PowerEdge SAS SSD Characteristics and Metrics*

April, 2017

Type	Capacity (GB)	MODEL	Part Number	NAND Technology	Endurance DWPD 5 Years	Endurance TBW (TB)	Seq Read 128KB (MB/s)	Seq Write 128KB (MB/s)	Rand. Read 4KB (IOPS)	Rand. Write 4KB (IOPS)	MTBF (Hours)
WI	400	Toshiba PM3 PX04SM	GM5R3	A19nm eMLC	10.0	7,300	1,050	1,050	200K	157K	2M
	400	Toshiba PM4 PX05SM	5VHHG	A15nm eMLC	10.0	7,300	1,050	1,050	200K	109K	2M
	800	Toshiba PM3 PX04SM	M91TJ	A19nm eMLC	10.0	14,600	1,050	1,050	200K	177K	2M
	800	Toshiba PM4 PX05SM	CN3JH	A15nm eMLC	10.0	14,600	1,050	1,050	200K	113K	2M
	1600	Toshiba PM3 PX04SM	77K16	A19nm eMLC	10.0	29,200	1,000	850	195K	90K	2M
	1600	Toshiba PM4 PX05SM	GVTYD	A15nm eMLC	10.0	29,200	1,050	1,050	200K	125K	2M
	400	HGST Ultrastar SSD1600MM	G1D1K	20nm MLC	10.0	7,300	1,001	820	139K	110K	2.5M
	800	HGST Ultrastar SSD1600MM	CW988	20nm MLC	10.0	14,600	1,025		140K	108K	2.5M
	1600	HGST Ultrastar SSD1600MM	5HR3X	20nm MLC	10.0	29,200	1,100	765	130K	100K	2.5M
MU	800	HGST SSD1600MM SED	265TH	20nm MLC	10.0	14,600	1,100	765	130K	100K	2.5M
	1600	HGST SSD1600MM SED	NF76W	20nm MLC	10.0	29,200	1,100	765	130K	100K	2.5M
	400	Samsung PM1635a	MFC6G	V-NAND TLC	3.0	2,190	950	600	199K	61K	2M
	800	Samsung PM1635a	HF06W	V-NAND TLC	3.0	4,380	950	970	200K	76K	2M
	1600	Samsung PM1635a	W5PP5	V-NAND TLC	3.0	8,760	940	1,010	200K	91K	2M
	3200	Samsung PM1635a	8RC8K	V-NAND TLC	3.0	17,520	940	1,010	204K	99K	2M
	480	Toshiba PM3 PX04SV	N5Y85	A19nm eMLC	3.0	2,628	1,050	1,050	205K	78K	2M
	480	Toshiba PM4 PX05SV	43PCJ	A15nm eMLC	3.0	2,628					2M
	960	Toshiba PM3 PX04SV	YYC10	A19nm eMLC	3.0	5,256	1,050	1,050	205K	85K	2M
	960	Toshiba PM4 PX05SV	503M7	A15nm eMLC	3.0	5,256	1,040	1,040	200K	70K	2M
	1920	Toshiba PM3 PX04SV	4XC39	A19nm eMLC	3.0	10,512	1,050	1,050	205K	85K	2M
	1920	Toshiba PM4 PX05SV	V0K7V	A15nm eMLC	3.0	10,512	1,040	1,050	204K	97K	2M
	3840	Toshiba PM3 PX04SV	GYMY9	A19nm eMLC	3.0	21,024	1,050	1,050	205K	86K	2M
	3840	Toshiba PM4 PX05SV	3DDFT	A15nm eMLC	3.0	21,024	1,000	1,000			2M
RI	480	Toshiba PM3 PX04SR	06VJ7	A19nm eMLC	1.0	876	1040	1,040	200K	34K	2M
	480	Toshiba PM4 PX05SR	JGXK2	A15nm eMLC	1.0	876	1050	1050	200K	20K	2M
	960	Toshiba PM3 PX04SR	4KG4X	A19nm eMLC	1.0	1,752	1040	1,040	200K	33K	2M
	960	Toshiba PM4 PX05SR	MWGK7	A15nm eMLC	1.0	1,752	1050	1050	200K	30K	2M
	1920	Toshiba PM3 PX04SR	R87FK	A19nm eMLC	1.0	3,504	1040	1,040	200K	33K	2M
	1920	Toshiba PM4 PX05SR	0FYFW	A15nm eMLC	1.0	3,504	1050	1050	200K	35K	2M
	3840	Toshiba PM3 PX04SR	M09K5	A19nm eMLC	1.0	7,008	1050	1,050	204K	33K	2M
	3840	Toshiba PM4 PX05SR	XCRDV	A15nm eMLC	1.0	7,008	1050	1050	190K	35K	2M
	480	HGST Ultrastar SSD1600MR	MFGN5	20nm MLC	1.0	876	1,100	700	130K	30K	2.5M
	960	HGST Ultrastar SSD1600MR	HX5K5	20nm MLC	1.0	1,752	1,100	700	130K	30K	2.5M
	1920	HGST Ultrastar SSD1600MR	VCWFG	20nm MLC	1.0	3,504	1,100	700	130K	30K	2.5M
	480	Samsung PM1633a	8Y64H	V-NAND TLC	1.0	876	925	615	199K	21K	2M
	960	Samsung PM1633a	7FNRX	V-NAND TLC	1.0	1,752	950	990	201K	33K	2M
	1920	Samsung PM1633a	086DD	V-NAND TLC	1.0	3,504	950	1,000	201K	37K	2M
	3840	Samsung PM1633a	JR1HP	V-NAND TLC	1.0	7,008	1,400	1,250	190K	80K	2M
	7.65	Samsung PM1633a	8498W	V-NAND TLC	1.0	14,016	950	1,010	217K	35K	2M
	15.36	Samsung PM1633a	D75C7	V-NAND TLC	1.0	28,032	950	960	217K	38K	2M

Dell puts its enterprise hard drive (HDD) and solid state drive (SSD) offerings through a rigorous validation process before they are ever considered as additions to PowerEdge server portfolio. Enterprise-class SSDs are designed around enterprise application I/O (input/output) requirements with random I/O performance, reliability and protection of data during a sudden power-down. Choosing the right drives for your workload sis crucial to obtain a balance of performance, capacity and cost in your data center.

PowerEdge SATA SSD Characteristics and Metrics

Type	Capacity (GB)	MODEL	Part Number	NAND Technology	Endurance DWPD 5 Years	Endurance TBW (TB)	Seq Read 128KB (MB/s)	Seq Write 128KB (MB/s)	Random Read 4KB (IOPS)	Random Write 4KB (IOPS)	MTBF (Hours)
WI	200	Intel S3710	2THX8	20nm MLC	9.9	3,600	**510**	**300**	**81K**	**45K**	2M
	400	Intel S3710	7C7FK	20nm MLC	11.4	8,300	**510**	**425**	**81K**	**45K**	2M
	800	Intel S3710	DPD14	20nm MLC	11.6	16,900	**510**	**425**	**81K**	**45K**	2M
MU	200	Intel S3610 1.8"	NDDN1	20nm MLC	3.0	1,100	500	220	70K	11K	2M
	200	Intel S3610	3481G	20nm MLC	3.0	1,100	**500**	**228**	**80K**	**16K**	2M
	200	Toshiba HK4E	X1RMG	MLC	3.0	1,095	500	270	75K	20K	2M
	240	Samsung SM863 1.8"	JK90M	3D V32 MLC	3.0						
	240	Samsung SM863a	28F3R	3D V32 MLC	3.6	1,577	**450**	**370**	**87K**	**13K**	2M
	400	Intel S3610 1.8"	09TVP	20nm MLC	4.1	3,000	500	370	70K	22K	2M
	400	Intel S3610	65WJJ	20nm MLC	4.1	3,000	**500**	**400**	**80K**	**33K**	2M
	400	Toshiba HK4E	VKT80	MLC	3.0	2,190	500	480	75K	30K	2M
	480	Samsung SM863 1.8"	VNXGK	3D V32 MLC	3.0						
	480	Samsung SM863a	2RGGR	3D V32 MLC	3.6	3,154	**510**	**480**	**87K**	**23K**	2M
	800	Intel S3610 1.8"	N7RGD	20nm MLC	3.6	5,300	500	380	70K	17K	2M
	800	Intel S3610	9F3GY	20nm MLC	3.6	5,300	**500**	**480**	**80K**	**37K**	2M
	800	Toshiba HK4E	VCRY6	MLC	3.0	4,380	500	480	75K	30K	2M
	960	Samsung SM863 1.8"	8VN4J	3D V32 MLC	3.0						
	960	Samsung SM863a	DD4G0	3D V32 MLC	3.6	6,307	**510**	**480**	**87K**	**28K**	2M
	1600	Intel S3610	2CC4N	20nm MLC	3.7	10,700	550	500	84k	27k	2M
	1600	Toshiba HK4E	DMF5Y	MLC	3.0	8,760	500	480	75K	30K	2M
	1920	Samsung SM863a	K5P0T	3D V32 MLC	3.6	945	**510**	**480**	**85K**	**29K**	2M
RI	480	Intel S3510	008R8	16nm MLC	0.3	275	**480**	**440**	**70K**	**23K**	2M
	480	Intel S3520	64TMJ	16nm 3D	1.1	945	**410**	**315**	**60K**	**21K**	2M
	480	Samsung PM863 1.8"	73K84	3D V32 TLC							
	480	Samsung PM863a	JHJ2J	3D V32 TLC	1.3	1,139	**500**	**460**	**85K**	**18K**	2M
	800	Intel S3510	CM65W	16nm MLC	0.3	450	**480**	**440**	**70K**	**23K**	2M
	800	Intel S3520	K49V9	16nm 3D	1.1	1,663	**410**	**315**	**65K**	**21K**	2M
	960	Samsung PM863 1.8"	T2G0Y	3D V32 TLC							
	960	Samsung PM863a	3D6WK	3D V32 TLC	1.3	2,278	**500**	**460**	**85K**	**23K**	2M
	960	Intel S3520	VXG5N	16nm 3D	1.0	1,750	**410**	**315**	**65K**	**21K**	2M
	1200	Intel S3510	KYTDG	16nm MLC	0.3	660	**480**	**440**	**70K**	**23K**	2M
	1600	Intel S3510	DTH1X	16nm MLC	0.3	880	**480**	**440**	**70K**	**23K**	2M
	1600	Intel S3520	R3J3Y	16nm 3D	1.0	2,925	450	380	67.5K	17K	2M
	1920	Samsung PM863a	9W12R	3D V32 TLC	1.3	4,555	**500**	**470**	**83K**	**23K**	2M
	3840	Samsung PM863a	9Y3HD	3D V32 TLC	1.3	9,110	**500**	**470**	**83**	**26K**	2M
Boot	120	Intel S3510	KX83R	16nm MLC	0.3	70	**465**	**135**	**70K**	**7K**	2M
	120	Intel S3520	394XT	16nm 3D	1.9	412	180	165	43K	31K	2M
	120	Samsung PM863 1.8"	Y4VWW	3D V32 TLC							
	120	Samsung PM863	WRTYP	3D V32 TLC	1.0	219	**370**	**130**	**86K**	**10K**	2M

* Disclaimer:
These are performance specifications at the drive level (not system level) obtained from the vendor site and from internal Dell testing. Values are for guidance only and subject to change and may vary in different environments.

Intel SSD Specs
http://ark.intel.com/#@SolidStateDrives
Samsung SSD Specs
http://www.samsung.com/us/dell/
http://www.samsung.com/semiconductor/products/flash-storage/enterprise-ssd/

Toshiba Specs
http://storage.toshiba.com/dell
http://toshiba.semicon-storage.com/us/product/storage-products/enterprise-ssd.html
HGST Specs
http://www.hgst.com/products/solid-state-solutions

Inputs	
Disk Qty	6
Disk Size (GB)	960
Disk Speed	SSD
RAID Type	RAID10
RAID Penalty	2
Read %	80%
Write %	20%
IO Block Size	64

Storage	
Raw Storage	5760
Usable Storage	2880

Calculation Outputs

Total RAW IOPS

Min	Median	Max
60000	330000	600000

Actual IOPS

Min	Median	Max
54000	297000	540000

Data Transfer MB/s

Min	Median	Max
3375.0	18562.5	33750.0

For information on the difference between Total and Actual read the Description Sheet

Fixed Variables

	IOPS		
Disk Speed	**Min**	**Median**	**Max**
SSD	10000	55000	100000
SAS 15K	175	193	210
SAS 10K	140	140	140
SATA 10K	125	138	150
SATA 7.2K	75	88	100

RAID Write Penalty	
RAID	**Penalty**
RAID0	0
RAID1	2
RAID5	4
RAID6	6
RAID10	2

IO Block Size (KB)
1
2
4
8
16
32
64
128