# Lenovo Global Technology

ThinkSystem SR655
3.10 GHz, AMD EPYC 7232P

<table>
<thead>
<tr>
<th>Test Sponsor</th>
<th>Lenovo Global Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tested by</td>
<td>Lenovo Global Technology</td>
</tr>
<tr>
<td>CPU2017 License</td>
<td>9017</td>
</tr>
<tr>
<td>Test Date</td>
<td>Mar-2020</td>
</tr>
<tr>
<td>Hardware Availability</td>
<td>Jan-2020</td>
</tr>
<tr>
<td>Software Availability</td>
<td>Aug-2019</td>
</tr>
</tbody>
</table>

## SPEC CPU 2017 Floating Point Rate Result

**SPECrate®2017_fp_base = 68.9**

**SPECrate®2017_fp_peak = 69.4**

## Hardware

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Copies</th>
<th>SPECrate®2017_fp_base (68.9)</th>
<th>SPECrate®2017_fp_peak (69.4)</th>
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<tr>
<td>503.bwaves_r</td>
<td>16</td>
<td>162</td>
<td>154</td>
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<tr>
<td>507.cactuBSSN_r</td>
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<td>508.namd_r</td>
<td>16</td>
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</tr>
<tr>
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<td>16</td>
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<tr>
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<td>554.roms_r</td>
<td>16</td>
<td>34.6</td>
<td>33.4</td>
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**CPU Name:** AMD EPYC 7232P
**Max MHz:** 3200
**Nominal:** 3100
**Enabled:** 8 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:** 32 MB I+D on chip per chip,
8 MB shared / 2 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 (x86_64)
**Kernel:** 4.12.14-195-default
**Compiler:** C/C++/Fortran: Version 2.0.0 of AOCC
**Parallel:** No
**Firmware:** Lenovo BIOS Version CFE1070 released Dec-2019
**File System:** xfs
**System State:** Run level 3 (multi-user)
**Base Pointers:** 64-bit
**Peak Pointers:** 64-bit
**Other:** jemalloc: jemalloc memory allocator library v5.2.0
**Power Management:** BIOS set to prefer performance at the cost of additional power usage
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CPU2017 License: 9017
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Software Availability: Aug-2019

Results Table

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SPECrate®2017_fp_base = 68.9

SPECrate®2017_fp_peak = 69.4

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

(Continued on next page)
### Operating System Notes (Continued)

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)

### Environment Variables Notes

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

```bash
LD_LIBRARY_PATH = 
   "'/home/cpu2017-1.1.0-amd-rome-aocc200-C3/amd_rate_aocc200_rome_C_lib/64;
    /home/cpu2017-1.1.0-amd-rome-aocc200-C3/amd_rate_aocc200_rome_C_lib/32:"

MALLOCP_CONF = "retain:true"
```

### 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.

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.

Yes: The test sponsor attests, as of date of publication, that CVE-2018-3640 (Spectre variant 3a) is mitigated in the system as tested and documented.

Yes: The test sponsor attests, as of date of publication, that CVE-2018-3639 (Spectre variant 4) 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 5.2.0 is available here:
https://github.com/jemalloc/jemalloc/releases/download/5.2.0/jemalloc-5.2.0.tar.bz2

### Platform Notes

BIOS settings:
Set Operating Mode set to Maximum Performance
NUMA nodes per socket set to NPS1

Sysinfo program /home/cpu2017-1.1.0-amd-rome-aocc200-C3/bin/sysinfo
Rev: r6365 of 2019-08-21 295195f888a3d7ed1e6e46a485a0011
running on linux-01om Sun Mar 1 18:59:42 2020

SUT (System Under Test) info as seen by some common utilities.
For more information on this section, see

(Continued on next page)
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Platform Notes (Continued)

https://www.spec.org/cpu2017/Docs/config.html#sysinfo

From /proc/cpuinfo

model name: AMD EPYC 7232P 8-Core Processor
  1 "physical id"s (chips)
  16 "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 : 8
siblings : 16
physical 0: cores 0 1 4 5 8 9 12 13

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): 16
On-line CPU(s) list: 0-15
Thread(s) per core: 2
Core(s) per socket: 8
Socket(s): 1
NUMA node(s): 1
Vendor ID: AuthenticAMD
CPU family: 23
Model: 49
Model name: AMD EPYC 7232P 8-Core Processor
Stepping: 0
CPU MHz: 3100.000
CPU max MHz: 3100.000
CPU min MHz: 1500.000
BogoMIPS: 6188.32
Virtualization: AMD-V
L1d cache: 32K
L1i cache: 32K
L2 cache: 512K
L3 cache: 8192K
NUMA node0 CPU(s): 0-15
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 aperfmpref pni
pclmulqdq monitor ssse3 fma cx16 sse4_1 sse4_2 movbe popcnt aes xsave avx f16c
rdRand lahf_lm cmp_legacy svm extapic cr8_legacy abm sse4a misalignsse 3dnowprefetch
oswv 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 vmvcall fsgsbase bmi1 avx2 smep
bm12 cqm rdt_a rdseed adx smap clflushopt clwb sha_ni xsaveopt xsavec xgetbv1 xsave
xsavec llc cqm_occup_llc cqm_mbb_total cqm_mbb_local clzero irperf xsaveerptr arat npt

(Continued on next page)
Platform Notes (Continued)

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: 1 nodes (0)
    node 0 cpus: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
    node 0 size: 257767 MB
    node 0 free: 256991 MB
    node distances:
        node 0
    0:  10

From /proc/meminfo
    MemTotal:       263953436 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"

    uname -a:
        Linux linux-01om 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

(Continued on next page)
Platform Notes (Continued)

run-level 3 Mar 1 18:57

SPEC is set to: /home/cpu2017-1.1.0-amd-rome-aocc200-C3

/dev/sda2    xfs    893G  71G   823G   8%  /

From /sys/devices/virtual/dmi/id
BIOS:    Lenovo    CFE107O 12/28/2019
Vendor:  Lenovo
Product: ThinkSystem SR655 -[7Y00000000]-
Product Family: ThinkSystem
Serial:   0123456789

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 Samsung M393A4K40DB2-CWE 32 kB 2 rank 3200
8x Unknown Unknown

(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) |
---------------------------------------------------------------------

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++             | 508.namd_r(base, peak) 510.parest_r(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
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Compiler Version Notes (Continued)
==============================================================================
Fortran, C | 521.wrf_r(base, peak) 527.cam4_r(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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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

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

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Base Portability Flags (Continued)

521.wrf_r: -DSPEC_CASE_FLAG -Mbyteswapio -DSPEC_LP64
526.blender_r: -funsigned-char -D__BOOL_DEFINED -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:
-ffito -f-Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Wl,-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 -z muldefs -lmvec -lamdlibm -ljemalloc -lflang

C++ benchmarks:
-std=c++98 -ffito -f-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 -Wl,-ffast-math -Wl,-march=znver2
-mllvm -loop-unswitch-threshold=200000 -mllvm -vector-library=LIBMVEC
-mllvm -unroll-threshold=100 -flv-function-specialization
-mllvm -enable-partial-unswitch -z muldefs -lmvec -lamdlibm
-ljemalloc -lflang

Fortran benchmarks:
-ffito -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Wl,-ffast-math
-funroll-loops -Mrecursive -mllvm -vector-library=LIBMVEC -z muldefs
-Kieee -fno-finite-math-only -lmvec -lamdlibm -ljemalloc -lflang

Benchmarks using both Fortran and C:
-ffito -Wl,-mllvm -Wl,-function-specialize
-Wl,-mllvm -Wl,-region-vectorize -Wl,-mllvm -Wl,-vector-library=LIBMVEC
-Wl,-mllvm -Wl,-reduce-array-computations=3 -Wl,-ffast-math
-march=znver2 -fstruct-layout=3 -mllvm -unroll-threshold=50
-fremap-arrays -mllvm -function-specialize -mllvm -enable-gvn-hoist

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Lenovo Global Technology

ThinkSystem SR655
3.10 GHz, AMD EPYC 7232P

SPECrate®2017_fp_base = 68.9
SPECrate®2017_fp_peak = 69.4

CPU2017 License: 9017
Test Date: Mar-2020
Test Sponsor: Lenovo Global Technology
Hardware Availability: Jan-2020
Tested by: Lenovo Global Technology
Software Availability: Aug-2019

Base Optimization Flags (Continued)

Benchmarks using both Fortran and C (continued):
- 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 -lmvec -ljemalloc -lflang

Benchmarks using both 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 -region-vectorize -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 -z muldefs
- -lmvec -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
- -lmvec -ljemalloc -lflang

Peak Compiler Invocation

C benchmarks:
clang

C++ benchmarks:
clang++

Fortran benchmarks:
flang

(Continued on next page)
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Peak Compiler Invocation (Continued)

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

Peak Portability Flags

Same as Base Portability Flags

Peak Optimization Flags

C benchmarks:
- flto -Wl,-ml1vm -Wl,-function-specialize
- -Wl,-ml1vm -Wl,-region-vectorize -Wl,-ml1vm -Wl,-vector-library=LIBMVEC
- -Wl,-ml1vm -Wl,-reduce-array-computations=3 -Ofast -march=znver2
- -mno-sse4a -fstruct-layout=5 -ml1vm -vectorize-memory-aggressively
- -ml1vm -function-specialize -ml1vm -enable-gvn-hoist
- -ml1vm -unroll-threshold=50 -fremap-arrays
- -ml1vm -vector-library=LIBMVEC -ml1vm -reduce-array-computations=3
- -ml1vm -global-vectorize-slp -ml1vm -inline-threshold=1000
- -flv-function-specialization -lmvec -lamdlibm -ljemalloc -lflang

C++ benchmarks:
508.namd_r: basepeak = yes
510.parest_r: basepeak = yes

Fortran benchmarks:
503.bwaves_r: basepeak = yes
549.fotonik3d_r: flto -Wl,-ml1vm -Wl,-function-specialize
- -Wl,-ml1vm -Wl,-region-vectorize
- -Wl,-ml1vm -Wl,-vector-library=LIBMVEC
- -Wl,-ml1vm -Wl,-reduce-array-computations=3 -O3
- -march=znver2 -funroll-loops -Mrecursive
- -ml1vm -vector-library=LIBMVEC -Kieee

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Peak Optimization Flags (Continued)

549.fotonik3d_r (continued):
-ffinite-math-only -lmvec -lamdlibm -ljemalloc -lflang

554.roms_r:
-fflto -Wl,-mllvm -Wl,-function-specialize
-llw -mllvm -Wl,-region-vectorize
-llw -mllvm -Wl,-vector-library=LIBMVEC
-llw -mllvm -Wl,-reduce-array-computations=3
-llw -mllvm -Wl,-enable-X86-prefetching -O3 -march=znver2
-ffunroll-loops -Mrecursive -mllvm -vector-library=LIBMVEC
-Kieee -ffinite-math-only -lmvec -lamdlibm -ljemalloc -lflang

Benchmarks using both Fortran and C:
-fflto -Wl,-mllvm -Wl,-function-specialize
-llw -mllvm -Wl,-region-vectorize -llw -mllvm -Wl,-vector-library=LIBMVEC
-llw -mllvm -Wl,-reduce-array-computations=3 -Ofast -march=znver2
-mlvm-sse4a -fstruct-layout=5 -mllvm -vectorize-memory-aggressively
-mlvm -function-specialize -mlvm -enable-gvn-ghost
-mlvm -unroll-threshold=50 -fremap-arrays
-mlvm -vector-library=LIBMVEC -mlvm -reduce-array-computations=3
-mlvm -vectorize-memory-aggressively
-mlvm -function-specialize -mlvm -enable-gvn-ghost
-mlvm -unroll-threshold=50 -fremap-arrays
-mlvm -vector-library=LIBMVEC
-mlvm -reduce-array-computations=3
-mlvm -global-vectorize-slp -mlvm -inline-threshold=1000
-ffl-function-specialization -O3 -ffunroll-loops -Mrecursive -Kieee
-ffinite-math-only -lmvec -lamdlibm -ljemalloc -lflang

Benchmarks using both C and C++:
511.povray_r:
-std=c++98 -fflto -Wl,-mllvm -Wl,-function-specialize
-llw -mllvm -Wl,-region-vectorize
-llw -mllvm -Wl,-vector-library=LIBMVEC
-llw -mllvm -Wl,-reduce-array-computations=3
-llw -mllvm -Wl,-x86-use-vzeroupper=false -Ofast
-march=znver2 -mlvm-sse4a -fstruct-layout=5
-mlvm -vectorize-memory-aggressively
-mlvm -function-specialize -mlvm -enable-gvn-ghost
-mlvm -unroll-threshold=50 -fremap-arrays
-mlvm -vector-library=LIBMVEC
-mlvm -reduce-array-computations=3
-mlvm -global-vectorize-slp -mlvm -inline-threshold=1000
-ffl-function-specialization -mlvm -unroll-threshold=100
-mlvm -enable-partial-unswitch
-mlvm -loop-unswitch-threshold=200000 -lmvec -lamdlibm
-ljemalloc -lflang

526.blender_r:
basepeak = yes

(Continued on next page)
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Peak Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++:
507.cactuBSSN_r: basepeak = yes

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-Rome-E.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-Rome-E.xml

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