

SSD Buying Guide

October 21, 2019

(click to travel – hit table of contents link to return – see donators at end of sheet!)

CONTENTS

DESKTOP/LAPTOP USE	1
SATA.....	1
Budget SATA.....	1
Performance SATA.....	2
Secondary SATA.....	2
Storage/Games.....	3
NVMe.....	4
Desktop/Performance	4
Mobile/Small Form Factor/Budget	5
WORKSTATION USE	6
Prosumer	6
Prosumer & Consumer.....	6
High Endurance.....	7
NOTES.....	8
Other Drives.....	8
Obsolete Drives	8
Uncommon/Other Drives	8
Technology.....	9
Controllers & DRAM/HMB	9
NAND.....	9
Glossary.....	10
Summary of Drive Combinations	14

Note: drives are not in any particular order, but are same-line for similar hardware

DESKTOP/LAPTOP USE

In most cases and for most users a SATA SSD will be sufficient for everyday use. The NVMe protocol has many advantages, for example better efficiency with less overhead, but these performance benefits are minor for the average user. Both SATA (AHCI) and NVMe drives come in the M.2 form factor although some M.2 sockets only support one protocol or the other. A SSD, regardless of type, is in general a huge upgrade from a mechanical HDD. However, not all SSDs are created equal, and it can be difficult to choose one given the current market.

SATA

SATA SSDs come in both the 2.5" and M.2 form factors. It's also possible to place them into enclosures, for example for transmission over USB, but this requires UASP support for proper use of TRIM/UNMAP. SSDs in an enclosure will also take a performance hit. Generally, only SSDs with a DRAM cache should be used for OS/mixed-use except on light or secondary machines. SSDs intended for storage or games will mostly be engaged in read operations and as such DRAM is not as critical. The presence of SRAM in the controller does not count as having DRAM. While an OS SSD might be only 120GB in size, a storage drive will usually be 480GB or more.

BUDGET SATA (SUITABLE FOR OS ON THE CHEAP)

Micron 1100¹ | Crucial MX300 | (Marvell 88SS1074 + 32L 3D TLC)

Team L5 Lite 3D² | Sunbow X3³

ADATA SU800/SX850/SX950U | HP S700 Pro | Team Delta RGB SSD | (SMI SM2258 + 32L TLC)

Gigabyte UD Pro | Seagate BarraCuda SSD | (Phison S10 + 64L 3D TLC)

Kingston UV500⁴

HP M700⁵

Mushkin Enhanced Reactor⁶

WD Blue Non-3D/2D

SK Hynix Gold S31

¹ The Micron 1100 is the OEM variant of the consumer Crucial MX300.

² This drive has variable NAND (should be 32L and 256GB/die, regardless).

³ Similar to the L5 Lite 3D, but purchase with caution.

⁴ The HyperX Fury RGB uses same hardware but is prone to overheating due to LEDs.

⁵ DRAM-less but with quality 2D Samsung MLC.

⁶ 2D MLC with an older, DRAM-equipped controller (SM2246EN). Beware, multiple SKUs.

PERFORMANCE SATA (BEST SATA DRIVES FOR OS)

Samsung 860 EVO⁷

Crucial MX500 | Lexar NS200⁸ | Team Vulcan SSD | Intel 545s⁹ | Kingston KC600

WD Blue 3D | SanDisk Ultra 3D

ADATA SX950U¹⁰

SECONDARY SATA (OS FOR SECONDARY/OLD/LIGHT MACHINES)

Kingston A400¹¹

Inland SATA SSD | Patriot Burst | PNY CS900 | (Phison S11 + 64L 3D TLC)

ADATA SU650/SU655 | HP S700 Non-Pro | (SMI SM2258XT + 32L 3D TLC)

Hyundai Sapphire

Silicon Power A55/S55¹²

Gigabyte SSD Non-Pro

Crucial BX500¹³ | Mushkin Source | Team MS30¹⁴ | Team GX1/GX2 |

(SMI SM2258XT + 64L/96L 3D TLC)

WD Blue Non-3D/2D

ADATA SU750

⁷ The older 850 EVO has multiple variations but would fit into this category.

⁸ The NS200 has a shorter warranty period but higher TBW than the MX500.

⁹ SM2259 vs. SM2258 of the other drives, but is quite similar.

¹⁰ 240GB SKU uses 32L TLC and is Budget SATA, higher capacities use 64L like the MX500.

¹¹ This drive has 2D/planar TLC but is exceptionally common.

¹² Variable hardware but assumed DRAM-less.

¹³ Utilizes 96L TLC with the 960GB SKU, as well as the SM2259XT (similar to SM2258XT).

¹⁴ This drive comes in the M.2 form factor only. It should have the same hardware as the BX500, but unconfirmed.

STORAGE/GAMES (NON-PRIMARY/OS DRIVE)

Kingston A400

ADATA SU650 | HP S700 Non-Pro | (SMI SM2258XT | 32L 3D TLC)

Hyundai Sapphire

Micron 1100 | Crucial MX300

ADATA SU800/SX850/SX950U | HP S700 Pro | Team Delta RGB SSD

Inland SATA SSD | Patriot Burst | PNY CS900 | (Phison S11 + 64L 3D TLC)

Gigabyte SSD Non-Pro

Silicon Power A55/S55

Crucial BX500 | Mushkin Source | (SMI SM2258XT + 64L 3D TLC)

Team MS30 | Team GX1/GX2

ADATA SU630/SU635 (QLC)

Samsung 860 QVO (QLC)¹⁵

WD Blue Non-3D/2D

Addlink S22 | Kingston Q500 | (Phison S11T/S13T & QLC)

¹⁵ This drive has DRAM cache but is not also listed under Budget SATA due to QLC performance.

NVME

The NVMe protocol has many advantages over AHCI related to commands, queue depth, interrupts, parallelism/threads, general efficiency, I/O and processing overhead, IOPS, latency, raw bandwidth, etc. Most general users will only see small performance gains, for example with game load times, by moving to a NVMe SSD over SATA. Consumer motherboards are currently quite limited in PCIe lanes and therefore potential bandwidth, with some exceptions (X570).

However, M.2 sockets with PCIe support are becoming more common especially with PCIe 4.0 support on AMD's X570. There are users who like to have that extra performance under the hood for when they might need it. NVMe drives inherently should not add a lot of cost so a budget variant may be a viable option for those looking to leave SATA behind. Not all NVMe drives are created equal despite the belief that they all have the same performance profile.

Mobile and small form factor machines can benefit from the superior power efficiency and smaller thermal footprint found with four-channel controllers and single-sided drives. QLC is also useful here as it has a higher density than MLC and TLC while potentially being cheaper. Additionally, NVMe can cut down further by omitting DRAM cache, using NVMe's HMB technology to use system memory instead. For the Mobile/SFF/Budget category I suggest TLC-based drives for capacities at 512GB or less and the QLC-based drives (660p, P1) only at 1-2TB.

DESKTOP/PERFORMANCE (HIGH PERFORMANCE DESKTOP)

ADATA SX8200 (S11) Non-Pro | HP EX920 | Mushkin Pilot | Intel 760p¹⁶ | (SMI SM2262 + 64L)

ADATA SX8200 (S11) Pro | HP EX950 | Pilot-E | KC2000 (96L) | (SMI SM2262EN + 64/96L TLC)

Phison E12 Drives (see list at end, or the row under Prosumer & Consumer)

ADATA S40G/SX8100¹⁷

¹⁶ The Intel 760p, unlike the other drives that share its hardware, is single-sided up to and including the 1TB SKU.

¹⁷ Borderline Budget NVMe.

MOBILE/SMALL FORM FACTOR/BUDGET (SATA REPLACEMENT)

Intel 660p (QLC) | Crucial P1 (QLC)¹⁸ | Intel 665p¹⁹

HP EX900 | Mushkin Helix-L | Lexar NM600

ADATA SX6000 Pro/S5

ADATA SX6000 Lite

WD SN500

Corsair MP300 | Inland Pro. NVMe | Kingston A1000 | MDSSD SBX | Patriot Scorch

| Team MP32 | (Phison E8 + 64L 3D TLC)

Kingston A2000²⁰

Team MP33

¹⁸ The Crucial P1 differs from the 660p in some ways: more DRAM cache, double-sided w/DDR4 at the 2TB SKU.

¹⁹ 660p but with 96-layer QLC.

²⁰ Borderline High Performance NVMe.

WORKSTATION USE

Those with systems that have higher demands, specifically production and development, may opt for higher-end NVMe drives. These demands can include everything from mass virtual machines, media creation, server tasks, programming with development environments, 3D modeling, and much more. Requirements can still differ, however; a mixed-use machine might benefit from consumer-type performance, such as random 4K low queue depth. Or maybe all that is needed is higher queue depth performance along with sustained write performance. Fast sequential performance or consistent steady state may be desirable. And lastly, someone might require write endurance with a high TBW/DWPD (warranty) rating.

PROSUMER²¹ (STEADY STATE)

WD Black (2018)²² | WD Black SN750²³ | SanDisk Extreme Pro NVMe

PROSUMER & CONSUMER (WORK & PLAY)

MyDigitalSSD BPX Pro | Corsair MP510 | Addlink S70 | Seagate FireCuda/BarraCuda 510

| Silicon Power P34A80 | Sabrent Rocket | Inland Premium | Gigabyte Aorus |

PNY XLR8 CS3030 | HIKVision C2000 | Patriot Viper VPN100 | Asura Genesis Xtreme

| Team Cardea II/Liquid/MP34 | (Phison E12 & 64L 3D TLC)

Samsung 970 EVO

Samsung 970 EVO Plus²⁴

ADATA SX8200 Pro/S11 Pro²⁵ | HP EX950 | Mushkin Pilot-E | Kingston KC2000 |

(SM2262EN + 64L/96L TLC)

Corsair MP600 | Essencore ECT455 | Galax HOF 4.0 | Gigabyte Aorus Gen4 | MSI Lighting

| Patriot Viper VP4100 | PNY CS4040 | Team Cardea Zero/Z440 | Sabrent Rocket 4.0 |

Inland Perf. | ADATA XPG GAMMIX S50 | (Phison E16 + 96L TLC)

²¹ These drives have consistent writes/performance (small, static SLC cache) ideal for certain workloads.

²² This drive, along with the 970 series and the smaller capacity (<=512GB) E12 drives, is single-sided.

²³ Updated version of the WD Black (2018): new firmware, heatsink, and a 2TB SKU.

²⁴ Updated version of the 970 EVO: 96L NAND, refined firmware.

²⁵ These drives (SM2262EN) are optimized for peak performance at the cost of consistency.

HIGH ENDURANCE (HIGH TBW/WARRANTY)

E12 & E16 (see above)

Samsung 970 Pro²⁶

²⁶ This drive is MLC-based and has no SLC cache so has consistent write performance. MLC has three times higher raw endurance than TLC. The SATA-based 860 Pro also technically fits here.

NOTES

It's difficult to cover all the different questions people might have about selecting the proper SSD for their needs. In many cases any SSD will do, and in most cases any drive under the SATA Performance heading will be the best compromise. This guide is not intended to encourage people to go one way or another, or to choose one brand over another; rather, it is to offer a form of differentiation based on the hardware specialization of the drives. Manufacturers do choose to go after specific markets when they design their drives.

The information that follows is presented to cover some drives you might come across that are not explicitly listed in the guide. Note that Optane and OEM drives are considered outside of the guide's scope and are therefore omitted. Also, please check my spreadsheet for portable drives. I also cover what I term "obsolete" drives that have been effectively replaced by superior alternatives, despite still being available. I also briefly delve into the technology and hardware behind SSDs. Lastly, a glossary is offered that breaks down the various acronyms used in the guide.

OTHER DRIVES

Crucial BX300 – Budget SATA (Marvell 88SS1074 + 32L 3D MLC)

SanDisk Ultra II – Budget SATA (Marvell 88SS9189/9190 + 2D TLC)

Samsung 850 EVO – Performance SATA

Various Toshiba/OCZ, Plextor, etc. – assume Secondary SATA

OBSOLETE DRIVES

ADATA SX6000 Non-Pro (Overheats)

Samsung 960 EVO²⁷ (Overpriced/out-classed)

UNCOMMON/OTHER DRIVES

2D/planar TLC drives (e.g. WD Green SSD) – should be avoided in most cases

HP S600, Team L5 Lite 2D – garbage tier

Bill-of-material (BOM)²⁸ drives (e.g. SanDisk SSD Plus) – avoid or Storage/Games

²⁷ This drive is not obsolete from a performance standpoint, there are simply better alternatives.

²⁸ These drives have variable hardware and are therefore considered inconsistent.

TECHNOLOGY

Although SSDs seem to be a confusing mish-mash of terminologies they essentially break down into their hardware components: the controller, which usually determines if it has DRAM cache or not, and the NAND or flash memory. To see combinations, check summary after the glossary. Note that firmware and error-correction (ECC) also impact performance and endurance.

DRAM cache increases NAND lifespan by reducing write amplification (WAF) and also increases write performance. It is used to store mapping/translation data and can defer changes to the “table of contents” metadata as contained on the drive’s NAND. NVMe drives can use HMB technology to use system memory with a small performance penalty. Ideally, DRAM (or HMB) should be present in primary and mixed-use drives and with anything of importance.

NAND comes in 2D and 3D (BiCS) forms with more layers for the latter usually being better as it allows for a balance between performance, density, and endurance. The flash has a native speed (MT/s) as well as a faster pSLC/SLC buffer with some reserved (over-provisioned) space for wear-leveling and garbage collection (GC). Most drives are now TLC with MLC becoming less common and QLC more common; more levels means more voltage states, potentially increasing density at the cost of performance and endurance.

CONTROLLERS & DRAM/HMB

SMI SM22xx/SM22xxEN – DRAM cache

SMI SM22xxXT – DRAM-less (SM2263XT – DRAM-less w/HMB)

Phison S10/E8/E12/E16 – DRAM cache

Phison S11 – DRAM-less (E8T can use HMB)

Marvell 88SS1074 – DRAM cache

Marvell 88NV1120 – DRAM-less

Samsung – DRAM cache

Maxio MAS0902A-B2C – DRAM-less

Realtek RTS5760 – DRAM cache (Realtek RTS5763/DL – DRAM-less w/HMB)

NAND

IMFT or Intel/Micron, most commonly paired with SMI controllers

Toshiba, most commonly paired with Phison controllers

SanDisk, used in WD and SanDisk drives (often relabeled Toshiba)

Samsung, used in Samsung drives

GLOSSARY

2.5" – typical form factor for SATA, SATAe, and U.2 drives. Can be of varying height, usually 7mm.

2D/planar – two-dimensional NAND. Older type of NAND that is moving out of production except for budget-oriented drives. Also called planar because it sits on a plane.

3D – three-dimensional NAND. Newer type of NAND with a varying amount of layers. The third dimension offers more space between cells, reducing cell-to-cell interference. This allows greater headroom for a balance between higher density, higher performance, and endurance.

32L – 32-layer 3D NAND.

64L – 64-layer 3D NAND.

96L – 96-layer 3D NAND.

AHCI – advanced host controller interface. An old standard that did not anticipate the very low latencies and very high IOPS of solid state devices.

ARM – Arm Holdings. Designer of microcontrollers including the ones found in SSDs.

BCH – Bose-Chaudhuri-Hocquenghem codes, an ECC scheme as used on some SSD controllers like the Phison S10.

BiCS – bit cost scaling; in general BiCS = 32-layer, BiCS2 = 48-layer, BiCS3 = 64-layer, and BiCS4 = 96-layer.

CE – chip enable. Effectively, the maximum number of targets or dies per controller channel.

Conversion – conversion of SLC blocks to native NAND (e.g. TLC) used with dynamic SLC cache, for example Micron's DWA.

DDR3 – double data rate 3rd generation SDRAM. DRAM used in older computers and as DRAM cache on many SSDs. Also found in a low-power configuration (LPDDR3).

DDR4 – double data rate 4th generation SDRAM. Type of DRAM now common in computers and for DRAM cache on some SSDs. Also found in a low-power configuration (LPDDR4).

Direct-to-TLC – method of writing directly to native NAND when the SLC cache is exhausted.

DRAM – dynamic random-access memory. Volatile memory that is significantly faster than the flash used in a SSD, used as cache for mapping/translation and wear-leveling data.

DWA – dynamic write acceleration. Micron’s method of converting blocks between SLC and the native format on-the-fly as deemed necessary.

DWPD – drive writes per day. This is a measure of how many actual writes can be done to the NAND per day while not exceeding the warranted TBW.

ECC – error-correcting code. Used in SSDs to correct data errors, with limits. Initial TLC drives would slow down due to reliance on ECC to read “fuzzy” data that had remained unchanged. This was fixed with static data refresh algorithms that rewrite stale data, but it began as an issue with TLC due to the increased amount of voltage states and thus sensitivity. ECC is a critical aspect of SSD endurance. Some controllers, like the Phison S10, suffer for using BCH-based ECC in comparison to the now more-common LDPC-based ECC.

Folding – transfer of data from SLC blocks to a MLC/TLC/QLC block, for example 3 SLC blocks to 1 TLC block. Reduces NAND wear as this is written sequentially but is less performant. Can be done on-die without intervention of the controller or DRAM.

FTL – flash translation layer. Enables the OS to treat the SSD like a HDD, providing translation of addresses and garbage collection. Often in DRAM and SLC cache for faster accesses.

GC – garbage correction. The consolidation of written data to allow for the erasure of blocks, usually in tandem with wear-leveling.

HDD – hard disk drive. A mechanical/magnetic hard drive utilizing heads and platters for non-volatile storage.

HMB – host memory buffer. A NVMe technology that allows a SSD to utilize system memory (RAM) for DRAM cache instead of having dedicated memory on the drive’s PCB.

IMFT – IM Flash Technologies. Joint-founded by Intel and Micron, recently fully acquired by Micron. Manufactures NAND.

IOPS – input/output operations per second. This is a measure of how many input and output operations can be completed per second.

LDPC – low density parity codes. A type of ECC increasingly used by modern SSDs.

M.2 – previously NGFF or next generation form factor. A socket that accepts a varying length of device, not limited to SSDs, with “keying” of the connector/fingers to determine the interface. Can act as direct PCIe and/or expose as USB and SATA.

MLC – multi-level cell, often taken to indicate double-level cell. Twice the capacity of SLC but with only one-tenth the endurance, and less performance as well. Two-bit with four voltage states.

MT/s – megatransfers per second. Number of operations per second that transfer data, related to ONFI/Toggle with NAND.

NAND – not-and logic gate. Equivalent to an AND gate followed by a NOT gate.

NVMe – NVM Express, or non-volatile memory express. A protocol designed for the future of storage with superior capabilities to AHCI.

ONFI – Open NAND Interface Working Group. A group focusing on open standards for NAND.

Overprovisioning – reserving NAND for the controller’s usage to assist in wear-leveling, garbage collection, performance (static SLC and FTL), and other uses. Increases endurance and often write performance.

PCB – printed circuit board. The portion of the drive that supports and connects other components.

PCIe – PCI Express, or peripheral component interconnect express. Serial connection acting as a switch to provide communication between devices and the CPU.

P/E – program/erase cycles. Once data is written to the NAND it has to be erased to be rewritten. This value is therefore how many writes the cells can withstand before the data becomes corrupt and unreadable. This is a measurement of endurance. A 1TB drive of 1,000 P/E QLC NAND can withstand, for example, about 1PB of writes before accounting for the WAF.

pSLC – pseudo-SLC. Usually TLC NAND acting in SLC mode. Referred to as “SLC cache,” this uses three times the capacity for the same amount of data with the advantage of faster speeds. pSLC can be static or dynamic and some drives have both. Blocks in SLC mode can move to blocks of native NAND in a process known as folding. pSLC can be flushed to TLC in the background and, when full, newer controllers can write directly to the TLC portion of the drive.

QLC – quad-level cell. Four times the capacity of SLC but with only one-third the endurance of TLC, and less performant. Four-bit with sixteen voltage states.

SATA – serial advanced technology attachment. Old bus interface/standard for storage devices.

SATA Express – also known as SATAe, interface supporting both SATA and PCIe devices.

SCSI – small computer system interface. Set of standards for computers to communicate with peripheral devices via commands.

SDRAM – synchronous dynamic random-access memory.

SKU – stock keeping unit. Distinct type of item, used to connote a specific model and capacity.

SLC – single-layer cell. The least-capacious but most performant type of flash with the highest endurance. Single-bit with two voltage states.

SMI – Silicon Motion. Designer of many SSD controllers.

SRAM – static random-access memory. All SSD controllers have this type of local memory in small amounts. It can be used like DRAM cache, but is faster; basically CPU cache.

SSD – solid state drive. Device using circuits as memory to provide non-volatile storage.

TBW – total bytes written. Amount of actual data written to the NAND.

TLC – triple-level cell. Three times the capacity of SLC but with only one-third the endurance of MLC, and less performant than both. Three-bit with eight voltage states.

TRIM/UNMAP – commands to mark data blocks as no longer needed. TRIM as a SATA command marks blocks as free for rewriting which improves performance and endurance. UNMAP is a SCSI command that works similarly for block reclamation.

U.2 – also known as SFF-8639, interface similar to SATA Express with PCIe and SATA lanes.

UASP – USB attached SCSI protocol. Uses the SCSI command set for USB devices, including external SSDs.

USB – universal serial bus. Standard for connections and communication between computers and peripheral devices. Several different iterations with varying bandwidth.

WAF – write amplification factor. The proportion of how much is written for an actual piece of data; if the drive ends up doing 15GB of writes for 10GB of final data, this is a WAF of 1.5, which is not uncommon with consumer workloads. Impacts wear.

WD – Western Digital. Manufacturer of storage devices including SSDs. Owner of SanDisk.

SUMMARY OF DRIVE COMBINATIONS**Marvell 88SS1074²⁹****2D/Planar TLC NAND from SanDisk (15nm)**

WD Blue Non-3D

32L 3D TLC NAND from IMFT (384-Gbit)

Micron 1100

Crucial MX300

64L 3D TLC NAND from SanDisk

WD Blue 3D

SanDisk Ultra 3D

64L 3D TLC NAND from Toshiba

Kingston HyperX Fury

Kingston UV500

Marvell 88NV1120³⁰**32L 3D TLC NAND from IMFT (384-Gbit)**

Hyundai Sapphire

64L 3D TLC NAND from Micron

HP S600

SK Hynix Quartz**72L 3D TLC NAND from Hynix**

SK Hynix Gold S31

²⁹ The Marvell 88SS1074 is dual-core, four-channel (4x8 CE) with DRAM cache.

³⁰ The Marvell 88NV1120 is dual-core, two-channel (2x4 CE) without DRAM cache.

SMI SM2258³¹**32L 3D TLC NAND from IMFT (384-Gbit)**

ADATA SU800

HP S700 Pro

Team Delta RGB SSD

ADATA SX950U (240GB)

32L 3D TLC NAND from various (256-Gbit)

Team L5 Lite 3D

TC Sunbow X3

64L 3D TLC NAND from IMFT

Crucial MX500

ADATA SX950U (>240GB)

Lexar NS200

Team Vulcan SSD

SMI SM2259³²**64L 3D TLC NAND from IMFT**

Intel 545s

Kingston KC600

SMI SM2258XT³³**2D MLC from Samsung**

HP M700

32L 3D TLC NAND from IMFT (384-Gbit)

ADATA SU650/SU655

HP S700 Non-Pro

Silicon Power A55/S55

³¹ The SMI SM2258 is single-core, four-channel (4x8 CE) with DRAM cache.

³² SM2258 with improved LDPC.

³³ SM2258XT with improved LDPC.

64L 3D TLC NAND from IMFT

Crucial BX500
Mushkin Source
Team MS30

SMI SM2259XT³⁴**96L 3D TLC NAND from IMFT**

Crucial BX500 (960GB)

SMI SM2262³⁵**64L 3D TLC NAND from IMFT**

ADATA SX8200 Non-Pro
HP EX920
Mushkin Pilot
Intel 760p

SMI SM2262EN³⁶**64L 3D TLC NAND from IMFT**

ADATA SX8200 Pro/S11 Pro
HP EX950

64L/96L 3D TLC NAND from Micron

Mushkin Pilot-E

96L 3D TLC NAND from Toshiba

Kingston KC2000

SMI SM2263³⁷**64L 3D QLC NAND from IMFT**

Intel 660p
Crucial P1

³⁴ The SMI SM2258XT is single-core, four-channel (4x8 CE) without DRAM cache.

³⁵ The SMI SM2262 is dual-core, eight-channel (8x4 CE) with DRAM cache.

³⁶ The SMI SM2262EN is dual-core, eight-channel (8x4 CE) with DRAM cache.

³⁷ The SMI SM2263 is dual-core, four-channel (4x4 CE) with DRAM cache.

96L 3D TLC NAND from Toshiba

Kingston A2000

SMI SM2263XT³⁸**64L 3D TLC NAND from IMFT**

HP EX900

Mushkin Helix-L

Lexar NM600

Phison S10³⁹**64L 3D TLC NAND from Toshiba (BiCS3)**

Gigabyte UD Pro

Seagate BarraCuda SSD

Phison S11⁴⁰**2D/Planar TLC from Toshiba (15nm)**

Kingston A400⁴¹

64L 3D TLC NAND from Toshiba

Inland SATA SSD

Patriot Burst

PNY CS900

Gigabyte SSD Non-Pro

Phison S11T/S13T**64L 3D QLC NAND**

Addlink S22

Kingston Q500

³⁸ The SMI SM2263XT is dual-core, four-channel (4x4 CE) without DRAM cache but with HMB.

³⁹ The Phison S10 is quad-core, eight-channel (4x8 CE) with DRAM cache designed for 2D/planar NAND.

⁴⁰ The Phison S11 is single-core, two-channel (2x8 CE) without DRAM cache.

⁴¹ This drive has been seen with 32L/384Gb Micron TLC in some regions.

Phison E8T⁴²**64L 3D TLC NAND from Toshiba**

Gigabyte NVMe

Inland Basic NVMe

Phison E8⁴³**64L 3D TLC NAND from Toshiba**

Corsair MP300

Inland Professional NVMe

Patriot Scorch

MyDigitalSSD SBX

Kingston A1000

Team MP32

Phison E12⁴⁴**64L 3D TLC NAND from Toshiba**

MyDigitalSSD BPX Pro

Corsair MP510

Addlink S70

Seagate FireCuda/BarraCuda 510

Silicon Power P34A80

Sabrent Rocket

Inland Premium

Team MP34 / Cardea II / Cardea Liquid

Gigabyte Aorus (RGB)

PNY XLR8 CS3030

Asura Genesis Xtreme

⁴² The Phison E8T is dual-core, four-channel (4x8 CE) without DRAM cache (HMB).

⁴³ The Phison E8 is dual-core, four-channel (4x8 CE) with DRAM cache.

⁴⁴ The Phison E12 is dual-CPU, eight-channel (8x4 CE) with DRAM cache.

Phison E16⁴⁵**96L 3D TLC NAND from Toshiba**

Corsair MP600

Essencore ECT455

Galax HOF 4.0

Gigabyte Aorus 4.0

Inland Performance

MSI Lightning

Patriot Viper VP4100

PNY CS4040

Team Cardea Zero/Z440

Sabrent Rocket 4.0

ADATA XPG GAMMIX S50

Samsung Proprietary**64L 3D TLC NAND from Samsung**

Samsung 860 EVO (SATA – Samsung MJX⁴⁶)

Samsung 970 EVO (NVMe – Samsung Phoenix⁴⁷)

64L 3D QLC from Samsung

Samsung 860 QVO (SATA – Samsung MJX²²)

96L 3D TLC NAND from Samsung

Samsung 970 EVO Plus (NVMe – Samsung Phoenix)

Realtek RTS5760⁴⁸**32L 3D TLC NAND from IMFT (384-Gbit)**

ADATA SX6000 Non-Pro

⁴⁵ The Phison E16 is dual-CPU, eight-channel (8x4 CE) with DRAM cache & a 4.0 PHY.

⁴⁶ The Samsung MJX is tri-core, eight-channel (8x8 CE) with DRAM cache.

⁴⁷ The Samsung Phoenix is penta-core, eight-channel (8x8 CE) with DRAM cache.

⁴⁸ The Realtek RTS5760 is four-channel with DRAM cache.

Realtek RTS5762**64L 3D TLC NAND**

ADATA S40G

ADATA SX8100

Realtek RTS5733DMQ**64L 3D TLC NAND from IMFT**

ADATA SU750

Realtek RTS5763DL⁴⁹**64L 3D TLC NAND from IMFT**

ADATA SX6000 Pro/S5

ADATA SX6000 Lite

WD Proprietary**64L 3D TLC NAND from SanDisk**WD Black (2018)⁵⁰

SanDisk Extreme Pro NVMe

WD SN750

WD SN500⁵¹**Maxio MAS0902A-B2C****64L 3D QLC from IMFT**

ADATA SU630/SU635

ADATA SD600Q

⁴⁹ The Realtek RTS5763DL is four-channel without DRAM cache but with HMB.

⁵⁰ The controller in the WD Black (2018) and SN750 is tri-core, eight-channel with DRAM cache.

⁵¹ This controller lacks corresponding DRAM and also does not utilize HMB

TOP DONATORS

These donations help make it possible for me to continue creating content for the community. Thank you!

James Alston

Josh Chapman

Joel Magaña