SUPERTALENT ULTRADRIVE GX(SLC)/GX(MLC) PERFORMANCE ANALYSIS WHITEPAPER

2.5" SATA-II SOLID STATE DRIVE

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1.0 ABSTRACT

In March 2009 SuperTalent introduced its UltraDrive series to market. This whitepaper outlines some of the performance testing done by SuperTalent showing the outstanding performance of the UltraDrive series.

Both UltraDrive series achieved Sequential Read and Write speeds as high as 250MB/sec on the ATTO benchmark. With IOMETER the UltraDrive GX(MLC) measured over 10,000 Sequential Read IOPS and nearly 16000 Sequential Write IOPS and 6500 Random Read IOPS and around 4000 Random Write IOPS. The UltraDrive GX(SLC) series (SLC Flash) results were even better for Sequential Write, and Random Read and Write, yielding over 13,000 Sequential Read IOPS and nearly 7500 Random Read IOPS and 5000-6000 Random Write IOPS.

Compared to a standard 7200RPM HDD from Seagate the 128GB UltraDrive GX(MLC) lowered boot time by nearly 70 percent; booting the system in just over 9 seconds vs. nearly 30 seconds.

Although the UltraDrives are available in densities ranging from 32GB to 256GB this whitepaper will focus on the performance of the 64-256GB Density Products.

2.0 PRODUCT OVERVIEW

2.1 PRODUCT FEATURES

- Capacity: 32-256GB
- 64MB Internal Cache
- Form Factor: 2.5" HD (100.20mm x 69.85mm x 9.5mm)
- MLC or SLC Flash
- Fully compliant with SATA revision 2.6
  - Compatible with SATA 3.0Gb/s and SATA 1.5Gb/s interfaces
- Fully compliant with ATA-7 Standard
- PIO, DMA, UDMA (up to 6, dependent on host) supported
- Rugged Metal Case
- Minimum 10 year data retention
- Built in wear leveling algorithm
- Built in error detection and correction
- 100% tested HW and SW
- Designed and Manufactured in USA

2.2 PRODUCT ORDERING PART NUMBERS

Product Family	Capacity	Flash	Channel/Retail Part Number	OEM Part Number
UltraDrive GX(MLC)	64GB	MLC	FTM64GX25H	SX64B6X25H
	128GB	MLC	FTM28GX25H	SX28B7X25H
	256GB	MLC	FTM56GX25H	SX56B7X25H
UltraDrive GX(SLC)	64GB	SLC	FTD64GX25H	ST64A6X25H
	128GB	SLC	FTD28GX25H	ST28A7X25H

3.0 TEST SETUP

3.1 TESTED DRIVES

Name	Type	Capacity	RPM (if HDD)
UltraDrive GX(MLC)	SSD	256GB	N/A
	SSD	128GB	N/A
	SSD	64GB	N/A
UltraDrive GX(SLC)	SSD	128GB	N/A
	SSD	64GB	N/A
Intel X25M	SSD	80GB	N/A
Seagate SP38081215AS	HDD	80GB	7200

3.2 TEST SYSTEM SETUP

Motherboard: ASUS P5Q3 8500

CPU: Intel Core 2 Duo E8500 @ 3.16GHz

Memory: 2GB DDR3 UDIMM @ 1066MT/s

OS Related Software: Windows Vista Business 32-bit

Windows XP Pro SP2 (for HDTach only)

3.3 BENCHMARKING SOFTWARE

We used the following software to benchmark the performance of the UltraDrive family.

- ATTO v2.02
- IOMETER v2006.07.27
- HDBench v3.4
- HDTach RW 3.0.1.0
- HDTune v2.54

4.0 TEST RESULTS

4.1 ATTO

ATTO Disk Benchmark is a Hard Disk Benchmarking tool which is also useful in measuring SSD performance. The test provides measured Write and Read Transfer rates under various transfer sizes.

Write Performance on the UltraDrive Series is fairly consistent between densities, peaking around 250MB/sec for 128KB and greater transfer sizes. The UltraDrive Series outperforms the Intel X25-M for transfers larger than 8KB, and significantly outperforms for transfers larger than 16KB. The Seagate HDD peaks out around 77MB/sec for 32KB and larger transfer sizes.

Read Performance on the UltraDrive Series is also fairly consistent, although the 128GB MLC Drive lags slightly behind the others. The Read Performance shows consistent gains as the transfer size increases from 512Bytes to 64KBytes. Read Performance is similar between the UltraDrive family and the Intel X25M for transfer sizes above 32KB. For small transfer sizes 16KB and below the UltraDrive family outperforms the Seagate HDD.
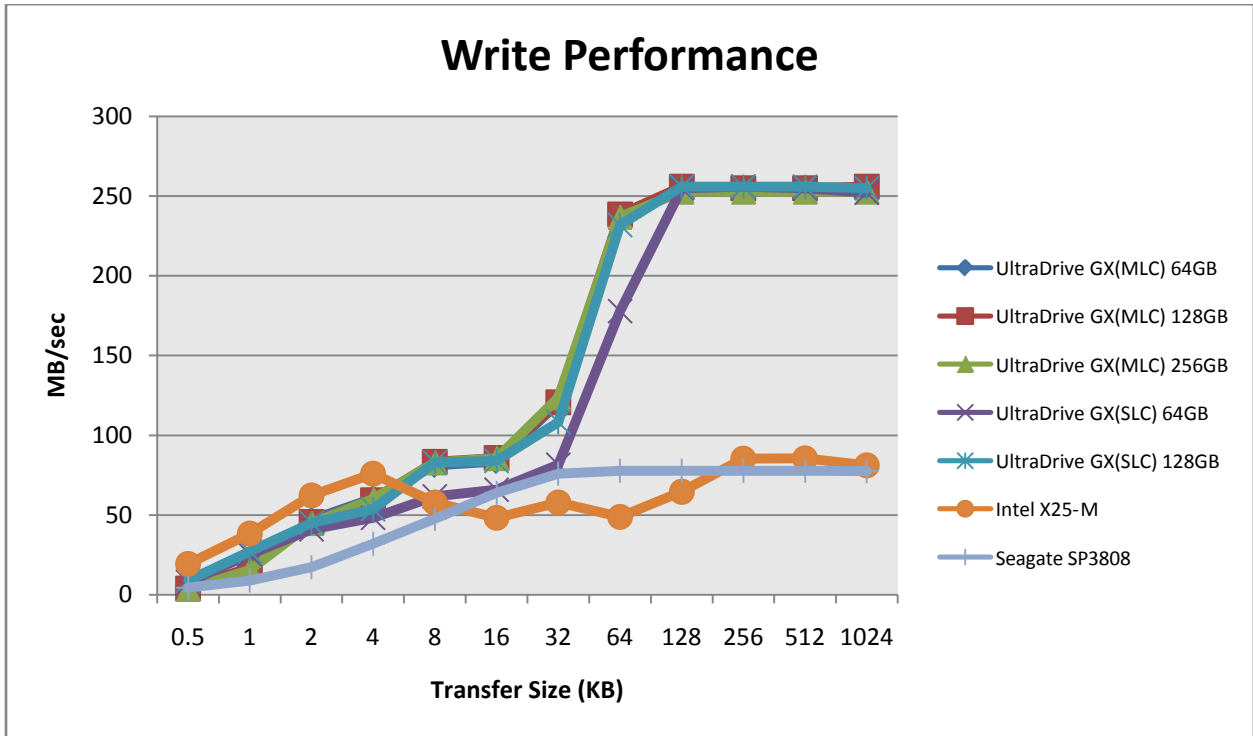
Figure 1: ATTO Write Performance

Figure 2: ATTO Read Performance

4.2 IOMETER

IOMETER is an I/O subsystem characterization tool. It is highly useful for characterizing disk performance in server and workstation environments where often IOPS are more critical than Bandwidth. It was originally developed by Intel in 1998 and since then has been supported by the Open Source Development Lab.

For our testing we focused on the most commonly used measurement of 4KB transaction size IOPS in both Random and Sequential Read and Write. We cycled Queue Depth from 1 to 32 with an Exponential step type. The results were outstanding!

Generally the UltraDrive GX(MLC) series (MLC Flash) supported over 10,000 Sequential Read IOPS and nearly 16000 Sequential Write IOPS and 6500 Random Read IOPS and around 4000 Random Write IOPS. The UltraDrive GX(SLC) series (SLC Flash) results were even better for Sequential Write, and Random Read and Write, yielding over 13,000 Sequential Read IOPS and nearly 7500 Random Read IOPS and 5000-6000 Random Write IOPS.

Compared to the Intel X25M the UltraDrive outperformed on Random Read by 30% and on Random Write by a factor of 14x. Compared to the Seagate HDD, well there is really no comparison in terms of IOPS, the UltraDrive SSD outperformed this standard SATA HDD by a factor of 100 to 1 in both Random Read and Write IOPS.
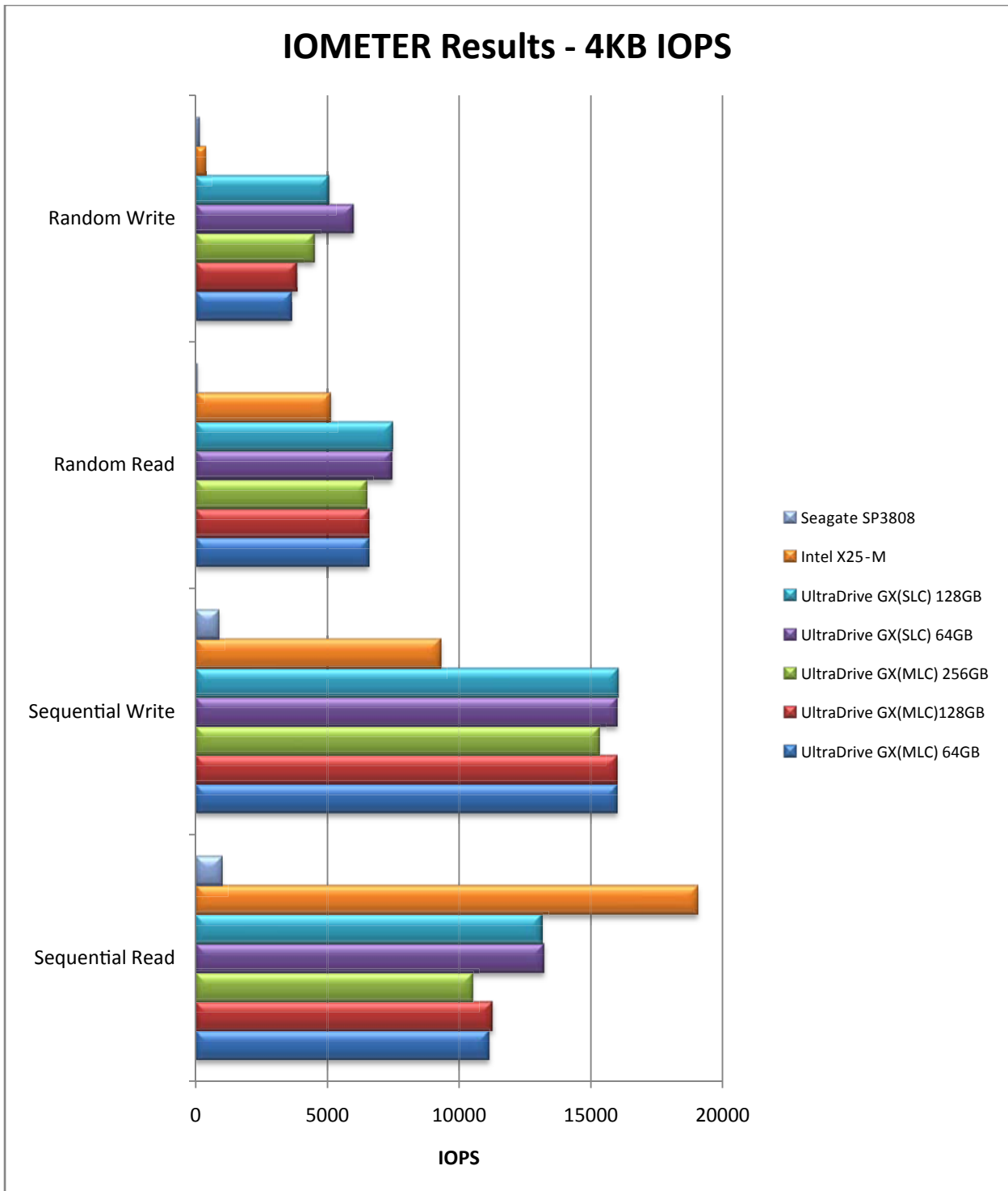
Figure 3: IOMETER 4KB IOPS

4.3 HDTACH

HDTach is an easy to use low level hardware benchmark available from Simpli Software. It will measure Burst Read Speeds, Average Read and Write Speeds, Random Access Time and CPU Utilization. One of the nice things about HDTach compared to other tests is that it will measure performance across the entire disk instead of focusing within a file residing in a small portion of the disk. For the purposes of our testing we focused on Average Read and Write speeds and Random Access Time.

The UltraDrive Family ranged in Average Read Speed from 194 to 213 MBytes per Second which was similar to the measured Average Read Speed of the Intel X25-M. The Average Read Speeds were roughly 3x those measured on the Seagate 7200RPM HDD.

Average Write Speeds for the UltraDrive Family ranged from 144 to 177 MBytes per Second. With the UltraDrive GX(SLC)(SLC Flash) generally outperforming by 5-10% the UltraDrive GX(MLC)(MLC Flash) family. This is to be expected due to the natively better write performance of SLC Flash, however, the fact that the results were so close shows how much a user can do with a much more economical MLC Flash based SSD.

Average Access Time for all of the SSDs we measured was 0.1mS. Compared to the Seagate HDD which had an access time of over 15mS this was a significant improvement. It seems most SSDs these days are converging at 0.1mS access time performance.

HDTach Average Measured Bandwidth

■ Average Write   ■ Average Read

Drive	Average Write	Average Read
Seagate SP3808	62.1	62.3
Intel X25-M	16.6	221
UltraDrive GX(SLC) 128GB	155.3	212.9
UltraDrive GX(SLC) 64GB	177.3	211.9
UltraDrive GX(MLC) 256GB	162.8	209.5
UltraDrive GX(MLC) 128GB	137.2	197
UltraDrive GX(MLC) 64GB	144	194.3

Bandwidth (MB/Sec)
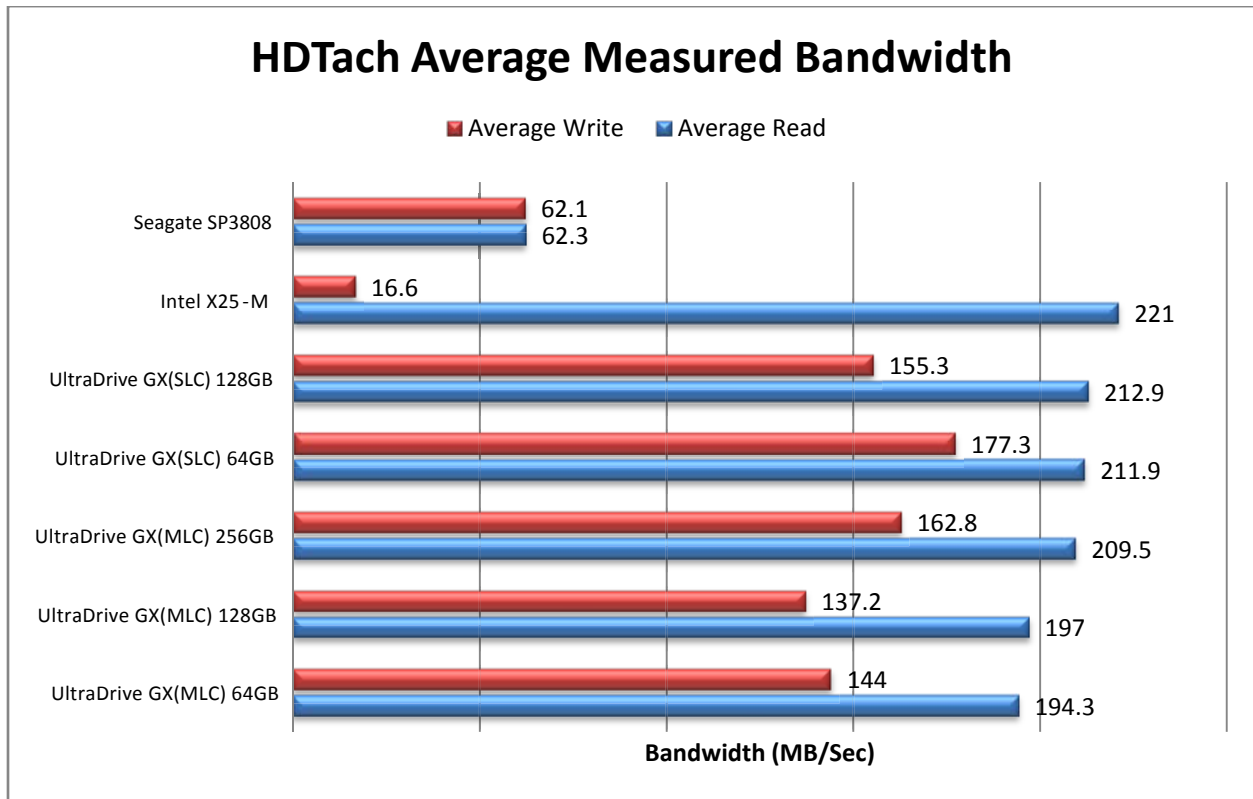
Figure 4: HDTach Average Measured Speeds

Average Access Time

- Seagate SP3808
- Intel X25-M
- UltraDrive GX(SLC)128GB
- UltraDrive GX(SLC)64GB
- UltraDrive GX(MLC) 256GB
- UltraDrive GX(MLC) 128GB
- UltraDrive GX(MLC) 64GB

0   2   4   6   8   10   12   14   16

Access Time (mS)
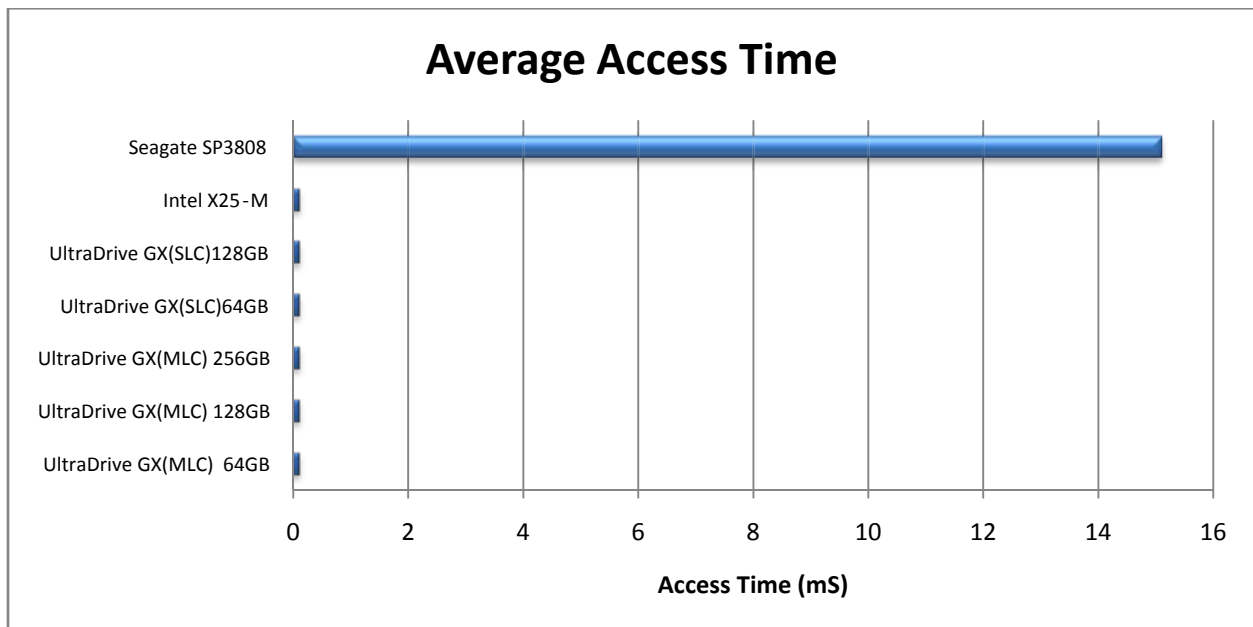
Figure 5: HDTach Average Access Time

4.4 HDBENCH

HDBench is another benchmarking tool available from HDBench.net useful in measuring Sequential and Random Read and Write Bandwidth. Again you can see the UltraDrive family's superior write performance.
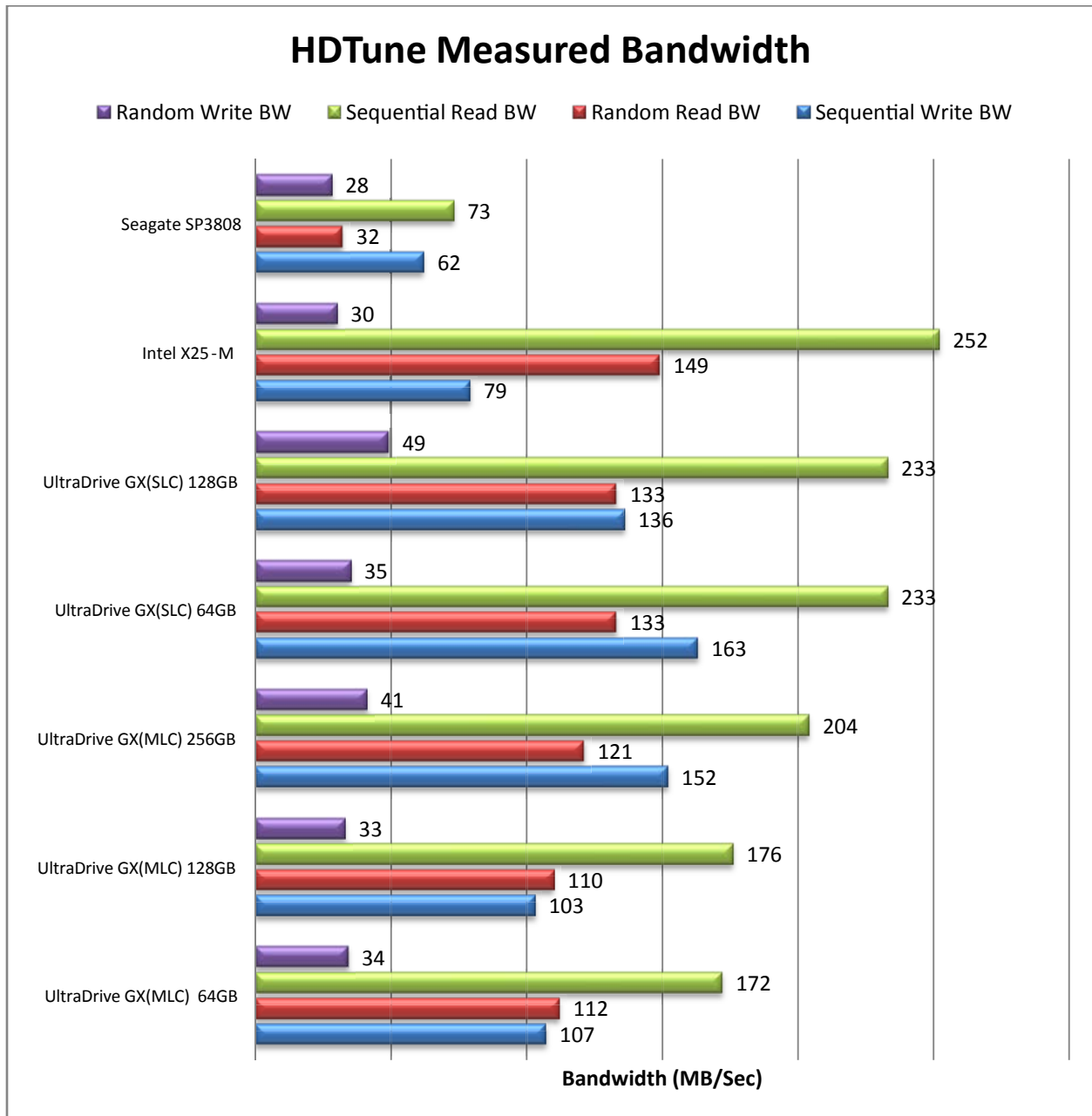

HDTune Measured Bandwidth

Legend: ■ Random Write BW ■ Sequential Read BW ■ Random Read BW ■ Sequential Write BW

Seagate SP3808
- Random Write BW: 28
- Sequential Read BW: 73
- Random Read BW: 32
- Sequential Write BW: 62

Intel X25-M
- Random Write BW: 30
- Sequential Read BW: 252
- Random Read BW: 149
- Sequential Write BW: 79

UltraDrive GX(SLC) 128GB
- Random Write BW: 49
- Sequential Read BW: 233
- Random Read BW: 133
- Sequential Write BW: 136

UltraDrive GX(SLC) 64GB
- Random Write BW: 35
- Sequential Read BW: 233
- Random Read BW: 133
- Sequential Write BW: 163

UltraDrive GX(MLC) 256GB
- Random Write BW: 41
- Sequential Read BW: 204
- Random Read BW: 121
- Sequential Write BW: 152

UltraDrive GX(MLC) 128GB
- Random Write BW: 33
- Sequential Read BW: 176
- Random Read BW: 110
- Sequential Write BW: 103

UltraDrive GX(MLC) 64GB
- Random Write BW: 34
- Sequential Read BW: 172
- Random Read BW: 112
- Sequential Write BW: 107

Bandwidth (MB/Sec)

Figure 6: HDBench Measured Bandwidths

Note: In Rev 1.3 we updated these numbers we found data entry errors in the previous versions

4.5 HDTUNE

We used HDTune to measure the average and maximum Read Bandwidth across the entire address space of the SSD when reading 64KB files sequentially. HDTune shows excellent Read Performance for the entire UltraDrive family, although the relatively fewer number of Flash devices on the 64GB UltraDrive GX(MLC) shows up in the final performance numbers. The UltraDrive LE 128GB actually manages to outperform the Intel X25-M on average Read Bandwidth.
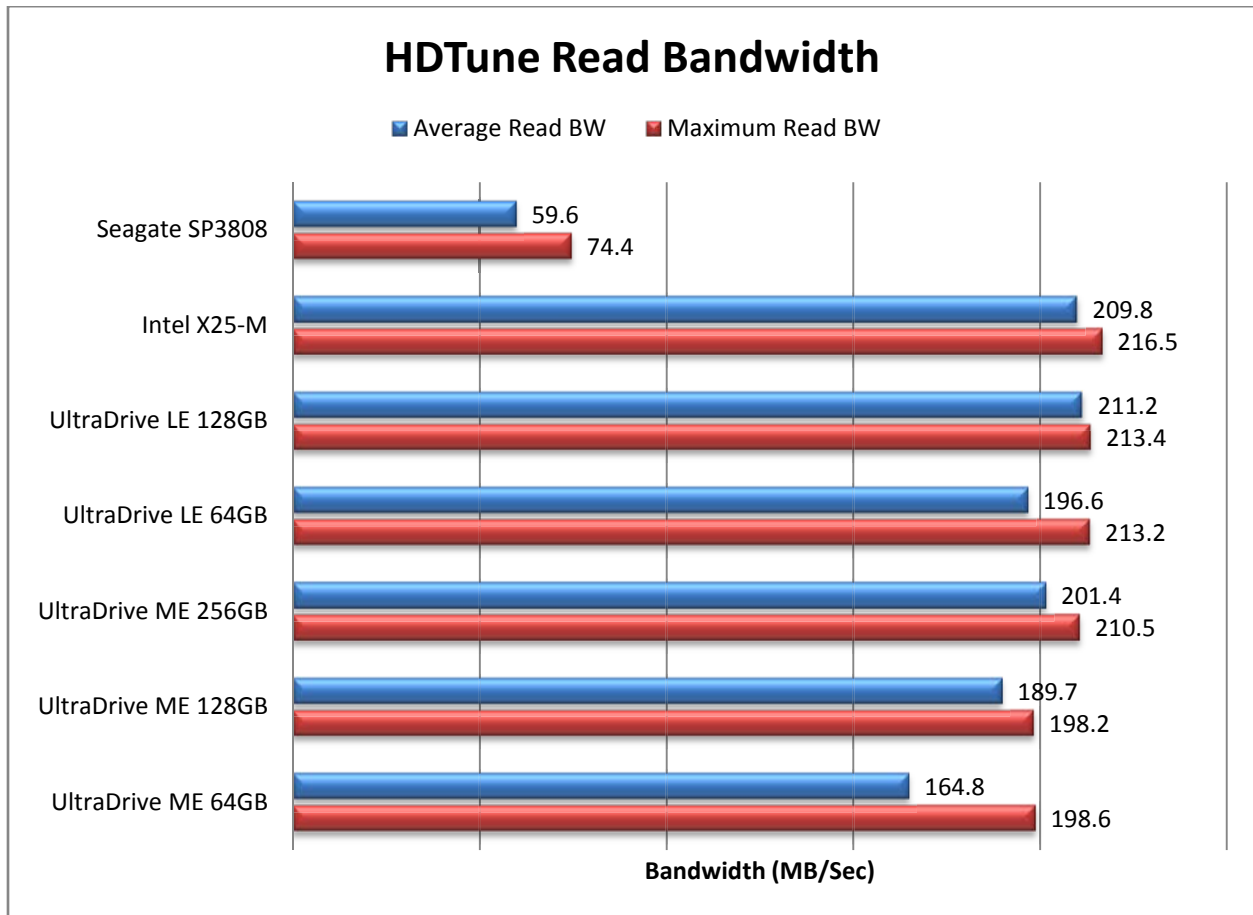
HDTune Read Bandwidth

■ Average Read BW   ■ Maximum Read BW

Device	Average Read BW	Maximum Read BW
Seagate SP3808	59.6	74.4
Intel X25-M	209.8	216.5
UltraDrive LE 128GB	211.2	213.4
UltraDrive LE 64GB	196.6	213.2
UltraDrive ME 256GB	201.4	210.5
UltraDrive ME 128GB	189.7	198.2
UltraDrive ME 64GB	164.8	198.6

Bandwidth (MB/Sec)

Figure 7: HDTune Read Bandwidth

4.6 WINDOWS XP BOOT TIMES

The final test we did was to measure the time it took to boot the system with Windows XP. This is likely one of the most noticeable differences for laptop users switching from Hard Disk Drives to UltraDrive SSDs. Here we observed nearly a 70% reduction in wait time versus a Hard Disk: from nearly 30 seconds to just over 9 seconds.
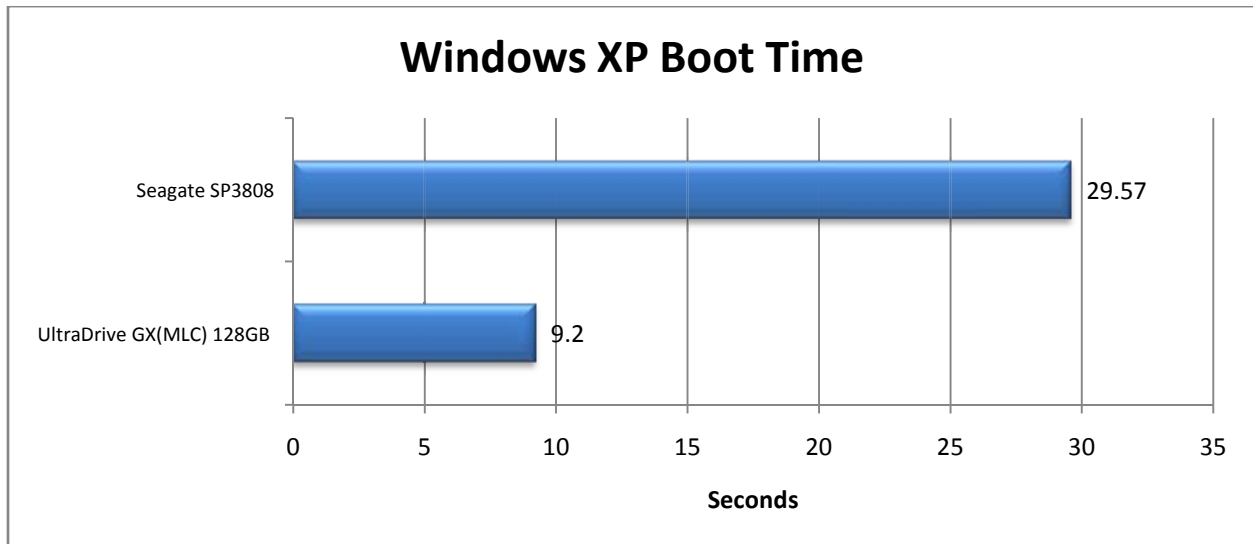
Windows XP Boot Time

	Seconds
Seagate SP3808	29.57
UltraDrive GX(MLC) 128GB	9.2

Figure 8: Windows XP Boot Times

5.0 CONCLUSION

Despite the lack of a single definitive performance test or measurement the UltraDrive family shows off its outstanding performance across a number of benchmarks. A typical 7200 RPM HDD stands no chance competing on performance against SuperTalent's UltraDrive family, and even the gold standard in consumer SSDs, Intel's X25-M has a tough time competing on all but Read Bandwidth. In Write Bandwidth and IOPS the UltraDrive GX(MLC)family delivers the performance the consumer PC market has been clamoring for, making it the ideal SSD for laptop users with small (32GB) to moderate (256GB) portable storage requirements. The UltraDrive GX(SLC) family delivers both the performance and the cycling reliability that the enterprise market needs for C: drive performance, and front end storage requirements to finally begin to replace expensive FC and SAS HDDs with lower cost and higher performance SSDs.

FOR MORE INFORMATION

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