Technical white paper

HP ZBook x2 G4 Detachable Workstation

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Introduction

Surprisingly versatile, consistently powerful

Introducing the HP ZBook x2 Detachable Workstation. With remarkable performance, driven by the latest-generation of quad-core Intel® processors and NVIDIA® Quadro® graphics, and optimized for Adobe Creative Cloud® no PC is better suited to turn your vision into reality.

The optional 4K HP DreamColor display means your customers can expect high-quality, consistent color day-in and day-out. And the 10-bit color design offers superb color fidelity.

It offers up to 32 GB of memory in a dual-channel design, meaning that the HP ZBook x2 can perform well under heavy loads. Available NVMe PCIe SSDs in capacities up to 2 TB[1], and HP Z Turbo drives of up to 512 GB[1] offer more performance than traditional SATA hard disk drives.

A choice of Windows 10 operating systems, including Windows 10 Pro 64 and Windows 10 Enterprise 64-bit, organizes all the horsepower. Built to meet MIL-STD 810G requirements[2], the HP ZBook x2 G4 is one powerful, reliable, mobile Workstation!

Feature summary

Windows 10 Pro for Workstations

Be productive in any situation. Windows 10 Pro[3] and powerful security, collaboration, and connectivity features from HP help you power through your day on the HP ZBook x2.

Available HP DreamColor Display

Immerse yourself in 1 billion colors on a stunning 4K multi-touch HP DreamColor Display[4]. Work in any lighting with the optional anti-glare touchscreen.

HP Quick Keys for short deadlines

Work quickly and comfortably with 18 equivalent shortcuts at your fingertips, customized for all your favorite Adobe® applications.

Full-performance, detachable Bluetooth® keyboard

The full-sized keyboard is Bluetooth®-enabled to stay active when detached, so you have access to shortcut key combinations when working in applications like Adobe® Photoshop®.

Sleek and Portable Design

Experience the intersection of mobility & performance in a fully-machined, aluminum and die-cast magnesium body starting at just 3.59 pounds[5] and 14.6 mm thin when in tablet mode.

Available NVIDIA® Quadro® 3D Graphics

The NVIDIA® Quadro® graphics deliver real-time visualization of multi-layered artwork and creative projects.

Quad-core Intel® Core™ processors

Work at the speed of your ideas with the latest Intel® Core™ processors and up to 4.2 GHz[6] of turbo boost at your fingertips.

Up to 32 GB RAM Dual Channel Memory

32 GB RAM over dual channels - more responsive under heavier workloads like complex layering in Photoshop.

Up to 512 GB HP Z Turbo Drive or 2 TB NVMe PCIe SSD[1]

Work anywhere with confidence. HP Z Turbo Drive storage is 4X faster than SATA SSD and 14X faster than traditional HDD storage. NVMe PCIe SSDs deliver excellent performance and higher capacities.

Software Certification

The HP ZBook x2 undergoes dozens of tests for certification and optimized performance with the industry's leading software providers like Adobe® and Autodesk.

Military Standard 810G Testing[2]

Designed to go anywhere and handle the toughest workloads. Tested for altitude, shock, drop, explosive atmosphere, frozen and high temperatures, sand, humidity and more.

Dual fan active cooling

Experience the dual-fan active cooling system, designed to dissipate heat from the powerful NVIDIA® graphics cards and quad-core Intel® processors.

HP Fast Charge with long battery life

Enjoy peace of mind with Ultrabook™-class battery life for maximum productivity. With the 90W Smart AC Adapter, get ultra-fast recharge (50% in just 30 minutes)[7].

Chassis highlights and system architecture

Thin & light detachable industrial design

The HP ZBook x2 G4 features a bold and powerful aesthetic, utilizing a high strength precision cut aluminum chassis and Gorilla Glass covers. A robust, sturdy, articulating kickstand enables ideal usability when open and closes flush. The detachable Bluetooth® keyboard stays active when detached delivers a best-in-class typing experience using a stiffened aluminum deck and keys uniquely designed with ideal contouring, separation, and size. An optional pen that never needs charging responds with 4,096 pressure-sensitive levels and natural tilt capabilities. And you get simple, fast connectivity to displays, mobile devices, and external storage with the optional HP ZBook Dock with Thunderbolt 3[4].

Modes


Laptop


Detached


Tablet


Docked

Multiple modes and ultimate versatility— go from laptop to tablet whenever inspiration strikes:

- **Laptop** Review and edit your work with an integrated 160 degree stand and full-sized keyboard
- **Detached** Create naturally with a Bluetooth® keyboard that keeps working even when detached
- **Tablet** Capture and sketch on-the-go with the pen and HP Quick Keys featuring 18 Adobe app shortcuts
- **Docked** View and edit your work on dual 4K displays using the HP ZBook Dock with Thunderbolt 3[4]

The HP ZBook x2 offers the same full-performance capability in every operating mode.

Processor

New Intel® processor Micro-architecture

The HP ZBook x2 G4 supports the latest dual-and quad-core Intel® Core™ processors with Intel® Turbo Boost Technology 2.0[6]:

- 7th Generation Intel® Core™ i7 processor (i7-7500U (2 core), i7-7600U (2-core))
- 8th Generation Intel® Core™ i7 processor (i7-8650U (4-core), i7-8550U (4-core))
- 8th Generation Intel® Core™ i5 processor (i5-8250U (4-core))

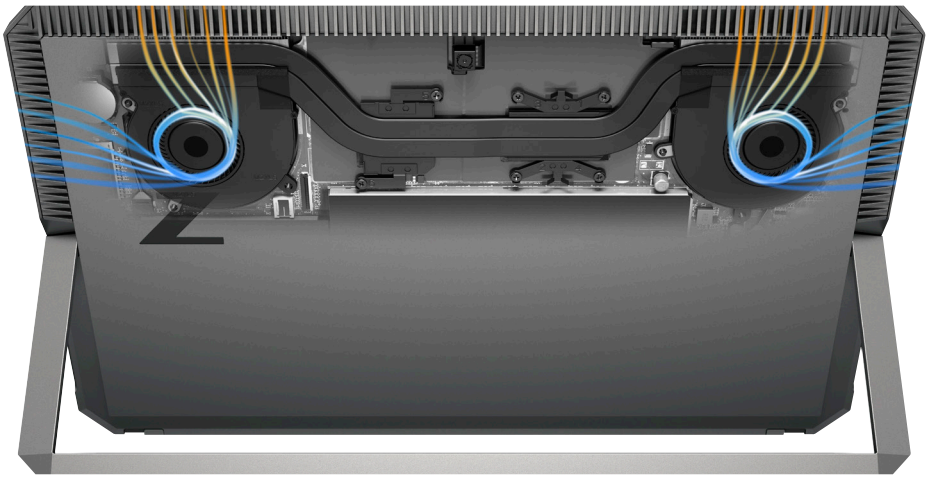
7th and 8th Gen Intel® Core™ processors utilize a power-efficient microarchitecture, advanced process technology, and silicon optimizations. On processors with Intel® Turbo Boost Technology 2.0, performance and power are dynamically controlled—for cores and graphics—boosting performance precisely when it is needed and saving energy when it counts[6]. The U-series processors support two cores and four threads with Intel® Hyper-Threading Technology (Intel® HT Technology)[8], enabling a unique balance between performance and mobility in notebooks.

Intel® Core™ with vPro™ Technology capable

Intel® Core™ with vPro™ Technology[9] is a selectable feature that is available on units configured with select processors, a qualified Intel® Centrino® WLAN module and a preinstalled Windows OS. It provides advances in remote manageability, security, energy efficient performance, and wireless connectivity.

Intel® Active Management Technology (iAMT)[11] 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 systems regardless of their power state.

Thermal Management



HP Active Cooling utilizes Intel®'s Dynamic Platform and Thermal Framework (DPTF) for smart thermal throttling along with an adjustable speed dual-fan, designed to dissipate heat from the powerful NVIDIA® graphics cards and quad-core Intel® processors. This innovative thermal management enables processor Turbo Boost for maximum performance and keeps the system cool when running demanding workloads.

Workstation reliability

Optimize your HP ZBook for peak performance with HP Performance Advisor which automatically configures your system with the latest settings and drivers. Be confident that your HP ZBook can withstand the demands of professional computing with ISV application certification, 120,000 hours of testing through the HP Total Test Process. The HP ZBook x2 G4 is designed to meet MIL-STD-810G testing[2] standards. HP Sure Start Gen3[10] helps 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.

Operating system

Preinstalled OS

- Windows 10 Pro 64[3]
- Windows 10 Home 64[3]
- Windows 10 Home Single Language 64[3]
- FreeDOS 2.0

Supported OS

- Windows 10 Enterprise 64[3]

NOTE: The HP ZBook x2 G4 does not support Windows 8 or Windows 7. In accordance with Microsoft's support policy, HP does not support the Windows 8 or Windows 7 operating system on products configured with Intel® 7th generation and forward processors, and does not provide any Windows 8 or Windows 7 drivers on http://www.support.hp.com.

Designed with the environment in mind

HP is committed to environmental sustainability and energy efficiency and offers ENERGY STAR® certified and EPEAT® registered configurations[11] of the HP ZBook x2 G4 and low halogen[12] components. The HP Workstation design team takes a proactive approach to recycling and selecting materials that help reduce the impact to the environment that goes beyond industry regulations.

Ports and connectors

The HP ZBook x2 G4 includes:

- 1 headphone/microphone combo
- 1 power connector
- 1 HDMI 1.4
- 1 USB 3.0 (charging)
- 2 USB 3.1 Type-C™ Thunderbolt™ 3 (DisplayPort™ 1.2)

Thunderbolt™ 3 utilizes the industry standard USB Type-C™ port that brings together data, video, and power (15 W maximum for bus powered devices) on the same cable. Up to two (2) streams (8 lanes) of DisplayPort™ 1.2 are supported over a single Thunderbolt™ 3 port. With an Intel® certified Thunderbolt™ cable, support up to two 4K displays or one 5K display over a single Thunderbolt™ 3 port.

DisplayPort™ 1.2 protocol features supported on Thunderbolt™ 3 ports include:

- **Legacy displays (HDMI, DVI, VGA)** may be attached to the Thunderbolt™ port with a certified dongle
- **DisplayPort™ monitors** capable of supporting DisplayPort™ 1.2 may be directly attached to the Thunderbolt™ 3 port to achieve DisplayPort™ High Bit Rate 2 (HBR2) with a dongle
- **Thunderbolt™ 3 enabled monitors** may be directly attached to the Thunderbolt™ 3 port to achieve HBR2 and Multi-Stream Transport (MST)
- **DisplayPort™ 1.2 MST daisy-chaining** is supported through the Thunderbolt™ 3 port on Thunderbolt™ 3 enabled devices or DisplayPort™ 1.2 monitors (requires monitor with DisplayPort™ 1.2 MST capability) with a dongle

Expansion Slots include 1 smart card reader and 1 SD media card reader (SD supports next generation secure digital and is backward compatible to SDHC, SDXC).

Options include a 720p HP webcam (front-facing), 720p HD webcam with near infrared (IR) (front-facing); and an 8 MP (world-facing camera)[4]. Windows Hello face authentication provides a secure way to access your Windows 10 devices. It utilizes the HP ZBook x2 G4 camera configured for near IR imaging to authenticate and unlock Windows devices as well as unlock your Microsoft Passport.

Storage

The HP ZBook x2 offers a range of SSD storage devices based on the M.2 industry-standard form factor. Table 1 lists the supported devices and provides a brief comparison based on the different SSD designs. Refer to Appendix A for further details on SSD storage technology and performance.

Table 1: HP ZBook x2 G4 storage options

Device class and description	Supported devices
HP Z Turbo Drive M.2 PCIe (NVMe) SSD MLC • MLC (Multi-Level Cell) technology offers higher performance compared to TLC technology • NVMe controller design improves performance over previous generation PCIe SSDs	256 GB HP Z Turbo Drive MLC Solid State Drive[1] 512 GB HP Z Turbo Drive MLC Solid State Drive[1]
M.2 PCIe (NVMe) SSD TLC • TLC (Three-Layer Cell) technology offers increased SSD capacity • NVMe controller design improves performance over previous generation PCIe SSDs	256 GB PCIe TLC Solid State Drive[1] 512 GB PCIe TLC Opal 2 Solid State Drive[1] 1 TB PCIe TLC Solid State Drive[1] 2 TB PCIe TLC Solid State Drive[1]
M.2 SATA SSD • Legacy SATA interface limits performance compared to devices using PCIe interface • Exceeds SATA HDD performance	512 GB SATA-3 SS TLC SSD FIPS-140-2[1] 128 GB SATA SSD[1]

Note: The HP ZBook x2 G4 supports a single M.2 storage device.

Graphics

The HP ZBook x2 G4 includes standard Intel® integrated graphics, and offers optional NVIDIA® Quadro® M620 discrete graphics. NVIDIA® Quadro® graphics are designed, optimized, and tested in conjunction with NVIDIA® to meet the needs of mission critical workstation and enterprise deployments. They are ISV tested, certified, and supported for professional applications.

Integrated

- Intel® HD Graphics 620[13]
- Intel® UHD Graphics 620[13]

Discrete

- NVIDIA® Quadro® M620 (2 GB GDDR5 dedicated)

With NVIDIA® Optimus™ technology, users can experience the full performance benefits of discrete graphics with the battery life of an integrated graphics solution. NVIDIA® Optimus™ automatically and seamlessly optimizes the HP ZBook x2 G4 to offer the best performance or best battery life depending on the application.

Battery

The HP 4-cell Long Life Polymer Battery (70 WHr) provides up to 10 hours of battery life for maximum productivity and ultra-fast recharge (50% in just 30 minutes)[7]. Battery life will vary depending on various factors including product model, configuration, application load, features, use, wireless functionality, and power management settings. The maximum capacity of the battery will naturally decrease with time and usage[14].

Standby life will vary depending on various factors including battery, Memory, CPU, EC and LAN chip. Power Conservation is aided by:

- NVIDIA® Optimus™
- Hibernation
- Standby
- ACPI compliance

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. HP ZBooks ship with the power supply option designed to best meet the demands of a full-loaded system running an intense workload. When configured with integrated graphics, the HP ZBook x2 G4 ships with the HP 65 W Slim Smart AC Adapter. When configured with discrete (NVIDIA®), the HP ZBook x2 ships with a 90 W external AC power adapter. Both power supplies have a minimum of 88% efficiency rating.

Excess energy demands

The HP ZBook x2 G4 power system can be configured to run in Full Use, Balanced, or Power Saving modes. When the HP ZBook is connected to AC power, it will attempt to pull the current it needs. If the energy demand exceeds the power supply rating, the management system within the BIOS will automatically draw additional power from the battery. In this case, it is possible to drain the battery while connected to AC power. When running at maximum capacity, low wattage power supplies may produce noticeable but not harmful heat. The HP ZBook x2 G4 is compatible with 65 W and higher power adapters.

Smart power adapters

The smart feature for the power adapter informs the user about power issues with a pop-up message: “For full performance, connect a higher capacity AC adapter." As power demands increase, the HP 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 invoke video balance mode in systems with discrete graphics. System CPU functions are prioritized over battery charging.

HP Power adapters are offered as after-market options for users that require more watts or a spare. When using a docking station to connect to larger and/or multiple displays, or running resource-intensive applications, HP recommends the 90 W power adapter.

Reliability Testing

The HP ZBook x2 G4 Detachable workstation is designed with reliability in mind and undergoes the HP Total Test Process, formal Adobe Creative Cloud testing and MIL-STD-810G testing[2].

HP Total Test Process

The HP Total Test Process is a multi-tiered product validation with comprehensive, end-to-end diagnostics, and a minimum of 120,000 hours of testing per platform. On the HP ZBook x2 G4, HP also integrated Adobe Creative Cloud testing into the formal development process, working with Adobe quality assurance teams.

MIL-STD-810G testing

The HP ZBook x2 G4 is designed to meet MIL-STD 810G tests[2] for 24x7x365 reliability. 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 HP ZBook x2 G4 passed all 14 MIL-STD-810G tests[2] for the following:

- Altitude
- Bench Handling
- Crash Hazard
- Drop
- Dust
- Explosive Atmosphere
- Freeze/Thaw
- Functional Shock
- High Temperature
- Humidity
- Low Temperature
- Sand
- Temperature Shock
- Vibration test

See Appendix B for details.

Networking

The HP ZBook x2 G4 supports wireless networking WLAN:

- HP hs3110 HSPA+ Intel® Mobile Broadband Module
- Intel® Dual Band Wireless-AC 8265 802.11a/b/g/n/ac (2x2) Wi-Fi and Bluetooth® 4.2 Combo[15]

Security

The HP ZBook x2 G4 offers a full suite of enterprise-class security tools including:

- A keyboard-integrated smart card reader for authentication
- Near field communication that makes it easy to accept contactless payments from mobile devices
- BIOS-level security and malware protection with HP Sure Start Gen 3[10]
- A built-in Infra-red camera which supports Windows Hello authentication
- On-device fingerprint capabilities
- SSD Encryption, with optional FIPS and Opal 2 SSDs
- For Windows 10, Trusted Platform Module (TPM) 2.0

BIOS

- HP BIOSphere Gen3[16]
- HP Sure Start Gen3[10]
- HP DriveLock | HP Automatic DriveLock
- BIOS Update via Network
- Master Boot Record Security
- Power On Authentication
- Secure Erase[17]
- Absolute Persistence Module[18]
- Pre-boot Authentication

Client Security Software

- HP Client Security Suite Gen3[19]
- HP Security Manager (including Credential Manager and HP Password Manager)[20]
- HP Fingerprint Sensor
- Power On Authentication[21]
- Device Access Manager
- Microsoft Defender[22]
- HP WorkWise[23]

Display options

The HP ZBook x2 G4 offers a choice of Ultra High Definition (UHD) IPS LED 4K displays that provide a clear image with lifelike detail, anti-glare screens, and multi-touch support. Wide viewing angles make collaboration easy. For exceptional, consistent 10-bit color precision, out-of-the-box color calibration, and sRGB, BT709, and Adobe® RGB coverage choose HP DreamColor. Table 2 lists display options for the HP ZBook x2 G4.

Table 2: HP ZBook x2 G4 display options

Display[24]	Resolution	Refresh rate	Brightness	Viewing angle
14-inch diagonal 4K UHD IPS LED w/multi-touch	3840 x 2160	60 Hz	300 cd/m^2	UWVA
14-inch diagonal 4K UHD IPS LED DreamColor w/multi-touch	3840 x 2160	60 Hz	300 cd/m^2	UWVA

Refer to Appendix C for an in-depth discussion of color calibration, bit depth, pixels per inch, viewing angles, refresh rates, and viewing angles. Understanding these measurements and why they are important is helpful when choosing a display.

External HP Z Displays

External HP Z Displays[25] offer additional screen area and flexibility. External displays can connect directly to the USB-C (DP 1.2) or HDMI ports, or for "one-click" convenience, through the HP ZBook Dock with Thunderbolt 3[4]. Sizes range from 22- to 34-inch diagonal in several resolutions and docking supports multiple displays.

Multiple display support

This section covers using multiple displays with the HP ZBook x2 G4 in standalone mode, when docked with the HP ZBook Dock with Thunderbolt 3[4], and with DisplayPort™ 1.2 enabled monitors.

Standalone

Standalone displays can be connected to the HP ZBook x2 via the integrated HDMI and Thunderbolt™ 3 connectors.

Note: Thunderbolt™ 3 is a super-set of Thunderbolt™ 2 (adapter required), DisplayPort™, PCIe 3rd Gen, and USB 3.1. Connection is through the USB-C port. Referred to simply as "Thunderbolt™ 3" in this section, the full description is "USB 3.1 Type-C™ Thunderbolt™ 3 (DisplayPort™ 1.2)".

Undocked, the HP ZBook x2 supports a maximum of three independent displays—the internal panel plus two external displays connected to two of these ports: HDMI, (1st) Thunderbolt™ 3, (2nd) Thunderbolt™ 3. Table 3 lists the number of displays supported in standalone (undocked) mode.

Table 3: Number of displays supported in standalone (undocked) mode.

HP ZBook x2 G4 display type	Graphics	Number of displays supported	Ports (use 2)
4K IPS	Intel® Integrated	3 (1 internal + 2 external)	HDMI (1st) Thunderbolt™ 3 (2nd) Thunderbolt™ 3
4K IPS	Hybrid (Intel® Integrated plus NVIDIA® Quadro®)	3 (1 internal + 2 external)	HDMI (1st) Thunderbolt™ 3 (2nd) Thunderbolt™ 3
HP DreamColor 4K IPS	NVIDIA® Quadro® (discrete graphics only mode enabled)	3 (1 internal + 2 external)	HDMI (1st) Thunderbolt™ 3 (2nd) Thunderbolt™ 3

Docked

The ZBook Dock with Thunderbolt 3 includes (1) Thunderbolt™ 3, (1) VGA, and (2) DisplayPort™ 1.2 ports. The number of independent displays supported varies by the configuration. Table 4 lists the display support in docked mode.

Table 4: Number of displays supported in docked mode.

HP ZBook x2 G4 display type	Graphics	Number of displays supported	Ports
4K IPS	Intel® Integrated	3 (1 internal + 2 external)	Use 2 of the following: Thunderbolt™ 3 VGA (1st) DisplayPort™ 1.2 (2nd) DisplayPort™ 1.2
4K IPS	Hybrid (Intel® Integrated plus NVIDIA® Quadro®)	5 (1 internal + 4 external)	Thunderbolt™ 3 VGA (1st) DisplayPort™ 1.2 (2nd) DisplayPort™ 1.2
HP DreamColor 4K IPS	NVIDIA® Quadro® (discrete graphics only mode enabled)	4 (1 internal + 3 external)	Use 3 of the following: Thunderbolt™ 3 VGA (1st) DisplayPort™ 1.2 (2nd) DisplayPort™ 1.2

DisplayPort™ 1.2 MST

Additional multi-display configurations are also available using DisplayPort™ 1.2 MST (Multi-Stream Transport) or "daisy-chaining" capability. A standard feature of the HP Z24n G2, HP Z27n G2, and the HP Z24x G2 DreamColor—daisy-chaining uses MST to connect multiple displays from a single DisplayPort™ on the host computer. It is supported on displays that have both a DisplayPort™ 1.2 input and a DisplayPort™ 1.2 output. For more information on multi-display configurations using DisplayPort™ 1.2 and MST, refer to the Technical white paper: Multiple displays on HP ZBook Mobile Workstations.

Hybrid graphics and the pre-OS environment

Due to an industry standard, only displays connected to the integrated graphics may be used during Pre-OS. When hybrid graphics (both integrated and discrete) are in use on the HP ZBook x2 G4, display(s) attached to the discrete graphics card are not viewable during pre-OS. For example, if the HP ZBook boots with the panel closed and an external display attached via DisplayPort™ driven by the NVIDIA® Quadro® card, that display cannot show images during Pre-OS, such as during Power-on Self-Test, BIOS setup, diagnostics, or entering the Power-On Password.

Multiple display management

On the HP ZBook x2 G4, set up and manage multiple displays with Windows Display Manager, or when using NVIDIA® graphics, either the NVIDIA® Control Panel or Windows Display Manager.

To launch Windows Display Manager, right-click any empty area of your desktop, and then select Display Settings. Use the **Windows logo key + P** to choose a presentation display mode (PC screen only, Duplicate, Extend, Second screen only).

HP ZBook x2 Keyboard

The HP ZBook x2 Keyboard delivers a best-in-class typing experience with 1.5 mm of key travel, a stiffened, anodized aluminum deck, and back-lit keys designed for ideal contouring, separation, and size. The patterned polyurethane bottom cover provides a cushioned, non-slip surface, and contrasts with the smooth aluminum top for a comfortable feel. Additional features include an integrated, 95 WHr long-life battery and smart-card reader.

The 85-key-compatible keyboard features a full-sized (18.7 x 18.4 mm) key layout with desktop keyboard features such as editing keys, left and right control and alt keys, and function keys. U.S. and International key layouts are available. For North America, a US/Euro Spanish Keyboard option is also available. Other features include hot keys for instant access to power conservation and brightness.

The extra-large clickpad features a chemically-etched antiglare surface, and includes an ON/OFF on/off button, two-way scroll support, gesture support, two integrated buttons, and image sensor technology for enhanced performance and improved precision on scroll and gesture.

The keyboard supports two primary operating modes: attached to the tablet (via integrated USB connection), or remote (via Bluetooth®). The keyboard automatically switches modes when the keyboard and tablet are attached or detached.

Attached (USB) keyboard modes

With the keyboard physically connected to the tablet via USB, the system recognizes the keyboard position and automatically disables keypad operation in certain configurations. For additional flexibility, the keyboard-to-tablet connection is reversible, allowing the keyboard to attach with the keypad facing up or down. Table 5 describes the attached keyboard modes:

Table 5: Attached (USB) keyboard modes

Keyboard mode	Keyboard functional status
Laptop – typical laptop configuration	Keypad and smartcard reader enabled
Tablet – kickstand closed and lid open	Keypad disabled, smartcard reader enabled
Clamshell – kickstand open and lid open	Keypad disabled, smartcard reader enabled

Note: With the keypad facing up, the keyboard can fold backward to form a stand or "tent". With the keypad facing down, the keyboard can fold flat against the back of the tablet.

Bluetooth® keyboard mode

The built-in Bluetooth® capability and battery allow the keyboard to operate without being physically attached to the tablet. Under normal operation, booting the system with the keyboard attached to the tablet (via the USB connection) automatically enables the Bluetooth® connection and pairs the keyboard and tablet.

To pair the keyboard manually:

1. Depress the keyboard power button for 3 seconds; the keyboard enters Discovery Mode for 2 minutes
2. Use the Windows Bluetooth® Control Panel to select "HP ZBook Create Keyboard x2"
3. Enter the PIN code to complete manual pairing

Charging

The keyboard battery charges automatically when connected to the tablet. (Charging may be limited if the tablet battery has less than 10% power remaining). The keyboard battery can also use an external charger via the built-in micro USB connector.

Status LED

They keyboard LED indicates the Bluetooth® and charging status. Table 6 lists the keyboard LED status codes.

Table 6: Keyboard LED status codes

Keyboard status	LED Code
Bluetooth® pairing	Blue - blinking
Bluetooth® ON	Blue - solid
Battery low (less than 10%)	Red - solid
Charging (via micro USB)	White - solid (priority over solid slue when keyboard is in Bluetooth® mode)
Keyboard at 100% charge with external power present & keyboard OFF	LED goes from solid white to OFF
Keyboard at 100% Charge with Keyboard ON in Bluetooth® mode	LED goes from solid white to solid blue
Keyboard OFF	OFF
Battery power too low for system start-up	OFF – Blinking red – OFF (when the power button is pressed)

HP ZBook x2 Professional Pen

The optional HP ZBook x2 Pen is designed to be nearly indistinguishable from a precision writing instrument, with a natural feel optimized for painting, sketching, modeling, and writing. The tapered ergonomic form naturally rests between thumb and forefinger and the long length provides counterbalance. The rubber grip and subtle flare towards the front of the pen helps relieve grip pressure and limit hand fatigue.

The pen includes two buttons—one in the grip generally used for selection, and one on the end of the pen, typically used as an eraser. Button functions are customizable.

Pen attributes, including pen tip feel and pressure, eraser feel, side button function, and application-specific functions are customizable through the HP Create Control Panel software. Refer to the HP ZBook x2 User Guide for complete details.

The custom-tailored carry case protects the pen when not in use and has convenient slips to store up to three extra nibs and a nib removal tool. The pen includes replaceable felt-tip and POM (Polyoxymethalene plastic) nibs. Replacement nibs are available for purchase. Table 7 highlights features of the HP ZBook x2 Pen.

Table 7: HP ZBook x2 Pen features

Feature	Description
High-precision tip	1.6 mm tip size (0.063 inch) helps ensure pinpoint accuracy
Ergonomic design	Professional design featuring well-balanced weight distribution and a customized, latex-free, silicone rubber grip
Programmable control button	User-programmable side button, customizable for individual applications
Battery-free design	EMR Technology does not require batteries
Precise pressure sensitivity	4,096 levels of pressure sensitivity for precise pen control
Hovering capability	Control the on-screen pen cursor by hovering the pen above the screen surface
Low-latency technology	200 Hz report rate minimizes inking latency or lag
Tail Eraser	Intuitive eraser design, user-programmable for alternate
Tilt support	Tilt-stroke support for improved usability and stylus control (compared to non-tilt pens)
Palm rejection	Rest your hand on the screen surface without registering unintended inputs
Replaceable nibs	Replaceable/interchangeable POM & felt-tip nibs allow users to choose their preference

EMR Technology

The HP ZBook x2 Pen uses EMR (Electro-Magnetic Resonance) technology to deliver virtually zero latency without batteries or wires. It offers 4,096 levels of pressure sensitivity (up to 2x the sensitivity of typical detachables), plus tilt and bearing support that helps capture the nuances and subtleties intended by the user. When combined with the finely textured, matte surface of the HP ZBook x2 display, the HP ZBook x2 Pen offers a natural inking experience similar to pen and paper.

EMR technology operates by alternating between two operating modes at a rapid rate:

1. The sensor grid attached to the back of the display panel creates a magnetic field and sends energy into the pen.
2. Once the pen is energized, it redirects energy though the pen circuitry as a radio frequency (RF) signal.
3. At that point, the sensor grid stops sending, and switches over to listening mode to detect the pen's location above the grid.
4. By measuring the signal strength at several points along the grid, the system determines precisely where the pen is located, as well as when the pen tip is pressed down, and how hard it is pressed down.

Pen technology comparison

The HP ZBook x2 Pen offers many professional features not available with other pen designs in the market today. Table 8 compares the HP ZBook x2 Pen with other current HP pen technologies.

Table 8: HP ZBook x2 Pen technology comparison

Features	HP ZBook x2 Pen (Wacom EMR)	HP Elite x2 (Wacom AES)	HP Spectre x360 (Synaptics)	HP Consumer (Microsoft N-trig)
Pen technology	EMR	Capacitive	Capacitive	Capacitive
Creative professional pen design	✓			
Low hardware latency	✓			
Battery-free	✓			
Tilt support	✓			✓
4,096 levels of pressure	✓			✓
Maximum starting pressure <20 grams	✓	✓	✓	✓
Tail eraser	✓			✓
Number of side buttons	1	2	2	1
Eraser pressure and tilt	✓			
Advanced pen software (HP Create Control Panel)	✓			
Supports simultaneous pen & touch	✓	✓		✓

Note: Similar pen technologies are often referred to with different names. Capacitive (or Projected Capacitive) is the same core technology used in pens described as "Pro-Cap", "AES" and "N-trig".

HP Quick Keys

Located on the left and right of the tablet display screen, the integrated HP Quick Keys are programmable buttons designed to activate application shortcuts and other user-defined keystroke combinations. The keys are located for easy access when using the system in the tablet or laptop configurations, and combine for a total of 18 possible shortcuts. The buttons feature embossed or debossed icons to provide tactile feedback for blind-discovery and differentiation. Buttons are grouped or separated based on functionality and physical distinction. Key definitions can be mirrored for ambidextrous operation. Figure 1 shows the HP Quick Key Layout.

Figure 1: HP Quick Keys layout

The top two buttons on each side of the display are capable of three modes (definitions), selected with the Mode Select buttons. LEDs located directly above the buttons indicate the current mode (1, 2 or 3). The lower three buttons on each side are dedicated to individual definitions.

The system includes four sets of preset key definitions:

- Adobe Photoshop
- Adobe Lightroom
- Adobe Illustrator
- "All Other" (general purpose/Windows 10)

Appendix D shows examples of the preset definitions for Adobe Photoshop and All Other.

Users can create, change, and store custom key definitions (any series of keystrokes) using the HP Create Control Panel software. Refer to the HP ZBook x2 User Guide for complete details.

HP Create Control Panel software

The HP Create Control Panel software interface makes it easy to customize the HP ZBook x2 tablet, HP ZBook x2 Professional Pen, and HP Quick Keys, and to create individual environments tailored for professional applications. Figure 2 shows the HP Create Control Panel, a representation of the HP Quick Keys configuration for the current application, and the status of other options.

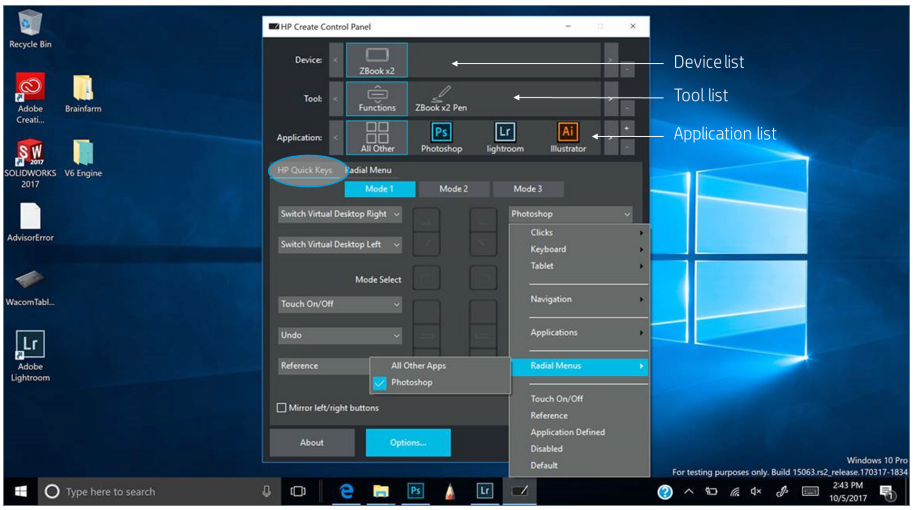


Figure 2: HP Create Control Panel example

Use the **Device List** to select the pen-compatible device to customize. Typically, this is the HP ZBook x2, but it is possible to add other external devices. Use the **Tool List** to select the tool (for example the HP ZBook x2 Pen) or functions (for example the HP Quick Keys) that you want to configure. Use the **Application List** to select the application where the configuration applies.

Table 9 summarizes the primary features of the HP Create Control Panel software.

Table 9: HP Create Control Panel feature summary

Feature	Description
Customizing the HP Quick Keys	Define the HP Quick Key functions
Customizing the pen	Customize settings for pen tip feel and pressure, eraser feel, side button function, and other application-specific pen functions
Calibrating the pen	Compensate for viewing angle and adjust for parallax; manually recalibrate the pen
Adding applications	Add new software applications into the HP Create Control Panel environment
Adding devices	Customize tools (such as the HP ZBook x2 Pen and HP Quick Keys) and application settings for devices connected to the tablet
Adding tools	Add tools to a device
Backing up and restoring settings	Save/restore current settings and user preferences with the HP Create Control Panel Preferences, remove your preferences, or remove all user preferences
Importing expert settings	Import customized settings that have been specified in an XML (Extensible Markup Language) file. Each XML file may include customized settings for one or more applications. These settings may apply to the HP Quick Keys, On-Screen Controls, pen button or eraser, and other functions.

The HP Create Control Panel software is pre-loaded on the HP ZBook x2, and is available by selecting the Windows “Start button” or the HP Create Control Panel icon in the Windows task tray. Refer to the HP ZBook x2 User Guide for complete details.

HP ZBook x2 Accessories

Table 10 lists the accessories[4] available for the HP ZBook x2.

Table 10: HP ZBook x2 accessories

Accessory and HP part number	Description
HP ZBook x2 Case **HP Part Number Y7B68UT#ABA**	Protective case that provides additional protection to the HP ZBook x2 featuring productivity features including an ergonomic hand harness, shoulder strap, and built in VESA mounting capabilities
HP ZBook X2 Pen Bundle **HP Part Number 1VY59UT#ABA**	Professional ergonomic design featuring battery-free EMR (Electro-Magnetic Resonance) technology, 4,096 levels of pressure sensitivity, tilt support, programmable side-button and tail eraser, and replaceable/interchangeable POM & felt-tip nibs.The included pen case protects the pen when not in use, and offers convenience features such as slips to store up to 3 extra nibs and a nib removal tool.
HP ZBook x2 Pen Nib Set Bundle **HP Part Number 1VY60UT#ABA**	Set of 10 replacement nibs. (6) felt-tip and (4) POM
HP ZBook Dock with Thunderbolt 3 **150 Watt: P5Q58UT#ABA** **200 Watt: P5Q61UT#ABA**	Expansive device, display, and network connectivity plus simultaneous system charging through one cable from the dock to your HP ZBook

Appendix A: Storage technology

The HP ZBook x2 supports a range of SSD storage devices based on the M.2 industry-standard form factor. Appendix A describes the current storage trends, the benefits of the M.2 standard, and the flash memory technologies influencing HP's choice of SSD storage offerings.

Background

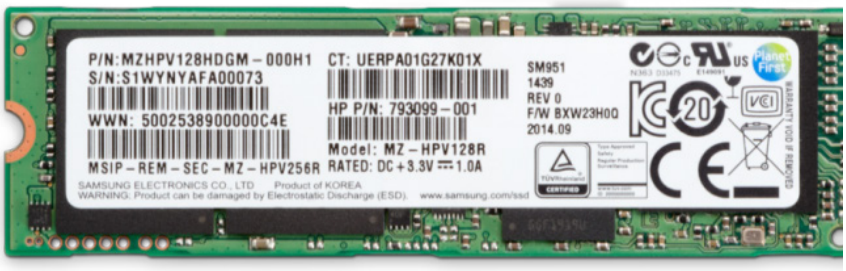
Traditional SATA HDDs and SATA SSDs have reached a performance ceiling. SATA HDDs are limited by the mechanical nature of the devices, while SATA SSDs are limited by the 6 Gb/s SATA bus throughput ceiling. Shifting focus from SATA to the multi-lane PCI express (PCIe) bus provides a significant performance increase today, and performance growth for the foreseeable future.

The first generation of M.2 PCIe SSDs used the PCIe Gen 2 interface, which improved throughput over SATA. Today's new high-end M.2 drives support PCIe x4 (four lanes of bandwidth), along with the Non-Volatile Memory Express (NVMe) control protocol for even greater performance.

The M.2 standard

Designed to replace the mSATA standard, M.2 is an industry-standard for internal expansion cards. Currently, the most common form factor is 22 mm x 80 mm, although the specification supports varies lengths and widths. Exposed buses through M.2 are SATA 3.0, PCIe 3.0, and USB 3.0.

Specific to SSD storage devices, the M.2 specification supports up to four PCIe lanes as well as the NVMe (Non-Volatile Memory express) host controller interface. M.2 also supports other types of expansion cards including WLAN (Wi-Fi), 3G/LTE (WWAN), etc.



The NVMe Host Controller

NVMe is a new control protocol for SSDs, designed from the ground up for SSDs. The NVMe architecture takes advantage of the unique properties of pipeline-rich, random access, memory-based storage to lower data latency and improve overall performance.

M.2 PCIe NVMe SSD features and benefits

- Maximizes real estate
  - Long double-sided PCBs double the storage capacity within the footprint of mSATA SSD devices
- Utilizes the same connector for four PCIe lanes and one SATA 3.0 6 Gb/s port
  - Compatible with legacy storage interface (SATA)
  - Same form-factor and interface provides path to future PCIe storage devices
- Reduces bottlenecks by connecting directly to PCIe
  - Excellent performance for large files and big data workflows
  - Lane aggregation helps keep the I/O pipeline full and increases overall bandwidth
  - Simpler storage hierarchy reduces latency
- Improves performance with NVMe Controller designed for non-volatile memory storage devices
  - Lowers latency resulting in significantly improved Random Read performance
  - Lowers command overhead
  - Exploits the parallelism available in modern host hardware and software

Performance

The HP ZBook x2 G4 supports 3 types of M.2 SSDs:

- mSATA devices offering better performance than SATA HDD's at comparable cost
- PCIe (NVMe) SSD **TLC** devices using **TLC** (Three Layer Cell) NAND flash technology for reliable, cost-optimized performance that greatly exceeds mSATA devices
- HP Z Turbo Drive PCIe (NVMe) SSD **MLC** devices using **MLC** (Multi-Layer Cell) NAND flash technology. Denoted as "multi-layer", **MLC** flash typically employs two layer memory cells, and offers the highest performance and endurance available in HP Z Workstations.

Figure A-1 shows the relative performance of these three technologies compared to a traditional SATA HDD and a SATA SSD. Note the dramatic improvement in read performance with PCIe NVMe technology, and the further improvements in read and write performance gained by using MLC flash memory.

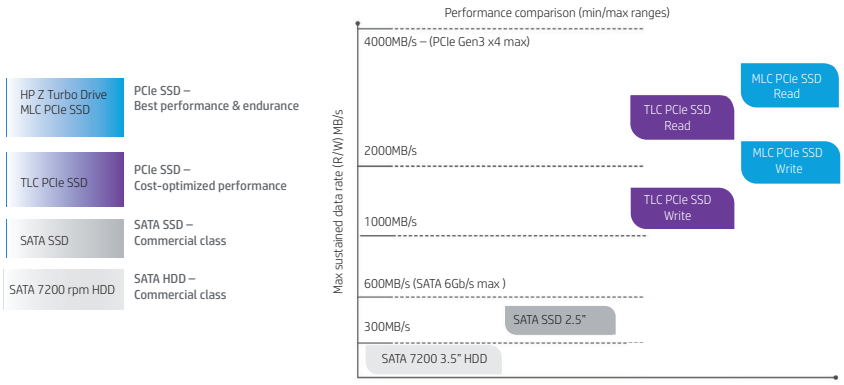


Figure A-1: SSD relative performance comparison (comparing average sequential read and sequential write speeds)

Specific performance varies with capacity. As an example, Table A-1 compares the performance of HP MLC and TLC PCIe NVMe drives at 512 MB[1] capacity. Sequential write performance will decrease for large data transfers that fill the cache.

Table A-1: HP PCIe NVMe SSD comparison (M.2 in native slot on motherboard)

	HP Z Turbo Drive MLC PCIe SSD 512 GB	HP TLC PCIe SSD 512 GB
Connection	PCIe 3x4 (4 lanes)	PCIe 3x4 (4 lanes)
Sequential read	Up to 3200 MB/s	Up to 2,800 MB/s
Sequential write	Up to 1800 MB/s	Up to 1,600 MB/s

For additional information on the full range of HP PCIe NVMe SSDs, refer to the whitepaper:

PCIe Solid State Drives for HP Workstations - http://www8.hp.com/h20195/v2/getpdf.aspx/c04200260.pdf

Appendix B: MIL-STD-810G[2]

MIL-STD-810G[2] testing is from the US 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 x2 G4. 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 organizations design their equipment for enhanced durability. The MIL-STD-810G[2] 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 life cycle
- Develop analysis and test criteria tailored to the equipment and its environmental life cycle
- Evaluate equipment life cycles when exposed to environmental stresses
- Identify deficiencies and defects in the design, materials, manufacturing processes, packaging techniques, and maintenance methods

A third party performs the various MIL-STD-810G[2] 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.

Altitude test

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

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

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 HP ZBook does not eject sub-elements and that its restraining devices will not fail during crash situations.

Drop test

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 test

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

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

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

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 HP 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

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

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

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

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 20M/S at a temperature of 60°C (140°F) for 4.5 hours (every 90 minutes, the unit is rotated 90°).

Temperature Shock test

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 test

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.

Appendix C: Display technology background

Display resolution is the most obvious measure of a display's performance. But other factors contribute to your overall viewing experience, including color calibration, viewing angles, and bit depth.

Color calibration

The matching of colors to a base color or from one device to another is called color calibration. It is widely employed in products like displays and printers to ensure an accurate representation of color. Displays use red, green, and blue to show the range of colors. For extra accuracy, HP Z Displays are factory calibrated to produce consistency across all displays, no matter where or how they are used. This out-of-the box color calibration ensures the visual integrity of the content creator's work from day one.

Bit depth

Bit depth refers to the amount of colors a display can produce. The most common display bit depths are 8- and 10-bits per RGB channel. For example, an 8-bit RGB display can show 256 shades of red, 256 shades of green, and 256 shades of blue per pixel. 10-bit RGB displays produce 1,024 shades of red, 1,024 shades of green, and 1,024 shades of blue per pixel. The difference in bit depths is most noticeable during color-intensive applications such as photo editing, animation, and designing. HP's UHD 4K Z Displays are 10-bit and produce more than one billion colors, essentially eliminating banding, artifacts, and contouring.

Pixels per inch

The pixels per inch (PPI) measure the pixel density of a screen, which can give you a good indication of the clarity and sharpness of the display. For example, the pixels on a 27" UHD/4K display would be four times smaller than the pixels on a 27" FHD display leading to an image that is four times clearer. Having these crisp images in HP's UHD/4K displays reduces eye strain and increases the precision and productivity of the user. Figure C-1 and Table C-1 show resolutions by display type.

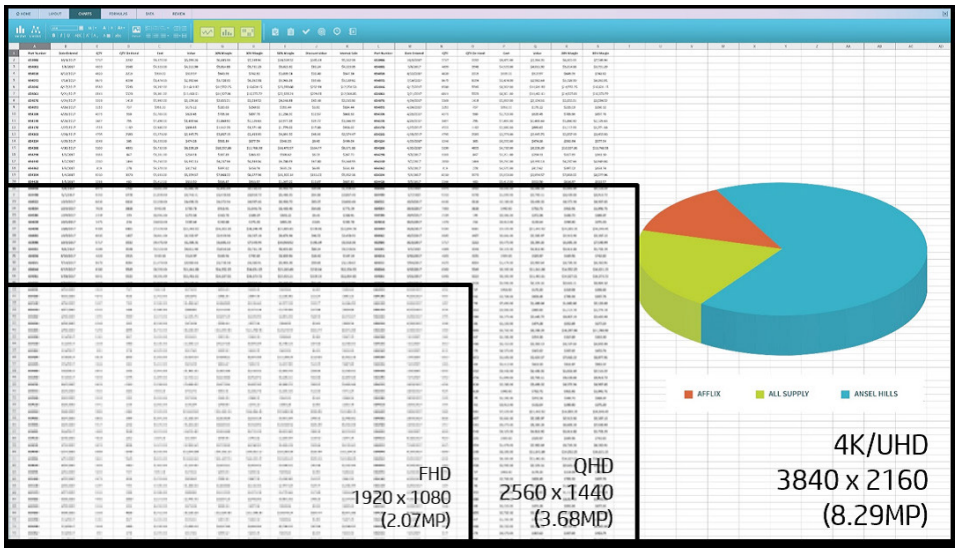


Figure C-1: Resolution by display type

Table C-1: Display type definitions

Video standard	Full name	Resolution
HD	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[13]	Ultra High Definition	3840 x 2160
Cinema 4K[13]	Cinema High Definition	4096 x 2160
QQHD/5K	Quad Quad High Definition	5760 x 2880

Viewing angles

The viewing angle of a display represents how far to the left or right, and how far down or up the content on the display can be observed without loss of image integrity. In-Plane Switching (IPS) displays have an optimal viewing angle of up to 178 degrees horizontally and vertically. By altering the direction of pixels within the display (parallel instead of perpendicular), an IPS display allows the screen to be viewed comfortably from several positions. HP UHD 4K Z Displays have viewing angles of 178 degrees horizontally and vertically, which is especially useful when several users are collaborating on one screen, or when the screen is viewed at an angle. Figure C-2 shows the effect of different viewing angles.

The ultra-wide viewing angle (UWVA), which is available on our HP ZBook 17 G4 displays, measures at 85/85/85/85.

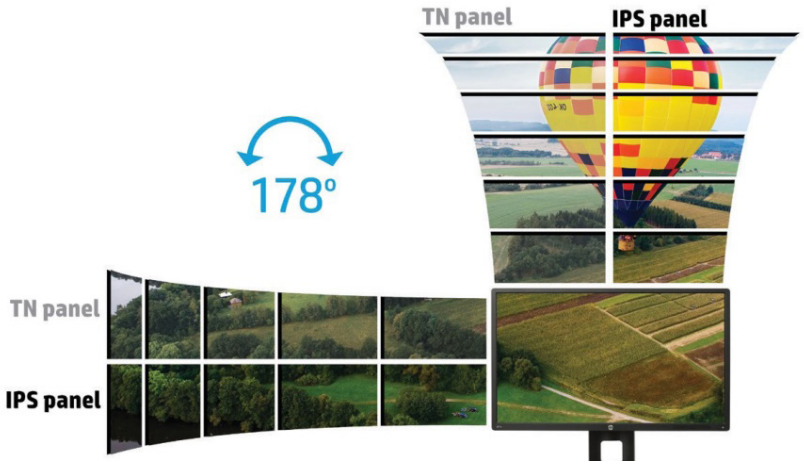


Figure C-2: The effect different viewing angles have on an IPS display versus a traditional display.

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 meter (cd/m^2) 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.

Appendix D: Example HP Quick Keys presets

Figures D-1 through D-6 illustrate the preset HP Quick Key definitions for the All Other and Adobe Photoshop® applications. Presets are also supplied for Adobe Illustrator® and Adobe Lightroom®. Note how many of the key definitions change as you cycle through Modes 1 to 3.

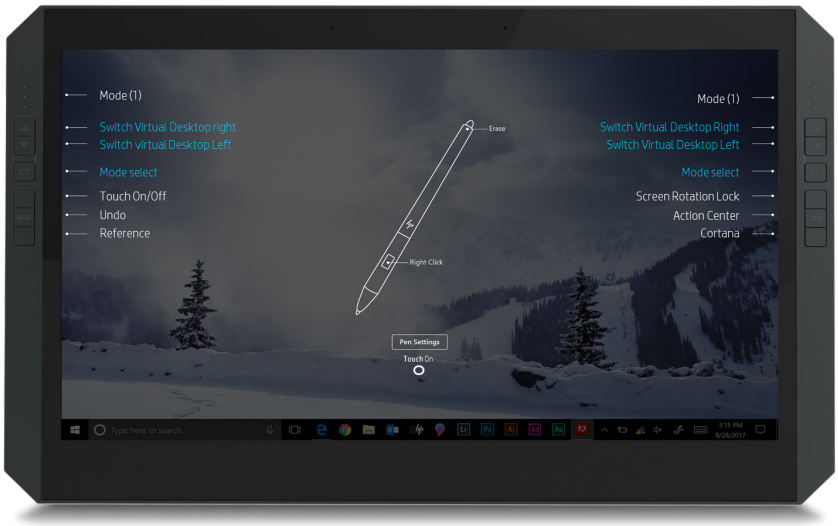


Figure D-1: All Other Mode 1

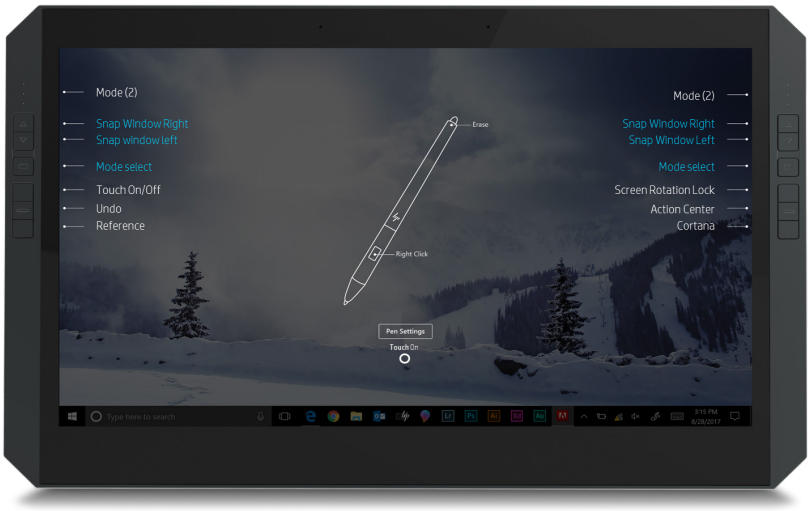


Figure D-2: All Other Mode 2

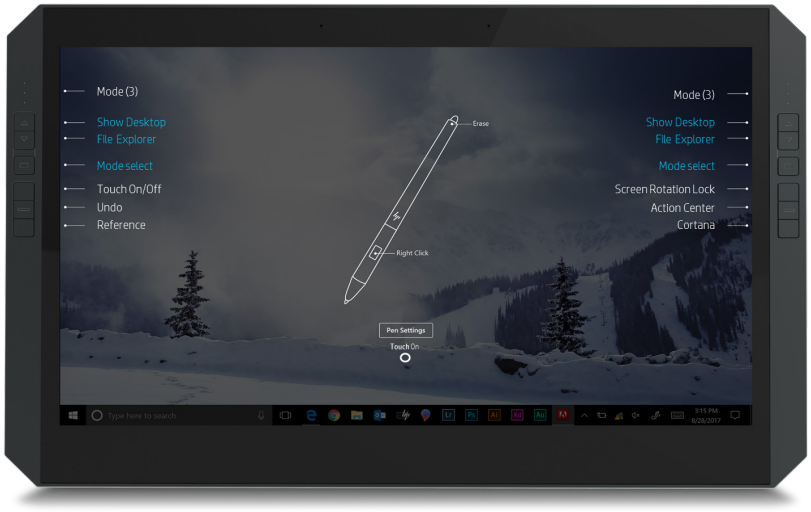


Figure D-3: All Other Mode 3

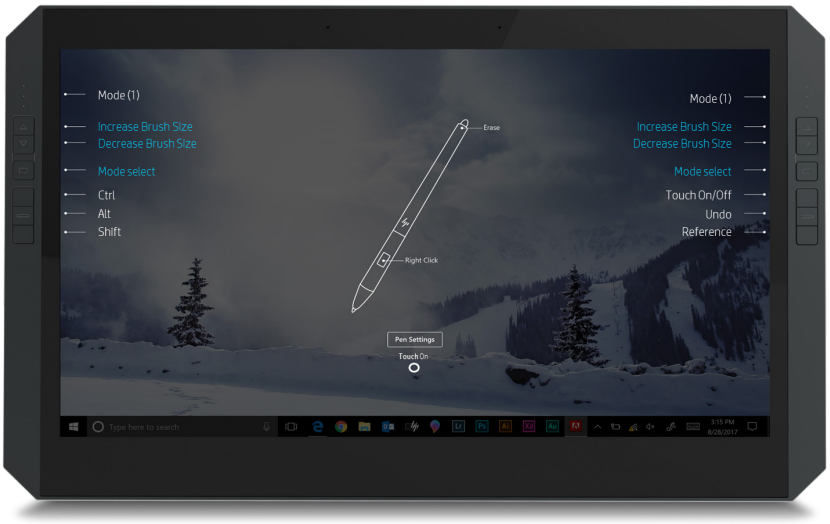


Figure D-4: Adobe Photoshop Mode 1

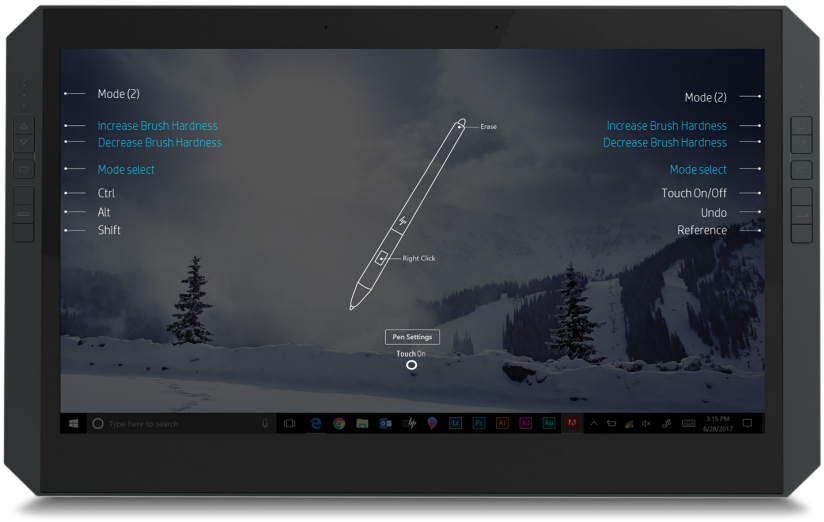


Figure D-5: Adobe Photoshop Mode 2

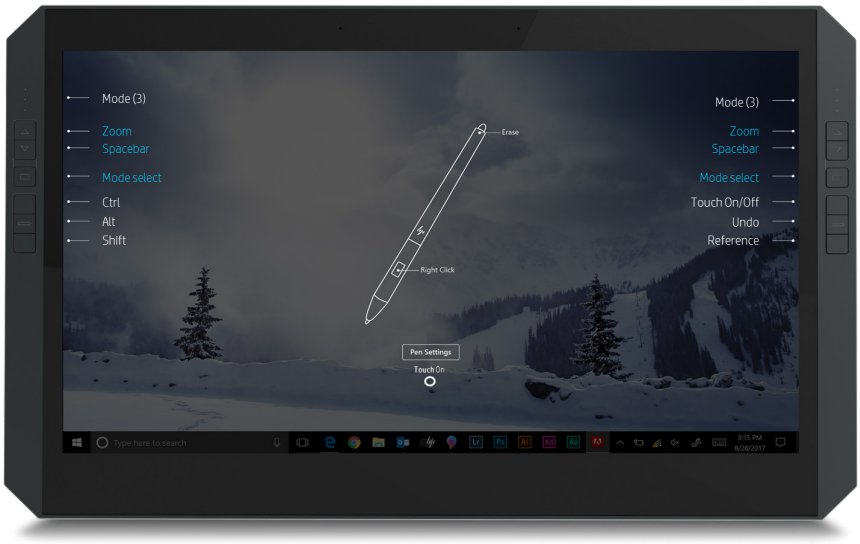


Figure D-6: Adobe Photoshop Mode 3

[1] For hard drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 30 GB (for Windows 10) of system disk is reserved for system recovery software.
[2] MIL-STD-810G testing is not intended to demonstrate fitness of U.S. Department of Defense (DoD) contract requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage requires an optional HP Accidental Damage Protection CarePack.
[3] Not all features are available in all editions or versions of Windows. Systems may require upgraded and/or separately purchased hardware, drivers and/or software 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 http://www.windows.com.
[4] Sold separately or as an optional feature.
[5] Weight will vary by configuration.
[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] Recharges your battery up to 50% within 30 minutes when the system is off or in standby mode. Power adapter with a minimum capacity of 90 watts is required. After charging has reached 50% capacity, charging will return to normal. Charging time may vary +/-10% due to System tolerance.
[8] Intel® HT Technology (HT) is designed to improve performance of multi-threaded software products and requires a computer system with a processor supporting HT and an HT-enabled chipset, BIOS and OS. Please contact your software provider to determine compatibility. Not all customers or software applications will benefit from the use of HT. See http://www.intel.com/info/hyperthreading for more information.
[9] Requires a Windows operating system, network hardware and software, connection with a power source, and a direct (non VPN) corporate network connection which is either cable or wireless LAN. Some functionality of Intel® Core™ i5 with vPro™/Core™ i7 with vPro™/Xeon® with vPro™ technology, such as Intel® Active Management technology and Intel® Virtualization technology, requires additional third-party software in order to run. Availability of future "virtual appliances" applications for Intel® Core™ i5 with vPro™/Core™ i7 with vPro™/Xeon® with vPro™ technology is dependent on third-party software providers. Compatibility with future "virtual appliances" is yet to be determined.
[10] HP Sure Start Gen3 is available on HP EliteBook, HP ZBook, and HP Z Workstation products equipped with Intel® 7th and 8th generation processors.
[11] EPEAT® registered where applicable. EPEAT registration varies by country. See www.epeat.net for registration status by country. Search keyword generator on HP's 3rd party option store for solar generator accessories at http://www.hp.com/go/options.
[12] External power supplies, power cords, cables and peripherals are not low halogen. Service parts obtained after purchase may not be low halogen.
[13] HD content required to view HD images.
[14] See http://www.bapco.com for additional details.
[15] 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.
[16] HP BIOShere Gen3 requires Intel® 7th or 8th generation processors.
[17] For the methods outlined in the National Institute of Standards and Technology Special Publication 800-88.
[18] BIOS Absolute Persistence module is shipped turned off, and will be activated when customers purchase and activate a subscription. Service may be limited. Check with Absolute for availability outside the U.S. The optional subscription service of Absolute Recovery Guarantee is a limited warranty. Certain conditions apply. For full details visit: http://www.absolute.com/company/legal/agreements/computrace-agreement. If Data Delete is utilized, the Recovery Guarantee payment is null and void. In order to use the Data Delete service, customers must first sign a Pre-Authorization Agreement and either create a PIN or purchase one or more RSA SecurID tokens from Absolute Software.
[19] HP Client Security Suite Gen3 requires Windows and Intel® 7th or 8th generation processors.
[20] HP Password Manager: Some websites and applications may not be supported. User may need to enable or allow the add-on/extension in the internet browser.
[21] Power On Authentication: HP commercial platforms support password with this feature and fingerprint where applicable.
[22] Opt in and internet connection required for updates.
[23] HP WorkWise smartphone app is available as a free download on the App Store and Google Play.

Sign up for updates
hp.com/go/getupdated

Share with colleagues

4AA7-2991ENW, May 2018