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R32_5_1_Xavier_AX720_1

ARMv8 rev 0 testing with a Jetson-AGX and NVIDIA Tegra Xavier on Ubuntu 18.04 via the Phoronix Test Suite.

Automated Executive Summary

M.2 SSD had the most wins, coming in first place for 62% of the tests.

The results with the greatest spread from best to worst included:

Flexible IO Tester (Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory) at 97.667x
Flexible IO Tester (Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory) at 44.83x
Flexible IO Tester (Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory) at 16x
Flexible IO Tester (Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory) at 13.085x
Flexible IO Tester (Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory) at 13.062x
Flexible IO Tester (Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory) at 10.89x
Flexible IO Tester (Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk

Target: Default Test Directory) at 10.869x
Flexible IO Tester (Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory) at 7.383x
iPerf (Server Address: 192.168.1.3 - Server Port: 5201 - Duration: 10 Seconds - Test: UDP - 1000Mbit Objective - Parallel: 1) at 1.01x
CUDA Mini-Nbody (Test: Original) at 1x.

Test Systems:

eMMC

Processor: ARMv8 rev 0 @ 2.27GHz (8 Cores), Motherboard: Jetson-AGX, Memory: 16GB, Disk: 62GB Ultra USB 3.0 + 31GB HBG4a2, Graphics: NVIDIA TEGRA, Monitor: PHL 247E6, Network: 2 x Intel I210

OS: Ubuntu 18.04, Kernel: 4.9.201-tegra (aarch64), Desktop: Unity 7.5.0, Display Server: X Server 1.19.6, Vulkan: 1.2.131, Compiler: GCC 7.5.0 + CUDA 10.2, File-System: ext4, Screen Resolution: 1920x1080

Kernel Notes: Transparent Huge Pages: always
Compiler Notes: --build=aarch64-linux-gnu --disable-libquadmath --disable-libquadmath-support --disable-werror --enable-bootstrap --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-fix-cortex-a53-843419 --enable-gnu-unique-object --enable-languages=c,ada,c++,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-plugin --enable-shared --enable-threads=posix --host=aarch64-linux-gnu --program-prefix=aarch64-linux-gnu- --target=aarch64-linux-gnu --with-default-libstdcxx-abi=new --with-gcc-major-version-only -v
Disk Notes: CFQ / data=ordered,relatime,rw / Block Size: 4096
Processor Notes: Scaling Governor: tegra_cpufreq schedutil

M.2 SSD

USB 3.0

USB2.0

Micro SD Card

Processor: ARMv8 rev 0 @ 2.27GHz (8 Cores), Motherboard: Jetson-AGX, Memory: 16GB, Disk: 256GB INTEL SSDPEKKW256G8 + 62GB Ultra USB 3.0 + 31GB HBG4a2, Graphics: NVIDIA Tegra Xavier, Monitor: PHL 247E6, Network: 2 x Intel I210

OS: Ubuntu 18.04, Kernel: 4.9.201-tegra (aarch64), Desktop: Unity 7.5.0, Display Server: X Server 1.19.6, Display Driver: NVIDIA 32.5.1, OpenGL: 4.6.0, Vulkan: 1.2.131, Compiler: GCC 7.5.0 + CUDA 10.2, File-System: ext4, Screen Resolution: 1920x1080

Kernel Notes: Transparent Huge Pages: always
Compiler Notes: --build=aarch64-linux-gnu --disable-libquadmath --disable-libquadmath-support --disable-werror --enable-bootstrap --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-fix-cortex-a53-843419 --enable-gnu-unique-object --enable-languages=c,ada,c++,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-plugin --enable-shared --enable-threads=posix --host=aarch64-linux-gnu --program-prefix=aarch64-linux-gnu- --target=aarch64-linux-gnu --with-default-libstdcxx-abi=new --with-gcc-major-version-only -v
Disk Notes: none / data=ordered,relatime,rw / Block Size: 4096
Processor Notes: Scaling Governor: tegra_cpufreq schedutil

Type C

CPU Stress

CUDA Test

LPDDR4

Processor: ARMv8 rev 0 @ 2.27GHz (8 Cores), Motherboard: Jetson-AGX, Memory: 16GB, Disk: 256GB INTEL SSDPEKKW256G8 + 256GB Tech + 62GB Ultra USB 3.0 + 31GB HBG4a2 + 15GB i-TF, Graphics: NVIDIA Tegra Xavier, Monitor: PHL 247E6, Network: 2 x Intel I210

OS: Ubuntu 18.04, Kernel: 4.9.201-tegra (aarch64), Desktop: Unity 7.5.0, Display Server: X Server 1.19.6, Display Driver: NVIDIA 32.5.1, OpenGL: 4.6.0, Vulkan: 1.2.131, Compiler: GCC 7.5.0 + CUDA 10.2, File-System: ext4, Screen Resolution: 1920x1080

Kernel Notes: Transparent Huge Pages: always
Compiler Notes: --build=aarch64-linux-gnu --disable-libquadmath --disable-libquadmath-support --disable-werror --enable-bootstrap --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-fix-cortex-a53-843419 --enable-gnu-unique-object --enable-languages=c,ada,c++,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-plugin --enable-shared --enable-threads=posix --host=aarch64-linux-gnu --program-prefix=aarch64-linux-gnu- --target=aarch64-linux-gnu --with-default-libstdcxx-abi=new --with-gcc-major-version-only -v
Processor Notes: Scaling Governor: tegra_cpufreq schedutil

RS-232UART

Processor: ARMv8 rev 0 @ 2.27GHz (8 Cores), Motherboard: Jetson-AGX, Memory: 16GB, Disk: 256GB INTEL SSDPEKKW256G8 + 31GB HBG4a2 + 15GB i-TF, Graphics: NVIDIA Tegra Xavier, Monitor: PHL 247E6, Network: 2 x Intel I210

OS: Ubuntu 18.04, Kernel: 4.9.201-tegra (aarch64), Desktop: Unity 7.5.0, Display Server: X Server 1.19.6, Display Driver: NVIDIA 32.5.1, OpenGL: 4.6.0, Vulkan: 1.2.131, Compiler: GCC 7.5.0 + CUDA 10.2, File-System: ext4, Screen Resolution: 1920x1080

Kernel Notes: Transparent Huge Pages: always
Processor Notes: Scaling Governor: tegra_cpufreq schedutil

LAN

LAN1

LAN2

Processor: ARMv8 rev 0 @ 2.27GHz (8 Cores), Motherboard: Jetson-AGX, Memory: 16GB, Disk: 256GB INTEL SSDPEKKW256G8 + 31GB HBG4a2 + 15GB i-TF, Graphics: NVIDIA Tegra Xavier, Monitor: EDIIG0219, Network: 2 x Intel I210 + Intel 8265 / 8275

OS: Ubuntu 18.04, Kernel: 4.9.201-tegra (aarch64), Desktop: Unity 7.5.0, Display Server: X Server 1.19.6, Display Driver: NVIDIA 32.5.1, OpenGL: 4.6.0, Vulkan: 1.2.131, Compiler: GCC 7.5.0 + CUDA 10.2, File-System: ext4, Screen Resolution: 1920x1080

Kernel Notes: Transparent Huge Pages: always
Compiler Notes: --build=aarch64-linux-gnu --disable-libquadmath --disable-libquadmath-support --disable-werror --enable-bootstrap --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-fix-cortex-a53-843419 --enable-gnu-unique-object --enable-languages=c,ada,c++,go,d,fortran,objc,obj-c++ --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-nls --enable-plugin --enable-shared --enable-threads=posix --host=aarch64-linux-gnu --program-prefix=aarch64-linux-gnu- --target=aarch64-linux-gnu --with-default-libstdcxx-abi=new --with-gcc-major-version-only -v
Processor Notes: Scaling Governor: tegra_cpufreq schedutil

R32_5_1_Xavier_AX720_1

	eMMC	M.2 SSD	USB 3.0	USB2.0	Micro SD Card	Type C	CPU Stress	CUDA Test	LPDDR4	RS-232 UART	LAN	LAN1	LAN2
CUDA Mini-Nbody - Original ((NBody^2)/s)								35.798					
Standard Deviation								0%					
CUDA Mini-Nbody - Cache Blocking ((NBody^2)/s)								36.857					
Standard Deviation								0%					
CUDA Mini-Nbody - Loop Unrolling ((NBody^2)/s)								36.922					
Standard Deviation								0%					
CUDA Mini-Nbody - SOA Data Layout ((NBody^2)/s)								36.676					
Standard Deviation								0%					
CUDA Mini-Nbody - F.D.T.Z ((NBody^2)/s)								36.677					
Standard Deviation								0%					
Stress-NG - Crypto (Bogo Ops/s)							1190						
Standard Deviation							1.1%						
Stress-NG - Forking (Bogo Ops/s)							6591						
Standard Deviation							1.5%						
Stress-NG - CPU Stress (Bogo Ops/s)							766.00						
Standard Deviation							29.2%						
Stress-NG - Matrix Math (Bogo Ops/s)							6288						
Standard Deviation							0.4%						

Stress-NG - Vector Math (Bogo Ops/s)							24875
Standard Deviation							0.4%
Stress-NG - Memory Copying (Bogo							1761
Standard Deviation							0.2%
Stress-NG - G.C.S.F (Bogo Ops/s)							115612
Standard Deviation							3.2%
Stress-NG - G.Q.D.S (Bogo Ops/s)							20.34
Standard Deviation							3%
Flexible IO Tester - Seq Read - Linux AIO - No - Yes - 4KB (IOPS)	41333	**94413**	24233	**7228**	14100	75867	
Normalized	43.78%	100%	25.67%	7.66%	14.93%	80.36%	
Standard Deviation	1.1%	3.1%	0.2%	0.3%		1.1%	
Flexible IO Tester - Seq Read - Linux AIO - No - Yes - 8MB (IOPS)	34	**293**	12	**3**	9	95	
Normalized	11.6%	100%	4.1%	1.02%	3.07%	32.42%	
Standard Deviation		0.8%					
Flexible IO Tester - Seq Write - Linux AIO - No - Yes - 4KB (IOPS)	23846	56900	6364	6426	**6054**	**65800**	
Normalized	36.24%	86.47%	9.67%	9.77%	9.2%	100%	
Standard Deviation	5.1%	0.2%	0.4%	0.3%	4.6%	1.5%	
Flexible IO Tester - Seq Write - Linux AIO - No - Yes - 8MB (IOPS)	14	**32**	**2**	3	5	**32**	
Normalized	43.75%	100%	6.25%	9.38%	15.63%	100%	

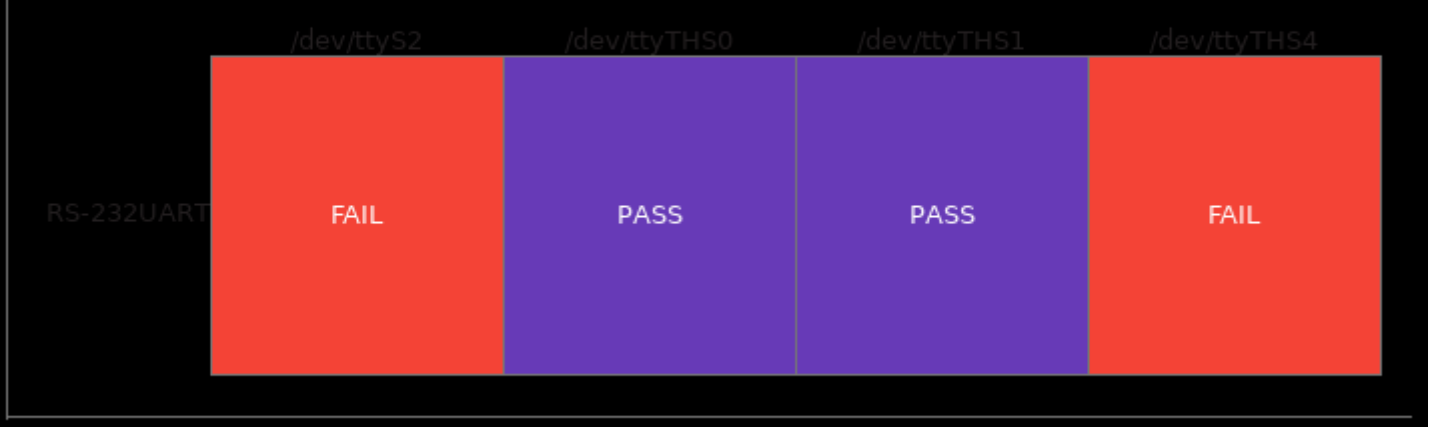
R32_5_1_Xavier_AX720_1

Flexible IO Tester - Seq Read - Linux AIO - No - Yes - 4KB (MB/s)	162	369	94.5	28.2	55.2	299	
Normalized	43.9%	100%	25.61%	7.64%	14.96%	81.03%	
Standard Deviation	0.9%	3.2%	0.2%	0.2%	0.1%	0.7%	
Flexible IO Tester - Seq Read - Linux AIO - No - Yes - 8MB (MB/s)	304	2376	121	53.0	102	790	
Normalized	12.79%	100%	5.09%	2.23%	4.29%	33.25%	
Standard Deviation		0.7%		1.1%			
Flexible IO Tester - Seq Write - Linux AIO - No - Yes - 4KB (MB/s)	93.2	222	24.6	25.1	23.6	257	
Normalized	36.26%	86.38%	9.57%	9.77%	9.18%	100%	
Standard Deviation	5.1%	0.3%	2%	0.5%	4.4%	1.4%	
Flexible IO Tester - Seq Write - Linux AIO - No - Yes - 8MB (MB/s)	137	282	38.6	48.4	66.8	285	
Normalized	48.07%	98.95%	13.54%	16.98%	23.44%	100%	
Standard Deviation	1.5%		0.5%	1%	0.2%		
Stream - Copy (MB/s)							48644
Standard Deviation							0.3%
Stream - Scale (MB/s)							49412
Standard Deviation							0.1%
Stream - Triad (MB/s)							48398
Standard Deviation							0.5%
Stream - Add (MB/s)							48764
Standard Deviation							0.6%

iPerf - 192.168.1.3 - 5201 - 10 Seconds - UDP - 100Mbit Objective - 1 (Mbits/s)	100	100	100
iPerf - 192.168.1.3 - 5201 - 10 Seconds - UDP - 1000Mbit Objective - 1 (Mbits/s)	**947**	**956**	**956**
Normalized	99.06%	100%	100%
Standard Deviation	0.2%		

Serial Loopback Test

/dev/ttyS2, /dev/ttyTHS0, /dev/ttyTHS1, /dev/ttyTHS4



CUDA Mini-Nbody 2015-11-10

Test: Original



CUDA Mini-Nbody 2015-11-10

Test: Cache Blocking



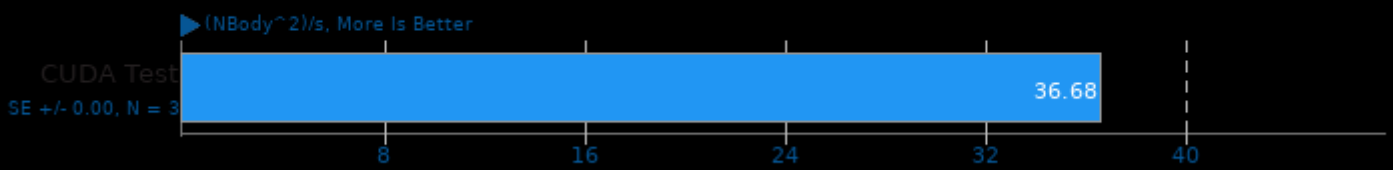
CUDA Mini-Nbody 2015-11-10

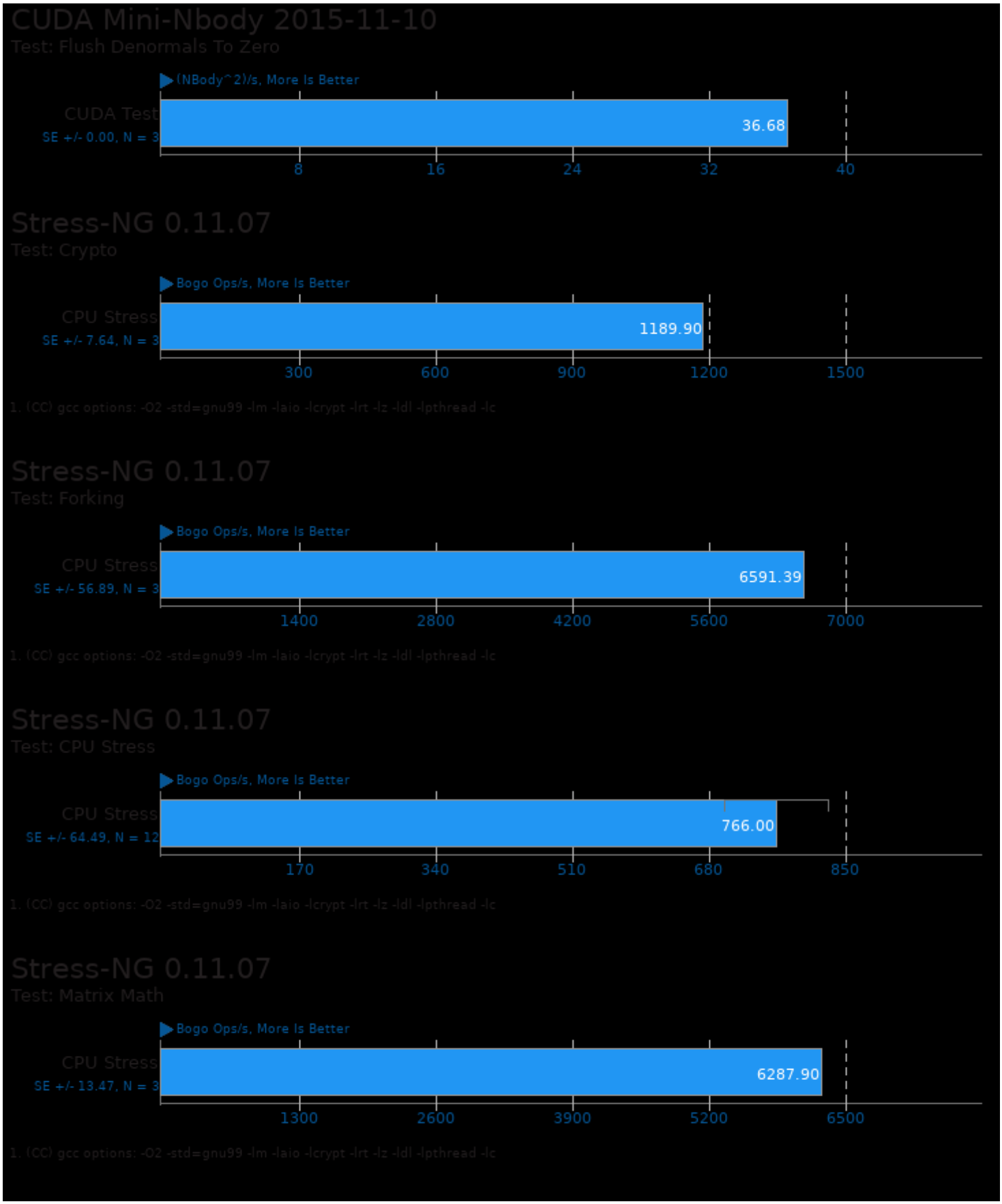
Test: Loop Unrolling

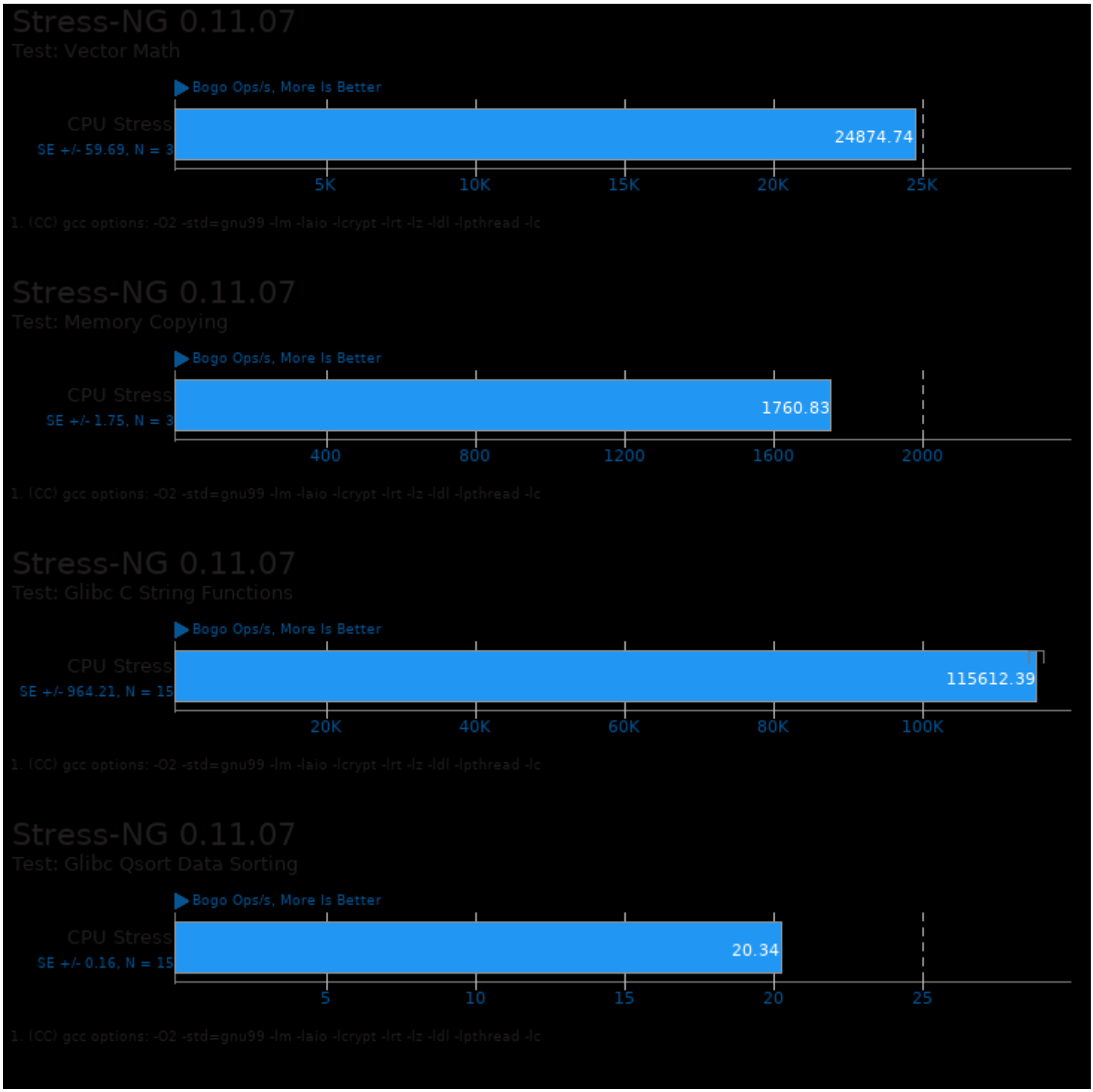


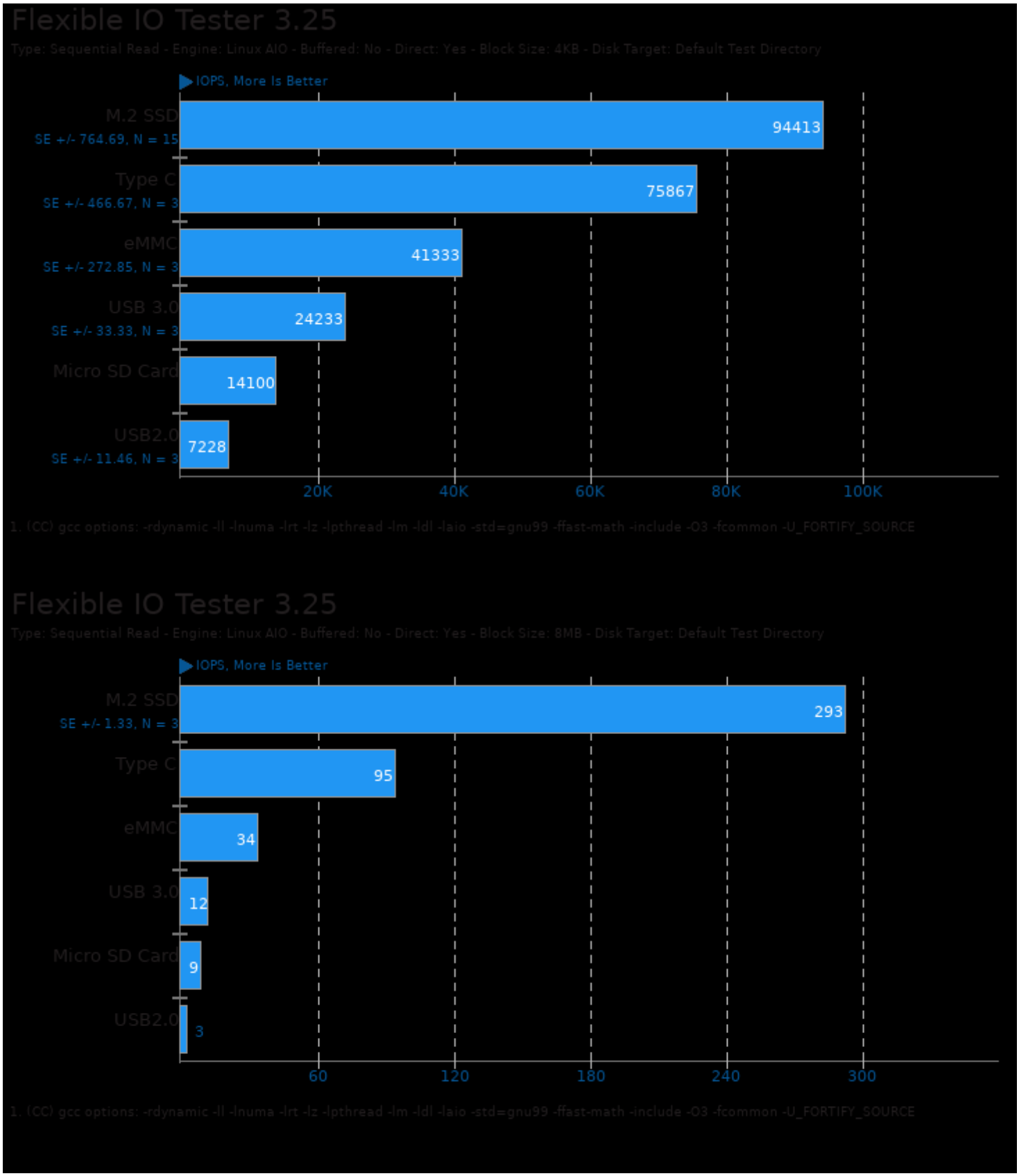
CUDA Mini-Nbody 2015-11-10

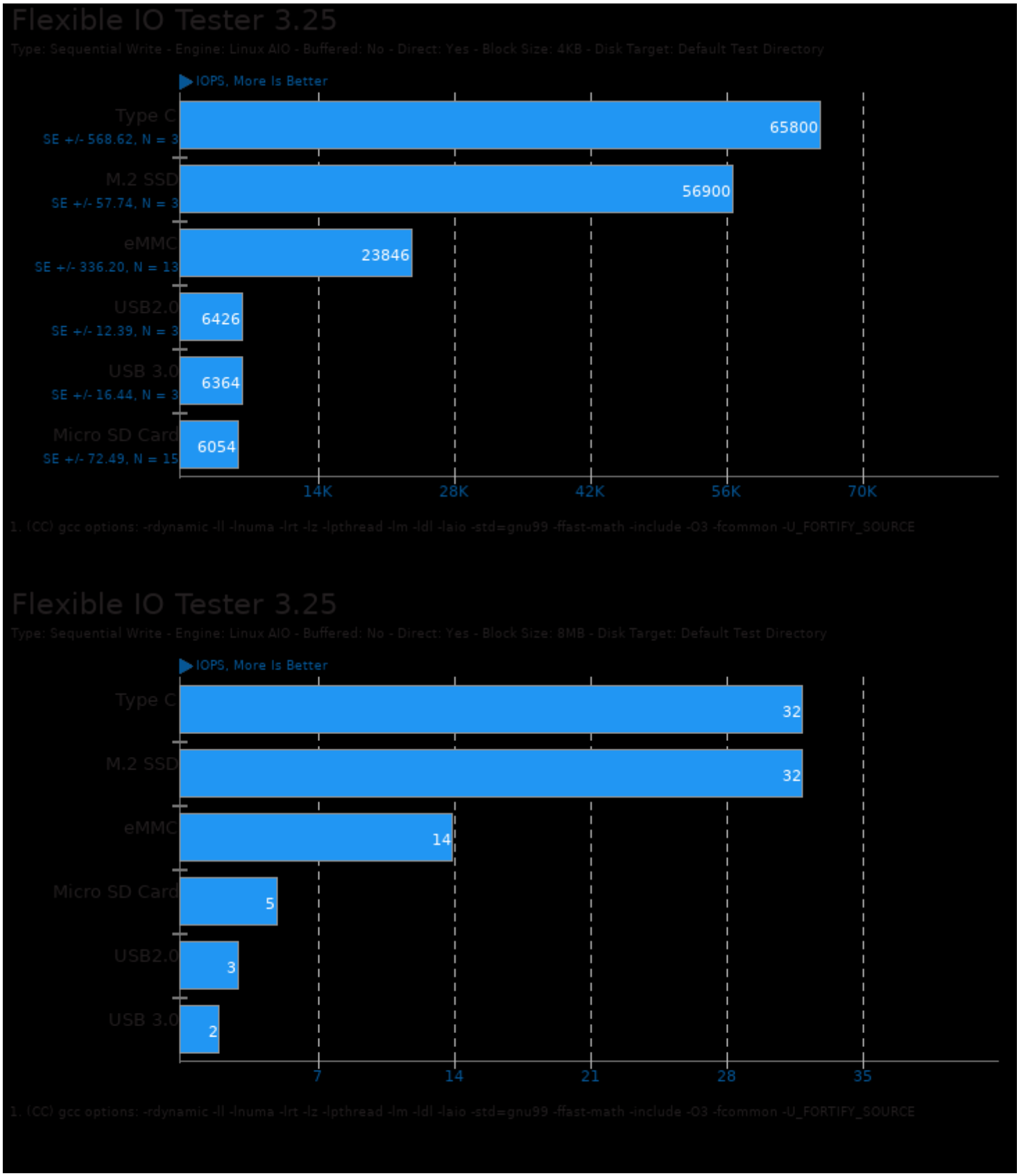
Test: SOA Data Layout



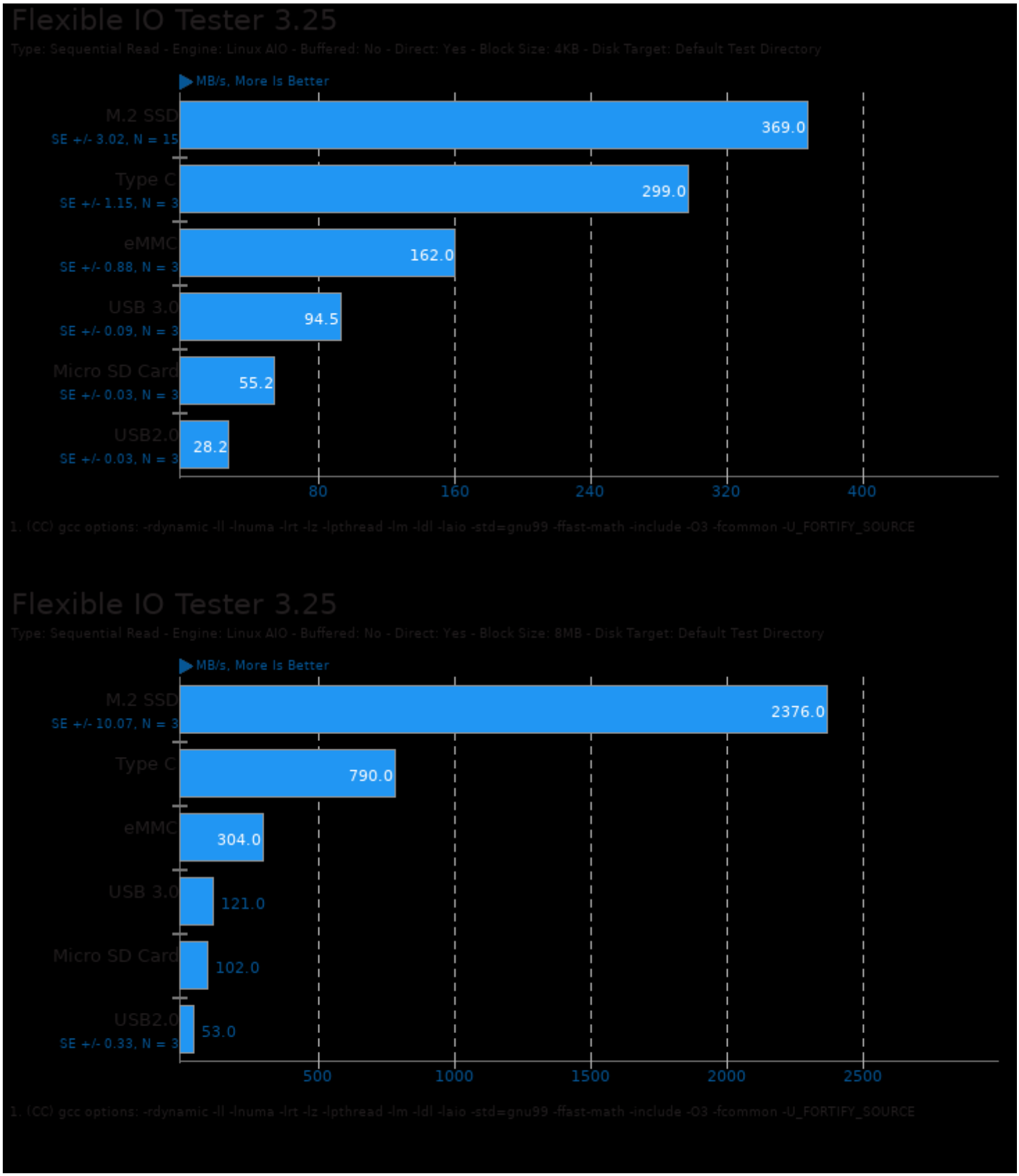

CUDA Mini-Nbody 2015-11-10
Test: Flush Denormals To Zero
(NBody^2)/s, More Is Better
CUDA Test
SE +/- 0.00, N = 3
36.68
8
16
24
32
40
Stress-NG 0.11.07
Test: Crypto
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 7.64, N = 3
1189.90
300
600
900
1200
1500
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc
Stress-NG 0.11.07
Test: Forking
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 56.89, N = 3
6591.39
1400
2800
4200
5600
7000
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc
Stress-NG 0.11.07
Test: CPU Stress
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 64.49, N = 12
766.00
170
340
510
680
850
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc
Stress-NG 0.11.07
Test: Matrix Math
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 13.47, N = 3
6287.90
1300
2600
3900
5200
6500
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc

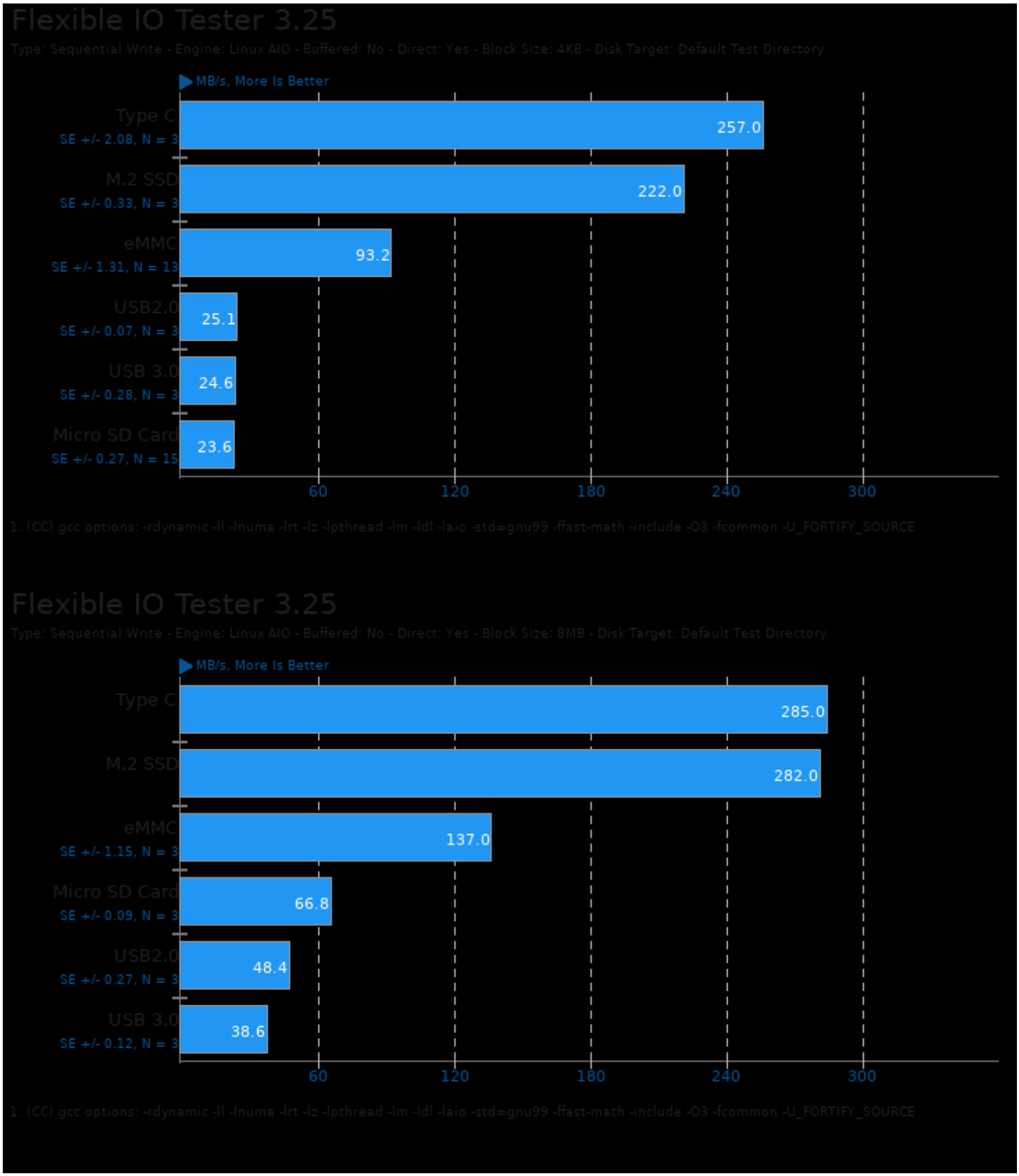

Stress-NG 0.11.07
Test: Vector Math
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 59.69, N = 3
24874.74
5K
10K
15K
20K
25K
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc
Stress-NG 0.11.07
Test: Memory Copying
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 1.75, N = 3
1760.83
400
800
1200
1600
2000
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc
Stress-NG 0.11.07
Test: Glibc C String Functions
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 964.21, N = 15
115612.39
20K
40K
60K
80K
100K
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc
Stress-NG 0.11.07
Test: Glibc Qsort Data Sorting
Bogo Ops/s, More Is Better
CPU Stress
SE +/- 0.16, N = 15
20.34
5
10
15
20
25
1. (CC) gcc options: -O2 -std=gnu99 -lm -laio -lcrypt -lrt -lz -ldl -lpthread -lc


Flexible IO Tester 3.25
Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory
IOPS, More Is Better
M.2 SSD
SE +/- 764.69, N = 15
94413
Type C
SE +/- 466.67, N = 3
75867
eMMC
SE +/- 272.85, N = 3
41333
USB 3.0
SE +/- 33.33, N = 3
24233
Micro SD Card
14100
USB2.0
SE +/- 11.46, N = 3
7228
20K
40K
60K
80K
100K
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE
Flexible IO Tester 3.25
Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory
IOPS, More Is Better
M.2 SSD
SE +/- 1.33, N = 3
293
Type C
95
eMMC
34
USB 3.0
12
Micro SD Card
9
USB2.0
3
60
120
180
240
300
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE

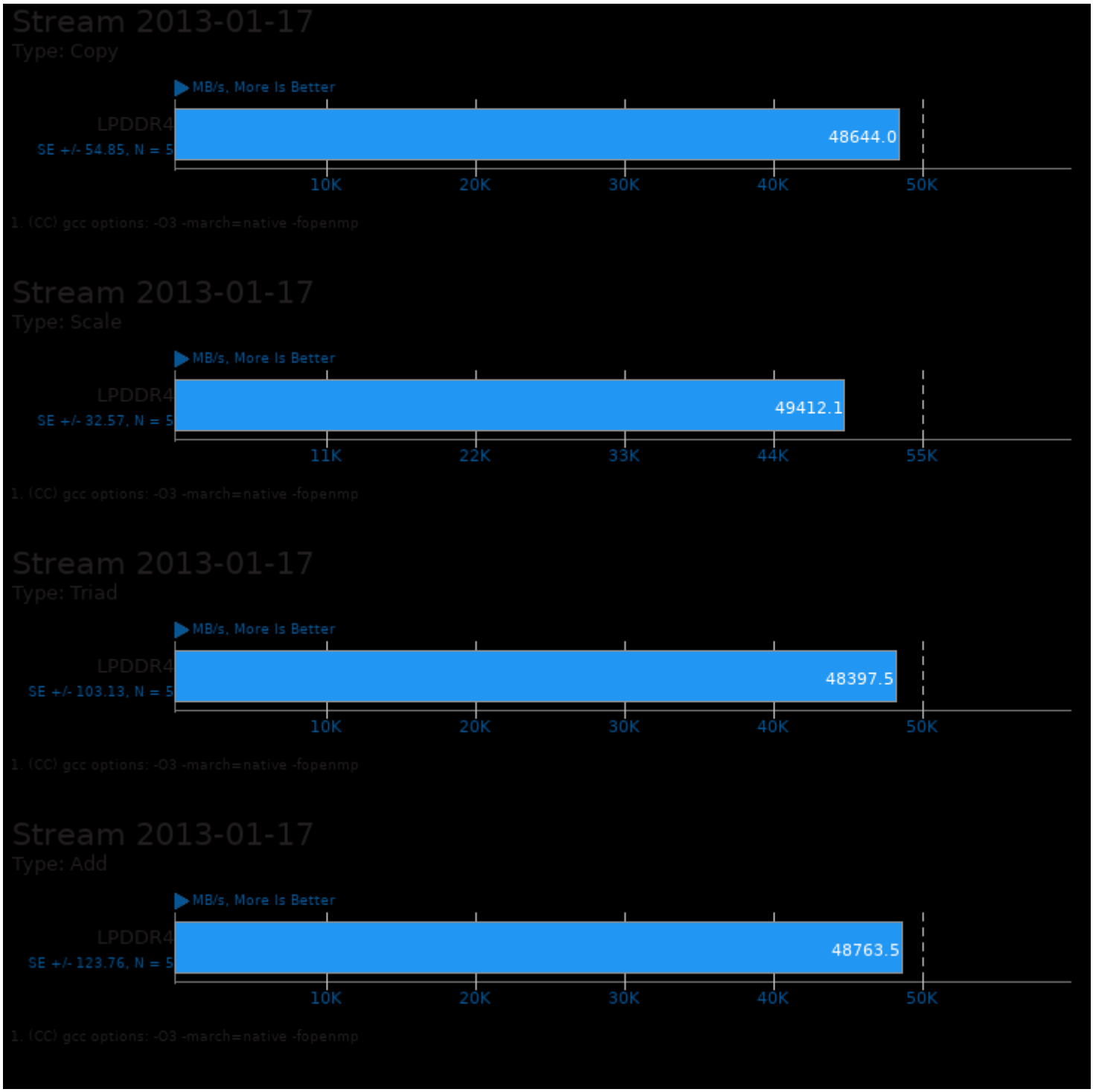

Flexible IO Tester 3.25
Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory
IOPS, More Is Better
Type C
SE +/- 568.62, N = 3
65800
M.2 SSD
SE +/- 57.74, N = 3
56900
eMMC
SE +/- 336.20, N = 13
23846
USB2.0
SE +/- 12.39, N = 3
6426
USB 3.0
SE +/- 16.44, N = 3
6364
Micro SD Card
SE +/- 72.49, N = 15
6054
14K
28K
42K
56K
70K
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE

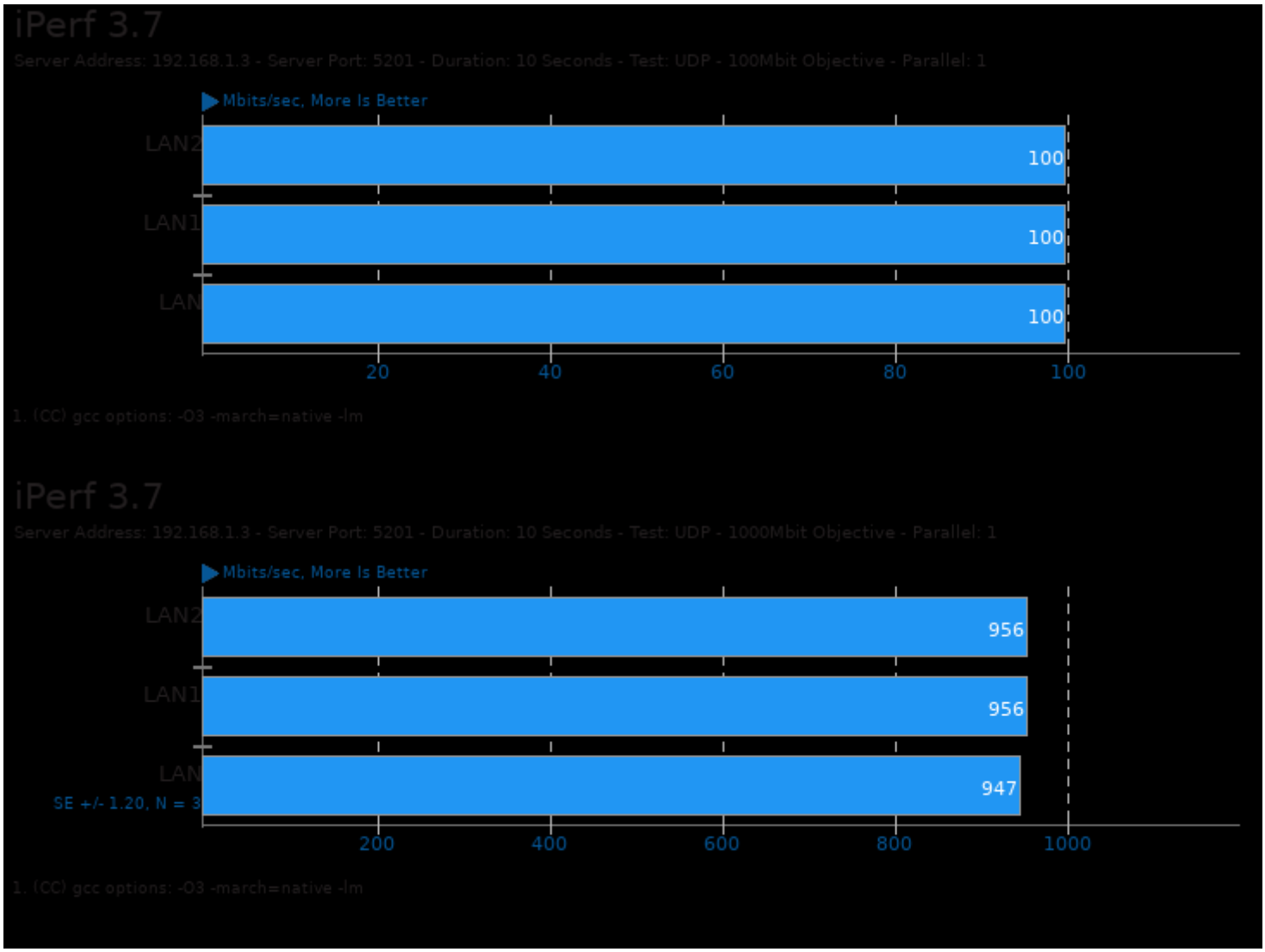
Flexible IO Tester 3.25
Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory
IOPS, More Is Better
Type C
32
M.2 SSD
32
eMMC
14
Micro SD Card
5
USB2.0
3
USB 3.0
2
7
14
21
28
35
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE


Flexible IO Tester 3.25
Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory
MB/s, More Is Better
M.2 SSD
SE +/- 3.02, N = 15
369.0
Type C
SE +/- 1.15, N = 3
299.0
eMMC
SE +/- 0.88, N = 3
162.0
USB 3.0
SE +/- 0.09, N = 3
94.5
Micro SD Card
SE +/- 0.03, N = 3
55.2
USB2.0
SE +/- 0.03, N = 3
28.2
80
160
240
320
400
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE
Flexible IO Tester 3.25
Type: Sequential Read - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory
MB/s, More Is Better
M.2 SSD
SE +/- 10.07, N = 3
2376.0
Type C
790.0
eMMC
304.0
USB 3.0
121.0
Micro SD Card
102.0
USB2.0
SE +/- 0.33, N = 3
53.0
500
1000
1500
2000
2500
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE


Flexible IO Tester 3.25
Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory
MB/s, More Is Better
Type C
SE +/- 2.08, N = 3
257.0
M.2 SSD
SE +/- 0.33, N = 3
222.0
eMMC
SE +/- 1.31, N = 13
93.2
USB2.0
SE +/- 0.07, N = 3
25.1
USB 3.0
SE +/- 0.28, N = 3
24.6
Micro SD Card
SE +/- 0.27, N = 15
23.6
60
120
180
240
300
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE

Flexible IO Tester 3.25
Type: Sequential Write - Engine: Linux AIO - Buffered: No - Direct: Yes - Block Size: 8MB - Disk Target: Default Test Directory
MB/s, More Is Better
Type C
285.0
M.2 SSD
282.0
eMMC
SE +/- 1.15, N = 3
137.0
Micro SD Card
SE +/- 0.09, N = 3
66.8
USB2.0
SE +/- 0.27, N = 3
48.4
USB 3.0
SE +/- 0.12, N = 3
38.6
60
120
180
240
300
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE


Stream 2013-01-17
Type: Copy
MB/s, More Is Better
LPDDR4
SE +/- 54.85, N = 5
48644.0
10K
20K
30K
40K
50K
1. (CC) gcc options: -O3 -march=native -fopenmp
Stream 2013-01-17
Type: Scale
MB/s, More Is Better
LPDDR4
SE +/- 32.57, N = 5
49412.1
11K
22K
33K
44K
55K
1. (CC) gcc options: -O3 -march=native -fopenmp
Stream 2013-01-17
Type: Triad
MB/s, More Is Better
LPDDR4
SE +/- 103.13, N = 5
48397.5
10K
20K
30K
40K
50K
1. (CC) gcc options: -O3 -march=native -fopenmp
Stream 2013-01-17
Type: Add
MB/s, More Is Better
LPDDR4
SE +/- 123.76, N = 5
48763.5
10K
20K
30K
40K
50K
1. (CC) gcc options: -O3 -march=native -fopenmp



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