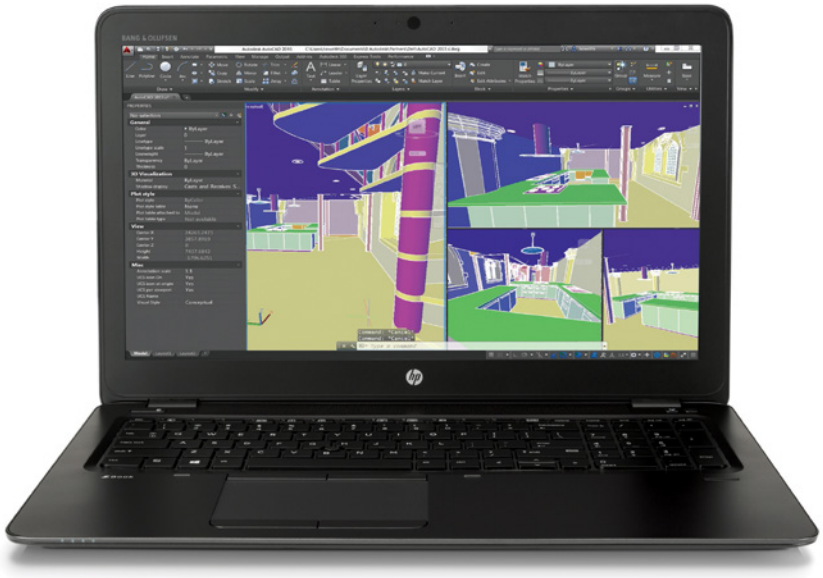
Technical white paper

HP ZBook 15u G3 Mobile Workstation

Ready to work from anywhere



Enjoy workstation performance in a low cost, compact package. The HP ZBook 15u with its 15.6” diagonal display is the perfect combination of mobility and cost.

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Chassis and system highlights

The ZBook 15u G3 mobile workstation delivers sleek Ultrabook™[1] style, impressive performance, and long battery life. HP's mobile workstation Ultrabook™ redefines mobile computing.

Innovative design

Inspiration can strike any time—be ready with a mobile workstation that starts at 4.18 lbs., 19.9 mm thin, and offers an optional touch screen,[2] integrated numeric keypad, and impressive battery life.

Figure 1. HP ZBook 15u G3

Professional performance

Get the performance you need with Windows 10,[3] up to 32 GB memory, AMD FirePro™ professional graphics, HP Z Turbo Drive G2, 1.5 TB[2] of total storage, and an FHD touch or UHD display.

Workstation reliability

Optimise your HP ZBook 15u G3 for peak performance with HP Performance Advisor[4] by automatically configuring your system with the most current settings and drivers. Be confident that your ZBook can withstand the demands of professional computing with workstation ISV application certifications; 115,000 hours of testing through the HP Total Test Process; and rigorous MIL-STD-810G testing standards.[13] Also, take advantage of HP Sure Start to help ensure a proper boot-up thanks to corruption detection, a self-healing BIOS, and recovery that restarts where it left off if the update stalls, fails, or is corrupted.

Designed with the environment in mind

HP is committed to environmental sustainability and energy efficiency. To reduce energy consumption, HP offers ENERGY STAR® certified mobile workstation configurations and meets EPEAT® Gold standards.[5] The HP Workstation design team has taken a proactive approach (beyond industry regulations) to recyclability and selecting materials that help reduce the impact to the environment.

System architecture

If you want value in a lightweight design, look no further. This workstation can be configured with up to 32 GB memory, AMD FirePro™ professional graphics, HP Z Turbo Drive G2, and 1.5 TB of total storage.

New technologies

New Intel® Processor Micro-architecture
The HP ZBook 15u G3 supports Intel®'s latest Core™ i5 and i7 processors,[6] featuring a new micro-architecture and a new instruction set including AVX2 (Advanced Vector Extensions 2.0) and FMA (floating-point fused multiply add instructions) that help deliver fast computing performance with low energy consumption. The Mobile Intel® CM236 chipset complements the HP ZBook 15u G3's core architecture.

Intel® vPro™ Technology Capable
Intel® Core i5 with vPro™ and Core i7 with vPro™ technology is a selectable feature that is available on units configured with select processors, a qualified Intel® Centrino® WLAN module, and a preinstalled Windows operating system. It provides improvements in remote manageability, security, energy efficient performance, and wireless connectivity. Intel® Active Management Technology (iAMT) offers built-in manageability and proactive security for networked mobile workstations, even when they are powered off* or when the operating system is inoperable. It can help identify threats before they reach the network, isolate infected systems, and update mobile workstations regardless of their power state.

Operating system

The HP ZBook 15u G3 is compatible with Windows operating systems. Windows has been designed to bring you one operating system that can handle all your work's toughest demands—no matter where you are.

The HP ZBook 15u G3 supports the operating systems seen below.

Table 1. Supported operating systems

Preinstalled OS	Supported OS
Windows 10 Pro 64[3]	Windows 10 Enterprise 64[3]
Windows 10 Home 64[3]	Windows 8.1 Enterprise 64
Windows 7 Professional 64 (available through downgrade rights from Windows 10 Pro)[8]	Windows 8.1 Professional 64

I/O and storage

I/O

The HP ZBook 15u G3 comes configured with two USB 3.0 ports (one charging), one USB 3.1 Gen 1 port, one VGA port, headset and microphone connections, an RJ-45 connection, a slide docking connector, a smart card reader, and a media reader slot that supports SD, SDHC, and SDXC.

The system ships with a WLAN/Bluetooth® card. The WLAN controller connects via a PCIe bus and the Bluetooth® controller connects via a USB 2.0 bus. Both controllers can be enabled or disabled in the BIOS F10 menu by enabling/disabling PCIe slot 1.

This mobile workstation is equipped with a dual-microphone array, Bang & Olufsen audio, and an optional 720p HD webcam.

Storage[9]

The PCIe NVMe specification provides the needed connectivity to the PCIe bus, enabling higher bandwidth. This results in a significant performance increase today and performance growth for the foreseeable future. Through a direct connection to the PCIe bus, the HP Z Turbo Drive G2 (PCIe M.2 2280 SSD) enables sequential performance that is 4 times faster than SATA SSDs. The HP ZBook 15u G3 supports a maximum of one M.2 NVMe drive and one 2.5 inch drive.

Graphics

The HP ZBook 15u G3 supports discrete graphics with AMD® FirePro™ W4190M with 2 GB dedicated GDDR5 video memory. The system supports integrated graphics with Intel® HD 5500 graphics. Hybrid graphics is also supported with one of the discrete GPU options and one of the integrated GPU options.

Battery

The HP ZBook 15u G3 has an extended battery life. The HP 3-cell Long Life Polymer Battery (46 WHr) has enough power to keep your workstation running for up to 10 hours,[7] depending on the configuration (FHD display, etc.)

Networking and security

Wireless networking

The HP ZBook 15u G3 supports WLAN (Intel® 802.11 2x2ac) and Bluetooth® (BT 4.1) both vPro™ and non-vPro™.

Table 2. 802.11 Wireless LAN options[11]

Intel® Dual Band Wireless-AC 8260 802.11 a/b/g/n/ac (2x2) WiFi + Bluetooth 4.2 combo adaptor (vPro™)
Intel® Dual Band Wireless-AC 8260 802.11 a/b/g/n/ac (2x2) WiFi + Bluetooth 4.2 combo adaptor (non-vPro™)
Intel® Dual Band Wireless-AC 3165 802.11 ac (1x1) WiFi and Bluetooth 4.0 combo adaptor (non-vPro™)

Security

The HP ZBook 15u G3 supports Integrated Smart Card Reader, Full Volume Encryption, a security lock slot, Trusted Platform Module (TPM) 2.0 security processor, and an optional fingerprint reader.

Display options

As a mobile workstation customer, we know that viewing your work precisely is critical to your success. You need the right display in order to accurately and efficiently get your work done. Our HP ZBook 15u G3 offers different display options[2] to ensure you will get the best visual experience. This section will help you choose the display that is right for you. Our mobile workstation can also be docked to take advantage of our HP Z Displays.

Display technology background and information

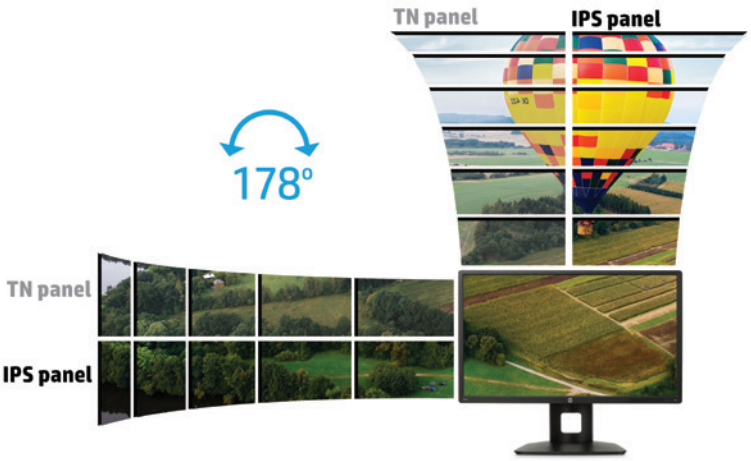
There are many different measures used to understand or express the performance of a mobile workstation-level display. Although display resolution, the most obvious measure, is important for clarity, there are other measures of a display that contribute to your viewing experience such as screen brightness, viewing angle, response rate, and bit-precision.

IPS displays
Our displays contain In-Plane Switching (IPS) technology. While Twisted Nematic (TN) displays are common in the industry, IPS displays offer superior viewing angles, colour accuracy and newer technology to create an immersive viewing experience.

Viewing angles
The viewing angle of a display represents how far left, right, down or up a display can be observed at with acceptable viewing performance. When looking at a TN screen from an angle, the images on the display often look faded or disappear completely. This is due to the TN displays' shallow viewing angle. Figure 1 below shows the effect different viewing angles have on a TN display. Alternatively, an IPS display has a larger viewing angle of up to 178 degrees that allows the screen to be viewed comfortably from several positions. Wider viewing angles are especially useful when several users are viewing one screen or the screen is not being viewed head-on.

Viewing angles are usually measured in a left/right/down/up format. This means they have an angle measurement for each viewing direction. A standard viewing angle (SVA) is 40/40/15/30. This means you can view it 40 degrees to the left, 40 degrees to the right, 15 degrees down, and 30 degrees up while still having adequate colour and detail. The next step up, wide viewing angle (WVA), measures in at 60/60/50/50. The ultra-wide viewing angle (UWVA), which is available on our HP ZBook 15u G3 displays, measures at 85/85/85/85.

Figure 2. The effect different viewing angles have on IPS and TN displays



Brightness

Luminance and brightness, while being different terms and measurements, represent the same thing. While brightness is a relative measure, luminance is an exact measurement of light output from your display. Luminance is measured in candelas per square metre (cd/m²) often referred to as cdm or, in the shorthand, nits. Simply put, a cdm measures the amount of light a screen produces relative to screen size, facilitating an easy comparison between differing screen sizes. Another benefit of measuring screen brightness in nits is how straightforward the scale is to understand: the more cdm, the brighter the screen.

While luminance is an important value to keep in mind, brighter doesn't always mean better. High luminance displays work great in bright environments but may not be suitable for lower light conditions. Be sure to assess your work location before selecting how bright your display will be.

Refresh rates

The refresh rate of a display measures the amount of times the display is updated every second. A higher refresh rate means decreased blurring and ghosting effects when using the display. Ghosting is the effect when an image or video moves on your display and leaves a faint trail. Having a good refresh rate, commonly around 60 Hz (60 images/second), assures video playback and display use is smooth.

Resolution

Screen resolution measures the amount of pixels a screen can display. Usually measured in the format "Width x Height", a display of 1920 x 1080 would contain 1920 pixels horizontally and 1080 pixels vertically for a total resolution of 2,073,600 pixels. A higher screen resolution means more pixels and more detail in the images on your display. Figures 2 and 3 illustrate the difference between a lower resolution display and a higher resolution display. A display with more pixels allows you to view more information on one screen due to increased pixel density. In theory, a display with more pixels should allow you to view more on your screen at once than a display with a lower pixel count.

Figure 3. FHD

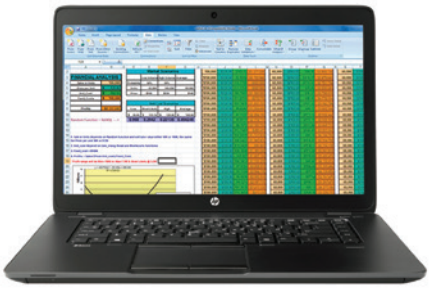
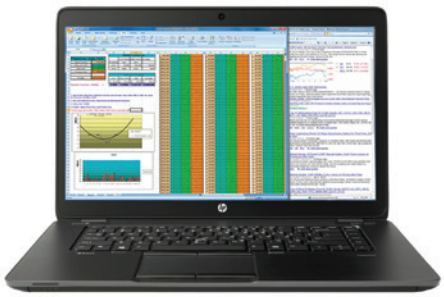


Figure 4. UHD



Similar to resolution, displays can be measured in pixels per inch (PPI). This simple measurement takes both screen size and resolution into account to define the amount of pixels per square inch present in the display. A display with a low PPI measurement has fewer pixels per inch and lower quality image production than a display with a high PPI measurement. Generally, image sensitive work requires a high PPI display.

Resolution types

Displays exist in several resolutions. Table 3, shown below, outlines the resolution differences of displays offered in the market.

Table 3. High definition video standards

Video standard	Full name	Resolution
HD[10]	High Definition	1280 x 720
HD+	High Definition Plus	1600 x 900
FHD	Full High Definition	1920 x 1080
QHD	Quad High Definition	2560 x 1440
QHD+	Quad High Definition Plus	3200 x 1800
UHD/4K[15]	Ultra High Definition	3840 x 2160
Cinema 4K[15]	Cinema High Definition	4096 x 2160
QQHD/5K	Quad Quad High Definition	5760 x 2880

HP display solutions

HP ZBook 15u G3 display options

The HP ZBook 15u G3 is crafted to maximise your productivity. The 15.6-inch diagonal screen size with a 16:9 aspect ratio provides a comfortable workspace and keyboard layout.

Table 4. HP ZBook 15u G3 display options

	Resolution	Refresh rate*	Brightness*	Viewing angle
15.6-inch diagonal FHD	1920 x 1080	60 Hz	300 cd/m²	SVA
15.6-inch diagonal FHD Touch	1920 x 1080	60 Hz	300 cd/m²	SVA
15.6-inch diagonal FHD	1920 x 1080	60 Hz	300 cd/m²	UWVA
15.6-inch diagonal UHD	3840 x 2160	60 Hz	300 cd/m²	UWVA

* All specifications represent the typical specifications provided by HP's component manufacturers; actual performance may vary either higher or lower.

HP Z Displays

We offer HP Z Displays for those times you need something bigger. Switching from an HP ZBook display to an HP Z Display is as simple as "click and go" when combined with a docking station. With sizes ranging from 22- to 34-inch diagonal displays, you can find the perfect size for your work. Choose from several different resolutions to best meet your display needs and even combine multiple displays side-by-side, so you can be as productive as possible.

All HP Z Displays and DreamColor Displays are supported on the HP ZBook G3 family. For more information, see hp.com/go/zdisplays.

When selecting a display, be sure to consider what the display will be used for. If visual details are important, a higher resolution display is a must. However, if you mainly use your computer for word processing and Excel, a lower resolution display is a cost-effective option.

Recap

With different resolutions, response rates, viewing angles, bit precision, and display types, the choice of display can be overwhelming. However, understanding what these measurements mean and why they are important is helpful when choosing a display. Our HP ZBook 15u G3 display options are perfect for any workstation-worthy job and can benefit professionals in any field.

Multiple display support

The HP ZBook 15u G3 supports up to a maximum of three independent displays[12] graphics when utilising iGPU graphics with and without the use of the HP UltraSlim Docking Station.

The number of independent displays supported depends on a number of factors, including if a docking station is used and if a DisplayPort™ Hub or "daisy-chain" capable display is being used.

HP ZBook 15u G3 Integrated Graphics without ZBook Dock:
Without the use of a dock, the HP ZBook 15u G3 supports up to three independent displays. These three displays can include a combination of the internal panel, HDMI 1.4, and the two Thunderbolt™ 3 ports on the system.

HP ZBook 15u G3 Integrated Graphics with ZBook Dock:
When using the HP ZBook Dock, the HP ZBook 15u G3 supports up to three independent displays. These three displays can include a combination of the internal panel, VGA, Thunderbolt™ 3 from the HP ZBook Dock, and ports from the Shared Bandwidth Hub on the HP ZBook Dock, including the VGA, DisplayPort™ 1 and DisplayPort™ 2.

Figure 5. Multiple Displays Configuration for HP ZBook 15u G3 with Integrated Graphics

Recommended Configurations

No Dock

Configuration	ZBook 15u G3
Max displays no dock	3

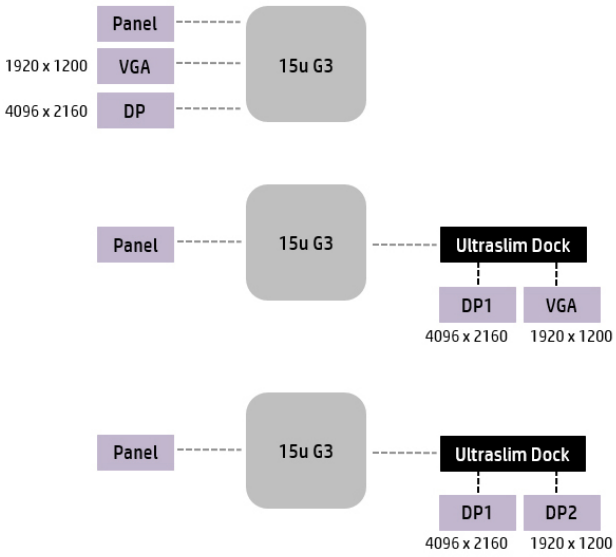
With Dock

Configuration	ZBook 15u G3
Max displays with dock #1	3

Configuration	ZBook 15u G3
Max displays with dock #2	3

IGPU

Reference Diagram



*DisplayPort connector supports a DisplayPort display, a HDMI display with a DP-to-HDMI dongle, a VGA display with a DP-to-VGA dongle, or a DVI display with a DP-to-DVI dongle.

DisplayPort™ 1.2 "daisy-chain" feature
DisplayPort™ v1.2 supports "Multi-Stream Transport," which allows multiple video streams across a single DisplayPort™ connection. This is commonly referred to as DP 1.2 "daisy-chain" feature where multiple displays may be driven by a single DisplayPort™ connector.

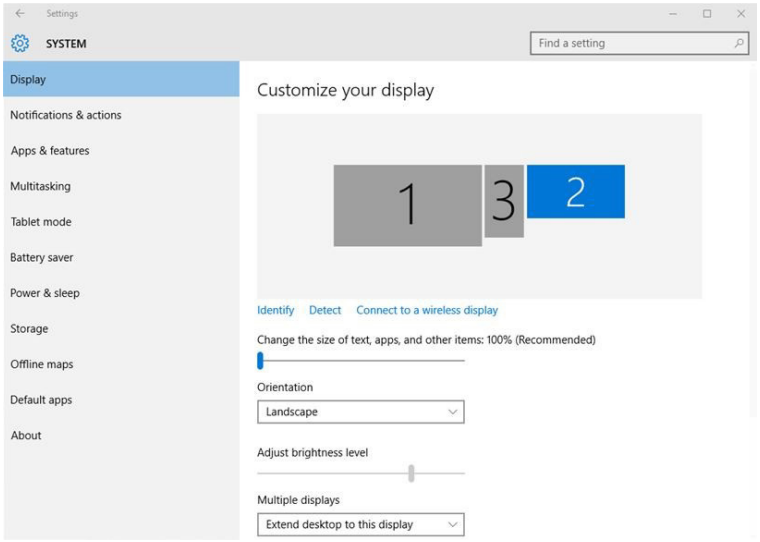
The HP ZBooks, UltraSlim Docking Station and the HP ZBook Dock support the DisplayPort™ v1.2 "daisy-chain" feature.With the use of a DisplayPort™ 1.2 hub or a DisplayPort™ 1.2 display that supports Multi-Stream Transport or "daisy- chaining," a user may connect multiple external displays to a single DP connector on a supporting docking station. A dongle is needed to connect Thunderbolt™ 3 port to a DisplayPort™ 1.2 hub or a DisplayPort™ 1.2 display for this feature. On all HP ZBooks, this capability provides for more flexibility on the type of displays and an expansion of the number of displays that may be used. For example, three DP displays may be connected with the use of a DP 1.2 hub with all three DP monitors connected to the hub, and the hub connected to a supporting docking station.

Multiple displays management

On the HP ZBook 15u G3, users may use Windows Display Manager to set up and manage multiple displays. To launch Windows Display Manager, right-click any empty area of your desktop, and then select **Screen Resolution** on Windows 8/8.1 or **Display Settings** on Windows 7 or 10. (Figure 6 shows the screen shot for Windows Display Manager).

Tip: A quick way to enable all displays connected (up to the maximum supported) in extended desktop mode is to use Windows presentation key and choose "Extend" mode.1- Connect displays.2- Press Windows logo key + P.3- Select Extend.

Figure 6. Screenshot for Windows Display Manager



SATA to PCIe technology transition for SSDs

This section highlights the transition from SATA protocol to PCIe protocol as it relates to solid-state storage (SSD) devices.[9]

Why the transition from SATA to PCIe?

HP ZBooks are transitioning from the use of SATA SSDs onto the PCI Express (PCIe) SSDs. M.2 is the new and smaller industry standard for factor that enables thinner and lighter HP ZBooks and provides support for various devices, focusing on SSDs that support either the legacy SATA interface or the PCIe interface. This transition fosters performance improvements of SSDs on the HP ZBook 15u G3. The HP Z Turbo Drive, built on the industry standard M.2 form factor, is a PCIe based NVMe SSD storage device that takes advantage of this advancement.

Today's SATA HDDs and SATA SSDs have reached a performance ceiling. HDDs are limited by the mechanical nature of the devices, while SATA SSDs are limited by the 6 Gb/s ceiling of the SATA bus. HP's SATA I/O working group has strategically shifted focus from the SATA bus to the multi-lane capabilities of PCI Express.

In order to support multi-lane PCIe devices, a new specification was needed to enable performance improvements of storage in small devices. The PCI Express M.2 specification was created and provides the needed connectivity to the PCIe bus providing both a significant performance bump today and performance growth for the foreseeable future.

Introduction to M.2 PCIe SSDs

M.2 is a specification for internally mounted computer expansion cards and associated connectors. Through different keying the M.2 specification supports multiple functions for add-in cards including WLAN11 (Wi-Fi), 3G/LTE (WWAN), and SSDs. Exposed buses through M.2 are SATA, PCIe 3.0, and USB 3.0 buses. M.2 storage devices replace mSATA with a denser, more flexible physical specification that is most suitable for SSDs, especially when utilised in small devices.

Figure 7: M.2 PCIe SSD

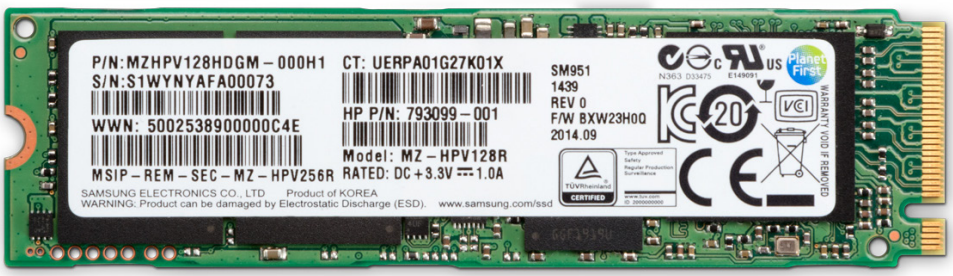


Table 5. Physical dimension specification of M.2 available for ZBook G3

	M.2
Board area (mm)	22 x 80

M.2 PCIe SSD benefits and features

- Maximises usage of card space
  - Longer modules and double-sided components population allows double the storage capacity within the footprint of mSATA SSD devices
- Four PCI Express lanes and one SATA 3.0 6 Gb/s port accessed through same connector
  - Compatibility to legacy storage interface (SATA)
  - Same form-factor and interface provides path to the PCIe storage devices of the future
- Reduces bottlenecks by connecting directly to the PCIe bus thus providing an excellent solution for those with large files and big data workflows
  - Bandwidth to the SSDs increases due to lane aggregation
  - Simpler storage hierarchy reduces latency
- NVMe Controller: designed specifically for non-volatile memory storage devices
  - Lowers latency that results in significantly better Random Read performance
  - Lowers command overhead
  - Exploits the parallelism available in modern host HW and SW

Figure 8. ACHI to NVMe Transition

Performance advantage with HP Z Turbo Drive

As previously mentioned, current mSATA SSDs connected via a SATA connection are limited by the 6 Gb/s ceiling of the SATA bus. With the implementation of the M.2 specification and use of PCIe SSD devices, performance levels now exceed 6 Gb/s.

The HP ZBook 15u G3 takes advantage of this opportunity by utilising the HP Z Turbo Drive, a PCIe SSD storage device built on the industry standard M.2 interface connected to the PCIe bus via the M.2 interface. In an HP ZBook 15u G3, the HP Z Turbo Drive connects to four lanes of PCIe G2.

Table 6. HP ZBook and Z Turbo Drive Generations

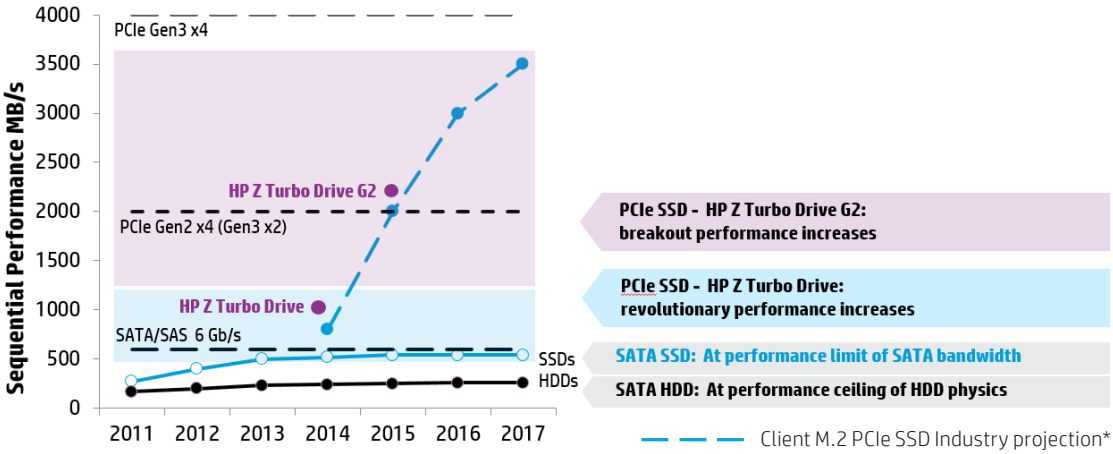
HP ZBook Generations	PCIE Generation	HP Z Turbo Drive Generation
G3	PCIe 3x4 (4 lanes)	G2
G2	PCIe 2x2 (2 lanes)	G1
G1	N/A	N/A

Table 7. HP Z Turbo Drive specifications on HP ZBook Mobile Workstations

	HP Z Turbo Drive G2 256 GB	HP Z Turbo Drive G2 512 GB
Connection	PCIe 3x4 (4 lanes)	PCIe 3x4 (4 lanes)
Sequential read	2260 MB/s	2260 MB/s
Sequential write	1260 MB/s	1600 MB/s

The chart below shows a comparison of storage device performance measured in MB/s. By directly connecting to the PCIe Bus, the HP Z Turbo Drive is able to considerably exceed previous performance capabilities.

Figure 9. Comparison of storage device performance



Detailed performance and benchmarking results

Figure 10. Sequential R/W performance (MB/s)

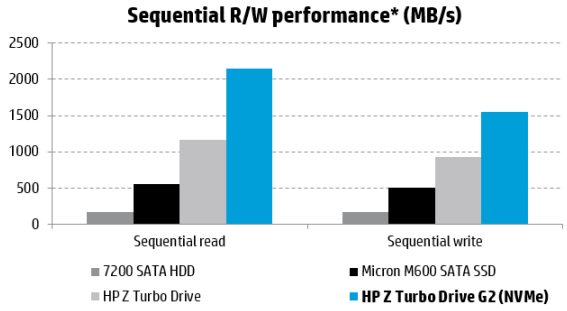
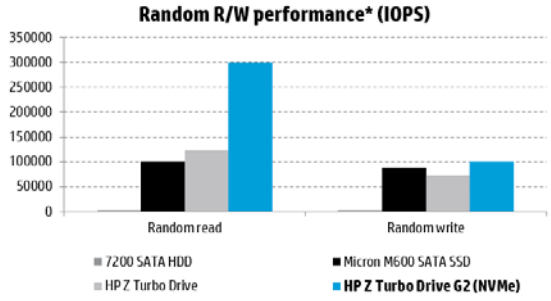


Figure 11. Random R/W performance (IOPS)



*Performance measured using IOMetre 2006 with queue depth 32

Customer advantages

The HP Z Turbo Drive benefits all workstation customer segments by allowing customers to realise performance gains due to improvements in storage performance. While workflows with large data files will see the most noticeable improvement, all users will appreciate the improved transfer rates and quicker performance.

These specific segments are:

- Product Development/AEC
- Media & Entertainment
- Finance
- Oil & Gas
- Geospatial

Summary

The transition from SATA to PCIe protocols for solid-state devices enables customers to utilise the M.2 form factor to benefit from faster data transfer speeds and improved storage performance. The HP Z Turbo Drive offering on the HP ZBook 15u G3 provides a huge performance gain over HDDs, enables large file/big data workflows, and offers impressive price/performance for NAND components. Integrating the HP Z Turbo Drive technology into HP platforms increases the flexibility of the storage subsystems and provides the user options for performance and capacity that stand out in the industry.

Power supply

Save size and weight

The HP ZBook 15u G3 Mobile Workstation takes the reliability and performance advantages of a workstation on the go. With Intel® processor technology and AMD mobile graphics cards, professionals can take their work with them wherever they travel. Our system requires an efficient power supply, which is why the HP ZBook 15u G3 ships standard with the HP 65W Slim Smart AC Adapter.

Function of the power supply

External power supplies convert the 120 V or 240 V AC power, depending on the country, from a wall outlet into DC current. The HP ZBook 15u G3 will only pull as much power as required to operate all operating components and open applications. The HP ZBook 15u G3 ships with the power supply option to best meet the demands of a fully loaded machine running an intense workload. Power supply units have an efficiency rating, measured as a percentage of power the machine uses out of total power pulled from the source.

What happens if the power supply is too low in wattage?

The HP ZBook 15u G3 can be configured in the settings to run in full use, balanced, or power saving modes. When the ZBook is connected to a landline, it will attempt to pull all of the current it needs from the wall. If the energy demand exceeds the power supply rating, the management system within the BIOS will automatically draw the additional power needed from the battery. In this case, it is possible to drain the battery while connected to a landline. When run at maximum capacity, low wattage power supplies may produce noticeable but not harmful heat.

The HP ZBook 15u G3 is compatible with power adapters 65W and above.

What makes the power adapter smart?

The smart feature displays a pop-up message:

“For full performance, connect a higher capacity AC adapter”

This message informs the user that as power demands increase, the ZBook may not perform at full capacity, which may result in longer battery charging time. In cases of extreme power demands, the system may also throttle back the processor or, with systems that have discrete video subsystems, a video balance mode may occur to further balance the power needs of the system.

Note: System CPU functions always have priority over battery charging, so charging delays will occur first.

Table 8. HP ZBook 15u G3 AC power adapter configure to order options

Adapter	External 65 Watt Slim Smart AC Adapter
Size	153 x 66 x 22 mm
Weight	0.70 lb (320 g)
Total cord length	6 feet (1.8 metres)
Barrel Size	4.5 mm

Switch it up

When workloads change or the user finds that they require a different power supply, all of the power supply sizes are offered as after-market options that customers can purchase at a later time. In the case of a professional using a docking station to connect at work, it is highly recommended to use the higher wattage power supply option. For many of these users, the purpose of a docking station is to connect to a larger and/or multiple displays, often to use more applications that require greater resources. For this reason, it is best to choose the higher wattage power supply. HP recommends the External HP 65 W Smart AC Adapter for optimal performance on the HP ZBook 15u G3.

MIL-STD-810G testing[13]

The HP ZBook 15u G3 Mobile Workstation is designed with reliability in mind, which is why it undergoes a series of tests. This testing consists of a variety of conditions that are intended to evaluate the reliability of the HP ZBook 15u G3 under a specific set of environmental conditions.

HP Total Test Process

The HP ZBook 15u G3 is intended to provide users with a reliable product wherever they go, under many conditions. In the design phase, we start with the HP Total Test Process. This is a multi-tiered product validation process with comprehensive, end-to-end diagnostics and a minimum of 115,000 hours of testing per platform. After this phase, we send our products to a third party to see how well they can match up against the MIL-STD-810G testing process.

MIL-STD-810G testing

MIL-STD-810G testing is from the Department of Defense (DoD) Test Method Standard for Environmental Engineering Considerations and Laboratory Tests. This standard, though created specifically for DoD, is widely used for a variety of technological devices, including the HP ZBook 15u G3. It outlines a broad range of tests that can be tailored to measure the reliability of specific pieces of equipment and is intended to help organisations design their equipment for enhanced durability. The MIL-STD-810G is a set of testing standards set by the U.S. military and it is now the most widely used international standard for testing a computer's durability. It uses a range of test methods to determine the reliability of the equipment. The series of tests performed are approved and used by all departments and agencies of the DoD. This set of standards is used to:

- Define the environmental stresses, durations, and equipment lifecycle
- Develop analysis and test criteria tailored to the equipment and its environmental life cycle
- Evaluate equipment lifecycles when exposed to environmental stresses
- Identify deficiencies and defects in the design, materials, manufacturing processes, packaging techniques, and maintenance methods

How does the HP ZBook 15u G3 measure up?

Below is the ZBook 15u G3 MIL-STD-810G testing report. The ZBook 15u G3 passed all 14 tests listed below and all tests were performed from a 3rd party to ensure accurate testing results and no bias in the reports.

Table 9. MIL-STD-810G tests passed by the HP ZBook 15u G3 in 2015

	MIL-STD-810G reference
Altitude	Method 500.5 Procedure I Method 500.5 Procedure II
Bench Handling	Method 516.6 Procedure IV
Crash Hazard Shock	Method 516.5 Procedure V
Drop	Method 516.6 Procedure IV
Dust	Method 510.5 Procedure I
Explosive Atmosphere	Method 511.5 Procedure I
Freeze/Thaw	Method 524.5 Procedure III

Functional Shock	Method 516.6 Procedure I
High temperature	Method 501.5 Procedure I Method 501.5 Procedure II
Humidity	Method 507.5 Procedure II
Low temperature	Method 502.5 Procedure I Method 502.5 Procedure II
Sand	Method 510.5 Procedure II
Temperature Shock	Method 503.5 Procedure I
Vibration	Method 514.6 Procedure I category 4 Method 514.6 Procedure I category 24

Testing scenarios

A third party performs the various MIL-STD-810G testing at its own facility. This eliminates any bias in the testing, and ensures that the durability of our products is accurately measured for customers. The variety of tests that the HP ZBook 15u G3 undergoes is listed below with explanations to the specific testing purpose.

Altitude test[13]
The Altitude test was performed in accordance with MIL-STD-810G, Method 500.5, Procedure I (Storage) and II (Operation). The altitude level simulated for both procedures was 15,000 feet (the highest equivalent altitude given within MIL-STD-810G for cargo pressures within military aircraft).

Bench Handling test[13]
The Bench Handling test was performed in accordance to the MIL-STD-810G, Method 516.6 Procedure IV. This test was designed to test whether the unit can withstand levels of shock resulting from bench handling, bench maintenance, and/or packaging.

Crash Hazard test[13]
The Crash Hazard test was performed in accordance to the MIL-STD-810G, Method 516.5 Procedure V. The purpose of this test was to ensure that the ZBook does not eject sub-elements and that it's restraining devices will not fail during crash situations.

Drop test[13]
The Drop test was performed in accordance with MIL-STD-810G, Method 516.6 Procedure IV. The objective of this test was to determine whether the unit could be safely operated after being dropped from desk height. For this test, 26 drops were performed from 30 in. onto every side, angle, and edge onto 2 in. of plywood over steel over concrete. Unit is powered down and checked for operation.

Dust Resistance test[13]
The Dust Resistance test was performed in accordance with MIL-STD-810G, Method 510.5, Procedure I (Dust). Test parameters were set so that the unit was dusted with Arizona Road Dust for six hours while being operated.

Explosive Atmosphere test[13]
The Explosive Atmosphere test was performed in accordance with MIL-STD-810G, Method 511.5, Procedure I. The objective of the test was to determine whether the unit can operate in fuel-air explosive atmospheres without igniting the surrounding atmosphere.

Freeze/Thaw test[13]

The Freeze/Thaw test was performed in accordance with MIL-STD-810G, Method 524.5 Procedure III. The objective of this test was to determine whether the unit could be safely operated after being exposed to a temperature drop of -10°C (14°F) for two hours. Unit was removed and checked for operation.

Functional Shock test[13]

The Functional Shock test was performed in accordance to the MIL-STD-810G, Method 516.6 Procedure I. The purpose of the functional shock test is to determine if the ZBook can operate after sudden exposure to physical shock. During this test, three shocks are performed across each axis and direction for a total of 18 shocks. Shock testing of products and materials determines to what degree the items can physically and functionally withstand a relatively infrequent, short time, moderately high-level force impulse that would be encountered in handling, transportation, and service environments. This test is done with the same machine as the one used for the Vibration test.

High Temperature test[13]

The High Temperature test was performed in accordance with MIL-STD-810G, Method 501.5, Procedure I (Storage) and II (Operation). This test evaluated the units' performance while it was being exposed to high temperature conditions: 60°C (140°F) operational and 71°C (160°F) non-operational.

Humidity test[13]

The Humidity test was performed in accordance with MIL-STD-810G, Method 507.5, Procedure II with the aggravated temperature-humidity cycle. Each cycle was one day (24 hours); ten cycles with the temperature being cycled between 30°C (86°F) and 60°C (140°F); and relative humidity was a constant 95%.

Low Temperature test[13]

The Low Temperature test was performed in accordance with MIL-STD-810G, Method 502.5, Procedure I (Storage) and II (Operation). This test evaluated the unit's performance while it was being exposed to low temperature conditions: -29°C (-20°F) operational and -51°C (-60°F) non-operational.

Sand test[13]

The Sand test was performed in accordance with MIL-STD-810G, Method 510.4 Procedure II. The objective of this test was to determine whether the unit could be safely operated after being exposed to blowing sand of up to 20 M/S at a temperature of 60°C (140°F) for 4.5 hours (every 90 minutes, the unit is rotated 90°).

Temperature Shock test[13]

The Temperature Shock test was performed in accordance with MIL-STD-810G, Method 503.5 Procedure I. The objective of this test was to determine whether the unit could be safely operated after being exposed to sudden changes in ambient temperature while non-operational. The high temperature was set to be 96°C (205°F) and the low temperature to be -51°C (-60°F); three high-to-low cycles were performed.

Vibration Resistance test[13]

The Vibration Resistance test was performed in accordance with MIL-STD-810G Test Method 514.6, Procedure I (Non-operational) and Procedure II (Operational). Test parameters were set to simulate the following:

- Operate the unit during a 1000-mile simulation of vibrations created by a truck driving on a U.S. highway
- Operate the unit after it has been subjected to higher levels of vibration while in storage

Terrain, road and surface discontinuities, vehicle speed, loading, structural characteristics, and suspension system are all reflected in this simulation.

Preferred Offerings

As a workstation customer, we know that you often need your product delivered quickly. That is why we have created the Preferred Offering program for HP ZBook Mobile Workstations. The Preferred Offering program aims to ensure high availability and short turn-around times on your orders.

The Preferred Offering program uses configurations that represent the mainstream components that make up a large percentage of shipments. Put simply, our most popular systems will be stocked with a buffer to assure the delivery of those systems to you in a timely manner. In fact, 90% of orders using the Preferred Offering program selections are filled in 6 days. And with roughly 40% of our mobile workstation parts on the Preferred Offering list, you have several options to choose from to build a system that fits your needs.

Table 10. The following AVs are part of the Preferred Offering program selection

HP ZBook 15u G3 Preferred Offerings	
Base unit	
M6G47AV	HP IDS DSC i5-6200U 15u-G3 Base NB PC
M6G48AV	HP IDS DSC i5-6300U 15u-G3 Base NB PC
M6G49AV	HP IDS DSC i7-6500U 15u-G3 Base NB PC
M6G50AV	HP IDS DSC i7-6600U 15u-G3 Base NB PC
Graphics	
Included in base unit	AMD FirePro™ M4190
Processor[6]	
Included in base unit	Intel® Core™ i5-6200u Dual Core
Included in base unit	Intel® Core™ i5-6300u Dual Core
Included in base unit	Intel® Core™ i7-6500u Dual Core
Included in base unit	Intel® Core™ i7-6600u Dual Core
Camera- integrated	
G8W56AV	WEBCAM Integrated 720p HD
Display	
M6G58AV	15.6 inch LED FHD SVA Anti-Glare enabled for Webcam (1920x1080)
M6G60AV	15.6 inch LED FHD UWVA Anti-Glare enabled for Webcam (1920x1080)
M6G62AV	15.6 inch LED UHD UWVA Anti-Glare enabled for Webcam (3840x2160)
Memory[14]	
M6G65AV	8 GB (2x4 GB) 2133MHz DDR4
M6G66AV	8 GB (1x8 GB) 2133MHz DDR4
M6G67AV	16 GB (2x8 GB) 2133MHz DDR4
M6G69AV	32 GB (2x16 GB) 2133MHz DDR4
HP Z Turbo Drive	
M6G72AV	256 GB Z Turbo Drive PCIe Solid State Drive
M6G73AV	512 GB Z Turbo Drive PCIe Solid State Drive
Internal Storage	
M6G71AV	256 GB M2 SATA-3 Self Encrypted OPAL2 Multi-Layer Cell Solid State Drive
M6G74AV	1 TB 5400RPM
M6G76AV	500 GB 7200RPM
Battery	
M6G79AV	3 Cell 46 WHr Long Life
AC Adapter	
P8A06AV	150 Watt Smart PFC Slim AC Adapter
Fingerprint Reader	
M9S21AV	Fingerprint Reader

Wireless LAN	
M9S14AV	Intel® 8260AN ac 2x2 + Bluetooth® 4.1 Combo
M9S15AV	Intel® 8260AN ac 2x2 + Bluetooth® 4.1 Combo Non vPro™

Resources, contacts, or additional links

HP ZBook 15u G3 Mobile Workstation
hp.com/go/Zbook15G3

Learn more at
hp.com/go/whitepapers

[1] Not all configurations qualify as an Ultrabook™.

[2] Sold separately or as an optional feature.

[3] Not all features are available in all editions or versions of Windows. Systems may require upgraded and/or separately purchased hardware, drivers, software or BIOS update to take full advantage of Windows functionality. Windows 10 is automatically updated, which is always enabled. ISP fees may apply and additional requirements may apply over time for updates. See microsoft.com.

[4] HP Performance Advisor requires Windows and an internet connection.

[5] EPEAT® registered where applicable. EPEAT registration varies by country. See epeat.net for registration status by country.

[6] Multi-core is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. Performance and clock frequency will vary depending on application workload and your hardware and software configurations. Intel®'s numbering is not a measurement of higher performance.

[7] Windows 10 MM14 battery life will vary depending on various factors including product model, configuration, loaded applications, features, use, wireless functionality, and power management settings. The maximum capacity of the battery will naturally decrease with time and usage. See bapco.com for additional details.

[8] This system is preinstalled with Windows® 7 Pro software and also comes with a license and media for Windows 10 Pro software. You may only use one version of the Windows software at a time. Switching between versions will require you to uninstall one version and install the other version. You must back up all data (files, photos, etc.) before uninstalling and installing operating systems to avoid loss of your data.

[9] For hard drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 16 GB (for Windows 7) and up to 30 GB (for Windows 8.1/10) of system disk is reserved for system recovery software.

[10] HD content required to view HD images.

[11] Wireless cards are optional or add-on features and requires separately purchased wireless access point and internet service. Availability of public wireless access points limited. The specifications for the 802.11ac WLAN are draft specifications and are not final. If the final specifications differ from the draft specifications, it may affect the ability of the notebook to communicate with other 802.11ac WLAN devices.

[12] Multiple displays may be connected to DP 1.2 Hub. DP 1.2 Hub is connected to a DisplayPort connector on the HP ZBook or Docking Station.

[13] Testing was not intended to demonstrate fitness for Department of Defense contracts requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage or damage under the MIL STD test conditions requires an optional HP Accidental Damage Protection Care Pack.

[14] Maximum memory capacities assume Windows 64-bit operating systems or Linux. With Windows 32-bit operating systems, memory above 3 GB may not all be available due to system resource requirements.

[15] 4K content required to view 4K resolution.

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