## Lenovo Global Technology

### SPEC CPU®2017 Floating Point Speed Result

**ThinkSystem ST50**  
(3.50 GHz, Intel Xeon E-2224G)

<table>
<thead>
<tr>
<th>SPECspeed®2017_fp_base</th>
<th>SPECspeed®2017_fp_peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>27.4</td>
<td>27.7</td>
</tr>
</tbody>
</table>

- **CPU2017 License:** 9017  
- **Test Sponsor:** Lenovo Global Technology  
- **CPU Name:** Intel Xeon E-2224G  
- **Max MHz:** 4700  
- **Nominal:** 3500  
- **Enabled:** 4 cores, 1 chip  
- **Orderable:** 1 chip  
- **Cache L1:** 32 KB I + 32 KB D on chip per core  
- **Cache L2:** 256 KB I+D on chip per core  
- **Cache L3:** 8 MB I+D on chip per chip  
- **Memory:** 64 GB (4 x 16 GB 2Rx8 PC4-2666V-E)  
- **Storage:** 1 x 960 GB SATA SSD  
- **Other:** None

### Hardware

<table>
<thead>
<tr>
<th>Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>OS: Red Hat Enterprise Linux 8.1 (Ootpa)</td>
</tr>
<tr>
<td>Kernel 4.18.0-147.el8.x86_64</td>
</tr>
<tr>
<td>Parallel: Yes</td>
</tr>
<tr>
<td>Firmware: Lenovo BIOS Version ITE109B released Apr-2020</td>
</tr>
<tr>
<td>File System: xfs</td>
</tr>
<tr>
<td>System State: Run level 3 (multi-user)</td>
</tr>
<tr>
<td>Base Pointers: 64-bit</td>
</tr>
<tr>
<td>Peak Pointers: 64-bit</td>
</tr>
<tr>
<td>Other: jemalloc memory allocator V5.0.1</td>
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<tr>
<td>Power Management: BIOS set to prefer performance at the cost of additional power usage</td>
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### Test Date:

Jun-2020  

### Hardware Availability:

Mar-2020  

### Software Availability:

Apr-2020  

<table>
<thead>
<tr>
<th>Test Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun-2020</td>
</tr>
</tbody>
</table>

### Software Availability:

Apr-2020  

### Tested by:

Lenovo Global Technology  

### Test Sponsor:

Lenovo Global Technology  

### Tested by:

Lenovo Global Technology  

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Lenovo Global Technology  

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### Tested by:

Lenovo Global Technology  

### Test Sponsor:
## Lenovo Global Technology

ThinkSystem ST50  
(3.50 GHz, Intel Xeon E-2224G)

### SPEC CPU®2017 Floating Point Speed Result

**SPECspeed®2017_fp_base = 27.4**  
**SPECspeed®2017_fp_peak = 27.7**

**Test Date:** Jun-2020  
**Test Sponsor:** Lenovo Global Technology  
**Hardware Availability:** Mar-2020  
**Tested by:** Lenovo Global Technology  
**Software Availability:** Apr-2020

### Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Base</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Peak</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
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</thead>
<tbody>
<tr>
<td>603.bwaves_s</td>
<td>4</td>
<td>756</td>
<td><strong>78.0</strong></td>
<td>755</td>
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<td><strong>78.0</strong></td>
<td>755</td>
<td>78.1</td>
<td>756</td>
<td><strong>78.0</strong></td>
</tr>
<tr>
<td>607.cactuBSSN_s</td>
<td>4</td>
<td>393</td>
<td>42.4</td>
<td>395</td>
<td>42.2</td>
<td>394</td>
<td><strong>42.3</strong></td>
<td>393</td>
<td>42.4</td>
<td>395</td>
<td>42.2</td>
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<tr>
<td>619.lbm_s</td>
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<td><strong>16.0</strong></td>
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<tr>
<td>621.wrf_s</td>
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<td>627.cam4_s</td>
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<td>19.2</td>
<td>460</td>
<td>19.3</td>
<td><strong>460</strong></td>
<td><strong>19.3</strong></td>
<td>461</td>
<td>19.2</td>
<td>460</td>
<td><strong>19.3</strong></td>
</tr>
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<td>628.pop2_s</td>
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<td>368</td>
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<tr>
<td>638.imagick_s</td>
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<td><strong>21.0</strong></td>
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<td>21.1</td>
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<tr>
<td>644.nab_s</td>
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<td>649.fotonik3d_s</td>
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<td><strong>17.9</strong></td>
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<td>17.9</td>
<td>509</td>
<td>17.9</td>
<td>510</td>
<td>17.9</td>
<td>510</td>
<td><strong>17.9</strong></td>
</tr>
<tr>
<td>654.roms_s</td>
<td>4</td>
<td>1023</td>
<td>15.4</td>
<td>1022</td>
<td>15.4</td>
<td><strong>1023</strong></td>
<td><strong>15.4</strong></td>
<td>1022</td>
<td>15.4</td>
<td>1022</td>
<td><strong>15.4</strong></td>
</tr>
</tbody>
</table>

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

### Operating System Notes

Stack size set to unlimited using "ulimit -s unlimited"

### Environment Variables Notes

Environment variables set by runcpu before the start of the run:  
**KMP_AFFINITY = "granularity=fine,compact"**  
**LD_LIBRARY_PATH = "/home/cpu2017-1.1.0-ic19.1.1/lib/intel64:/home/cpu2017-1.1.0-ic19.1.1/j e5.0.1-64"**  
**MALLOC_CONF = "retain:true"**  
**OMP_STACKSIZE = "192M"**

### General Notes

Binaries compiled on a system with 1x Intel Core i9-7980XE CPU + 64GB RAM  
memory using Redhat Enterprise Linux 8.0  
Transparent Huge Pages enabled by default  
Prior to runcpu invocation  
Filesystem page cache synced and cleared with:  
```bash  
sync; echo 3> /proc/sys/vm/drop_caches  
```

Yes: 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)
## General Notes (Continued)

is mitigated in the system as tested and documented.
jemalloc, a general purpose malloc implementation
built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5

## Platform Notes

Sysinfo program /home/cpu2017-1.1.0-ic19.1.1/bin/sysinfo
Rev: r6365 of 2019-08-21 295195f888a3d7edbb1e6e46a485a0011
running on localhost.localdomain Mon Jun  8 14:06:30 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 : Intel(R) Xeon(R) E-2224G CPU @ 3.50GHz
  1 "physical id"s (chips)
  4 "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 : 4
siblings : 4
physical 0: cores 0 1 2 3
```

From lscpu:

```
Architecture: x86_64
CPU op-mode(s): 32-bit, 64-bit
Byte Order: Little Endian
CPU(s): 4
On-line CPU(s) list: 0-3
Thread(s) per core: 1
Core(s) per socket: 4
Socket(s): 1
NUMA node(s): 1
Vendor ID: GenuineIntel
CPU family: 6
Model: 158
Model name: Intel(R) Xeon(R) E-2224G CPU @ 3.50GHz
Stepping: 10
CPU MHz: 4562.015
CPU max MHz: 4700.0000
CPU min MHz: 800.0000
BogoMIPS: 7008.00
Virtualization: VT-x
```

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST50
(3.50 GHz, Intel Xeon E-2224G)
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ThinkSystem ST50
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SPECspeed®2017_fp_base = 27.4
SPECspeed®2017_fp_peak = 27.7

Platform Notes (Continued)

uname -a:
  Linux localhost.localdomain 4.18.0-147.el8.x86_64 #1 SMP Thu Sep 26 15:52:44 UTC 2019
  x86_64 x86_64 x86_64 GNU/Linux

Kernel self-reported vulnerability status:

CVE-2018-3620 (L1 Terminal Fault): Mitigation: PTE Inversion; VMX: conditional
  cache flushes, SMT disabled
Microarchitectural Data Sampling: Mitigation: Clear CPU buffers; SMT disabled
CVE-2017-5754 (Meltdown): Mitigation: PTI
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 generic retpoline, IBPB:
  conditional, IBRS_FW, STIBP: disabled, RSB
  filling

run-level 3 Jun 8 09:49

SPEC is set to: /home/cpu2017-1.1.0-ic19.1.1
  Filesystem Type Size Used Avail Use% Mounted on
  /dev/sda3 xfs 812G 66G 747G 9% /home

From /sys/devices/virtual/dmi/id
  BIOS: LENOVO ITE109B 04/24/2020
  Vendor: LENOVO
  Product: INVALID
  Product Family: Lenovo Product
  Serial: INVALID

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 SMIOS" standard.
  Memory:
    4x SK Hynix HMA82GU7CJR8N-VK 16 GB 2 rank 2666

(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)
Lenovo Global Technology
ThinkSystem ST50 (3.50 GHz, Intel Xeon E-2224G)

SPECspeed®2017_fp_base = 27.4
SPECspeed®2017_fp_peak = 27.7

Compiler Version Notes (Continued)

-----------------------------------------------------------------------------
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
-----------------------------------------------------------------------------
C++, C, Fortran | 607.cactuBSSN_s(base, peak)
-----------------------------------------------------------------------------
Intel(R) C++ Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
-----------------------------------------------------------------------------
Fortran         | 603.bwaves_s(base, peak) 649.fotonik3d_s(base, peak)
                     654.roms_s(base, peak)
-----------------------------------------------------------------------------
Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
-----------------------------------------------------------------------------
Fortran, C      | 621.wrf_s(base, peak) 627.cam4_s(base, peak)
                     628.pop2_s(base, peak)
-----------------------------------------------------------------------------
Intel(R) Fortran Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
Intel(R) C Intel(R) 64 Compiler for applications running on Intel(R) 64,
Version 19.1.1.217 Build 20200306
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.
-----------------------------------------------------------------------------
Base Compiler Invocation

C benchmarks:
icc

(Continued on next page)
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ThinkSystem ST50
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SPECspeed®2017_fp_base = 27.4
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CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Tested by: Lenovo Global Technology

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

Test Date: Jun-2020
Hardware Availability: Mar-2020
Software Availability: Apr-2020

Base Compiler Invocation (Continued)

Fortran benchmarks:
ifort

Benchmarks using both Fortran and C:
ifort icc

Benchmarks using Fortran, C, and C++:
icpc icc ifort

Base Portability Flags

603.bwaves_s: -DSPEC_LP64
607.cactusBBSSN_s: -DSPEC_LP64
619.lbm_s: -DSPEC_LP64
621.wrf_s: -DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian
627.cam4_s: -DSPEC_LP64 -DSPEC_CASE_FLAG
628.pop2_s: -DSPEC_LP64 -DSPEC_CASE_FLAG -convert big_endian
   -assume byterecl
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 -std=c11 -xCORE-AVX2 -ipo -O3 -no-prec-div -qopt-prefetch
-ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp -DSPEC_OPENMP
-mbranches-within-32B-boundaries

Fortran benchmarks:
-m64 -Wl,-z,muldefs -DSPEC_OPENMP -xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
-nostandard-realloc-lhs -mbranches-within-32B-boundaries
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

Benchmarks using both Fortran and C:
-m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
-DSPEC_OPENMP -mbranches-within-32B-boundaries -n ostandard-realloc-lhs
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST50
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SPECspeed®2017_fp_base = 27.4
SPECspeed®2017_fp_peak = 27.7

Base Optimization Flags (Continued)

Benchmarks using Fortran, C, and C++:
- m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3 -no-prec-div
- qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4 -qopenmp
- DSPEC_OPENMP -mbranches-within-32B-boundaries -nostandard-realloc-lhs
- L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

Peak Compiler Invocation

C benchmarks:
icc

Fortran benchmarks:
ifort

Benchmarks using both Fortran and C:
ifort icc

Benchmarks using Fortran, C, and C++:
icpc icc ifort

Peak Portability Flags

Same as Base Portability Flags

Peak Optimization Flags

C benchmarks:
619.lbm_s: basepeak = yes
638.imagick_s: basepeak = yes
644.nab_s: -m64 -std=c11 -Wl,-z,muldefs -xCORE-AVX2 -ipo -O3
- no-prec-div -qopt-prefetch -ffinite-math-only
- qopt-mem-layout-trans=4 -qopenmp -DSPEC_OPENMP
- mbranches-within-32B-boundaries
- L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

Fortran benchmarks:

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

603.bwaves_s: 
`-m64 -Wl,-z,muldefs -prof-gen(pass 1) -prof-use(pass 2)`
`-DSPEC_SUPPRESS_OPENMP -DSPEC_OPENMP -ipo -xCORE-AVX2`
`-O3 -no-prec-div -qopt-prefetch -ffinite-math-only`
`-qopt-mem-layout-trans=4 -gopenmp -nostandard-realloc-lhs`
`-mbranches-within-32B-boundaries`
`-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

649.fotonik3d_s: Same as 603.bwaves_s

654.roms_s: basepeak = yes

Benchmarks using both Fortran and C:

621.wrf_s: 
`-m64 -std=c11 -Wl,-z,muldefs -prof-gen(pass 1)`
`-prof-use(pass 2) -ipo -xCORE-AVX2 -O3 -no-prec-div`
`-qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4`
`-DSPEC_SUPPRESS_OPENMP -gopenmp -DSPEC_OPENMP`
`-mbranches-within-32B-boundaries -nostandard-realloc-lhs`
`-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc`

627.cam4_s: basepeak = yes

628.pop2_s: basepeak = yes

Benchmarks using Fortran, C, and C++:

607.cactuBSSN_s: 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-CFL-B.html

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

http://www.spec.org/cpu2017/flags/Intel-ic19.1u1-official-linux64_revA.xml
http://www.spec.org/cpu2017/flags/Lenovo-Platform-SPECcpu2017-Flags-V1.2-CFL-B.xml

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