op-mode(s):        32-bit, 64-bit
     Byte Order:            Little Endian
     Address sizes:         43 bits physical, 48 bits virtual
     CPU(s):                128
     On-line CPU(s) list:   0-127
     Thread(s) per core:    2
     Core(s) per socket:    64
     Socket(s):             1
     NUMA node(s):          16
     Vendor ID:             AuthenticAMD
     CPU family:            23
     Model:                 49
     Model name:            AMD EPYC 7662 64-Core Processor
     Stepping:              0
     CPU MHz:               1996.267
     BogoMIPS:              3992.53
     Virtualization:        AMD-V
     L1d cache:             32K
     L1i cache:             32K
     L2 cache:              512K
     L3 cache:              16384K
     NUMA node0 CPU(s):     0-3,64-67
     NUMA node1 CPU(s):     4-7,68-71
     NUMA node2 CPU(s):     8-11,72-75
     NUMA node3 CPU(s):     12-15,76-79
     NUMA node4 CPU(s):     16-19,80-83
     NUMA node5 CPU(s):     20-23,84-87
     NUMA node6 CPU(s):     24-27,88-91
     NUMA node7 CPU(s):     28-31,92-95
     NUMA node8 CPU(s):     32-35,96-99
     NUMA node9 CPU(s):     36-39,100-103
     NUMA node10 CPU(s):    40-43,104-107
     NUMA node11 CPU(s):    44-47,108-111
     NUMA node12 CPU(s):    48-51,112-115
     NUMA node13 CPU(s):    52-55,116-119
     NUMA node14 CPU(s):    56-59,120-123
     NUMA node15 CPU(s):    60-63,124-127
     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 xtopology nonstop_tsc cpuid extd_apicid aperfmperf pni
     pclmulqdq monitor ssse3 fma cx16 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_l2 mwaitx cpb cat_l3 cdp_l3 hw_pstate sme ssbd sev ibrs ibpb stibp vmmcall
```

(Continued on next page)

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SPECspeed®2017_fp_peak = 121

CPU2017 License: 55　　　　　　　　　　　　　　　　　　　**Test Date:**　　Jan-2020
Test Sponsor:　Dell Inc.　　　　　　　　　　　　　　　**Hardware Availability:** Apr-2020
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Platform Notes (Continued)

```
    fsgsbase bmi1 avx2 smep bmi2 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 arat npt lbrv svm_lock nrip_save tsc_scale vmcb_clean
    flushbyasid decodeassists pausefilter pfthreshold avic v_vmsave_vmload vgif umip
    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 64 65 66 67
    node 0 size: 15548 MB
    node 0 free: 15440 MB
    node 1 cpus: 4 5 6 7 68 69 70 71
    node 1 size: 16126 MB
    node 1 free: 16072 MB
    node 2 cpus: 8 9 10 11 72 73 74 75
    node 2 size: 16126 MB
    node 2 free: 15977 MB
    node 3 cpus: 12 13 14 15 76 77 78 79
    node 3 size: 16125 MB
    node 3 free: 16042 MB
    node 4 cpus: 16 17 18 19 80 81 82 83
    node 4 size: 16126 MB
    node 4 free: 16067 MB
    node 5 cpus: 20 21 22 23 84 85 86 87
    node 5 size: 16126 MB
    node 5 free: 16082 MB
    node 6 cpus: 24 25 26 27 88 89 90 91
    node 6 size: 16096 MB
    node 6 free: 16058 MB
    node 7 cpus: 28 29 30 31 92 93 94 95
    node 7 size: 16125 MB
    node 7 free: 16094 MB
    node 8 cpus: 32 33 34 35 96 97 98 99
    node 8 size: 16126 MB
    node 8 free: 16082 MB
    node 9 cpus: 36 37 38 39 100 101 102 103
    node 9 size: 16126 MB
    node 9 free: 16091 MB
    node 10 cpus: 40 41 42 43 104 105 106 107
    node 10 size: 16126 MB
    node 10 free: 16096 MB
    node 11 cpus: 44 45 46 47 108 109 110 111
    node 11 size: 16125 MB
```

(Continued on next page)

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Platform Notes (Continued)

```
   node 11 free: 16095 MB
   node 12 cpus: 48 49 50 51 112 113 114 115
   node 12 size: 16126 MB
   node 12 free: 16026 MB
   node 13 cpus: 52 53 54 55 116 117 118 119
   node 13 size: 16126 MB
   node 13 free: 16003 MB
   node 14 cpus: 56 57 58 59 120 121 122 123
   node 14 size: 16126 MB
   node 14 free: 16094 MB
   node 15 cpus: 60 61 62 63 124 125 126 127
   node 15 size: 16111 MB
   node 15 free: 16076 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  12  12  12  12  12  12  12  12  12  12  12  12
     1:  11  10  11  11  12  12  12  12  12  12  12  12  12  12  12  12
     2:  11  11  10  11  12  12  12  12  12  12  12  12  12  12  12  12
     3:  11  11  11  10  12  12  12  12  12  12  12  12  12  12  12  12
     4:  12  12  12  12  10  11  11  11  12  12  12  12  12  12  12  12
     5:  12  12  12  12  11  10  11  11  12  12  12  12  12  12  12  12
     6:  12  12  12  12  11  11  10  11  12  12  12  12  12  12  12  12
     7:  12  12  12  12  11  11  11  10  12  12  12  12  12  12  12  12
     8:  12  12  12  12  12  12  12  12  10  11  11  11  12  12  12  12
     9:  12  12  12  12  12  12  12  12  11  10  11  11  12  12  12  12
    10:  12  12  12  12  12  12  12  12  11  11  10  11  12  12  12  12
    11:  12  12  12  12  12  12  12  12  11  11  11  10  12  12  12  12
    12:  12  12  12  12  12  12  12  12  12  12  12  12  10  11  11  11
    13:  12  12  12  12  12  12  12  12  12  12  12  12  11  10  11  11
    14:  12  12  12  12  12  12  12  12  12  12  12  12  11  11  10  11
    15:  12  12  12  12  12  12  12  12  12  12  12  12  11  11  11  10

 From /proc/meminfo
    MemTotal:       263574100 kB
    HugePages_Total:        0
    Hugepagesize:        2048 kB

 From /etc/*release* /etc/*version*
    os-release:
       NAME="SLES"
       VERSION="15-SP1"
       VERSION_ID="15.1"
       PRETTY_NAME="SUSE Linux Enterprise Server 15 SP1"
       ID="sles"
       ID_LIKE="suse"
       ANSI_COLOR="0;32"
       CPE_NAME="cpe:/o:suse:sles:15:sp1"
```

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Platform Notes (Continued)

```
uname -a:
   Linux linux-g3ob 4.12.14-195-default #1 SMP Tue May 7 10:55:11 UTC 2019 (8fba516)
   x86_64 x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

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: __user pointer sanitization
CVE-2017-5715 (Spectre variant 2):      Mitigation: Full AMD retpoline, IBPB:
                                        conditional, IBRS_FW, STIBP: conditional, RSB
                                        filling


run-level 3 Nov 25 12:20 last=5

SPEC is set to: /root/cpu2017-1.1.0
   Filesystem     Type  Size  Used Avail Use% Mounted on
   /dev/sda2      xfs   440G   36G  405G   9% /

From /sys/devices/virtual/dmi/id
    BIOS:    Dell Inc. 1.3.0 01/14/2020
    Vendor:  Dell Inc.
    Product: PowerEdge R7515
    Product Family: PowerEdge
    Serial:  5MGPH13

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:
    8x 80AD80B380AD HMA84GR7CJR4N-XN 32 GB 2 rank 3200
    8x Not Specified Not Specified

(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)
------------------------------------------------------------------------------
```

(Continued on next page)

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Compiler Version Notes (Continued)

```
AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
  AOCC_2_0_0-Build#191) (based on LLVM AOCC.LLVM.2.0.0.B191.2019_07_19)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
------------------------------------------------------------------------------


==============================================================================
C++, C, Fortran | 607.cactuBSSN_s(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
  AOCC_2_0_0-Build#191) (based on LLVM AOCC.LLVM.2.0.0.B191.2019_07_19)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
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Target: x86_64-unknown-linux-gnu
Thread model: posix
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Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
------------------------------------------------------------------------------


==============================================================================
Fortran         | 603.bwaves_s(base, peak) 649.fotonik3d_s(base, peak)
                | 654.roms_s(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
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Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
------------------------------------------------------------------------------


==============================================================================
Fortran, C      | 621.wrf_s(base, peak) 627.cam4_s(base, peak)
                | 628.pop2_s(base, peak)
------------------------------------------------------------------------------
AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
  AOCC_2_0_0-Build#191) (based on LLVM AOCC.LLVM.2.0.0.B191.2019_07_19)
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```

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Compiler Version Notes (Continued)

```
AOCC.LLVM.2.0.0.B191.2019_07_19 clang version 8.0.0 (CLANG: Jenkins
  AOCC_2_0_0-Build#191) (based on LLVM AOCC.LLVM.2.0.0.B191.2019_07_19)
Target: x86_64-unknown-linux-gnu
Thread model: posix
InstalledDir: /sppo/dev/compilers/aocc-compiler-2.0.0/bin
------------------------------------------------------------------------
```

Base 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`

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:
```
-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -ffast-math
-march=znver2 -fstruct-layout=3 -mllvm -unroll-threshold=50
```

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SPEC CPU®2017 Floating Point Speed Result

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Dell Inc.

PowerEdge R7515 (AMD EPYC 7662, 2.00 GHz)

$SPECspeed®2017\_fp\_base = 119$

$SPECspeed®2017\_fp\_peak = 121$

CPU2017 License: 55
Test Sponsor: Dell Inc.
Tested by: Dell Inc.

Test Date: Jan-2020
Hardware Availability: Apr-2020
Software Availability: Aug-2019

Base Optimization Flags (Continued)

C benchmarks (continued):
```
-fremap-arrays -mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -z muldefs -DSPEC_OPENMP -fopenmp
-fopenmp=libomp -lomp -lpthread -ldl -lmvec -lamdlibm -ljemalloc
-lflang
```

Fortran benchmarks:
```
-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -march=znver2
-funroll-loops -Mrecursive -mllvm -vector-library=LIBMVEC -z muldefs
-Kieee -fno-finite-math-only -DSPEC_OPENMP -fopenmp -fopenmp=libomp
-lomp -lpthread -ldl -lmvec -lamdlibm -ljemalloc -lflang
```

Benchmarks using both Fortran and C:
```
-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3 -ffast-math
-march=znver2 -fstruct-layout=3 -mllvm -unroll-threshold=50
-fremap-arrays -mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -funroll-loops -Mrecursive -z muldefs
-Kieee -fno-finite-math-only -DSPEC_OPENMP -fopenmp -fopenmp=libomp
-lomp -lpthread -ldl -lmvec -lamdlibm -ljemalloc -lflang
```

Benchmarks using Fortran, C, and C++:
```
-std=c++98 -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3
-Wl,-mllvm -Wl,-suppress-fmas -O3 -ffast-math -march=znver2
-fstruct-layout=3 -mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -reduce-array-computations=3 -mllvm -global-vectorize-slp
-mllvm -vector-library=LIBMVEC -mllvm -inline-threshold=1000
-flv-function-specialization -mllvm -loop-unswitch-threshold=200000
-mllvm -unroll-threshold=100 -mllvm -enable-partial-unswitch
-funroll-loops -Mrecursive -z muldefs -Kieee -fno-finite-math-only
-DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp -lpthread -ldl -lmvec
-lamdlibm -ljemalloc -lflang
```

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Base Other Flags

C benchmarks:
```
-Wno-return-type
```

Fortran benchmarks:
```
-Wno-return-type
```

Benchmarks using both Fortran and C:
```
-Wno-return-type
```

Benchmarks using Fortran, C, and C++:
```
-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: -flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast
-march=znver2 -mno-sse4a -fstruct-layout=5
-mllvm -vectorize-memory-aggressively
```

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Peak Optimization Flags (Continued)

619.lbm_s (continued):
```
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -vector-library=LIBMVEC
-mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000
-flv-function-specialization -DSPEC_OPENMP -fopenmp
-lmvec -lamdlibm -fopenmp=libomp -lomp -lpthread -ldl
-ljemalloc -lflang
```

638.imagick_s: Same as 619.lbm_s

644.nab_s: basepeak = yes

Fortran benchmarks:

603.bwaves_s: `-flto -Wl,-mllvm -Wl,-function-specialize`
```
-Wl,-mllvm -Wl,-region-vectorize
-Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -O3
-march=znver2 -funroll-loops -Mrecursive
-mllvm -vector-library=LIBMVEC -Kieee
-fno-finite-math-only -DSPEC_OPENMP -fopenmp
-fopenmp=libomp -lomp -lpthread -ldl -lmvec -lamdlibm
-ljemalloc -lflang
```

649.fotonik3d_s: Same as 603.bwaves_s

654.roms_s: basepeak = yes

Benchmarks using both Fortran and C:
```
-flto -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Ofast -march=znver2
-mno-sse4a -fstruct-layout=5 -mllvm -vectorize-memory-aggressively
-mllvm -function-specialize -mllvm -enable-gvn-hoist
-mllvm -unroll-threshold=50 -fremap-arrays
-mllvm -vector-library=LIBMVEC -mllvm -reduce-array-computations=3
-mllvm -global-vectorize-slp -mllvm -inline-threshold=1000
-flv-function-specialization -O3 -funroll-loops -Mrecursive -Kieee
-fno-finite-math-only -DSPEC_OPENMP -fopenmp -fopenmp=libomp -lomp
-lpthread -ldl -lmvec -lamdlibm -ljemalloc -lflang
```

Benchmarks using Fortran, C, and C++:

(Continued on next page)

Standard Performance Evaluation Corporation (info@spec.org)
https://www.spec.org/

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Software Availability: Aug-2019

Peak Optimization Flags (Continued)

607.cactuBSSN_s: basepeak = yes

Peak Other Flags

C benchmarks:
-Wno-return-type

Fortran benchmarks:
-Wno-return-type

Benchmarks using both Fortran and C:
-Wno-return-type

Benchmarks using Fortran, C, and C++:
-Wno-return-type

The flags files that were used to format this result can be browsed at
http://www.spec.org/cpu2017/flags/aocc200-flags-C3.html
http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE9.html

You can also download the XML flags sources by saving the following links:
http://www.spec.org/cpu2017/flags/aocc200-flags-C3.xml
http://www.spec.org/cpu2017/flags/Dell-Platform-Flags-PowerEdge-revE9.xml

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

Tested with SPEC CPU®2017 v1.1.0 on 2020-01-23 10:26:08-0500.
Report generated on 2020-04-14 15:18:32 by CPU2017 PDF formatter v6255.
Originally published on 2020-04-14.