## Lenovo Global Technology

**ThinkSystem ST250**  
(3.50 GHz, Intel Xeon E-2224G)

<table>
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<th>SPECspeed®2017_int_base = 11.7</th>
<th>SPECspeed®2017_int_peak = 12.0</th>
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<tr>
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<td>Test Date: Jun-2020</td>
<td>Hardware Availability: Mar-2020</td>
</tr>
<tr>
<td>CPU2017 License: 9017</td>
<td>Software Availability: Apr-2020</td>
</tr>
<tr>
<td>Tested by: Lenovo Global Technology</td>
<td></td>
</tr>
</tbody>
</table>

### Hardware

**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  
**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 15 SP1 (x86_64)  
**Kernel:** 4.12.14-195-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  
**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

---

### Threads

<table>
<thead>
<tr>
<th>Test</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
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<td>600</td>
<td>7.42</td>
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<tr>
<td>gcc_s</td>
<td>602</td>
<td>12.3</td>
<td>12.8</td>
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<td>mcf_s</td>
<td>605</td>
<td>8.37</td>
<td>16.5</td>
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<td>omnetpp_s</td>
<td>620</td>
<td>23.3</td>
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<td>623</td>
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<tr>
<td>x264_s</td>
<td>625</td>
<td>26.5</td>
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<tr>
<td>deepsjeng_s</td>
<td>631</td>
<td>7.24</td>
<td></td>
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<tr>
<td>leela_s</td>
<td>641</td>
<td>5.77</td>
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<tr>
<td>exchange2_s</td>
<td>648</td>
<td>20.4</td>
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<tr>
<td>xz_s</td>
<td>657</td>
<td>9.45</td>
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</table>
Lenovo Global Technology
ThinkSystem ST250
(3.50 GHz, Intel Xeon E-2224G)

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

Results Table

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Threads</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
<th>Ratio</th>
<th>Seconds</th>
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<th>Ratio</th>
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<tr>
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<td>4</td>
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<td>19.8</td>
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<td>85.9</td>
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<td>5.78</td>
<td>296</td>
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<tr>
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<td>20.4</td>
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<td>145</td>
<td>20.3</td>
<td>4</td>
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<td>20.4</td>
<td>144</td>
<td>20.4</td>
<td>145</td>
<td>20.3</td>
</tr>
</tbody>
</table>

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

Compiler Notes
The inconsistent Compiler version information under Compiler Version section is due to a discrepancy in Intel Compiler. The correct version of C/C++ compiler is: Version 19.1.1.217 Build 20200306 Compiler for Linux. The correct version of Fortran compiler is: Version 19.1.1.217 Build 20200306 Compiler for Linux.

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,scatter"
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"
MALLOCONF = "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:
General Notes (Continued)

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) 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.


Platform Notes

BIOS configuration:
Choose Operating Mode set to Maximum Performance

Sysinfo program /home/cpu2017-1.1.0-ic19.1.1/bin/sysinfo
Rev: r6365 of 2019-08-21 295195f888a3d7ed1b1e6e46a485a0011
running on linux-bfbk Tue Jun 2 18:51:12 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
Address sizes: 39 bits physical, 48 bits virtual
CPU(s): 4
On-line CPU(s) list: 0-3
Thread(s) per core: 1

(Continued on next page)
Lenovo Global Technology
ThinkSystem ST250
(3.50 GHz, Intel Xeon E-2224G)

SPEC CPU®2017 Integer Speed Result
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SPECspeed®2017_int_base = 11.7
SPECspeed®2017_int_peak = 12.0

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

Platform Notes (Continued)

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: 3500.000
CPU max MHz: 4700.0000
CPU min MHz: 800.0000
BogoMIPS: 7008.00
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 rdscp
lm constant_tsc arch_perfmon pebs bts rep_good nopl xtopology nonstop_tsc cpuid
aperfperf tsc_known_freq pni pclmulqdq dtes64 monitor ds_cpl vmx smx est tm2 ssse3
sdmb fma cx16 xtpr pdcm pclid sse4_1 sse4_2 x2apic movbe popcnt tsc_deadline_timer
aes xsave avx f16c rdrand lahf_lm abm 3dnowprefetch cpuid_fault epb invpcid_single
pti ssbd ibrs ibpb stibp tpr_shadow vnmi flexpriority ept vpid fsgsbase tsc_adjust
bm1 hle avx2 smep bmi2 eras invpcid rtm mpx rdseed adx smap clflushopt intel_pt
xsaveopt xsaves xgetbv1 xsavec xsaves dtherm ida arat pln pts hwp hwp_notify hwp_act_window
hwp_epp md_clear flush_l1d

From /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: 128331 MB
 node distances:
 node 0
 0: 10

From /proc/meminfo
 MemTotal: 131960036 kB
 HugePages_Total: 0
 Hugepagesize: 2048 kB

(Continued on next page)
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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-bfbk 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): 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: __user pointer sanitization
CVE-2017-5715 (Spectre variant 2): Mitigation: Indirect Branch Restricted Speculation, IBPB: conditional, IBRS_FW, STIBP: disabled, RSB filling

run-level 3 Jun 2 18:50

SPEC is set to: /home/cpu2017-1.1.0-ic19.1.1
  Filesystem Type Size Used Avail Use% Mounted on
  /dev/sda3 xfs 893G 63G 830G 8% /

From /sys/devices/virtual/dmi/id
  BIOS: Lenovo -[ISE115D-2.10]- 04/24/2020
  Vendor: Lenovo
  Product: ThinkSystem ST250 -[7Y45CT0WW]-
  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 frequent changes to hardware, firmware, and the "DMTF SMBIOS" standard.
Memory:
  4x SK Hynix HMAA4GU7AJR8N-VK 32767 MB 2 rank 2666

(Continued on next page)
## Lenovo Global Technology

ThinkSystem ST250  
(3.50 GHz, Intel Xeon E-2224G)  

<table>
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<tr>
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<th>Lenovo Global Technology</th>
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<td>Lenovo Global Technology</td>
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<td>Tested by:</td>
<td>Lenovo Global Technology</td>
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### SPEC CPU®2017 Integer Speed Result

#### Lenovo Global Technology

<table>
<thead>
<tr>
<th>Benchmark</th>
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<td>11.7</td>
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<tr>
<td>SPECspeed®2017_int_peak</td>
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#### Platform Notes (Continued)

(End of data from sysinfo program)

### Compiler Version Notes

<table>
<thead>
<tr>
<th>Environment</th>
<th>C</th>
<th>600.perlbench_s(base) 602.gcc_s(base, peak) 605.mcf_s(base, peak) 625.x264_s(base, peak) 657.xz_s(base, peak)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>600.perlbench_s(peak)</td>
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</tbody>
</table>

Intel(R) C Compiler for applications running on Intel(R) 64, Version 2021.1  
NextGen Build 20200304  
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

<table>
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<th>Environment</th>
<th>C</th>
<th>600.perlbench_s(base) 602.gcc_s(base, peak) 605.mcf_s(base, peak) 625.x264_s(base, peak) 657.xz_s(base, peak)</th>
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<td>C</td>
<td>600.perlbench_s(peak)</td>
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</table>

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.

<table>
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<tr>
<th>Environment</th>
<th>C</th>
<th>600.perlbench_s(base) 602.gcc_s(base, peak) 605.mcf_s(base, peak) 625.x264_s(base, peak) 657.xz_s(base, peak)</th>
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<tbody>
<tr>
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<td>C</td>
<td>600.perlbench_s(peak)</td>
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Intel(R) C++ Compiler for applications running on Intel(R) 64,  
Version 19.1.1.217 Build 20200306  
Copyright (C) 1985-2020 Intel Corporation. All rights reserved.

<table>
<thead>
<tr>
<th>Environment</th>
<th>C++</th>
<th>620.onettp_s(base, peak) 623.xalancbmk_s(base, peak) 631.deepsjeng_s(base, peak) 641.leela_s(base, peak)</th>
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<tbody>
<tr>
<td></td>
<td>C++</td>
<td>620.onettp_s(base, peak) 623.xalancbmk_s(base, peak) 631.deepsjeng_s(base, peak) 641.leela_s(base, peak)</td>
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(Continued on next page)
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| SPECspeed®2017_int_base = 11.7 |
| SPECspeed®2017_int_peak = 12.0 |

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

---

### Compiler Version Notes (Continued)

Fortran | 648.exchange2_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.

---

### Base Compiler Invocation

C benchmarks:
- icc

C++ benchmarks:
- icpc

Fortran benchmarks:
- ifort

---

### Base Portability Flags

600.perlbench_s: -DSPEC_LP64 -DSPEC_LINUX_X64
602.gcc_s: -DSPEC_LP64
605.mcf_s: -DSPEC_LP64
620.omnetpp_s: -DSPEC_LP64
623.xalancbmk_s: -DSPEC_LP64 -DSPEC_LINUX
625.x264_s: -DSPEC_LP64
631.deepsjeng_s: -DSPEC_LP64
641.leela_s: -DSPEC_LP64
648.exchange2_s: -DSPEC_LP64
657.xz_s: -DSPEC_LP64

---

### Base Optimization Flags

C benchmarks:
- -m64
- -qnextgen
- -std=c11
- -Wl,-plugin-opt=-x86-branches-within-32B-boundaries -Wl,-z,muldefs
- -xCORE-AVX2
- -ffast-math
- -flto
- -mfpmath=sse
- -funroll-loops
- -fuse-ld=gold
- -qopt-mem-layout-trans=4
- -fopenmp
- -DSPEC_OPENMP

(Continued on next page)
Lenovo Global Technology
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SPECSpeed®2017_int_base = 11.7
SPECSpeed®2017_int_peak = 12.0

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

---

**Base Optimization Flags (Continued)**

C benchmarks (continued):
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

C++ benchmarks:
-m64 -qnextgen -Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -xCORE-AVX2 -03 -ffast-math -flto -mfpmath=sse
-funroll-loops -fuse-ld=gold -qopt-mem-layout-trans=4
-L/usr/local/IntelCompiler19/compilers_and_libraries_2020.1.217/linux/compiler/lib/intel64_lin
-1qkmalloc

Fortran benchmarks:
-m64 -Wl,-plugin-opt=-x86-branches-within-32B-boundaries -xCORE-AVX2
-03 -ipo -no-prec-div -qopt-mem-layout-trans=4
-nostandard-realloc-lhs -align array32byte
-mbranches-within-32B-boundaries

---

**Peak Compiler Invocation**

C benchmarks:
icc

C++ benchmarks:
icpc

Fortran benchmarks:
ifort

---

**Peak Portability Flags**

600.perlbench_s: -DSPEC_LP64 -DSPEC_LINUX_X64
602.gcc_s: -DSPEC_LP64(*) -DSPEC_LP64
605.mcf_s: -DSPEC_LP64
620.omnetpp_s: -DSPEC_LP64
623.xalancbmk_s: -DSPEC_LP64 -DSPEC_LINUX
625.x264_s: -DSPEC_LP64
631.deepsjeng_s: -DSPEC_LP64
641.leela_s: -DSPEC_LP64
648.exchange2_s: -DSPEC_LP64
657.xz_s: -DSPEC_LP64

(*) Indicates a portability flag that was found in a non-portability variable.
Lenovo Global Technology

ThinkSystem ST250
(3.50 GHz, Intel Xeon E-2224G)

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

SPECspeed®2017_int_base = 11.7
SPECspeed®2017_int_peak = 12.0

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

Peak Optimization Flags

C benchmarks:

600.perlbench_s: -Wl,-z,muldefs -prof-gen(pass 1) -prof-use(pass 2)
-xCORE-AVX2 -ipo -O3 -no-prec-div
-qopt-mem-layout-trans=4 -fno-strict-overflow
-mbranches-within-32B-boundaries
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

602.gcc_s: -m64 -qnextgen -std=c11 -fuse-ld=gold
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -fprofile-generate(pass 1)
-fprofile-use=default.profdata(pass 2) -xCORE-AVX2 -flto
-Ofast(pass 1) -O3 -ffast-math -qopt-mem-layout-trans=4
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

605.mcf_s: basepeak = yes

625.x264_s: -m64 -qnextgen -std=c11
-Wl,-plugin-opt=-x86-branches-within-32B-boundaries
-Wl,-z,muldefs -xCORE-AVX2 -flto -O3 -ffast-math
-fuse-ld=gold -qopt-mem-layout-trans=4 -fno-alias
-L/usr/local/jemalloc64-5.0.1/lib -ljemalloc

657.xz_s: basepeak = yes

C++ benchmarks:

620.omnetpp_s: basepeak = yes
623.xalancbmk_s: basepeak = yes
631.deepsjeng_s: basepeak = yes
641.leela_s: basepeak = yes

Fortran benchmarks:

648.exchange2_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

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-SKL-J.xml
## Lenovo Global Technology

ThinkSystem ST250  
(3.50 GHz, Intel Xeon E-2224G)

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**CPU2017 License:** 9017  
**Test Sponsor:** Lenovo Global Technology  
**Tested by:** Lenovo Global Technology  
**Test Date:** Jun-2020  
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For questions about this result, please contact the tester. For other inquiries, please contact info@spec.org.

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