

# SSDs FOR CAD

CAD/CAM/CAE users should sit up and take notice. A Solid State Drive could be the most important workstation purchase you make this year, writes **Greg Corke**

**W**hen choosing a CAD workstation, storage often plays second fiddle to the CPU and GPU. Buy from a tier one vendor – the likes of Dell, HP, Fujitsu and Lenovo – and the default option is often a single 7,200 RPM SATA hard disk drive (HDD), even on some quite high-end machines.

The reality is, unless you're buying from a specialist system builder – Workstation Specialists, Scan, and InterPro, for example – high-performance Solid State Drive (SSD) storage is still considered a bit of a luxury.

But it shouldn't be like this. Prices of SSDs have dropped considerably and long-term reliability has improved. SSDs should now be considered a stock component for the modern workstation. But what exactly is an SSD and how does it differ from a standard HDD?

## SSD VS HDD

HDDs store data on platters that spin at high speeds (typically 7,200RPM). In order to read or write data, the drive head has to move across the platter, much like a laser moving across a CD when skipping from track to track.

When data is accessed from the same part of the platter, sequential read / write performance is pretty good. However, when data is more random, perhaps when retrieving multiple CAD parts that are stored on different parts of the platter, performance can be extremely poor. The reason for this is the drive head has to physically move into all the different positions, which can slow things right down.

SSDs are different insofar as they contain no moving parts at all. Data is stored on an array of NAND flash memory, which is managed by a controller, a dedicated processor that provides the bridge to the workstation via the SATA interface.

SSDs offer faster read and write transfer rates than HDDs – Operating Systems will boot quicker and applications will load faster. The time taken to open and save CAD data will also be reduced.

These are all important for CAD users, but the biggest advantage of an SSD over a HDD is when it comes to latency and random read / write performance.

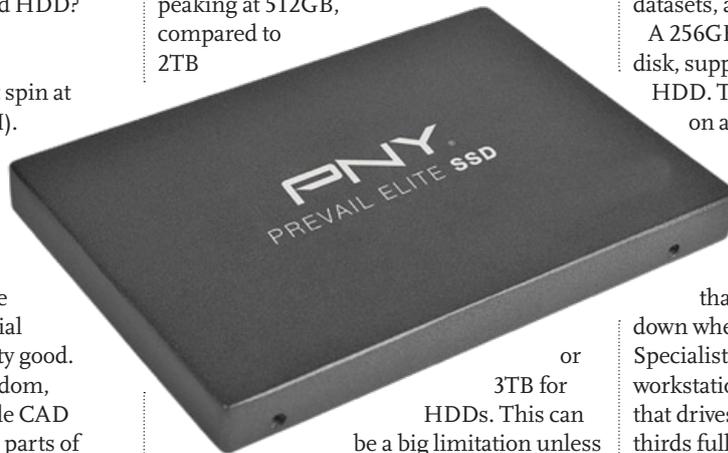
Latency (the time taken to respond to a read/

write request) is vastly superior in an SSD and it is this that makes the workstation as a whole feel incredibly responsive.

Much superior random read/write performance also means multi-tasking workflows are lightning quick. Opening apps, loading and saving data all at the same time shouldn't cripple your workstation as it often does with a HDD.

SSDs are also more durable than HDDs and handle shock and vibration much better. As there are no moving parts, they are silent in operation. Power consumption is also significantly reduced, as is heat production. All of these characteristics make them an excellent choice for mobile workstations.

The main downside of SSDs is the price per GB is quite high (approx £0.60 per GB compared to £0.04 per GB for HDDs). SSDs also have a limited maximum capacity, peaking at 512GB, compared to 2TB



or 3TB for HDDs. This can be a big limitation unless you have a huge budget. As a result, most CAD users will supplement a SSD with a HDD to store a significant part of their CAD data.

## UPGRADING TO AN SSD

When upgrading a workstation most users tend to focus on memory, graphics and CPU, while changing a hard drive tends to be about increasing capacity. But upgrading to a SSD can offer huge performance benefits.

Swapping out a HDD for a SSD should be pretty straightforward for most IT savvy users, but if you're a small design firm with limited technical knowledge it can be a daunting task.

First off, it needs to fit your workstation's drive bay. Most SSDs come in a 2.5-inch form factor, which is fine for laptops, but a 3.5-inch adapter will be needed for most desktop

workstations. Adapters sometimes come with the SSD drive, as part of an add-on kit, or are even included with your workstation chassis.

Setting up the drive is the next step. Off the shelf backup and recovery software from Norton or Acronis, for example, can handle migration from your HDD, but additional technical knowledge can be required.

Some SSD manufacturers also develop dedicated migration tools, which are bundled in with their drives.

Of course, if your workstation has slowed down from years of abuse, there's much to be said for starting from scratch with a fresh install of Windows and applications.

## SIZE MATTERS

A popular choice in CAD workstations is to have two storage devices. An SSD for operating system, applications and current datasets, and a HDD for other data.

A 256GB SSD is a good size for the primary disk, supplemented with a 1TB or 2TB

HDD. There are caveats to this and those on a strict budget may look to invest in a 128GB drive. However, some manufacturers offer reduced performance at lower capacities so check out the specs first.

It's also important to know that an SSD's performance can slow down when it becomes too full. Workstation Specialists, one of the UK's leading workstation manufacturers, recommends that drives should be kept no more than two thirds full for optimal performance.

Those with bigger budgets may look to 512GB drives. At this capacity it's also feasible that a HDD won't be required, particularly if a lot of their data is stored on servers.

For high-end workstations it is possible to boost performance by combining two SSDs to create a RAID 0 array. While this may improve sequential read/write rates, we have heard mixed reports about the benefits for random read/write performance. We have not tested this at DEVELOP3D.

## RELIABILITY AND ENDURANCE

For professional designers and engineers, endurance and reliability is every bit as important as performance. And while SSDs are much better than HDDs at withstanding shock, vibration, and temperature extremes, they are by no means immune to failure.

The good news is flash technology is

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getting better all the time and the controllers becoming more advanced with features specifically designed to prolong the life of the drive. Wear-leveling, for example, helps move program/erase cycles around the drive to ensure even wear.

Most professional SSDs come with a five-year warranty, compared to three in most consumer models. Manufacturers define drives by their mean time between failures (MTBF) predicted in millions of hours. Some manufacturers also give their drives an 'endurance rating'.

Monitoring software is sometimes bundled with SSDs to keep track of drive health. This

can help predict when a drive might fail, helping minimise the risk of unplanned downtime or catastrophic loss of data for those that don't follow a strict backup regime.

There's also the important issue of drive performance slowing down over time due to the NAND flash cells wearing down. Workstation Specialists says low cost SSDs can slow down by as much as 50% within a year of use. Suddenly the high performance drive you bought could actually be slowing your system down.

To assess long-term performance and reliability there's no substitute for broad testing out in the field. Workstation Specialists

has worked closely with Intel, Kingston, Corsair, Crucial and OCZ over the years and has found that Intel and Kingston are by far the most reliable, suffering from the least failure rates and long-term performance problems.

The Derby-based firm is currently investigating PNY and Samsung, who are relatively new to professional-grade SSDs.

## SSDs ON TEST

For the purpose of this article we looked at four SSD drives – the Intel SSD 520 Series, OCZ Vertex 4, PNY Prevail Elite and Samsung SSD 840 Pro. All come in a 2.5-inch form factor, meaning they are suitable



	PNY Prevail Elite	Samsung SSD 840 Pro
Capacity (GB)	240GB (also available in 120GB and 480GB)	512GB (also available in 128GB and 256GB)
Interface	SATA 6Gb/s	SATA 6Gb/s
Controller	SandForce SF2281	Samsung 3-core MDX controller
Memory Type	Enterprise Multi-Level Cell (eMLC)	Three-Level Cell (TLC)
Warranty	5 year limited	5 year limited
Manufacturer's quoted Mean Time Between Failures (MTBF)	2 million hours	1.5 million hours
Manufacturer's quoted sequential read/write performance (MB/s)	Up to 550 / 520 MB/s	Up to 540 / 520 MB/s
Manufacturer's quoted 4k random read/write performance (IOPS)	Up to 85,000 / 85,000	Up to 100,000 / 90,000
Website	<a href="http://pny-europe.com/ssd">pny-europe.com/ssd</a>	<a href="http://samsung.com/ssd">samsung.com/ssd</a>
Application benchmarks (lower is better)		
Windows load (secs)	37.5	37.5
SolidWorks 2011 application launch (secs)	6.9	6.2
SolidWorks CAD dataset open (secs)	43.3	42.8
SolidWorks Pack and Go (secs)	35.7	17.5
Synthetic benchmarks (bigger is better)		
Sequential read / write (MB/sec) (AS SSD benchmark)	516 / 310	513 / 453
Sequential read / write (MB/sec) (CrystalDiskMark)	513 / 324	537 / 518
4k random read / write (MB/sec) (AS SSD benchmark)	21 / 73	29 / 73
4k random read / write (MB/sec) (CrystalDiskMark)	31 / 92	33 / 88
512k random read / write (MB/sec) (CrystalDiskMark)	459 / 322	489 / 503
4K-64Thrd random read / write (MB/sec) (AS SSD benchmark)	201 / 74	373 / 210
4K QD32 random read / write (MB/sec) (CrystalDiskMark)	208 / 255	408 / 363
Access time read / write (ms) (AS SSD benchmark)	0.114 / 0.222 (lower is better)	0.066 / 0.040 (lower is better)
Price	£149	£346 (256GB model = £158)

for laptops and desktops (with an adapter). All are SATA 3 (6Gb/s), which will need to be supported in your workstation to get the best performance out of these drives, particularly with regards to sustained read/write performance. All support AES 256-bit encryption to help keep data secure. All come with a 5-year warranty.

The Intel SSD 520 Series offers a huge range of capacities but the 180GB or 240GB are likely to appeal to most CAD users. The 60GB and 120GB models are arguably too small for serious CAD use and also deliver reduced performance, as does the 480GB version. Check out intel.com for the full specs.

While the NAND flash memory is home grown, Intel uses a third party controller – LSI’s SandForce SF-2281.

The retail box, which is about £10-15 more than the bare bones drive, comes kitted out with everything you might need for installation – desktop adapter, power and data cable, and a DVD of software. The Intel Migration software, which helps transfer OS, apps, documents, and personal settings from an old drive, and the Intel SSD Toolbox software, which monitors and manages the health of the drive, are also available for free download.

The PNY Prevail Elite is classed as an enterprise SSD. PNY makes a lot of noise

about its endurance, which it rates at 10,000 program /erase cycles. To put this in perspective, this is over three times that of its entry-level enterprise SSD, the Prevail and ten times that of its entry-level consumer SSD, the XLR8. All the other drives on test don’t rate their products in this way so it’s not possible to give direct comparisons.

The Prevail Elite’s high endurance rating is partly down to the enterprise class NAND flash memory that it uses (eMLC). However, like the Intel 520 Series, it also features LSI’s SandForce SF-2281 controller, which includes some advanced NAND flash management technology. According to PNY, this helps



OCZ Vertex 4	Intel SSD 520 Series	Seagate Barracuda ST2000DM001
256GB (also available in 64GB, 128GB and 512GB)	240GB (also available in 60GB, 120GB, 180GB and 480GB)	2TB
SATA 6Gb/s	SATA 6Gb/s	SATA 6Gb/s
Indilinx Everest 2	SandForce SF2281	N/A
Multi-Level Cell (MLC)	Multi-Level Cell (MLC)	N/A
5 years	5 year limited	1 year
2 million hours	1.2 million hours	N/A
Up to 560 / 510 MB/s	Up to 550 / 520 MB/s	Up to 210 MB/s
Up to 90,000 / 85,000	Up to 50,000 / 80,000	N/A
ocztechnology.com	intel.com	seagate.com
40.2	40.7	74.5
6.1	7.1	9.7
43.0	43.4	46.1
14.0	35.1	90.3
481 / 398	501 / 234	156 / 177
429 / 423	500 / 244	183 / 180
28 / 86	23 / 75	0.6 / 1.1
31 / 102	27 / 89	0.7 / 1.4
337 / 427	436 / 188	59 / 94
336 / 288	232 / 75	1.5 / 1.1
354 / 342	238 / 171	1.5 / 1.5
0.136 / 0.024 (lower is better)	0.158 / 0.199 (lower is better)	14.65 / 19.38 (lower is better)
£136	£155	£58