



Workstation Innovation News



by Robert Green,
Cadalyst
Contributing
Expert



Professional Graphics Selection and Optimization

Find the best solution for your GPU needs

I like to think of CAD workstations as a collection of components that must work well together to yield the best performance. I've noticed most conversations about workstation components inevitably wind up focusing on processors, cores, and RAM — which are crucial — but the graphics card is an oft misunderstood critical component. High performance graphics processing units (GPUs) such as today's NVIDIA Quadro and AMD FirePro graphics cards offer substantial performance gains for certain CAD and visualization workflows and picking the best one isn't always an obvious choice.

In order to optimize the performance of the CAD applications you use on your HP Z Workstation, you must understand the graphics card options available to you, so you can make your best choice.

The Basics

To start our discussion, let's establish some basic terms for the purposes of categorizing graphics performance. I'll break CAD graphics use into four categories with a functional description of what tasks are performed in each.

Professional 2D: 2D CAD is the primary use, but some 3D modeling may be done at times with some basic 3D visualization.

Entry Level 3D: 3D modeling is the primary use, but advanced visualization and rendering are used only sparingly.

Mid-range 3D: 3D modeling is the primary use, but much more real time rotation and visualization is used and some external rendering or animation applications may be used but are not the normal workflow.

High-end 3D: Large models/buildings are modeled and external rendering/visualization at very high resolutions (4K) along with high speeds required.

Using the HP Z820 Workstation spec sheet, [here's a list of compatible graphics cards.](#)

Professional 2D
Intel® integrated graphics
NVIDIA Quadro 410

Subscribe

From our sponsors



cadalyst

Recommended Products



HP Workstation Finder Tool

Get started



All-in-One Workstation. Z1

Learn more



Affordable performance and flexibility, re-defined. Z230

Learn more

Performance you want. Value you need.

Entry 3D

NVIDIA Quadro K600 1GB Graphics

Mid-range 3D

NVIDIA Quadro K2000 2GB Graphics

High End 3D

NVIDIA Quadro 6000 6GB Graphics

NVIDIA Quadro K6000 12GB Graphics

AMD FirePro W7000 4GB Graphics

NVIDIA Quadro K4000 3GB Graphics

Now that you know what graphics options are available for the workstations, how do you choose one?

What Are You Using?

As you can see from our four categories of use and graphics card specifications, it's how you use your software that determines what kind of graphics you need. To figure out your CAD use patterns, consider:

- What applications do you use?
- What percentage of your work is 2D vs. 3D?
- How much visualization do you do in your 3D applications?
- How much rendering do you do?
- How large are the models you visualize and render?

Bear in mind that not all users have the same CAD workflows, so you may need to break down your CAD usage patterns by group or department. There's no substitute for going through this exercise — it's the only way you'll truly understand your graphics requirements.

You can now compare your current usage patterns to determine the usage category your users' workstations fall into. You can then use the category you determine to find the appropriate graphics card for your workstation based on HP's recommendations.

Pro Graphics Specifications

Now that you've got a firm grasp on your CAD usage, it's time to select the actual graphics card. That requires some technical comprehension.



Different graphics cards have different sizes, slot requirements, and interface outputs. (Image credit: NVIDIA Corp.)

Just as your workstation's motherboard has a processor, your graphics board has a graphic processor that uses memory with varying degrees of memory bandwidth to achieve its maximum level of performance. Understanding these specifications goes a long way towards specifying the graphics card you need to get your CAD modeling and rendering done. Let's first look at a summary table of NVIDIA Quadro graphics boards and note some of their specifications.



Z420

[Learn more](#)



Our most versatile workstation ever.
Z620

[Learn more](#)



Our ultimate workstation.
Z820

[Learn more](#)



World's first workstation Ultrabook.
ZBook 14

[Learn more](#)



Designed to perform.
ZBook 15

[Learn more](#)



Expand your creative capabilities.
ZBook 17

[Learn more](#)



Visual power to overachieve.
Z24i

[Learn more](#)

All screen images courtesy of Autodesk

Additional Resources

[HP Certification](#)

[HP Performance Advisor](#)

[HP Remote Graphics](#)

[HP Total Care](#)

[HP ePrint & Share](#)

[HP & Autodesk Brochure](#)

[Autodesk Strategic Partners](#)

[HP Workstations and Architecture, Engineering & Construction](#)

[HP Workstations and Product Development](#)

[HP Z1 G2 Workstation Video](#)

QUADRO DESKTOP WORKSTATION SPECIFICATIONS						
BOARD FEATURES	Quadro K6000	Quadro K5000	Quadro K4000	Quadro K2000/D	Quadro K600	Quadro 410
Memory Size	12GB GDDR5	4GB GDDR5	3GB GDDR5	2GB GDDR5	1GB DDR3	512MB DDR3
Memory Interface	384-bit	256-bit	192-bit	128-bit	128-bit	64-bit
Memory Bandwidth	288 GBps	173 GBps	134GBps	64 GBps	29 GBps	14 GBps
NVIDIA® CUDA™ Parallel Processor Cores	2880	1536	768	384	192	192
Max Power Consumption	225W	122W	80W	51W	41W	37W
Power Connector	2x6-pin	1x 6-pin	1x 6-pin			
Number of slots	2	2	1	1	1	1
# Simultaneous Displays ²	4	4	4	4	2	2
Display Connectors	DVI-I DVI-D DP DP 3pin Stereo ¹	DVI-I DVI-D DP DP 3pin Stereo ¹	DVI-I DP DP 3pin Stereo ¹	DVI-I DP ^a DP ^a	DVI-I DP	DVI-I DP
ECC (Error Correcting Code)	✓ _s	✓ _s				
OpenGL	4.4	4.4	4.4	4.4	4.4	4.4
Shader Model	5.0	5.0	5.0	5.0	5.0	5.0
DirectX	11	11	11	11	11	11
NVIDIA 3D Vision® Pro	✓	✓	✓	✓	✓	✓
NVIDIA® Mosaic Technology	✓	✓	✓	✓	✓	✓
Multi-Display Synchronization	Quadro Sync	Quadro Sync				
NVIDIA SLI® Support ³	✓	✓				
NVIDIA® nView® Desktop Management Technology	✓	✓	✓	✓	✓	✓
High-Performance Video I/O ⁴	✓	✓	✓			

A study of the graphics card specifications, as illustrated in this summary table from NVIDIA, clears up the mystery behind graphics board performance and compatibility with your workstation.

Memory Size: Generally speaking, the more memory the graphics board has, the more geometry it can process, buffer, and stream to your monitor. As screen resolutions, color depths, model sizes, and animation use (typically measured in rendered frames per second) increases, these memory intensive functions become even more critical. In simple terms, the amount of memory present on the GPU allows your model to be

- loaded fully into memory where it can be processed rapidly without swapping to disk or system memory,
- rendered to visual images that are sent to your screen, and
- repeated at whatever frame per second rate your application uses.

Memory Technology: Of the two types of RAM used in Quadro and FirePro boards the DDR3 RAM is the same type used in most workstations while the higher cost GDDR5 RAM is a lower latency, phase aligned architecture that speeds memory access.

Memory Interface and Bandwidth: As graphics boards become more powerful and need to stream more (and higher resolution) graphics, it is imperative that they be able to access memory on the widest possible interface — for example on the Quadro K6000's 384-bit width is 6 X wider than the Quadro 410's 64-bit value. The width of the memory combined with the speed of the memory technology (DDR3 or GDDR5) combined to reveal the memory bandwidth — which determines the amount of graphics that can be processed on a steady state basis. The more you need high resolution and high speed video, the more you need wide memory interfaces on your graphics board.

Parallel Cores: Why have all that memory and bandwidth? So the graphics processor can solve bigger problems! And, the number of parallel processors (called CUDA cores by NVIDIA or Stream Processors by AMD) in the GPU itself is the determining factor in how large graphical tasks can be solved quickly.



The AMD FirePro W7000 sports a 256-bit, 156 GB bandwidth memory architecture with 4 GB of GDDR5 RAM — making it a great choice for high end 3D software applications on high power workstations.

Workstation Requirements

For any given graphic card there are some mechanical, power, and output requirements that your workstation must be able to support. The most important specifications to note are:

Maximum Power Consumption: Rated in watts. The key issue here is whether your workstation's power supply can handle the graphics card.

Number of Slots: The number of full length slots the graphics card will consume. For larger cards that require 2 slots, the key issue is if your workstation has the available space to house the card.

Simultaneous Displays and Connectors: For workstations where multiple displays will be required (typically 2 for CAD) you need to be sure the graphics card can support your requirements and that the connector interface for your monitors is supported.



NVIDIA's K4000 is the highest power card in the Quadro family that installs in a single slot, making it an ideal choice for aggressive usage in smaller workstations.

For CAD workstations, the mechanical room and power supply robustness are the factors that will restrict your available graphics card options. For example, if you have an HP Z230 Workstation with only a single full length expansion slot available you won't be able to fit a Quadro K6000 into the case – and even if you could the power supply couldn't keep up.

Making sure you select the right graphics card to suit your workstation's chassis and power supply is a great reason to stick with the recommendations HP provides for your workstation.

What Software Will You Use?

For any given software programs, it pays to check on the workstation and GPU recommendations to confirm your hardware will give you optimal performance. HP created graphics optimization guides specifically for software manufacturers [SolidWorks](#) and [Autodesk](#). This is your starting point for selecting the right GPU for your needs.

Just because you understand your current CAD use patterns doesn't mean they'll stay the same, right? Because workstations and GPU's will typically offer a 3 year life span, you must consider how your CAD software usage categories will evolve during those 3 years. Ask yourself the following diagnostic questions:

- Will our usage of 2D go away in the next 3 years?
- Will more users perform visualization/rendering in the next 3 years?
- Will our typical model sizes increase during the next 3 years?

Depending on the answers to these questions, you may see the need to purchase a graphics card today that is suited to what you'll be doing in the future. In fact, purchasing a graphics card a category above your current usage is a viable way to stave off obsolescence and optimize graphics performance over the lifetime of your workstation.

How Will Software Change?

Another important consideration is how software will change during the next three years. As CAD software uses more of the GPU to perform renderings (rather than using the CPU as is mainly the case today), the GPU and graphics subsystems in our workstations will become even more crucial.

While it's impossible to say how much commercial CAD packages will migrate computation away from the CPU to the GPU in future years, it is clear — as evidenced even in AutoCAD's graphics hardware acceleration — that users will want higher performance 3D rendering and visualization. It seems logical to assume that the CAD software we work with will become more dependent on GPU power over time.

Consider the following diagnostic questions:

- Will we continue to update our CAD design software?
- Will we become more dependent on fast rendering/visualization in our design processes?
- Will we need to accommodate these changes on workstations as they age?

The more you answer, "Yes," to these questions, the more likely it is you'll need a more powerful GPU now to keep your workstations running optimally during its three-year life span.

Professional Level Benefits

Professional graphics cards deliver additional benefits beyond their technical specs that can increase performance and lower your cost of ownership over the lifetime of your workstation worth considering:

Three-year warranty: No surprise replacement costs!

Certified software drivers: Extensive testing with major CAD software vendors provides you with software drivers that deliver maximum performance over the life of your card.

Automated driver updates: HP's Performance Advisor software (included with HP Z Workstations) automatically detect and deploy updated new certified drivers for your CAD applications so your IT staff won't have to.

Consider what it would cost to replace a graphics card or spend hours searching for a certified driver and you'll start to appreciate why a professional graphics solution can

actually lower your cost of maintenance over a three year workstation life span.

Wrapping Up

When specifying your new workstations you'll have to select which processors, how much RAM and what types of disks you need to support your CAD usage but don't forget that the graphics card is another consideration! By understanding the tasks your users need to complete and matching those needs to your graphics hardware you can specify workstations that perform optimally.

About the Author

Robert Green provides CAD implementation, consulting, and programming services for a variety of companies throughout the United States and Canada. He holds a degree in mechanical engineering from the Georgia Institute of Technology and is the author of *Expert CAD Management: The Complete Guide*. Reach him via his web site at www.cad-manager.com.

Notes and Disclaimers

© Copyright 2014 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice. The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein. NVIDIA, the NVIDIA logo, Quadro, Kepler, FXAA, TXAA, Maximus, NVIEW, Tesla and Mosaic are trademarks and/or registered trademarks of NVIDIA Corporation in the U.S. and other countries. AMD, the AMD arrow logo, FirePro, and combinations thereof, are trademarks of Advanced Micro Devices, Inc. All other trademarks are the property of their respective owners.

1. Optional.
2. Includes directly attached displays and displays connected through DisplayPort 1.2 hubs.
3. On both GPU Cache and on-board DRAM.
4. On GDDR5 memory only.
5. On SLI Certified Platforms.
6. High Performance Video I/O includes support for NVIDIA SDI Capture and Output boards and GPUDirect for Video enabled 3rd party I/O boards.
7. OpenGL 4.1 on Mac OS X, OpenGL 4.3 on Windows using Bootcamp 8 K2000D has DVI-I, DVI-D, mDP.

You are currently subscribed to **Workstation Innovation News** as %%emailaddr%%.
Please do not reply to this message. If you wish to leave this mailing list, simply [Unsubscribe](#).
Cadalyt is a division of Longitude Media LLC, P.O. Box 832, Dover, MA 02030.
© 2014 Longitude Media Group, Inc. All Rights Reserved. Refer to our [Privacy Policy](#).
Send us your feedback: customerservice@longitudemedia.com