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## cpu-memory-scaling

9900K 52x49x49 DDR4-4133-C16-2T

### Automated Executive Summary

*Intel Core i9-9900K had the most wins, coming in first place for 55% of the tests.*

### Test Systems:

#### 3200 C16 Dual Rank

#### 3600 C16 Dual Rank

Processor: AMD Ryzen 7 3700X 8-Core @ 3.60GHz (8 Cores / 16 Threads), Motherboard: MSI B450 GAMING PRO CARBON AC (MS-7B85) v1.0 (1.C2 BIOS), Chipset: AMD Starship/Matisse, Memory: 32GB, Disk: Samsung SSD 970 EVO 500GB + 1000GB Western Digital WD10EZEX-08W + 250GB Samsung SSD 850 + 4001GB Western Digital WD40EZRZ-00G, Graphics: Sapphire AMD Radeon RX 470/480/570/570X/580/580X/590 8GB (1120/2100MHz), Audio: AMD Ellesmere HDMI Audio, Monitor: 24G1WG4 + VX228, Network: Intel I211 + Intel-AC 9260

OS: Solus 4.1, Kernel: 5.6.13-153.current (x86\_64), Desktop: Budgie, Display Server: X Server 1.20.9, OpenGL: 4.6 Mesa 20.2.0 (LLVM 10.0.1), OpenCL: OpenCL 2.0 beignet 1.4 (git-fc5f430c), Vulkan: 1.2.131, Compiler: GCC 9.3.0 + Clang 10.0.1 + LLVM 10.0.1, File-System: ext4, Screen Resolution: 3840x1080

Kernel Notes: amdgpu.si\_support=1 amdgpu.cik\_support=1 amdgpu.pppfeaturemask=0xffffffff

Environment Notes: \_\_GL\_MaxFramesAllowed=1

Compiler Notes: --build=x86\_64-solus-linux --enable-\_cxa\_atexit --enable-cet --enable-clocale-gnu --enable-default-ssp --enable-gnu-indirect-function --enable-gold --enable-languages=c,c++,fortran --enable-ld=default --enable-lto --enable-multilib --enable-plugin --enable-shared --enable-threads=posix --target=x86\_64-solus-linux --with-arch\_32=i686 --with-gcc-major-version-only --with-gnu-ld --with-linker-hash-style=gnu --with-multilib-list=m32,m64

Processor Notes: Scaling Governor: acpi-cpufreq ondemand - CPU Microcode: 0x8701021

Security Notes: itlb\_multihit: Not affected + l1tf: Not affected + mds: Not affected + meltdown: Not affected + spec\_store\_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre\_v1: Mitigation of usercopy/swapgs barriers and \_\_user pointer sanitization + spectre\_v2: Mitigation of Full AMD retpoline IBPB: conditional STIBP: conditional RSB filling + tsx\_async\_abort: Not affected

## 2800 C16 Dual Rank

Processor: AMD Ryzen 7 3700X 8-Core @ 3.60GHz (8 Cores / 16 Threads), Motherboard: MSI B450 GAMING PRO CARBON AC (MS-7B85) v1.0 (1.C2 BIOS), Chipset: AMD Starship/Matisse, Memory: 32GB, Disk: Samsung SSD 970 EVO 500GB + 250GB Samsung SSD 850 + 1000GB Western Digital WD10EZEX-08W + 4001GB Western Digital WD40EZRZ-00G, Graphics: Sapphire AMD Radeon RX 470/480/570/570X/580/580X/590 8GB (1120/2100MHz), Audio: AMD Ellesmere HDMI Audio, Monitor: 24G1WG4 + VX228, Network: Intel I211 + Intel-AC 9260

OS: Solus 4.1, Kernel: 5.6.13-153.current (x86\_64), Desktop: Budgie, Display Server: X Server 1.20.9, OpenGL: 4.6 Mesa 20.2.0 (LLVM 10.0.1), OpenCL: OpenCL 2.0 beignet 1.4 (git-fc5f430c), Vulkan: 1.2.131, Compiler: GCC 9.3.0 + Clang 10.0.1 + LLVM 10.0.1, File-System: ext4, Screen Resolution: 3840x1080

Kernel Notes: amdgpu.si\_support=1 amdgpu.cik\_support=1 amdgpu.pppfeaturemask=0xffffffff

Environment Notes: \_\_GL\_MaxFramesAllowed=1

Compiler Notes: --build=x86\_64-solus-linux --enable-\_cxa\_atexit --enable-cet --enable-clocale-gnu --enable-default-ssp --enable-gnu-indirect-function --enable-gold --enable-languages=c,c++,fortran --enable-ld=default --enable-lto --enable-multilib --enable-plugin --enable-shared --enable-threads=posix --target=x86\_64-solus-linux --with-arch\_32=i686 --with-gcc-major-version-only --with-gnu-ld --with-linker-hash-style=gnu --with-multilib-list=m32,m64

Processor Notes: Scaling Governor: acpi-cpufreq ondemand - CPU Microcode: 0x8701021

Security Notes: itlb\_multihit: Not affected + l1tf: Not affected + mds: Not affected + meltdown: Not affected + spec\_store\_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre\_v1: Mitigation of usercopy/swapgs barriers and \_\_user pointer sanitization + spectre\_v2: Mitigation of Full AMD retpoline IBPB: conditional STIBP: conditional RSB filling + tsx\_async\_abort: Not affected

## 3600 C16 Dual Rank Tuned

Processor: AMD Ryzen 7 3700X 8-Core @ 3.60GHz (8 Cores / 16 Threads), Motherboard: MSI B450 GAMING PRO CARBON AC (MS-7B85) v1.0 (1.C2 BIOS), Chipset: AMD Starship/Matisse, Memory: 32GB, Disk: Samsung SSD 970 EVO 500GB + 1000GB Western Digital WD10EZEX-08W + 250GB Samsung SSD 850 + 4001GB Western Digital WD40EZRZ-00G, Graphics: Sapphire AMD Radeon RX 470/480/570/570X/580/580X/590 8GB (1120/2100MHz), Audio: AMD Ellesmere HDMI Audio, Monitor: 24G1WG4 + VX228, Network: Intel I211 + Intel-AC 9260

OS: Solus 4.1, Kernel: 5.6.13-153.current (x86\_64), Desktop: Budgie, Display Server: X Server 1.20.9, OpenGL: 4.6 Mesa 20.1.9 (LLVM 10.0.1), OpenCL: OpenCL 2.0 beignet 1.4 (git-fc5f430c), Vulkan: 1.2.131, Compiler: GCC 9.3.0 + Clang 10.0.1 + LLVM 10.0.1, File-System: ext4, Screen Resolution: 3840x1080

Kernel Notes: amdgpu.si\_support=1 amdgpu.cik\_support=1 amdgpu.pppfeaturemask=0xffffffff

Environment Notes: \_\_GL\_MaxFramesAllowed=1

Compiler Notes: --build=x86\_64-solus-linux --enable-\_cxa\_atexit --enable-cet --enable-clocale-gnu --enable-default-ssp --enable-gnu-indirect-function --enable-gold --enable-languages=c,c++,fortran --enable-ld=default --enable-lto --enable-multilib --enable-plugin --enable-shared --enable-threads=posix --target=x86\_64-solus-linux --with-arch\_32=i686 --with-gcc-major-version-only --with-gnu-ld --with-linker-hash-style=gnu --with-multilib-list=m32,m64

Processor Notes: Scaling Governor: acpi-cpufreq ondemand - CPU Microcode: 0x8701021

Security Notes: itlb\_multihit: Not affected + l1tf: Not affected + mds: Not affected + meltdown: Not affected + spec\_store\_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre\_v1: Mitigation of usercopy/swapgs barriers and \_\_user pointer sanitization + spectre\_v2: Mitigation of Full AMD retpoline IBPB: conditional STIBP: conditional RSB filling + tsx\_async\_abort: Not affected

## Intel Core i9-9900K

Processor: Intel Core i9-9900K @ 5.20GHz (8 Cores / 16 Threads), Motherboard: EVGA 121-KS-E375 v1.0 (1.09

BIOS), Chipset: Intel 8th/9th, Memory: 16GB, Disk: Samsung SSD 970 EVO 500GB + 256GB PLEXTOR PX-256M6 + 240GB KINGSTON SH103S3 + 2000GB Western Digital WD2003FZEX-0 + 2000GB Samsung SSD 860, Graphics: ASUS NVIDIA GeForce GTX 1080 Ti 11GB, Audio: NVIDIA GP102 HDMI Audio, Monitor: U34G2G4R3 + XB271HU, Network: Intel I219-V

OS: Gentoo 2.7, Kernel: 5.4.37-ck (x86\_64), Display Server: X Server 1.20.8, Vulkan: 1.2.142, Compiler: GCC 9.3.0 + Clang 11.0.0Target: + LLVM 11.0.0 + CUDA 11.0, File-System: reiserfs

Compiler Notes: --bindir=/usr/x86\_64-pc-linux-gnu/gcc-bin/9.3.0 --build=x86\_64-pc-linux-gnu --datadir=/usr/share/gcc-data/x86\_64-pc-linux-gnu/9.3.0 --disable-esp --disable-fixed-point --disable-isl-version-check --disable-libada --disable-libssp --disable-systemtap --disable-werror --enable\_\_cxa\_atexit --enable-checking=release --enable-clocale-gnu --enable-default-pie --enable-default-ssp --enable-languages=c,c++,fortran --enable-libgomp --enable-libstdcxx-time --enable-lto --enable-multilib --enable-nls --enable-obsolete --enable-secureplt --enable-shared --enable-targets=all --enable-threads=posix --enable-vtable-verify --host=x86\_64-pc-linux-gnu --includedir=/usr/lib/gcc/x86\_64-pc-linux-gnu/9.3.0/include --mandir=/usr/share/gcc-data/x86\_64-pc-linux-gnu/9.3.0/man --with-isl --with-multilib-list=m32,m64 --with-python-dir=/share/gcc-data/x86\_64-pc-linux-gnu/9.3.0/python  
Processor Notes: Scaling Governor: intel\_pstate performance - CPU Microcode: 0x98  
Security Notes: itlb\_multihit: KVM: Vulnerable + l1tf: Not affected + mds: Vulnerable: Clear buffers attempted no microcode; SMT vulnerable + meltdown: Not affected + spec\_store\_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre\_v1: Mitigation of usercopy/swapgs barriers and \_\_user pointer sanitization + spectre\_v2: Mitigation of Full generic retpoline IBPB: conditional IBRS\_FW STIBP: conditional RSB filling + tsx\_async\_abort: Vulnerable: Clear buffers attempted no microcode; SMT vulnerable

### 9900K 52x52x49 3900C15-2T

Processor: Intel Core i9-9900K @ 5.20GHz (8 Cores / 16 Threads), Motherboard: EVGA 121-KS-E375 v1.0 (1.09 BIOS), Chipset: Intel 8th/9th, Memory: 32GB, Disk: Samsung SSD 970 EVO 500GB + 256GB PLEXTOR PX-256M6 + 240GB KINGSTON SH103S3 + 2000GB Western Digital WD2003FZEX-0 + 2000GB Samsung SSD 860, Graphics: ASUS NVIDIA GeForce GTX 1080 Ti 11GB (1569/5508MHz), Audio: NVIDIA GP102 HDMI Audio, Network: Intel I219-V

OS: Gentoo 2.7, Kernel: 5.4.48-ck (x86\_64), Desktop: KDE Plasma, Display Server: X Server 1.20.8, Display Driver: NVIDIA 455.38, OpenGL: 4.6.0, Vulkan: 1.2.142, Compiler: GCC 10.2.0 + Clang 11.0.0Target: + LLVM 11.0.0 + CUDA 11.1, File-System: reiserfs, Screen Resolution: 3440x1440

Compiler Notes: --bindir=/usr/x86\_64-pc-linux-gnu/gcc-bin/10.2.0 --build=x86\_64-pc-linux-gnu --datadir=/usr/share/gcc-data/x86\_64-pc-linux-gnu/10.2.0 --disable-esp --disable-fixed-point --disable-isl-version-check --disable-libada --disable-libssp --disable-systemtap --disable-werror --enable\_\_cxa\_atexit --enable-checking=release --enable-clocale-gnu --enable-default-pie --enable-default-ssp --enable-languages=c,c++,fortran --enable-libgomp --enable-libstdcxx-time --enable-lto --enable-multilib --enable-nls --enable-obsolete --enable-secureplt --enable-shared --enable-targets=all --enable-threads=posix --enable-vtable-verify --host=x86\_64-pc-linux-gnu --includedir=/usr/lib/gcc/x86\_64-pc-linux-gnu/10.2.0/include --mandir=/usr/share/gcc-data/x86\_64-pc-linux-gnu/10.2.0/man --with-isl --with-multilib-list=m32,m64 --with-python-dir=/share/gcc-data/x86\_64-pc-linux-gnu/10.2.0/python --without-zstd  
Processor Notes: Scaling Governor: intel\_pstate performance - CPU Microcode: 0x98  
Security Notes: itlb\_multihit: KVM: Vulnerable + l1tf: Not affected + mds: Vulnerable: Clear buffers attempted no microcode; SMT vulnerable + meltdown: Not affected + spec\_store\_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre\_v1: Mitigation of usercopy/swapgs barriers and \_\_user pointer sanitization + spectre\_v2: Mitigation of Full generic retpoline IBPB: conditional IBRS\_FW STIBP: conditional RSB filling + srbd: Vulnerable: No microcode + tsx\_async\_abort: Vulnerable: Clear buffers attempted no microcode; SMT vulnerable

### 9900K 52x52x49 3900C15-2T Full

### 9900K 52x52x49 3900C15-2T 3

Processor: Intel Core i9-9900K @ 5.20GHz (8 Cores / 16 Threads), Motherboard: EVGA 121-KS-E375 v1.0 (1.09 BIOS), Chipset: Intel 8th/9th, Memory: 32GB, Disk: Samsung SSD 970 EVO 500GB + 256GB PLEXTOR PX-256M6 + 240GB KINGSTON SH103S3 + 2000GB Western Digital WD2003FZEX-0 + 2000GB Samsung SSD 860, Graphics: ASUS NVIDIA GeForce GTX 1080 Ti 11GB (1569/5508MHz), Audio: NVIDIA GP102 HDMI Audio, Monitor: U34G2G4R3, Network: Intel I219-V

OS: Gentoo 2.7, Kernel: 5.4.48-ck (x86\_64), Desktop: KDE Plasma 5.20.3, Display Server: X Server 1.20.8, Display Driver: NVIDIA 455.38, OpenGL: 4.6.0, Vulkan: 1.2.142, Compiler: GCC 10.2.0 + Clang 11.0.0Target: + LLVM 11.0.0 + CUDA 11.1, File-System: reiserfs, Screen Resolution: 3440x1440

Compiler Notes: --bindir=/usr/x86\_64-pc-linux-gnu/gcc-bin/10.2.0 --build=x86\_64-pc-linux-gnu --datadir=/usr/share/gcc-data/x86\_64-pc-linux-gnu/10.2.0 --disable-esp --disable-fixed-point --disable-isl-version-check --disable-libada --disable-libssp --disable-systemtap --disable-werror --enable\_\_cxa\_atexit --enable-checking=release

```
--enable-clocale=gnu --enable-default-pie --enable-default-ssp --enable-languages=c,c++,fortran --enable-libgomp --enable-libstdcxx-time --enable-lto --enable-multilib
--enable-nls --enable-obsolete --enable-secureplt --enable-shared --enable-targets=all --enable-threads=posix --enable-vtable-verify --host=x86_64-pc-linux-gnu
--includedir=/usr/lib/gcc/x86_64-pc-linux-gnu/10.2.0/include --mandir=/usr/share/gcc-data/x86_64-pc-linux-gnu/10.2.0/man --with-isl --with-multilib-list=m32,m64
--with-python-dir=/share/gcc-data/x86_64-pc-linux-gnu/10.2.0/python --without-zstd
```

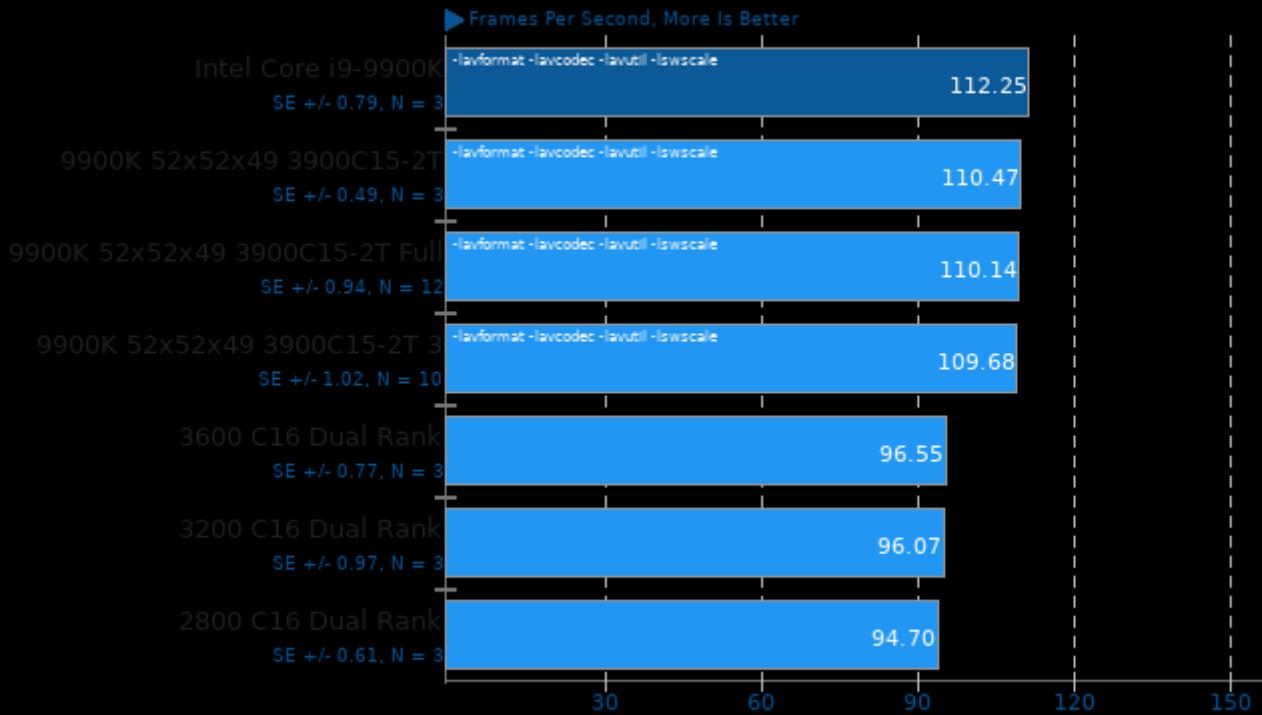
Processor Notes: Scaling Governor: intel\_pstate performance - CPU Microcode: 0x98

Security Notes: itlb\_multihit: KVM: Vulnerable + l1tf: Not affected + mds: Vulnerable: Clear buffers attempted no microcode; SMT vulnerable + meltdown: Not affected + spec\_store\_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre\_v1: Mitigation of usercopy/swapgs barriers and \_\_user pointer sanitization + spectre\_v2: Mitigation of Full generic retpoline IBPB: conditional IBRS\_FW STIBP: conditional RSB filling + srbd: Vulnerable: No microcode + tsx\_async\_abort: Vulnerable: Clear buffers attempted no microcode; SMT vulnerable

	3200 C16 Dual Rank	3600 C16 Dual Rank	2800 C16 Dual Rank	3600 C16 Dual Rank	Intel Core Tuned	9900K 52x52x49 3900C15-2	9900K 52x52x49 3900C15-2	9900K 52x52x49 3900C15-2
						T	T Full	T 3
<b>x264 - H.2.V.E (FPS)</b>	96.07	96.55	<b>94.70</b>		<b>112.25</b>	110.47	110.14	109.68
Normalized	85.59%	86.01%	84.37%		100%	98.41%	98.12%	97.71%
Standard Deviation	1.8%	1.4%	1.1%		1.2%	0.8%	3%	2.9%
<b>7-Zip Compression - C.S.T (MIPS)</b>	58805	59002	<b>57806</b>	60582	62125	<b>64389</b>	64041	63824
Normalized	91.33%	91.63%	89.78%	94.09%	96.48%	100%	99.46%	99.12%
Standard Deviation	0.9%	0.3%	0.5%	0.8%	0.7%	0.3%	0.5%	0.8%
<b>Timed GCC</b>	685.798	<b>682.171</b>	687.591	683.999	727.918			<b>750.678</b>
<b>Compilation - Time To Compile (sec)</b>								
Normalized	99.47%	100%	99.21%	99.73%	93.72%			90.87%
Standard Deviation	0.1%	0.1%	0.1%	0.1%	0.1%			0.2%
<b>Timed Linux Kernel</b>	71.363	70.725	<b>71.427</b>	70.783	<b>62.350</b>			65.807
<b>Compilation - Time To POV-Ray - Trace Time (sec)</b>	<b>45.173</b>	45.123	44.826	45.134	<b>38.162</b>			40.536
Normalized	87.37%	88.16%	87.29%	88.09%	100%			94.75%
Standard Deviation	1.7%	1.5%	1.5%	1.5%	1.9%			1.2%
<b>Sysbench - Memory (Events/sec)</b>	10680392	10935031	<b>10315816</b>	10947616	30351565			<b>30907670</b>
Normalized	84.48%	84.57%	85.13%	84.55%	100%			94.14%
Standard Deviation	0.2%	0.1%	0.1%	0.1%	0.2%			0.3%
<b>Sysbench - CPU (Events/sec)</b>	17539	<b>17509</b>	17608	17652	22108			<b>22828</b>
Normalized	76.83%	76.7%	77.13%	77.33%	96.85%			100%
Standard Deviation	0.1%	0%	0%	0%	0.1%			0%
<b>Tinymembench - Standard Memset</b>	16252	16968	<b>15025</b>	18432	<b>41447</b>			41125
Normalized	39.21%	40.94%	36.25%	44.47%	100%			99.22%
Standard Deviation	0.1%	0.2%	0.5%	0.1%	0.3%			0.6%
<b>Tinymembench - Standard Memcpy</b>	10334	10934	<b>9484</b>	11635	<b>25422</b>			25301
Normalized	40.65%	43.01%	37.31%	45.77%	100%			99.52%
Standard Deviation	0.1%	0.1%	0.1%	0.1%	0.2%			0.1%

**x264 2019-12-17**

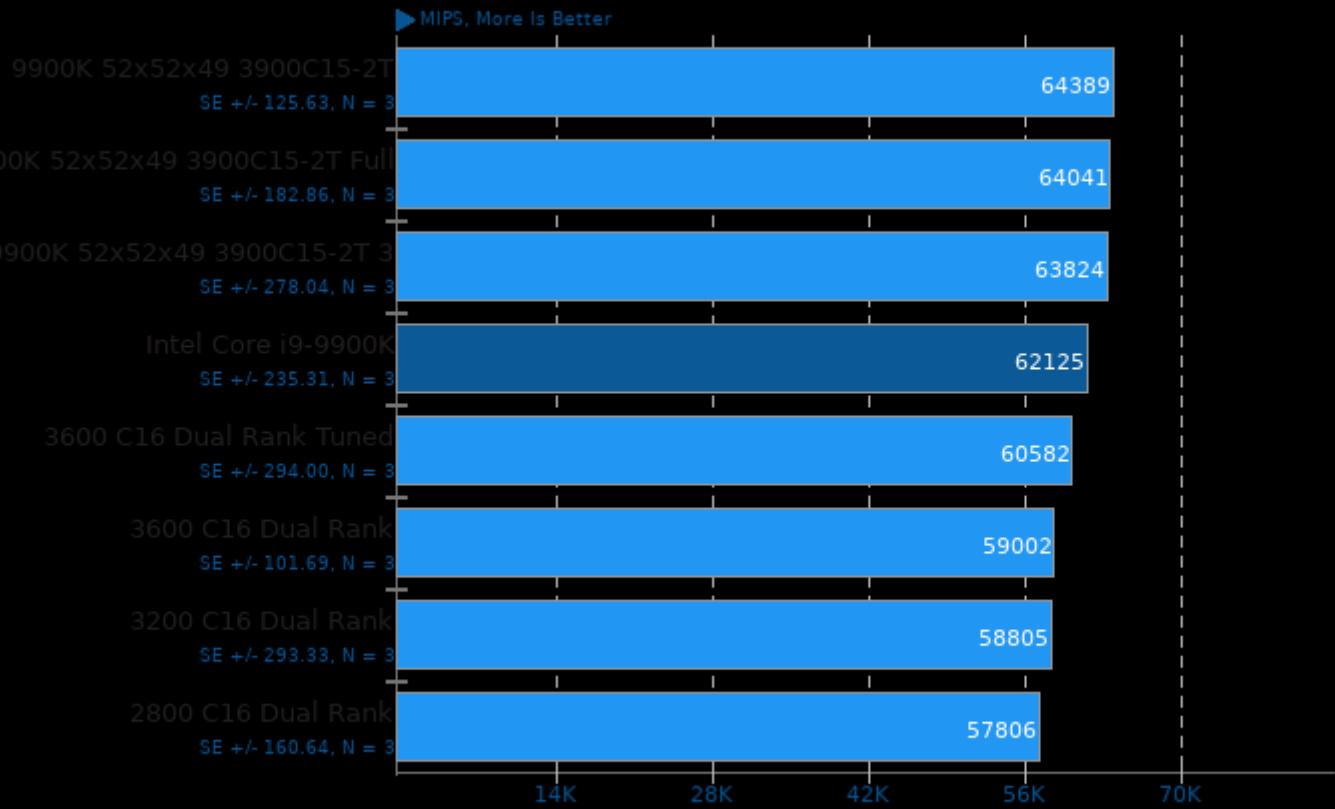
H.264 Video Encoding



1. (CC) gcc options: -fPIC -fno-tree-vectorize

## 7-Zip Compression 16.02

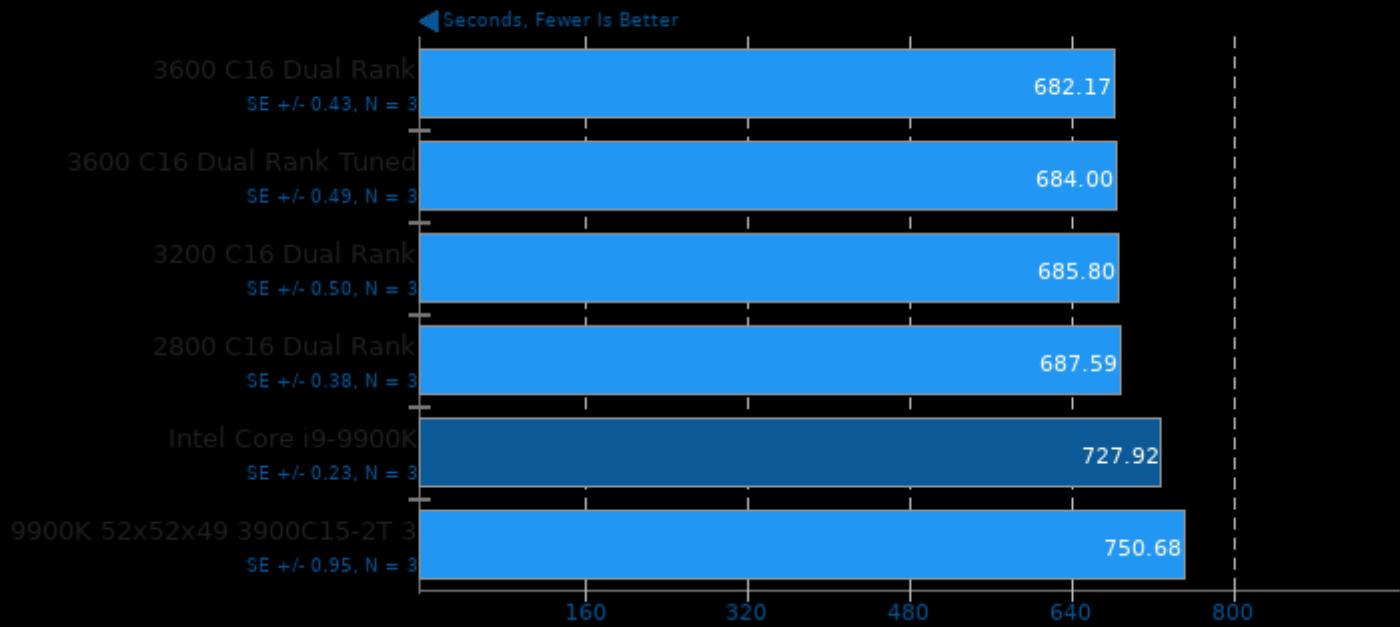
Compress Speed Test



1. (CXX) g++ options: -pipe -fthread

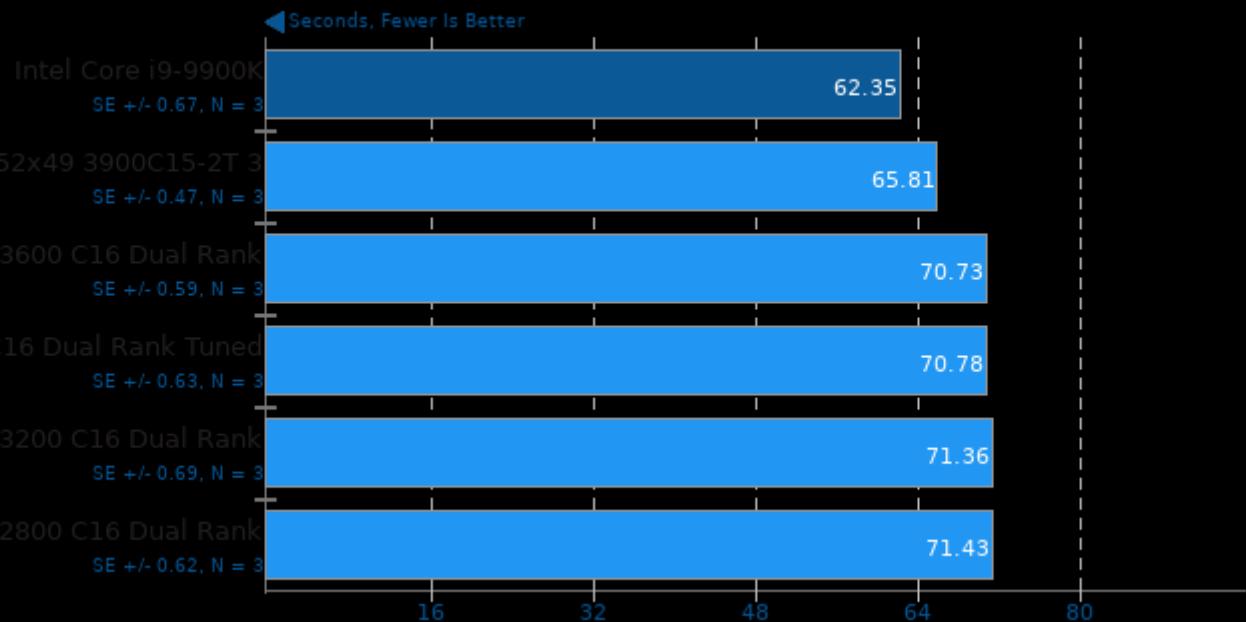
## Timed GCC Compilation 9.3.0

Time To Compile



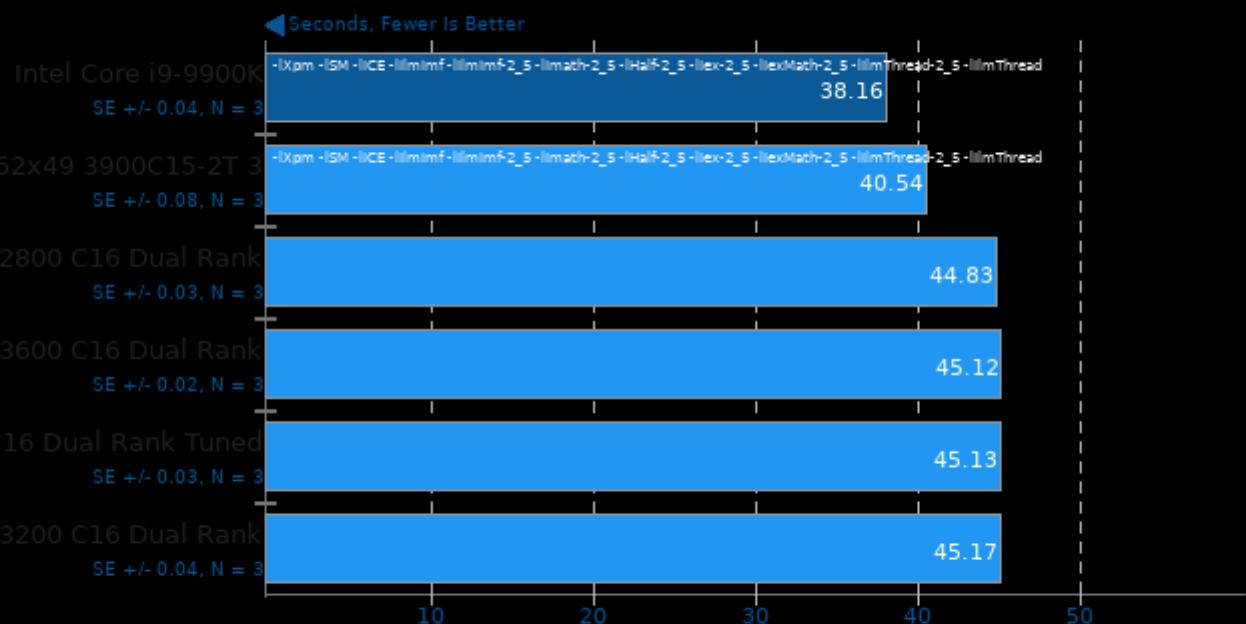
## Timed Linux Kernel Compilation 5.4

Time To Compile



## POV-Ray 3.7.0.7

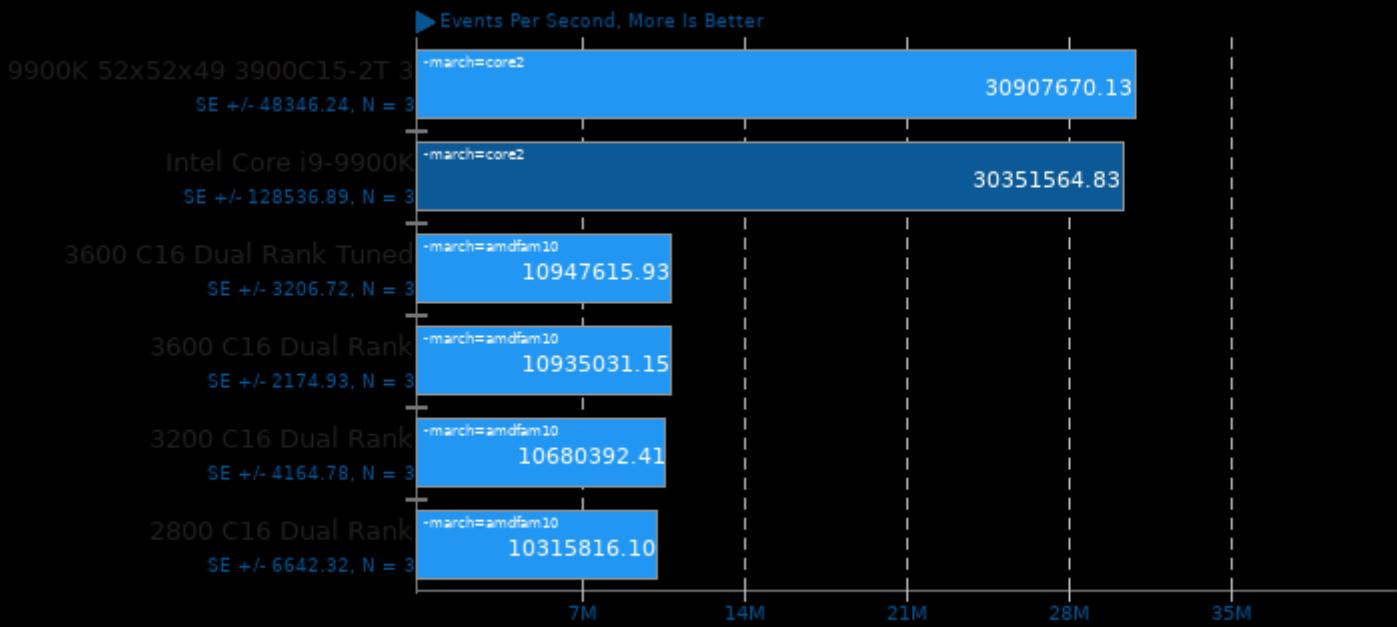
Trace Time



1. (CXX) g++ options: -pipe -O3 -ffast-math -march=native -pthread -lSDL -lpthread -lX11 -ltiff -ljpeg -lpng -lz -lrt -lm -lboost\_thread -lboost\_system

## Sysbench 2018-07-28

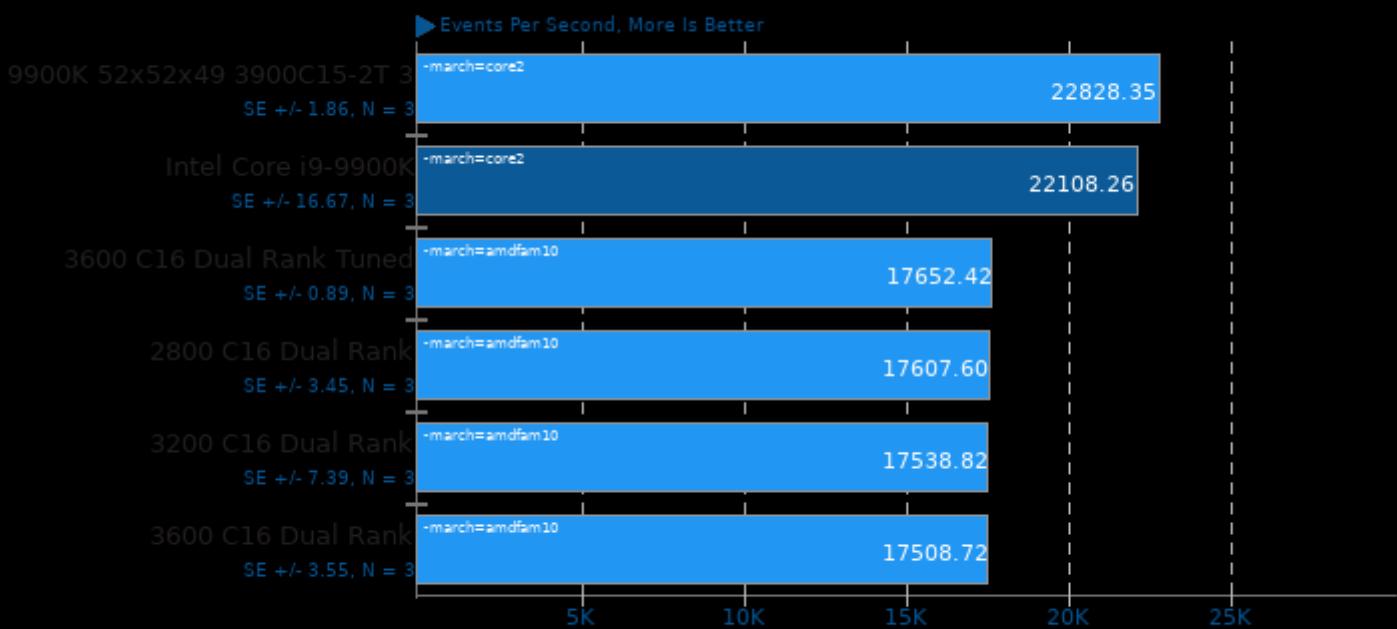
Test: Memory



1. (CC) gcc options: -pthread -O3 -funroll-loops -ggdb3 -rdynamic -ldl -lao -lm

## Sysbench 2018-07-28

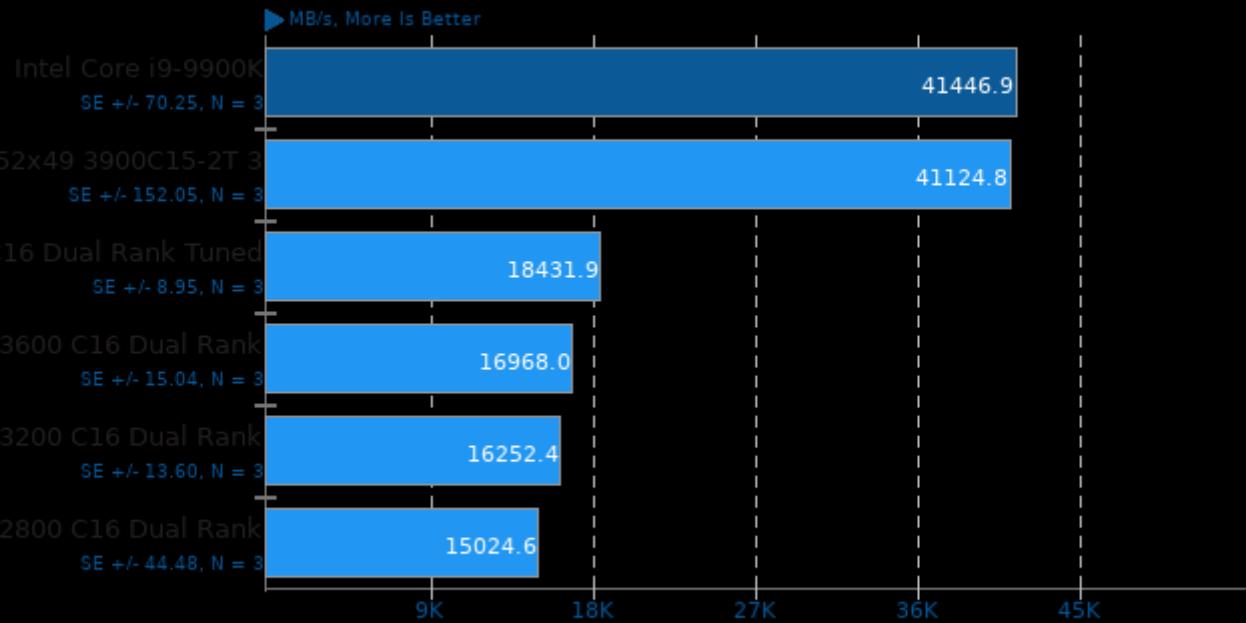
Test: CPU



1. (CC) gcc options: -pthread -O3 -funroll-loops -ggdb3 -rdynamic -ldl -lao -lm

## Tinymembench 2018-05-28

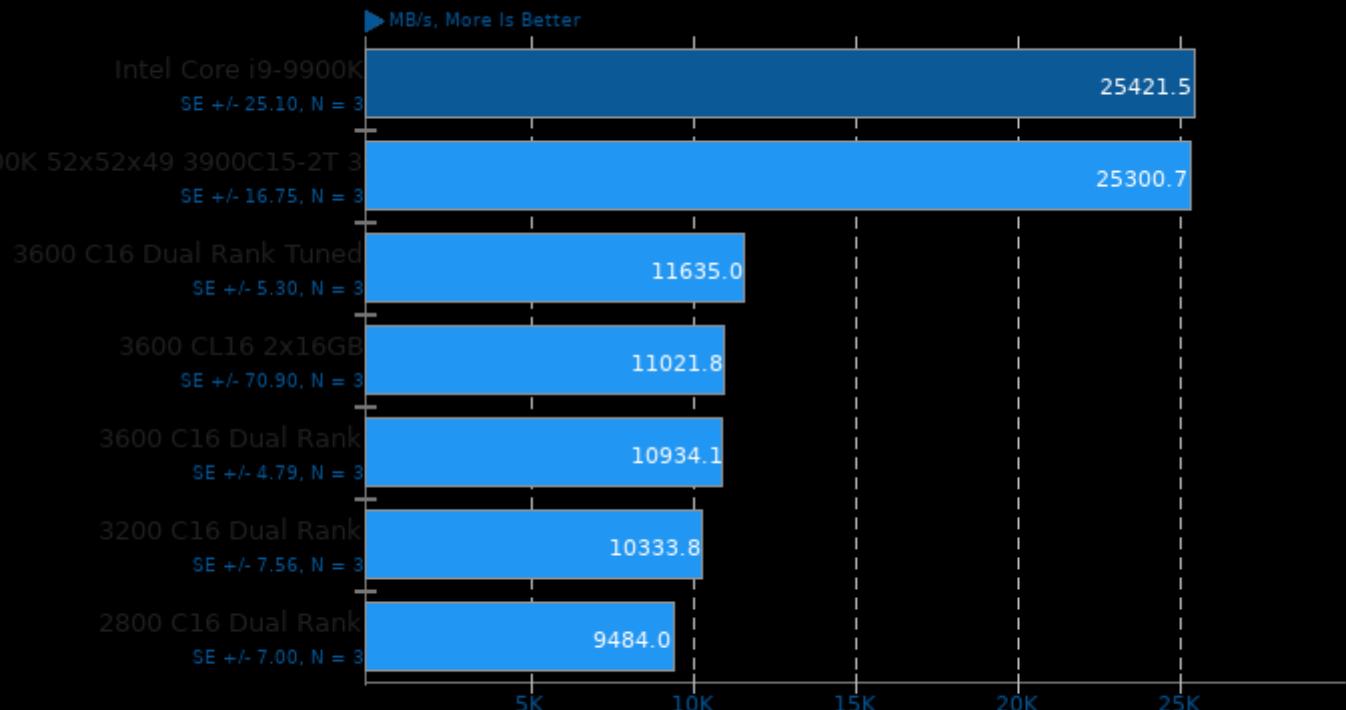
Standard Memset



1. (CC) gcc options: -O2 -lm

## Tinymembench 2018-05-28

Standard Memcpy



1. (CC) gcc options: -O2 -lm

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