

## Overview of Consumer SSD Offering

**HyperX:** Designed for enthusiasts and gamers, HyperX® 3K SSD is Kingston's fastest SSD product.

**KC300:** Targeted to the business user with additional security and power savings features, KC300 is a high-performing, business-oriented SSD with security and power saving features.

**V300:** Ideal for consumers, this entry-level SSD delivers a good mix of price and performance. It's designed for HDD replacement, with a balance between performance and entry-level pricing.

## Product Builds and Speed Differences – V300

In order to achieve a balance of price and performance, we must maintain the flexibility to source NAND Flash components from various Tier 1 NAND manufacturers. At times, this will mean that there is a difference in benchmarked performance, where certain builds outperform our advertised specification (450MB/s Read / Write) while other drives will meet the advertised specification. Regardless of revision, all V300 SSDs still demonstrate 10x performance when compared to HDDs.

## Product Testing Using ATTO

Our SSD performance specification is based on the ATTO benchmark, which demonstrates the sequential read and write capabilities of our drives using the LSI SandForce® controller; what is absent from these numbers and not often captured in benchmarks is the effectiveness of the underlying LSI SandForce DuraWrite™ technology. The DuraWrite architecture was designed to extend the life of the NAND used within Kingston® SSDs. It does this by using unique algorithms that reduce the amount of data written to the SSDs Flash memory cells, thus extending NAND and SSD life. A beneficial byproduct of this reduction is a resulting increase in performance when compressible data is used. (Learn more about DuraWrite in this [video](#).)

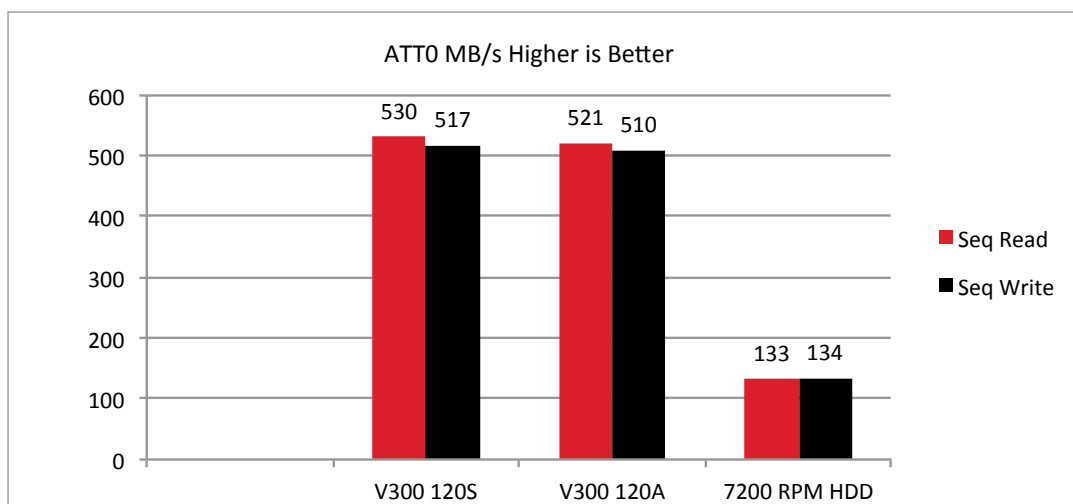


Figure 1

Figure 1 shows the results from ATTO using the V300 120GB SSD with both synchronous and asynchronous NAND Flash. Asynchronous NAND typically operates at a slower MT/s rate than synchronous NAND, but still enables a very high performing SSD. The HDD used in these tests is a 7200RPM 500GB SATA 6Gb/s. All drives in the following tests were used as the primary drive in the system running Windows 7 64 bit, installed on an ASUS 87 chipset desktop motherboard. Both the V300 SSDs were preconditioned with random writes before testing began. As you can see, both versions of the V300 are exceeding our baseline 450MB/s spec.

**Product Testing Using Crystal Disk Mark**

A few benchmarks, like Crystal Disk Mark, use fully random incompressible data by default, which as stated before, will produce a lower read score depending on the build of the V300 we are testing. Benchmarks like this typically send a pre-defined amount of data to the SSD and measure how long it takes to read from and write to it. This is fine, but it only gives a snapshot of SSD performance. Sequential read and write speeds are a key component of SSD performance but so are random 4k performance, boot times, application/game launching ability, application performance, waking from standby, time to complete system shut down, initiating system hibernation and opening apps while the SSD is engaged with other activities. We believe the sum of these features lead to a great user experience not captured in benchmarks and are the reasons why customers purchase SSDs.

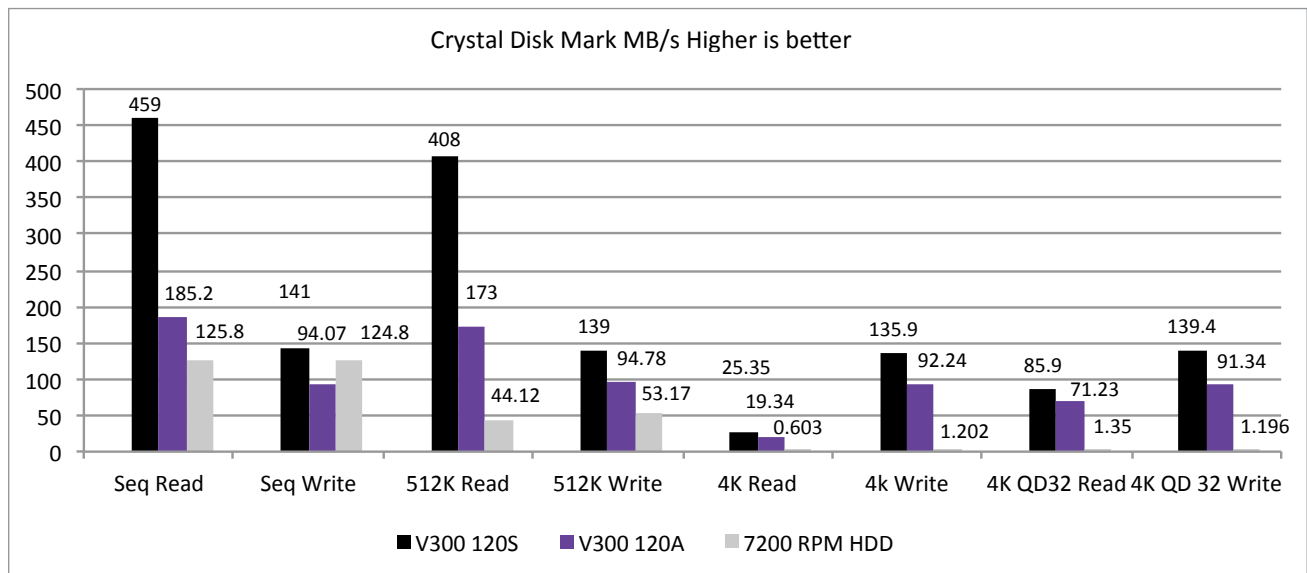


Figure 2

Typical users don't spend the bulk of their time on the computer copying incompressible data like MP3, MPEG and Zip files to and from their SSD. The data we deal with day in and day out is a mix of random, sequential, compressible, incompressible and everything in between. Figure 2 shows Crystal Disk Mark Scores for the test drives; and notice the effect of fully random incompressible data. The sequential scores

of both versions of the V300 drop from the speeds seen in ATTO but Pay close attention to the 4K Random scores; 4K random read/write measures how fast a drive is able to access small files that are randomly scattered across it. A drive with higher 4K numbers will be able to multi-task better, making for a more responsive operating system that can run more background programs (e.g. virus shield, firewall, torrents, instant messengers etc.) without any slowdowns or stuttering. For an operating system boot drive, 4K random read speeds are the most important, followed by 4K random write speed. Random incompressible data is worse case for any SSD yet both versions of the V300 are at least 7000 percent faster in 4k random writes and at least 3000 percent faster in 4k random reads.

**Product Testing Using Anvil**

Another popular synthetic benchmark is Anvil. We used a mixed workload with 46 percent compressible data, to represent a typical user’s mixed workload, so the SandForce DuraWrite feature is working here. Notice the 4K Que Depth (QD) of 4. Que depth is the amount of outstanding read and or writes requests waiting to access the system drive. A que depth of 0-5 covers the vast majority of a typical desktop/ notebook usage models. Once again, the V300 using asynchronous NAND tops the HDD by over 8,000 percent and 20,000 percent in random QD4 reads and writes. When data is at all compressible, write performance will go up.

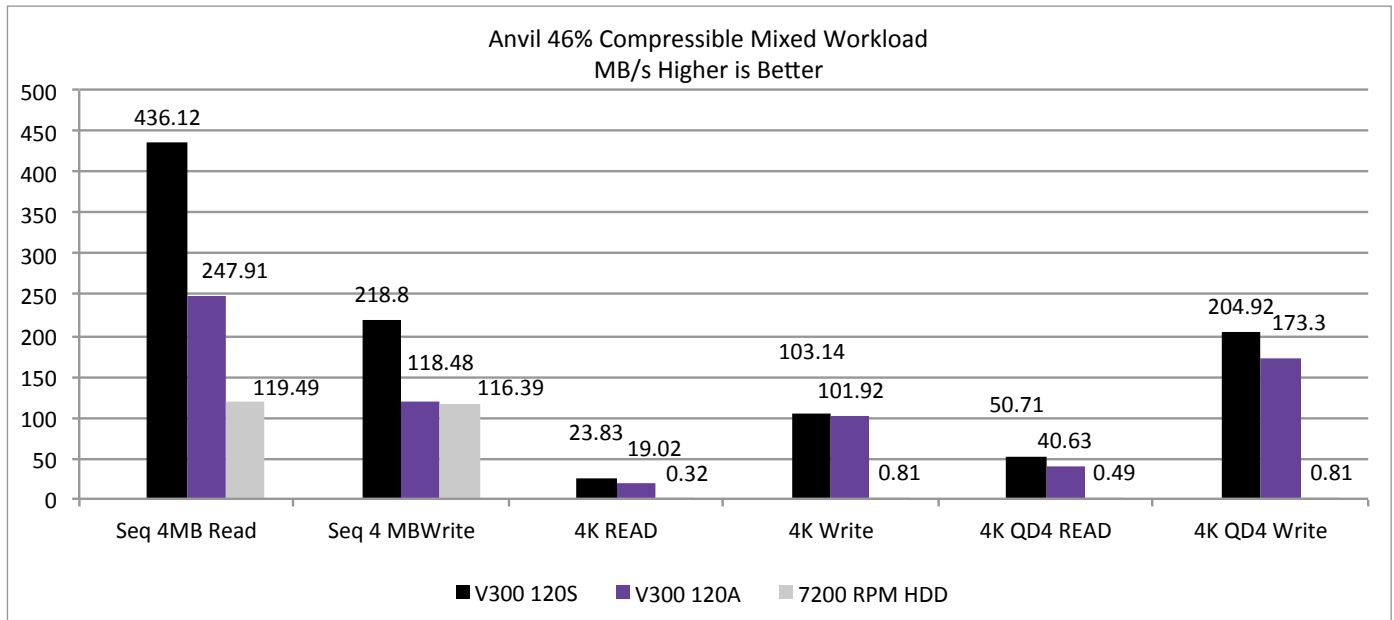


Figure 3

Anvil Storage Utilities will also provide a total drive score derived from totaling both sequential and random read/write scores. In Figure 4, you can see both V300s surpass the HDD by more than 1,000 percent.

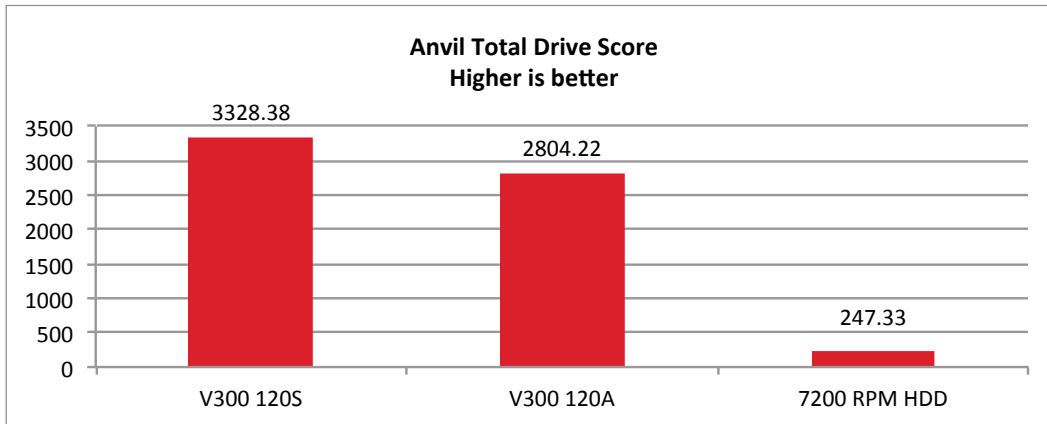


Figure 4

**PRODUCT TESTING USING PCMARK VANTAGE AND PCMARK 8**

To stress and measure the performance of Kingston drives in a different way, we use trace-based benchmarks that simulate a workload by playing back the I/O trace captured while the test was originally run using various applications. One of these trace-based tests is the PCMark Vantage storage benchmark. The storage benchmark focuses on applications that include music, video, pictures, games and security. The test suite measures how long it takes the drive to complete each task and provides an overall storage bandwidth in Bytes per second. It is important because it creates a more realistic snapshot of how the SSD would perform in real world scenarios common to the everyday user.

The comparison below demonstrates how the V300 dominates the HDD in everyday tasks. The performance delta is over 1,100 percent.

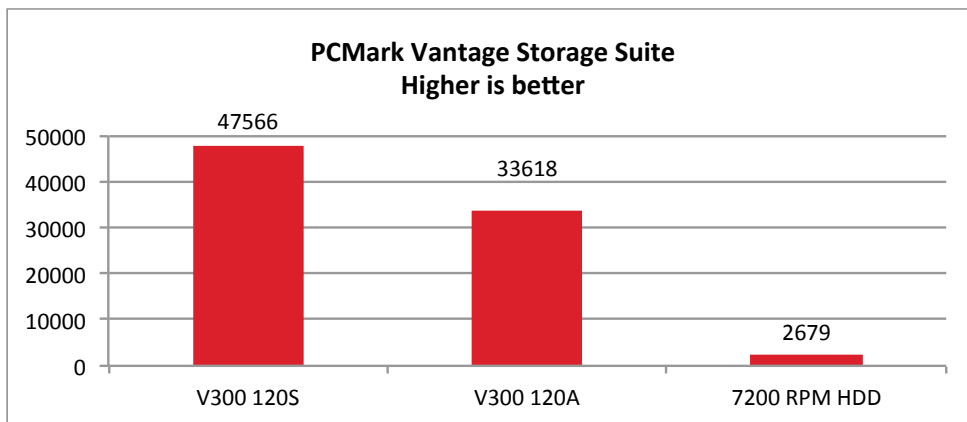


Figure 5

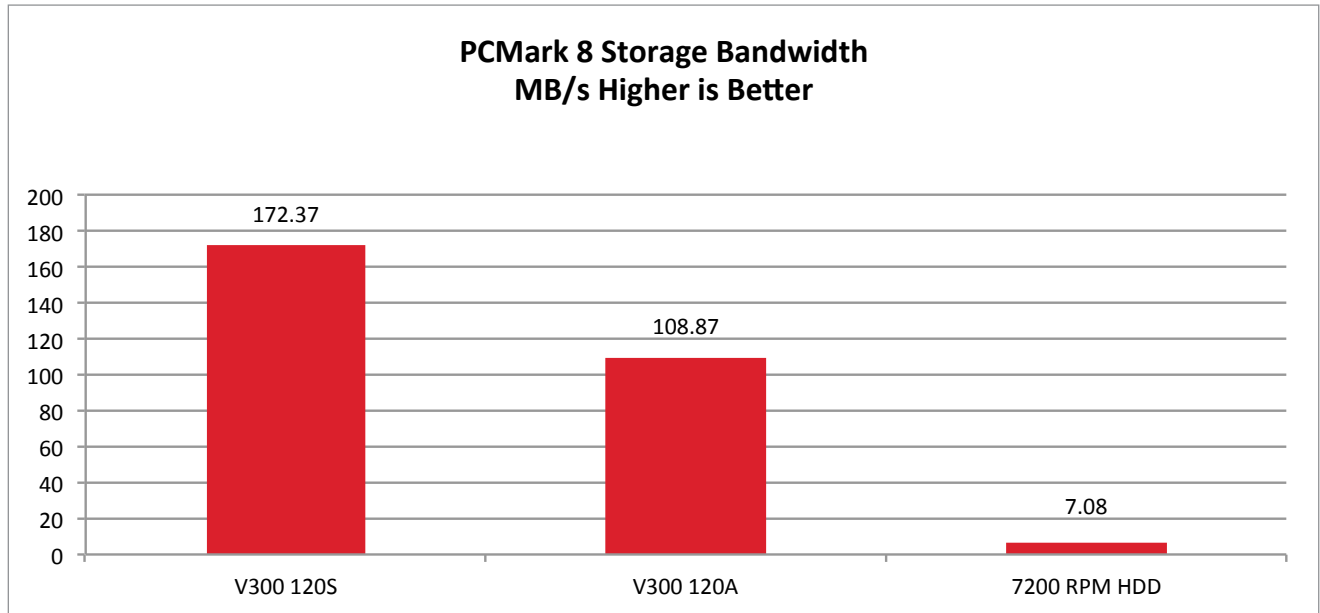


Figure 6

Recently, we implemented the PCMark 8 testing suite. The new workload uses traces from World of Warcraft, Battlefield, Adobe Photoshop, In Design, After Effects, Illustrator and Microsoft Office applications. This test suite also measures how long it takes the drive to complete tasks and provides storage bandwidth per task in Megabytes per second. As expected, the V300 120GB using Asynchronous NAND still outscores the HDD by more than 1,400 percent.

### Product Testing Using Real World Scenarios

The final testing segment involves actual user input using downloadable applications that allow you to edit, import, copy, play and create content. It simulates working with music, video, pictures and incorporates web browsing, game playing and file copying. In each test, the V300s, both Synchronous and Asynchronous, are significantly faster than the HDD. Similarly, they are very close to each other in performance in all tests with the exception of the file copy. The data used in the file copy test is composed of large, incompressible files and will demonstrate the worst-case scenario for the SSD, yet the SSD is still 60-percent faster than the HDD.

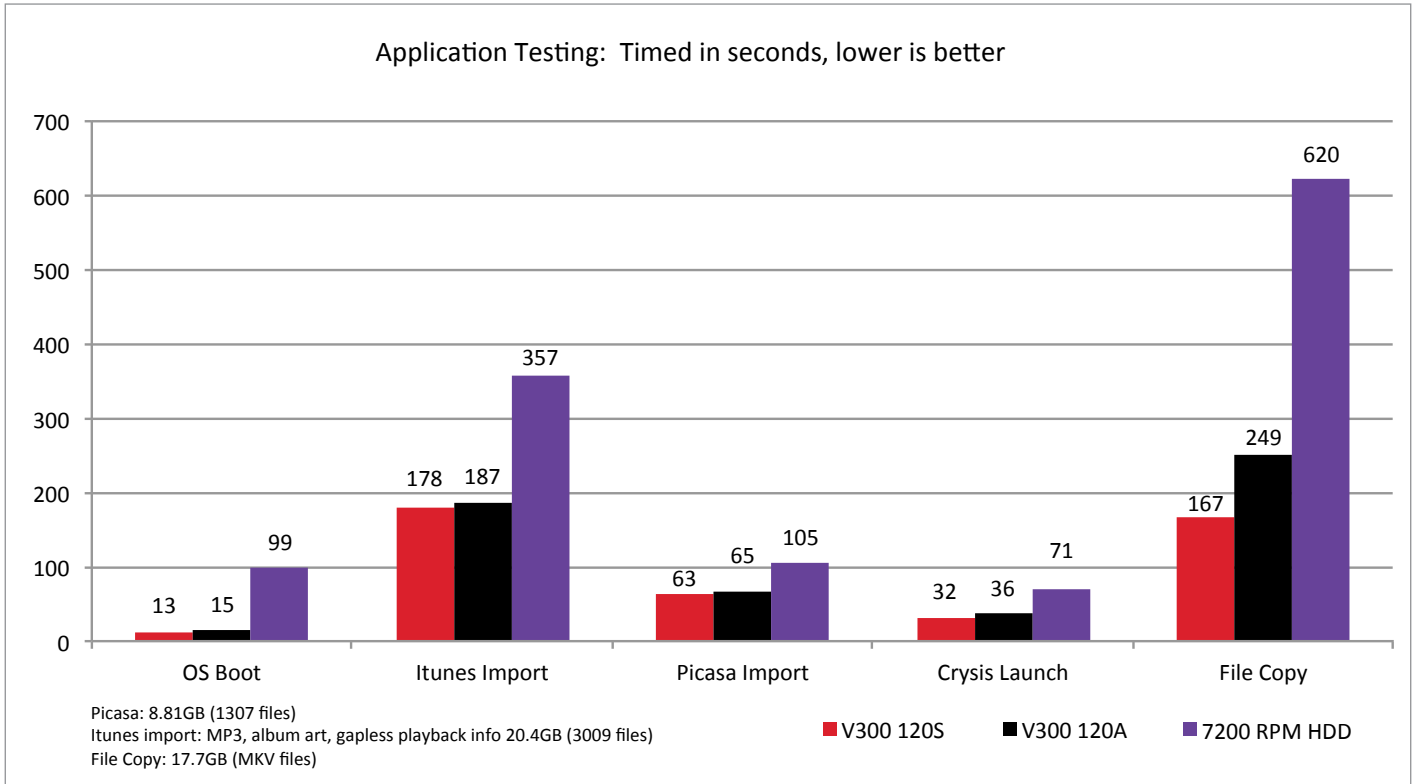


Figure 7

### A Word on Durawrite, Flash Endurance, and Smart Data

There is more to SSD performance than synthetic benchmarks can demonstrate. All Flash-based hardware (USB drives, tablets, music players, etc.) has a finite life. Think of your storage device as having a gas gauge tied to writes. Every write performed to the storage device will use up some endurance and the device will eventually wear out. SSD endurance is typically measured in TBW (total bytes written) and goes from hundreds of terabytes to petabytes, depending on drive capacity. DuraWrite technology effectively reduces these writes and extends the life of your SSD.

To demonstrate the effectiveness of DuraWrite, review the screen capture of the SMART data below. The data is from a PC used for gaming, video production, photo editing and typical Internet activity. In most cases, typical user data is at least partly compressible. Attribute 241 shows that the PC has sent 443 GBs of data to the SSD. This means that we would expect the SSD to have written at least 443GB to the NAND if not more. Attribute 233 displays the actual amount of writes to the SSD and demonstrates the SSD only wrote 285GB to the SSD, proving that for this specific workload, there is a fair amount of data that is

compressible. Anyone using a Kingston V300, KC300 or HyperX SSD can look at the same data with the Kingston SSD toolbox or any SMART reader.

```
231: (SSD Life Left)                Life Remaining 100%
233: (SSD Internal Reserved)       285
234: (SSD Internal Reserved)       443
241: (SSD Lifetime writes from host) lifetime writes  443
242: (SSD Lifetime reads from host) lifetime reads   493
```

### Final Thoughts

All Kingston SSDs go through a rigorous qualification process. The process begins with qualifying the NAND Flash components used, to ensure a high-quality product, and continues through each step of the manufacturing process before the drive leaves the warehouse.

We realize not all V300s will score the same across all benchmarks but we maintain all V300 SSDs meet the performance targets mentioned above and this is proven with test data. Benchmarks are a great way to quickly get an idea of performance but at the end of the day, your personal workload is better than any synthetic benchmark available.