Lenovo Global Technology
ThinkSystem ST250
(3.40 GHz, Intel Xeon E-2224)

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

CPU Name: Intel Xeon E-2224
Max MHz: 4600
Nominal: 3400
Enabled: 4 cores, 1 chip
Orderable: 1 chip
Cache L1: 32 KB I + 32 KB D on chip per core
L2: 256 KB I+D on chip per core
L3: 8 MB I+D on chip per chip
Other: None
Memory: 128 GB (4 x 32 GB 2Rx4 PC4-2666V-E)
Storage: 1 x 960 GB SATA SSD
Other: None

Software
OS: SUSE Linux Enterprise Server 12 SP5 (x86_64)
Kernel 4.12.14-120-default
Compiler: C/C++: Version 19.1.1.217 of Intel
C/C++ Compiler for Linux;
Fortran: Version 19.1.1.217 of Intel Fortran
Compiler for Linux
Parallel: Yes
Firmware: Lenovo BIOS Version ISE115D 2.10 released Apr-2020
File System: xfs
System State: Run level 3 (multi-user)
Base Pointers: 64-bit
Peak Pointers: 64-bit
Other: jemalloc memory allocator V5.0.1
Power Management: BIOS set to prefer performance at the cost of additional power usage
## Lenovo Global Technology

**ThinkSystem ST250**

(3.40 GHz, Intel Xeon E-2224)

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**SPECspeed**

- **2017_fp_base = 27.1**
- **2017_fp_peak = 27.4**

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### Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
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<th>Ratio</th>
<th>Seconds</th>
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<td><strong>15.6</strong></td>
<td>1008</td>
<td>15.6</td>
<td>1008</td>
<td>15.6</td>
</tr>
</tbody>
</table>

### 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:
  - `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)
Lenovo Global Technology
ThinkSystem ST250
(3.40 GHz, Intel Xeon E-2224)

SPECspeed®2017_fp_base = 27.1
SPECspeed®2017_fp_peak = 27.4

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

General Notes (Continued)

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, a general purpose malloc implementation
built with the RedHat Enterprise 7.5, and the system compiler gcc 4.8.5

Platform Notes

BIOS configuration:
Choose Operating Mode set to Maximum Performance and then set it to Custom Mode
C1 Enhanced Mode set to Enable

Sysinfo program /home/cpu2017-1.1.0-ic19.1.1/bin/sysinfo
Rev: r6365 of 2019-08-21 295195f888a3d7ed16e6e46a485a0011
running on linux-tzna Wed Jun 3 22:54:00 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-2224 CPU @ 3.40GHz
  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
Address sizes: 39 bits physical, 48 bits virtual
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

(Continued on next page)
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**Test Date:** Jun-2020
**Hardware Availability:** Mar-2020
**Software Availability:** Apr-2020

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### Platform Notes (Continued)

- **Model:** 158
- **Model name:** Intel(R) Xeon(R) E-2224 CPU @ 3.40GHz
- **Stepping:** 10
- **CPU MHz:** 3400.000
- **CPU max MHz:** 4600.0000
- **CPU min MHz:** 800.0000
- **BogoMIPS:** 6816.00
- **Virtualization:** VT-x
- **L1d cache:** 32K
- **L1i cache:** 32K
- **L2 cache:** 256K
- **L3 cache:** 8192K
- **NUMA node0 CPU(s):** 0-3

**Flags:**
- fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov
- pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall nx pdpe1gb rdtscp
- lm constant_tsc arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid
- aperfmperf tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3
- sdbg fma cx16 xtpr pdcm pcid sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer
- aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb invpcid_single
- bmi1 hle avx2 mbm2 erms invvpclm dtm pdseed adx smap clflushopt intel_pt
- xsaveopt xsavec xgetbv1 xsave dts aarch16x ida arat pln gts qhw notif hwp_act_window
- hwp_m clear flush_l1d

/proc/cpuinfo cache data
- cache size : 8192 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
- node 0 size: 128867 MB
- node 0 free: 128372 MB
- node distances:
- node 0
- 0: 10

From /proc/meminfo
- MemTotal: 131960060 kB
- HugePages_Total: 0
- Hugepagesize: 2048 kB

From /etc/*release* /etc/*version*
- SuSE-release:
  - SUSE Linux Enterprise Server 12 (x86_64)
  - VERSION = 12
  - PATCHLEVEL = 5

(Continued on next page)
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Platform Notes (Continued)

# This file is deprecated and will be removed in a future service pack or release.
# Please check /etc/os-release for details about this release.

```
os-release:
  NAME="SLES"
  VERSION="12-SP5"
  VERSION_ID="12.5"
  PRETTY_NAME="SUSE Linux Enterprise Server 12 SP5"
  ID="sles"
  ANSI_COLOR="0;32"
  CPE_NAME="cpe:/o:suse:sles:12:sp5"
```

```
uname -a:
x86_64 x86_64 x86_64 GNU/Linux
```

Kernel self-reported vulnerability status:

```
itlb_multihit:                  KVM: Mitigation: Split huge pages
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: Full generic retpoline, IBPB:
  conditional, IBRS_FW, STIBP: disabled, RSB filling
CVE-2017-5715 (Spectre variant 2): Mitigation: Sie usercopy/swapgs barriers and __user
  pointer sanitation
tsx_async_abort:                Mitigation: Clear CPU buffers; SMT disabled
```

```
run-level 3 Jun 3 22:53
```

From /sys/devices/virtual/dmi/id
```
BIOS:   Lenovo -[ISE115D-2.10]- 04/24/2020
Vendor: Lenovo
Product: ThinkSystem ST250 -[7Y45CTO0WW]-
Product Family: ThinkSystem
Serial:  1234567890
```

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
Lenovo Global Technology

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SPEC CPU®2017 Floating Point Speed Result

Copyright 2017-2020 Standard Performance Evaluation Corporation

Lenovo Global Technology

SPECspeed®2017_fp_base = 27.1
SPECspeed®2017_fp_peak = 27.4

CPU2017 License: 9017
Test Sponsor: Lenovo Global Technology
Test Date: Jun-2020
Tested by: Lenovo Global Technology
Software Availability: Apr-2020
Hardware Availability: Mar-2020

Platform Notes (Continued)

frequent changes to hardware, firmware, and the "DMTF SMBIOS" standard.
Memory:
4x SK Hynix HMAA4GU7AJR8N-VK 32767 MB 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)
| 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) 608.bwaves_s(base, peak) 610.imagick_s(base, peak) 617.cactuBSSN_s(base, peak) 627.cam4_s(base, peak) 633.pop2_s(base, peak) 649.fotonik3d_s(base, peak) 654.roms_s(base, peak) 656.bwaves_s(base, peak) 665.roms_s(base, peak) 682.pop2_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 C       | 610.immp_s(base, peak) 617.imagick_s(base, peak) 621.wrf_s(base, peak) 625.cactuBSSN_s(base, peak) 627.cam4_s(base, peak) 628.pop2_s(base, peak) 633.pop2_s(base, peak) 649.fotonik3d_s(base, peak) 654.roms_s(base, peak) 656.bwaves_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          | 610.immp_s(base, peak) 617.imagick_s(base, peak) 621.wrf_s(base, peak) 625.cactuBSSN_s(base, peak) 627.cam4_s(base, peak) 628.pop2_s(base, peak) 633.pop2_s(base, peak) 649.fotonik3d_s(base, peak) 654.roms_s(base, peak) 656.bwaves_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.

(Continued on next page)
Compiler Version Notes (Continued)

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

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.cactuBSSN_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

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SPECspeed®2017_fp_base = 27.1
SPECspeed®2017_fp_peak = 27.4

CPU2017 License: 9017
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<table>
<thead>
<tr>
<th>Base Optimization Flags (Continued)</th>
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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 -nostandard-realloc-lhs
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

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

<table>
<thead>
<tr>
<th>Peak Compiler Invocation</th>
</tr>
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</table>

C benchmarks:
icc

Fortran benchmarks:
ifort

Benchmarks using both Fortran and C:
ifort icc

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

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Same as Base Portability Flags

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C benchmarks:

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Hardware Availability: Mar-2020
Software Availability: Apr-2020

SPECspeed®2017_fp_base = 27.1
SPECspeed®2017_fp_peak = 27.4

Peak Optimization Flags (Continued)

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:
603.bwaves_s: -m64 -Wl,-z,muldefs -prof-gen(pass 1) -prof-use(pass 2)
-DSPEC_SUPPRESS_OPENMP -DSPEC_OPENMP -ipo -xCORE-AVX2
-03 -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
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)
-no-prec-div -qopt-prefetch -ffinite-math-only -qopt-mem-layout-trans=4
-DSPEC_SUPPRESS_OPENMP -qopenmp -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-SKL-J.html
# Lenovo Global Technology

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**SPECspeed®2017_fp_base** = 27.1  
**SPECspeed®2017_fp_peak** = 27.4

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-SKL-J.xml](http://www.spec.org/cpu2017/flags/Lenovo-Platform SPECcpu2017-Flags-V1.2-SKL-J.xml)

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

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