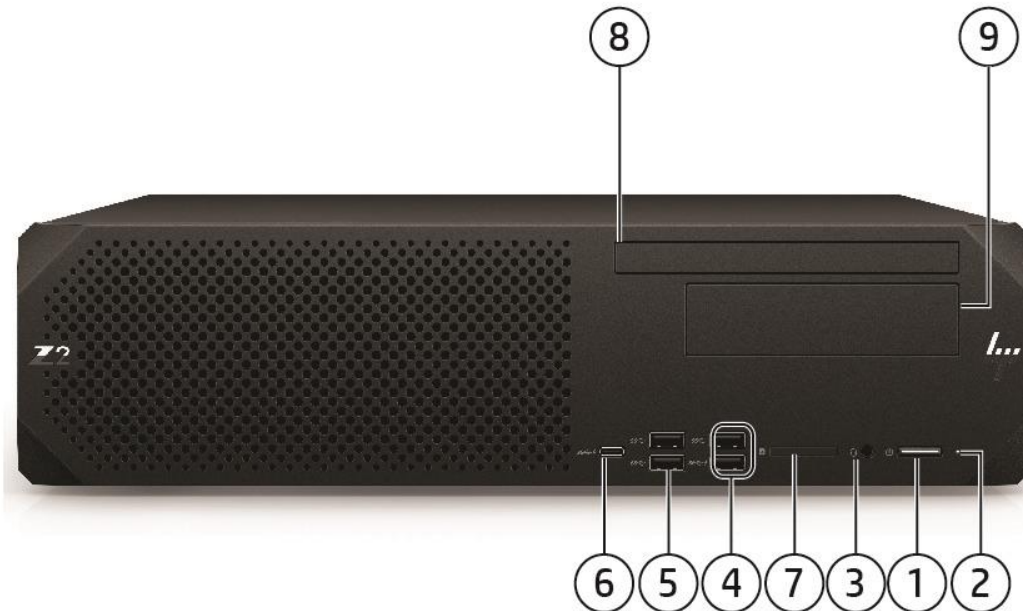


### Overview

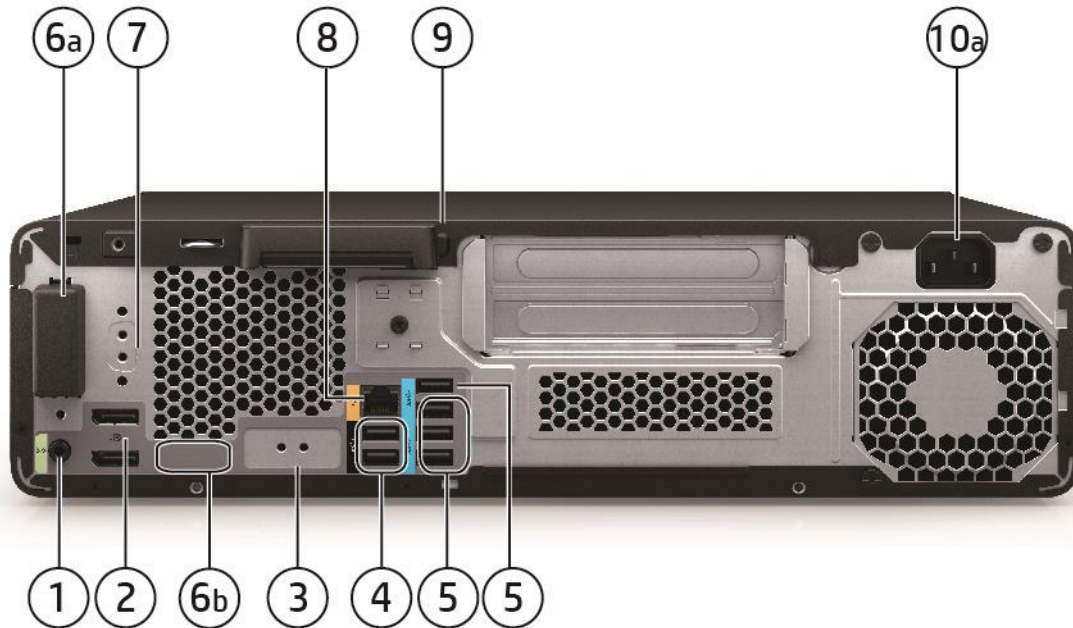
### HP Z2 G9 SFF Workstation Desktop PC



#### Front View

1. Power button
2. HDD Activity LED & Power button LED
3. Universal audio jack (with CTIA & OMTP headset support)
4. (2) USB-A 10Gbps port (1 charge port supports up to 5V/2.1A)
5. (2) USB-A 10Gbps port
6. (1) USB-C® 20Gbps port (charge supports up to 5V/3A)
7. Media Card Reader 4.0 (optional)
8. Slim ODD bay
9. Shared internal/external 3.5" bay

### Overview

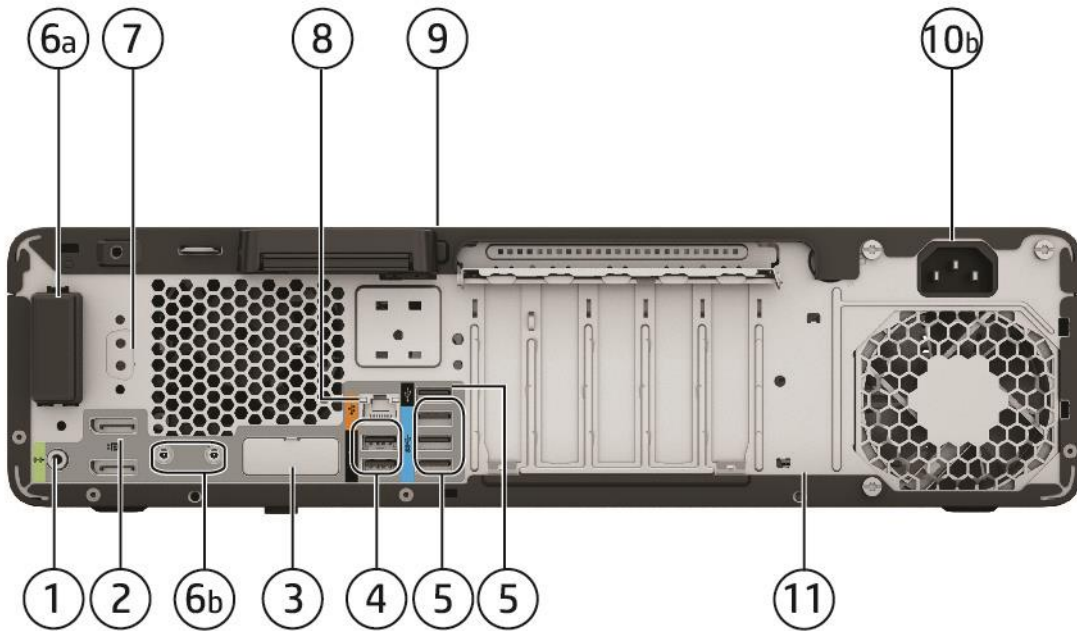


### Rear View (Full Height Graphics Enabled Chassis)

1. Audio line out
2. (2) DisplayPort 1.4 ports
3. Flex I/O module: choose one from the following:  
(1) DisplayPort 1.4, (1) HDMI 2.0b, (1) VGA, 1 Dual USB-A 5Gbps, 1 USB-C® 10Gbps (Power Delivery 15W, Alt Mode DisplayPort), (1) 2nd 1GbE LAN, (1) 1Gbps Fiber LC LAN, (1) Thunderbolt 3 with USB4 Type-C® 40Gbps port (cabled to PCIe AIC)
4. (2) USB-A 480Mbps ports
5. (3) USB-A 5Gbps ports  
(1) USB-A 480Mbps port
6. WLAN Antenna (optional)
  - a. Internal
  - b. External
7. 2nd serial port (optional)
8. (1) 1GbE LAN
9. Release latch
10. Power connector

**NOTE:** Onboard display support DP1.4/HBR2. Flex I/O module display support DP1.4/HBR3. All resolutions support up to 5120x3200 24bpp @60Hz.

### Overview



#### Rear View (Standard Chassis) – shown with rear jet black back cover option

- |  |  |
|--|--|
| <ol style="list-style-type: none"> <li>1. Audio line out</li> <li>2. (2) DisplayPort 1.4 ports</li> <li>3. Flex I/O module: choose one from the following:<br/>(1) DisplayPort 1.4, (1) HDMI 2.0b, (1) VGA, (1) Dual USB-A 5Gbps port, (1) USB-C® 10Gbps port (Power Delivery 15W, Alt Mode DisplayPort), (1) 2nd 1GbE LAN, (1) 1Gbps Fiber LC LAN, (1) Thunderbolt 3** USB4 Type-C® 40Gbps port (cabled to PCIe AIC)</li> <li>4. (2) USB-B 480Mbps ports</li> </ol> | <ol style="list-style-type: none"> <li>5. (3) USB-A 5Gbps ports (1) USB-A 480Mbps port</li> <li>6. WLAN Antenna (optional)             <ol style="list-style-type: none"> <li>a. Internal</li> <li>b. External</li> </ol> </li> <li>7. 2nd serial port (optional)</li> <li>8. (1) 1GbE LAN</li> <li>9. Release latch</li> <li>10. Power connector</li> <li>11. Rear jet black GS Mark Cover option (Not shown on the image)</li> </ol> |
|--|--|

**NOTE:** Onboard Display support DP1.4/HBR2. Flex I/O module Display support DP1.4/HBR3. Resolution all support up to 5120x3200 24bpp @60Hz.

\*\*Thunderbolt only supported on PCI-E slot3

### Overview

**Form Factor**

Small Form Factor

**Base Unit Options**

Standard Half Height Graphics Base Unit  
Full Height Graphics Base Unit

**Operating Systems**

Preinstalled:

- Windows 11 Pro - HP recommends Windows 11 Pro<sup>2</sup>
- Windows 11 Home - HP recommends Windows 11 Pro<sup>2</sup>
- Windows 10 Pro (available through downgrade rights from Windows 11 Pro)<sup>1,2,3</sup>
- Linux<sup>®</sup>-ready<sup>5</sup>
- Ubuntu<sup>®4,5</sup>
  - Intel 12<sup>th</sup> generation processors will support and preinstall Ubuntu 20.02 and 20.04.
  - Intel 13<sup>th</sup> generation processors support and preinstall Ubuntu 22.04 LTS

Web-supported only:

- Windows 10 Enterprise 64<sup>2</sup>

Supported Version:

- HP tested Windows 10, versions 20H2, 21H1 and 21H2 on this platform. For testing information on newer versions of Windows 10, please see: <https://support.hp.com/document/c05195282>.
- Red Hat<sup>®</sup> Enterprise Linux<sup>®</sup> Workstation 8<sup>5</sup>
- SUSE Linux<sup>®</sup> Enterprise Desktop 15<sup>5</sup>
- Ubuntu<sup>®4,5</sup>
  - Intel 12<sup>th</sup> generation processors will support and preinstall Ubuntu 20.02 and 20.04.
  - Intel 13<sup>th</sup> generation processors support and preinstall Ubuntu 22.04 LTS

<sup>1</sup> Device comes with Windows 10 and a free Windows 11 upgrade or may be preloaded with Windows 11. Upgrade timing may vary by device. Features and app availability may vary by region. Certain features require specific hardware (see Windows 11 Specifications).

<sup>2</sup> 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 is automatically updated and enabled. High speed internet and Microsoft account required. ISP fees may apply and additional requirements may apply over time for updates. See <http://www.windows.com>.

<sup>3</sup>This system is preinstalled with Windows 10 Pro software and also comes with a license for Windows 11 Pro software and provision for recovery 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.

<sup>4</sup> Not all features are available in all editions or versions of Ubuntu. Systems may require upgraded and/or separately purchased hardware, drivers, software or BIOS to take full advantage of Ubuntu functionality. Ubuntu may be automatically updated. ISP fees may apply, and additional requirements may apply over time for updates.

<sup>5</sup>For detailed Linux<sup>®</sup> OS/hardware support information, see: [http://www.hp.com/support/linux\\_hardware\\_matrix](http://www.hp.com/support/linux_hardware_matrix)

**NOTE:** Your product does not support Windows 8 or Windows 7. In accordance with Microsoft's support policy, HP does not support the Windows<sup>®</sup> 8 or Windows 7 operating system on products configured with Intel<sup>®</sup> and AMD<sup>®</sup> 7th generation and forward processors or provide any Windows<sup>®</sup> 8 or Windows 7 drivers on <http://www.support.hp.com>. A full list of HP products and the Windows 10 versions tested is available on the HP support website. <https://support.hp.com/us-en/document/c05195282>

### Overview

#### Intel 13<sup>th</sup> Generation Processors:

Intel® Core™ i5-13400 (2.5GHz P-Core base frequency, 1.8GHz E-Core base frequency, up to 3.3GHz E-Core Max Turbo frequency, up to 4.6 GHz P-core Max Turbo frequency, 20MB L3 cache, 6 P-cores and 4 E-cores, 16 threads)

Intel® Core™ i5-13500 (2.5GHz P-Core base frequency, 1.8GHz E-Core base frequency, up to 3.5GHz E-Core Max Turbo frequency, up to 4.8 GHz P-core Max Turbo frequency, 24MB L3 cache, 6 P-cores and 8 E-cores, 20 threads)

Intel® Core™ i5-13600 (2.7GHz P-Core base frequency, 2GHz E-Core base frequency, up to 3.7GHz E-Core Max Turbo frequency, up to 5 GHz P-core Max Turbo frequency, 24MB L3 cache, 6 P-cores and 8 E-cores, 20 threads)

Intel® Core™ i5-13600K (3.5GHz P-Core base frequency, 2.6GHz E-Core base frequency, up to 3.9GHz E-Core Max Turbo frequency, up to 5.1 GHz P-core Max Turbo frequency, 24MB L3 cache, 6 P-cores and 8 E-cores, 20 threads)

Intel® Core™ i7-13700 (2.1GHz P-Core base frequency, 1.5GHz E-Core base frequency, up to 4.1GHz E-Core base frequency, up to 5.1GHz E-Core base frequency, 30MB L3 cache, 8 P-cores and 8 E-cores, 24 threads)

Intel® Core™ i7-13700K (3.4GHz P-Core base frequency, 2.5GHz E-Core base frequency, up to 4.2GHz E-Core Max Turbo frequency, up to 5.3 GHz P-core Max Turbo frequency, 30MB L3 cache, 8 P-cores and 8 E-cores, 24 threads)

Intel® Core™ i9-13900 (2GHz P-Core base frequency, 1.5GHz E-Core base frequency, up to 4.2GHz E-Core Max Turbo frequency, up to 5.2 GHz P-core Max Turbo frequency, 36MB L3 cache, 8 P-cores and 16 E-cores, 32 threads)

Intel® Core™ i9-13900K (3GHz P-Core base frequency, 2.2GHz E-Core base frequency, up to 4.3GHz E-Core Max Turbo frequency, up to 5.4 GHz P-core Max Turbo frequency, 36MB L3 cache, 8 P-cores and 16 E-cores, 32 threads)

#### Intel 12<sup>th</sup> Generation Processors:

Intel® Core™ i9-12900K (2.4GHz E-core base frequency, 3.2GHz P-core base frequency, up to 3.9 GHz E-core Max Turbo frequency, up to 5.1 GHz P-core Max Turbo frequency, 30MB L3 cache, 8 P-cores and 8 E-cores, 24 threads)

Intel® Core™ i9-12900 (1.8GHz E-core base frequency, 5.0 GHz P-core base frequency, up to 3.8 GHz E-core Max Turbo frequency, up to 5.0 GHz P-core Max Turbo frequency, 30MB L3 cache, 8 P-cores and 8 E-cores, 24 threads)

Intel® Core™ i7-12700K (2.7 GHz E-core base frequency, 3.6 GHz P-core base frequency, up to 3.8 GHz E-core Max Turbo frequency, up to 4.9 GHz P-core Max Turbo frequency, 25MB L3 cache, 8 P-cores and 4 E-cores, 20 threads)

Intel® Core™ i7-12700 (1.6 GHz E-core base frequency, 2.1 GHz P-core base frequency, up to 3.6 GHz E-core Max Turbo frequency, up to 4.8 GHz P-core Max Turbo frequency, 25MB L3 cache, 8 P-cores and 4 E-cores, 20 threads)

Intel® Core™ i5-12600K (2.8 GHz E-core base frequency, 3.7 GHz P-core base frequency, up to 3.6 GHz E-core Max Turbo frequency, up to 4.9 GHz P-core Max Turbo frequency, 20MB L3 cache, 6 P-cores and 4 E-cores, 16 threads)

Intel® Core™ i5-12600 (3.3 GHz P-core base frequency, up to 4.8 GHz P-core Max Turbo frequency, 18MB L3 cache, 6 P-cores and 0 E-cores, 12 threads)

Intel® Core™ i5-12500 (3.0 GHz P-core base frequency, up to 4.6 GHz P-core Max Turbo frequency, 18MB L3 cache, 6 P-cores and 0 E-cores, 12 threads)

Intel® Core™ i5-12400 (2.5 GHz P-core base frequency, up to 4.4 GHz P-core Max Turbo frequency, 18MB L3 cache, 6 P-cores and 0 E-cores, 12 threads)

Intel® Core™ i3-12300 (3.5 GHz P-core base frequency, up to 4.4 GHz P-core Max Turbo frequency, 12MB, 4 P-cores. 8 threads)

Intel® Core™ i3-12100 (3.3 GHz P-core base frequency, up to 4.3 GHz P-core Max Turbo frequency, 12MB, 4 P-cores. 8 threads)

<sup>1</sup> Multicore 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, branding and/or naming is not a measurement of higher performance.

<sup>2</sup> Intel Turbo Boost performance varies depending on hardware, software and overall system configuration. See <http://www.intel.com/technology/turboboost> for more information.

<sup>3</sup> Intel vPro® requires Windows 10 Pro 64 bit or higher, a vPro supported processor, vPro enabled chipset, vPro enabled wired LAN and/or Wi-Fi 6E WLAN and TPM 2.0. Some functionality requires additional 3rd party software in order to run. Features of vPro® Essentials and Enterprise vary. See <http://intel.com/vpro>

### Overview

<sup>4</sup> Memory will run at 4400 speed (MT/s) if there is one DIMM per channel. 2 DIMMS per channel will run 4000 speed (MT/s). DIMMs must be the same, either 8GB or 16GB DIMMs. 32GB DIMMs run at 3200 MT/s.

<sup>5</sup> Error Correction Memory

<b>Color</b>	Black				
<b>Convertibility</b>	The SFF can either be placed flat on the desktop or made to stand on the desk with the optional tower stand.				
<b>Expansion Slots</b> (see system board section for more details) <sup>1</sup>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Standard Base Unit with Half Height PCIe</th> <th style="width: 50%;">Full Height Graphics PCIe Base Unit</th> </tr> </thead> <tbody> <tr> <td>Slot 1: PCIe Gen4 x16 Slot 2: PCIe Gen3 x4 Slot 3: PCIe Gen3 x4 - with x16 Connector Slot 4: PCIe Gen3 x1</td> <td>Slot 1: PCIe Gen4 x16<sup>1</sup> Slot 2: PCIe Gen4 x8 (with x16 connector)<sup>1</sup>  <sup>1</sup>When slot 2 is configured with a PCIe card, slot 1 will automatically downgrade to PCIe x8 electrical</td> </tr> </tbody> </table>	Standard Base Unit with Half Height PCIe	Full Height Graphics PCIe Base Unit	Slot 1: PCIe Gen4 x16 Slot 2: PCIe Gen3 x4 Slot 3: PCIe Gen3 x4 - with x16 Connector Slot 4: PCIe Gen3 x1	Slot 1: PCIe Gen4 x16 <sup>1</sup> Slot 2: PCIe Gen4 x8 (with x16 connector) <sup>1</sup>  <sup>1</sup> When slot 2 is configured with a PCIe card, slot 1 will automatically downgrade to PCIe x8 electrical
Standard Base Unit with Half Height PCIe	Full Height Graphics PCIe Base Unit				
Slot 1: PCIe Gen4 x16 Slot 2: PCIe Gen3 x4 Slot 3: PCIe Gen3 x4 - with x16 Connector Slot 4: PCIe Gen3 x1	Slot 1: PCIe Gen4 x16 <sup>1</sup> Slot 2: PCIe Gen4 x8 (with x16 connector) <sup>1</sup>  <sup>1</sup> When slot 2 is configured with a PCIe card, slot 1 will automatically downgrade to PCIe x8 electrical				
<b>Expansion Bays</b> (see storage section for more details)	(1) Shared internal/external 3.5" bay <b>NOTE:</b> This shared bay is supported only with Core i7 / i9 processors. (1) Internal 3.5" bay (1) Internal 3.5" bay (optional in Standard SFF. Not Available with Full Height Graphics Base Unit) (1) Dedicated 9.5mm slim optical disk drive bay				
<b>Front I/O</b>	2 Type-A SuperSpeed USB 10Gbps signaling rate port (1 charge port supports up to 5V/2.1A), 2 Type-A SuperSpeed USB 10Gbps signaling rate port, 1 Type-C SuperSpeed® USB 20Gbps signaling rate port (charge supports up to 5V/3A), 1 SD card reader (optional), 1 universal audio jack				
<b>Internal I/O</b>	(1) USB 480Mbps header for SD card reader (1) serial port available with header (1) serial and PS/2 available with header				
<b>Rear I/O</b>	(2) DisplayPort 1.4 [3], (1) Audio Line out, (1) 1GbE LAN, (3) USB-A 480Mbps ports, (3) USB-A 5Gbps ports, (1) serial (optional), (1) Flex I/O port (VGA, HDMI 2.0b, DisplayPort 1.4, USB-C® 10Gbps port (Power Delivery 15W, Alt Mode Display Port), Dual USB-A 5Gbps port, 2nd 1GbE LAN, (1) Thunderbolt 3 with USB4 Type-C® 40Gbps (cabled to PCIe AIC), (1) 1Gbps Fiber LC NIC				
<b>Optional I/O</b>	Flex IO* – choose one of the following options: (1) DisplayPort™ 1.4, (1) HDMI 2.0b, (1) VGA, (1) 2nd 1GbE LAN, (1) 1Gbps Fiber LC NIC, (1) Dual USB-A 5Gbps port, (1) USB® 10Gbps port (15W USB Power Delivery, Alt Mode DisplayPort™), (1) Thunderbolt™ 3 with USB4 Type-C® 40Gbps port (cabled to PCIe® AIC); Front – (1) SD card reader; Rear – (1) serial; (1) SD 4.0 card reader  <sup>*</sup> Flex IO port and one PCIe slot will be occupied when Thunderbolt is installed. Thunderbolt will be available in Q2, 2022 (1 <sup>st</sup> refresh).				
<b>Interfaces Supported</b>	SD card reader (optional)				
<b>On-board RAID Support</b>	SATA and NVME RAID 0 Striped Array SATA RAID and NVME RAID 1 Mirror Array				
<b>Chassis Dimensions (H x W x D)</b>	H: 3.95" [100mm] W: 15.1" [384mm] D: 12.1" [308mm] (Standard desktop orientation)				
<b>Packaged Dimensions</b>	H: 20.4" (514mm) W: 7.83" (199mm) D: 19.29" (490mm)				
<b>Weight</b>	Exact weights depend upon configuration (System weight only). Starting at 5.0kg (11.1lbs.)				

### Overview

<b>Temperature</b>	Operating: 5° to 35° C (40° to 95° F) Above 1524 m (5,000 feet) altitude, the maximum operating temperature is reduced by 1° C (1.8° F) for every 305 m (1,000 feet) increase in elevation Non-operating: -40° to 60° C (-40° to 140° F) Maximum rate of change: 10°C/hr
<b>Humidity</b>	Operating: 10% to 85% RH, non-condensing, 35° C maximum wet bulb Non-operating: 10% to 90% RH, non-condensing, 35° C maximum wet bulb
<b>Maximum Altitude (non-pressurized)</b>	Operating (with Rotational Hard Drives): 3,048 m (10,000 feet) Operating (with only Solid-State Drives): 5,000 m (16,404 feet) Non-operating: 12,192 m (40,000 feet) Maximum operating temperature is reduced as altitude increases. See Temperature for details.
<b>Power Supply</b>	260W PSU: only available with standard half height graphics base unit 260W wide-ranging, active Power Factor Correction, 92% Efficiency. <a href="#">LiteOn 260W PSU Efficiency Report</a> <a href="#">Chicony 260W PSU Efficiency Report</a> <a href="#">AcBel 260W PSU Efficiency Report</a>  450W PSU: only available with standard half height graphics base unit 450W wide-ranging, active Power Factor Correction, 90% Efficiency. <a href="https://www.plugloadsolutions.com/80PlusPowerSuppliesDetail.aspx?id=0&amp;type=2">https://www.plugloadsolutions.com/80PlusPowerSuppliesDetail.aspx?id=0&amp;type=2</a>  <a href="#">LiteOn 450W PSU Efficiency Report</a>  550W PSU: only available with full height graphics base unit 550W wide-ranging, active Power Factor Correction, 92% Efficiency. <a href="#">LiteOn550W PSU Efficiency Report</a> <a href="#">AcBel 550W PSU Efficiency Report</a>
<b>Backup Devices</b>	For a complete listing of compatible DAT tape drives, LTO tape drives and RDX Removable Disk Backup System offerings, please visit <a href="http://www.hp.com/go/connect">http://www.hp.com/go/connect</a>
<b>Chipset</b>	Intel® W680 chipset
<b>Memory</b>	4 DIMM slots, supporting up to 128GB ECC/non-ECC, DDR5 unbuffered DIMM memory. Speed depending on the system configuration. See Supported Components / Memory Section for details.

### Supported Components

Storage / Hard Drives*	Factory Configured	Option Kit	Option Kit Part Number	Support Notes
<b>SATA Hard Drives<sup>1</sup></b>				
500GB SATA 7200 rpm 6Gb/s 3.5" HDD	Y	Y	LQ036AA	1
1TB SATA 7200 rpm 6Gb/s 3.5" HDD	Y	Y	LQ037AA	1
2TB SATA 7200 rpm 6Gb/s 3.5" HDD	Y	Y	QB576AA	1
1TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)	Y	Y	WOR10AA	1
2TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)	Y	Y	2Z274AA	1
4TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)	Y	Y	K4T76AA	1
8TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)	Y	Y	2Z273AA	1
12TB 7200 RPM SATA-6G 3.5in Enterprise HDD	Y	Y	5S461AA	1
500GB SATA 7.2K SED SFF HDD	Y	Y	D8N29AA	1
<b>PCIe Solid State Drives</b>				
HP ZTurbo 512GB PCIe-Gen 4x4 TLC Z2 SSDKit	Y	Y	201G0AA	
HP ZTurbo 512GB PCIe-Gen 4x4 SED Z2 SSDKit	Y	Y	201F9AA	
HP ZTurbo 1TB PCIe-Gen 4x4 TLC Z2 SSDKit	Y	Y	201F5AA	
HP ZTurbo 2TB PCIe-Gen 4x4 TLC Z2 SSDKit	Y	Y	201F8AA	
HP Z Turbo Drive 1TB 2280 PCIe-4x4 SED OPAL2 TLC Z2 Kit SSD	Y	Y	223A3AA	
HP Z Turbo Drive 2TB 2280 PCIe-4x4 SED OPAL2 TLC Z2 Kit SSD	Y	Y	223A4AA	
Z Turbo 4TB 2280 PCIe-4x4 SED OPAL2 TLC M.2 Z2 Kit SSD	Y	Y	5S498AA	
HP 256GB PCIe NVME TLC M.2 Z2 G9 TWR/SFF SSD	Y	Y		
HP 500GB PCIe NVME TLC M.2 Z2 G9 TWR/SFF SSD	Y	Y		
HP 1TB PCIe NVME TLC M.2 Z2 G9 TWR/SFF SSD	Y	Y		
HP 256GB 2280 PCIe-4x4 NVMe Value M.2 Z2 Kit SSD	Y	Y	4M9Z1AA	
HP 512GB 2280 PCIe-4x4 NVMe Value M.2 Z2 Kit SSD	Y	Y	4M9Z2AA	
HP 1TB 2280 PCIe-4x4 NVMe Value M.2 Z2 Kit SSD	Y	Y	4M9Z3AA	
HP Z Turbo 4TB 2280 PCIe-4x4 TLC M.2 Z2 Kit SSD	Y	Y	5S492AA	
HP Z Turbo 2TB PCIe-4x4 TLC SSD Module	Y	Y	38T75AA	
HP Z Turbo 1TB 2280 PCIe-4x4 SED OPAL2 TLC M.2 SSD Module	Y	Y	38T76AA	
HP Z Turbo 1TB PCIe-4x4 TLC SSD Module	Y	Y	38T77AA	
HP Z Turbo 2TB 2280 PCIe-4x4 SED OPAL2 TLC M.2 SSD Module	Y	Y	38T79AA	
HP Z Turbo 512GB PCIe-4x4 TLC SSD Module	Y	Y	38T80AA	
HP Z Turbo 512GB 2280 PCIe-4x4 SED OPAL2 TLC M.2 SSD Module	Y	Y	38T81AA	
HP Z Turbo 4TB 2280 PCIe-4x4 TLC M.2 SSD Module	Y	Y	5S496AA	
HP Z Turbo 4TB 2280 PCIe-4x4 SED OPAL2 TLC M.2 SSD Module	Y	Y	5S497AA	

**NOTE 1:** HDD option kits also require purchase of separate cable kit (available Sept 2022). This option kit includes necessary components to install the HDD options in an internal or external bay.

**HP Z2 SFF HDD Cable Kit 6Z9U5AA.** This is only needed when HDD is purchased as AMO.



### Supported Components

\*For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

Graphics	Factory Configured	Option Kit	Option Kit Part Number	Supported # of cards	Support Notes
<b>Graphics Cable Adapters</b>					
HP DisplayPort To HDMI True 4k Adapter	Y	Y	2JA63AA		
HP Single miniDP-to-DP Adapter Cable	Y	Y	2MY05AA		
HP DisplayPort To DVI-D Adapter	Y	Y	FH973AA/A6		
HP DisplayPort To VGA Adapter	Y	Y	AS615AA/AT		
HP DisplayPort To VGA Adapter	Y	Y	AS615A6		
HP DisplayPort To VGA Adapter	Y	Y	F7W97AA		
HP USB-C to DisplayPort Adapter	Y	Y	4SH08AA		
HP USB-C to HDMI Adapter	Y	Y	4SH07AA		
HP USB-C to VGA Adapter	Y	Y	4SH06AA		
<b>Entry 3D Graphics</b>					
NVIDIA® T400 2 GB Graphics	Y	Y	340K8AA	2	1
NVIDIA® T400 4 GB Graphics	Y	Y	5Z7E0AA/AT	2	
NVIDIA® T600 4 GB Graphics	Y	Y	340K9AA	2	1
AMD Radeon RX 6400 4 GB DH DP+HDMI Graphics	Y	Y	6Q3U4AA	1	
AMD Radeon Pro WX 3200 4GB (4)mDP GFX, w/2 mDP-to-DP adapters	Y	Y	6YT68AA	1	
<b>Mid-range 3D Graphics</b>					
NVIDIA® T1000 4 GB Graphics	Y	Y		2	
NVIDIA® T1000 8 GB Graphics	Y	Y	5Z7D8AA/AT	2	
NVIDIA Long-Life T1000E 8 GB 4mDP Graphics	Y	Y	6V9V4AA/AT	2	
NVIDIA® RTX™ A2000 6 GB 4mDP Graphics	Y	Y	340L0AA	1	3
NVIDIA® RTX™ A2000 12GB Graphics*	Y	Y	5Z7D9AA/AT	1	3
NVIDIA Long-Life RTX A2000E 12 GB 4mDP Graphics	Y	Y	6V9V5AA/AT	1	
AMD Radeon™ Pro W6600 Graphics (8GB GDDR6 dedicated) *	Y	Y	340K5AA	1	
<b>High-end 3D Graphics</b>					
AMD Radeon™ RX 6700 XT Graphics (12 GB GDDR6 dedicated) *	Y	N		1	2
NVIDIA® RTX™ A4000 16 GB Graphics*	Y	Y	20X24AA/AT	1	2, 3
<b>Note 1:</b> NVIDIA® T400 (2 GB GDDR6 dedicated) and NVIDIA® T600 (4 GB GDDR6 dedicated) may go End of Life in late 2022.					
<b>Note 2:</b> Full Height Graphics (eg. NV A4000, AMD 6700) are only supported by Full Height Chassis/550W PSU)					
<b>Note 3:</b> Double wide card consumes 2 PCIe slots					

Memory	Factory Configured	Option Kit	Option Kit Part Number	Support Notes
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### Supported Components

HP 8GB (1x8GB) DDR5-4800 UDIMM NECC	Y	Y	4M9X9AA	2, 3
HP 16GB (1x16GB) DDR5-4800 UDIMM NECC	Y	Y	4M9Y0AA	2, 3
HP 16GB (1x16GB) DDR5-4800 UDIMM ECC	Y	Y	4M9Y1AA	1,2, 3
HP 32GB (1x32GB) DDR5-4800 UDIMM NECC	Y	Y	4M9Y2AA	2, 3
HP 32GB (1x32GB) DDR5- 4800 UDIMM ECC	Y	Y	4M9Y3AA	1, 2, ,3

**NOTE 1:** See Processor Overview section for processors that support ECC Memory.

**NOTE 2:** Two channels of DDR5 memory are supported. To realize full performance one DIMM must be inserted into each channel.

**NOTE 3:** Though the memory modules can run up to 4800MHz, the current platform will support the maximum memory speed of 4400MHz.

The system speed will be determined by these key factors:

Module Configuration	Description of configuration	Max Memory Speed (Actual Memory speed is dependent on CPU)
Single 8, 16 or 32GB DIMM per channel	Configurations that contain only one or two DIMM modules with DIMMs only in the black slots	4400MHz
Two 8 or 16GB DIMMs in a channel	Configurations with 3 or 4 DIMMs installed in a system. Memory DIMMs must all be of the same size.	4000MHz
Two 32GB DIMMs in a channel	Configurations with 3 or 4 32GB DIMMs installed in a system	3600MHz

### Optical and Removable Storage

	Factory Configured	Option Kit	Option Kit Part Number	Support Notes
HP DP25 Removable 2.5" HDD Frame/Carrier	N	Y	W3J84AA	
HP DP25 2.5 in HDD Spare Carrier	N	Y	W3J85AA	
HP Z2 SFF DVD-Writer 9.5mm Slim ODD	Y	Y	4L5J9AA	1
HP Z2 SFF DVD-ROM 9.5mm Slim ODD	Y	Y	4L5J8AA	1
HP CRU QX118 3.5 in Front Removable Frame/Carrier	Y	N		
HP CRU QX328 3.5 in Front Removable Frame/Carrier	Y	Y	4N012AA	2, 3
HP CRU Secure High Performance Storage Module with 2TB M.2 SSD	Y	Y	56Q87AA	4
HP CRU Secure High Performance Storage Module with 1TB M.2 SSD	Y	Y	56Q88AA	4
HP CRU Secure High Performance Storage Module with 512GB M.2 SSD	Y	Y	56Q89AA	4

**NOTE 1:** Duplication of copyrighted material is strictly prohibited. Actual speeds may vary. Double Layer media compatibility will widely vary with some home DVD players and DVD-ROM drives. Note that DVD-RAM cannot read or write to 2.6GB Single Sided/5.2 Double Sided-Version 1.0 Media.

**NOTE 2:** HP CRU QX328 3.5 in Front Removable Frame/Carrier is only compatible with Intel core i7 and core i9 processors

**NOTE 3:** Requires separate purchase of HP CRU SHIP Storage Module(s).

**NOTE 4:** HP CRU Secure High Performance Storage (SHIPS) Module Kit contains select M.2 SSD for install into a factory configured or after market option front removeable storage carrier (HP CRU QX328 Frame/Carrier).

### Supported Components

#### Networking and Communications

	Factory Configured	Option Kit	Option Kit Part Number	Support Notes
Integrated Intel® I219LM PCIe GbE Controller (Intel® vPro® with Intel® AMT 16.0)	Y	N		2
HP 1GbE LAN Flex Port 2020	Y	Y	141J6AA/AT	3
HP Flex 1GbE Fiber LC Single Port	Y	Y	20J15AA	3
Intel Ethernet I350-T4 4-Port 1Gb NIC*	N	Y	W8X25AA	3
Intel X550 10GBASE-T Dual Port NIC	Y	Y	1QL46AA	
Intel Ethernet Network Adapter I225-T1	Y	Y	406L9AA	
Intel Wi-Fi 6E AX211 BT 5.3 wireless card M.2 non-vPro <sup>1,**</sup>	Y	N		1
Allied Telesis AT-2911T/2-901 Dual Port 1GbE NIC	Y	Y	6E3Y9AA/AT	
NVIDIA Mellanox ConnectX-6 DX Dual Port 10/25GbE SFP28 NIC	Y	Y	436M8AA	

\*Intel I350-T4 4-port GbE NIC is an After Market Option only.

\*\*Intel AX211 must be configured at time of purchase. Not available as an After Market Option.

**NOTE 1:** Intel AX211 with external antenna support WIFI 6E. Wi-Fi 6E requires a Wi-Fi 6E router, sold separately, to function in the 6GHz band. Availability of public wireless access points limited. Wi-Fi 6E is backwards compatible with prior 802.11 specs. And available in countries where Wi-Fi 6E is supported. The integrated network connection is required to support Intel® vPro® Technology.

**NOTE 2:** If AMT is provisioned, then network teaming with the integrated LAN port is not possible.

**NOTE 3:** "Gigabit" Ethernet indicates compliance with IEEE standard 802.3ab for Gigabit Ethernet, and does not connote actual operating speed of 1 Gb/sec. For high speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required

#### Racking and Physical Security

	Factory Configured	Option Kit	Option Kit Part Number
HP Keyed Cable Lock	N	Y	T1A62AA
HP Master Keyed Cable Lock 10mm	N	Y	T1A63AA
HP Business PC Security Lock V3 Kit	N	Y	3XJ17AA

#### Input Devices

	Factory Configured	Option Kit	Option Kit Part Number
HP 320K Wired Keyboard	Y	Y	9SR37AA
HP 455 Programmable Wireless Keyboard	Y	Y	4R177AA
HP 975 USB+BT Dual-Mode Wireless Keyboard	Y	Y	3Z726AA
HP 655 Wireless Keyboard and Mouse Combo	Y	Y	4R009AA
HP 125 Wired Keyboard	Y	Y	266C9AA
HP Wired Desktop 320MK Mouse and Keyboard	Y	Y	9SR36AA
HP Wired 320M Mouse	Y	Y	9VA80AA
HP 128 Laser Wired Mouse	Y	Y	265D9AA
HP 125 Wired Mouse	Y	Y	265A9AA

### Supported Components

HP Creator 935 Black Wireless Mouse	Y	Y	1D0K8AA
HyperX Cloud MIX Wireless GAM HEADSET	N	Y	4P5K9AA
HyperX Cloud Core BLK GAM HEADSET	N	Y	4P4F2AA
HyperX Cloud Flight - Wireless Gaming Headset (Black-Red) (HX-HSCF-BK/AM)	N	Y	4P5L4AA
HyperX Cloud Stinger Core GAM HEADSET PC	N	Y	4P4F4AA
HyperX SoloCast - USB Microphone (Black) (HMIS1X-XX-BK/G)	N	Y	4P5P8AA

### Flexport Options

	Factory Configured	Option Kit	Option Kit Part Number
HP DP Flex Port 2020	Y	Y	141J7AA/AT
HP 1GbE LAN Flex Port 2020	Y	Y	141J6AA/AT
HP Flex 1GbE Fiber LC Single Port	Y	Y	20J15AA
HP Dual USB-A 3.2 Gen1 Flex 2020	Y	Y	141J8AA/AT
HP HDMI Flex Port	Y	Y	69D47AA/AT
HP USB-C 3.2 Gen2 Alt Flex Port 2020	Y	Y	141K6AA/AT
HP VGA Flex Port 2020	Y	Y	141K7AA/AT

### Miscellaneous

	Factory Configured	Option Kit	Option Kit Part Number
HP Z2 Internal Serial Port and PS/2 Port	Y	Y	141K9AA/AT
HP Z2 Power Cord Kit	Y	Y	1N1D5AA
HP Z2 2nd serial port adapter	Y	Y	141K8AA/AT
HP PCIe x1 Parallel Port Card	Y	Y	N1M40AA
HP Z2 SFF Dust Filter	Y	Y	4N002AA
HP Z2 SFF Dust Filter and Bezel	Y	Y	4N003AA
HP Z2 SFF HDD Cable Kit	N	Y	6Z9U5AA
HP Anyware Integrated Remote System Controller	Y	Y	7K6D9AA
HP Anyware Remote System Controller Main Board Adapter	Y	Y	7K6D8AA
HP Anyware Remote System Controller	Y	Y	7K6D7AA

### Software

	Factory Configured	Option Kit	Support Notes
HP Performance Advisor	Y	N	1
HP PC Hardware Diagnostics UEFI (Windows OS only)	Y	N	2
HP PC Hardware Diagnostics Windows		N	3
HP Wolf Security	Y	N	
HP Notifications	Y	N	
HP Desktop Support Utility	Y	N	
HP Documentation	Y	N	
HP Image Assistant	N	N	
HP Support Assistant	N	N	
myHP	Y	N	
HP Easy Clean	Y	N	
Kingsoft WPS Office	Y	N	4
My Office	Y	N	5

### Supported Components

Adobe Substance 3D Collection Plan	N	Y	6
WSL2/Ubuntu Data Science Stack	Y	N	7

**Note 1:** Supports, and preinstalled with Windows 10 only. Also available as a free download from <http://www.hp.com/go/performanceadvisor>

Note 2: Windows OS only

Note 3: Not available in Russia

Note 4: Only available in China

Note 5: Only available in Russia

Note 6: Not available in China

Note 7: Optional Software

### Supported Components

#### Operating Systems

Windows 11 Pro - HP recommends Windows 11 Pro<sup>2</sup>

Windows 11 Home - HP recommends Windows 11 Pro<sup>2</sup>

Windows 10 Pro (available through downgrade rights from Windows 11 Pro)<sup>1,2,3</sup>

Linux<sup>®</sup>-ready<sup>5</sup>

Ubuntu<sup>®4,5</sup>

- Intel 12<sup>th</sup> generation processors will support and preinstall Ubuntu 20.02 and 20.04.
- Intel 13<sup>th</sup> generation processors support and preinstall Ubuntu 22.04 LTS

<sup>1</sup> Device comes with Windows 10 and a free Windows 11 upgrade or may be preloaded with Windows 11. Upgrade timing may vary by device. Features and app availability may vary by region. Certain features require specific hardware (see Windows 11 Specifications).

<sup>2</sup> 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 is automatically updated and enabled. High speed internet and Microsoft account required. ISP fees may apply and additional requirements may apply over time for updates. See <http://www.windows.com>.

<sup>3</sup>This system is preinstalled with Windows 10 Pro software and also comes with a license for Windows 11 Pro software and provision for recovery 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.

<sup>4</sup> Not all features are available in all editions or versions of Ubuntu. Systems may require upgraded and/or separately purchased hardware, drivers, software or BIOS to take full advantage of Ubuntu functionality. Ubuntu may be automatically updated. ISP fees may apply and additional requirements may apply over time for updates.

<sup>5</sup>For detailed Linux<sup>®</sup> OS/hardware support information, see:

[http://www.hp.com/support/linux\\_hardware\\_matrix](http://www.hp.com/support/linux_hardware_matrix)

**NOTE:** Your product does not support Windows 8 or Windows 7. In accordance with Microsoft's support policy, HP does not support the Windows<sup>®</sup> 8 or Windows 7 operating system on products configured with Intel<sup>®</sup> and AMD<sup>®</sup> 7th generation and forward processors or provide any Windows<sup>®</sup> 8 or Windows 7 drivers on <http://www.support.hp.com>. A full list of HP products and the Windows 10 versions tested is available on the HP support website. <https://support.hp.com/us-en/document/c05195282>

### Supported Components

#### HP BIOS

Key features of the HP BIOS include:

- Deployment and manageability – HP BIOS provides several technologies that help integrate the HP Z2 G9 SFF Workstation Desktop PC into the enterprise, such as PXE, remote recovery, remote configuration, remote control, and BIOS (F10) Setup support for 15 languages.
- Network firmware updates – Update your BIOS via the cloud or standardize on a BIOS version hosted on an Enterprise network.
- Stability – HP BIOS supports the HP stable product roadmap by releasing only critical BIOS changes to the factory and advanced change notification.
- Class 3 UEFI specification version 2.7
- Absolute Persistence agent – For tracking and tracing services, available in select countries, separate software and purchase of a subscription is required.
- Thermal and power management – The HP BIOS provides and enables thermal and power management technologies so component temperatures are managed for high reliability and to assist in operating the HP Workstation computer in any enterprise environment.
- Acoustic performance – Industry leading acoustic emissions across the range of operating conditions.
- Serviceability – HP BIOS provides diagnostic and detailed service information.
- Upgrades and recovery – HP BIOS provides numerous ways to upgrade HP Workstation computers, including BIOS updates from within Windows (HP Firmware Update and Recovery), Capsule update, HP Client Manager, and fail-safe recovery. In addition, the HP BIOS Configuration Utility enables replication of BIOS settings within Windows while the Replicated Setup feature provides the same capability within BIOS (F10) Setup. The BIOS Configuration Utility is available from the HP support website.
- HP BIOS uses PKI signing of the BIOS for trusted BIOS upgrades and recovery.

Additional HP BIOS Features:

- Power-On password – Helps prevent an unauthorized user from powering on the system.
- Administrator password – Also known as the BIOS Setup password, this helps prevent unauthorized changes to the system configuration. If the administrator password is not known, the BIOS cannot be updated and changes cannot be made to BIOS settings using BIOS Setup or under the OS.
- S4/S5 Maximum Power Savings setting supports EU Lot6 requirement and allows the computer to power down below 0.5W in S4/S5 (when turned off). When S4/S5 Maximum Power Savings feature is enabled below features are turned off:
  - Power to expansion connectors / slots
  - Most Wake events other than power buttons and WOL (Wake on LAN supported by embedded Lan controller under S4/S5 Maximum Power Saving Enabled)
  - USB charging ports

HP Sure Start Gen7

- BIOS Integrity checking – Sure Start protection ensures that only trusted BIOS code is executed and not rootkits, viruses and malware. Verification is done upon boot up, shutdown and while the system is on.
- Sure Start is set by default to automatically repair the BIOS if corrupted or compromised but is policy driven for better manageability. Start is set by default to automatically repair the BIOS if corrupted or compromised but is policy driven for better manageability.
- Protecting beyond BIOS – Integrity checking and repair is extended to other data that should be protected such as network configuration parameters, platform specific information (i.e. system IDs), secure boot credentials, and other code the system needs to boot.

### Supported Components

- Audit enabled – System Audit via Sure Start Event Logs capture data such as incident, repair date and time for troubleshooting and investigating.

**NOTE:** HP Sure Start Gen7 is available on HP Workstation products equipped with Intel® 12th generation processors.

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## SOFTWARE COMPONENTS AND APPLICATIONS WITH WINDOWS

### Software

HP Support Assistant <sup>14</sup>  
HP Image Assistant  
HP Desktop Support Utility  
HP Documentation  
HP Notifications  
HP PC Hardware Diagnostics UEFI  
HP PC Hardware Diagnostics Windows  
HP Performance Advisor<sup>1</sup>  
myHP  
HP Easy Clean<sup>20</sup>  
WSL/Ubuntu Data Science Stack  
HP Privacy Settings  
Touchpoint Customizer for Commercial

### Manageability Features

HP Driver Packs<sup>2</sup>  
HP UWP Pack  
HP System Software Manager (SSM)  
HP Manageability Integration Kit Gen4<sup>3</sup>  
HP Smart Support<sup>5</sup>  
HP Client Catalog (download)  
HP Image Assistant (download)  
HP Cloud Recovery  
HP Client Management Script Library (download)  
HP BIOSphere Gen6 <sup>13</sup>

### Client Security Software

HP Client Security Suite Gen7<sup>4</sup> including: (including Credential Manager, HP Password Manager<sup>6</sup>, HP Spare Key)  
HP Power On Authentication  
Microsoft Defender<sup>7</sup>

### Security Management

HP Secure Erase <sup>16</sup>  
HP Wolf Pro Security Edition (optional) <sup>18</sup>  
HP Wolf Security for Business<sup>22</sup> Includes:  
HP Sure Click<sup>11</sup>  
HP Sure Sense<sup>12</sup>  
HP Sure Run Gen5<sup>9</sup>  
HP Sure Recover Gen4 <sup>10</sup>  
HP Sure Start Gen7<sup>8</sup>  
HP Tamper Lock  
HP Sure Admin <sup>17</sup>  
HP Client Security Manager Gen 7<sup>4</sup>



### Supported Components

- <sup>1</sup> HP Performance Advisor Software - HP Performance Advisor is ready to help you get the most out of your HP Workstation from day one—and every day after. Learn more or download at: <http://hp.com/PerformanceAdvisor>
- <sup>2</sup> HP Driver Packs not preinstalled, however available for download at <http://www.hp.com/go/clientmanagement>.
- <sup>3</sup> HP Manageability Integration Kit can be downloaded from <http://www8.hp.com/us/en/ads/clientmanagement/overview.html>
- <sup>4</sup> HP Client Security Manager Gen7 requires Windows and is available on the select HP PCs.
- <sup>5</sup> HP Smart Support automatically collects the telemetry necessary upon initial boot of the product to deliver device-level configuration data and health insights and is available preinstalled on select products, thru HP Factory Configuration Services; or it can be downloaded. For more information about how to enable HP Smart Support or for download, please visit <http://www.hp.com/smart-support>.
- <sup>6</sup> HP Password Manager requires Internet Explorer or Chrome or FireFox. Some websites and applications may not be supported. User may need to enable or allow the add-on / extension in the internet browser.
- <sup>7</sup> Microsoft Defender Opt in and internet connection required for updates.
- <sup>8</sup> HP Sure Start Gen 7 is available on select HP PCs and workstations. See product specifications for availability.
- <sup>9</sup> HP Sure Run Gen5 is available on select Windows 11 based HP Pro, Elite and Workstation PCs with select Intel® or AMD processors
- <sup>10</sup> HP Sure Recover Gen4 is available on select HP PCs and requires Windows 10 and an open network connection. You must back up important files, data, photos, videos, etc. before using HP Sure Recover to avoid loss of data. Network based recovery using Wi-Fi is only available on PCs with Intel Wi-Fi Module
- <sup>11</sup> HP Sure Click requires Windows 10 Pro or higher or Enterprise. See [https://bit.ly/2PrLT6A\\_SureClick](https://bit.ly/2PrLT6A_SureClick) for complete details.
- <sup>12</sup> HP Sure Sense requires Windows 11 Pro or Enterprise and supports Microsoft Internet Explorer, Google Chrome™, and Chromium™. Supported attachments include Microsoft Office (Word, Excel, PowerPoint) and PDF files in read only mode, when Microsoft Office or Adobe Acrobat are installed.
- <sup>13</sup> HP BIOSphere Gen6 features may vary depending on the platform and configurations.
- <sup>14</sup> HP Support Assistant requires Windows and Internet access.
- <sup>16</sup> Secure Erase - For the methods outlined in the National Institute of Standards and Technology Special Publication 800-88 "Clear" sanitation method. HP Secure Erase does not support platforms with Intel® Optane.
- <sup>17</sup> HP Sure Admin requires Windows 11, HP BIOS, HP Manageability Integration Kit from <http://www.hp.com/go/clientmanagement> and HP Sure Admin Local Access Authenticator smartphone app from the Android or Apple store.
- <sup>18</sup> HP Wolf Pro Security Edition is available preloaded on select SKUs and, depending on the HP product purchased, includes a paid 1-year or 3-year license. The HP Wolf Pro Security Edition software is licensed under the license terms of the HP Wolf Security Software - End-User license Agreement (EULA) that can be found at: [https://support.hp.com/us-en/document/ish\\_3875769-3873014-16](https://support.hp.com/us-en/document/ish_3875769-3873014-16) as that EULA is modified by the following: "7. Term. Unless otherwise terminated earlier pursuant to the terms contained in this EULA, the license for the HP Wolf Pro Security Edition (HP Sure Sense Pro and HP Sure Click Pro) is effective upon activation and will continue for either a twelve (12) month or thirty-six (36) month license term ("Initial Term"). At the end of the Initial Term you may either (a) purchase a renewal license for the HP Wolf Pro Security Edition from HP.com, HP Sales or an HP Channel Partner, or (b) continue using the standard versions of HP Sure Click and HP Sure Sense at no additional cost with no future software updates or HP Support.
- <sup>20</sup> HP Easy Clean requires Windows 10 RS3 and higher and will disable the keyboard, touchscreen, and clickpad only. Ports are not disabled. See user guide for cleaning instructions.
- <sup>22</sup> HP Wolf Security for Business requires Windows 10 or higher, includes various HP security features and is available on HP Pro, Elite, RPOS and Workstation products. See product details for included security features

### System Technical Specifications

#### System Board

**System Board Form Factor** Customized PCB 231.04 x 301.24 mm (9.213X11.86inches)

**Processor Socket** Single LGA-1700

**CPU Bus Speed** DMI

**Chipset** Intel® PCH W680

**Super I/O Controller** Nuvoton SIO21

**Memory Expansion Slots** 4 DDR5 memory slots

**Memory Type Supported** DDR5, UDIMM (Unbuffered), ECC& non-ECC

**Memory Modes** Non-Interleaved for single channel. Interleaved when both channels are populated.

**Memory Speed Supported** 3600MT/s to 4400MT/s DDR5, dependent on memory configuration<sup>1</sup>

<sup>1</sup>Though the memory modules can run up to 4800MHz, the current platform will only be able to support the maximum memory speed of 4400MHz.

The system speed will be determined by a number of key factors:

Module Configuration	Description of configuration	Max Memory Speed (Actual Memory speed is dependent on CPU)
Single 8, 16 or 32GB DIMM per channel	Configurations that contain only one or two DIMM modules with DIMMs only in the black slots	4400MHz
Two 8 or 16GB DIMMs in a channel	Configurations with 3 or 4 DIMMs installed in a system. Memory DIMMs must all be of the same size.	4000MHz
Two 32GB DIMMs in a channel	Configurations with 3 or 4 32GB DIMMs installed in a system	3600MHz

**Memory Protection** ECC available on data

**Maximum Memory** 128GB

**Memory Configuration (Supported)** 8GB, 16GB and 32GB non-ECC, 16GB and 32GB ECC unbuffered DIMMs are supported. ECC and non-ECC memory DIMMs cannot be mixed in the same system

**NOTE:** Maximum memory capacities assume 64-bit operating systems, such as Genuine Windows® 11 Professional 64 bit, Red Hat Linux 64-bit. 32-bit Windows Operating Systems support up to 4 GB.

#### PCI Express Connectors

Standard Base Unit with Half Height PCIe	Full Height Graphics PCIe Base Unit
Slot 1: PCIe Gen4 x16 Slot 2: PCIe Gen3 x4 Slot 3: PCIe Gen3 x4 - with x16 Connector Slot 4: PCIe Gen3 x1	Slot 1: PCIe Gen4 x16 <sup>1</sup> Slot 2: PCIe Gen4 x8 (with x16 connector) <sup>1</sup>  <sup>1</sup> When slot 2 is configured with a PCIe card, slot 1 will automatically downgrade to PCIe x8 electrical

### System Technical Specifications

- (1) M.2 2280 Storage (PCIe Gen4 x4)
- (1) M.2 2280 Storage (PCIe Gen4 x4)
- (1) M.2 2280 Storage (PCIe Gen4 x4)
- (1) M.2 2230 WLAN (PCIe Gen3 x1+ Intel CNVi)

**NOTE:** The PCIe Gen 4 x16 slot is meant for HP qualified cards, configured or after market. HP does not provide warranty support for 3rd party cards.

<b>Supported Interfaces</b>	<b>SATA</b>	Integrated (4) Serial ATA interfaces (6Gb/s SATA).
	<b>Serial Attached SCSI</b>	None
	<b>Integrated Graphics</b>	Intel® UHD Graphics 730 (on Core i5-12400/i3-12300/i3-12100 processors); Intel® UHD Graphics 770 (on Core i5/i7/i9 processors); Based on Unified Memory Architecture (UMA) - a region of system memory is reserved and dedicated to the graphics display. Support for Microsoft DirectX 12, OpenGL 4.6 and OpenCL 3.0 on Intel® UHD Graphics 730/770; Based on Unified Memory Architecture (UMA) - a region of system memory is reserved and dedicated to the graphics display.
		2 DP 1.4 graphics ports integrated in motherboard; Supports up to three simultaneous displays across DisplayPort*/HDMI*/DVI outputs. Max. resolution supported on onboard DP 1.4/HBR2 ports: 4096x2304 @ 60Hz, 24bpp Max. resolution supported on FlexIO DP 1.4/HBR3 port: 5120x3200 @60Hz, 24bpp
	<b>Network Controller</b>	Integrated Ethernet PHY Connection I219LM. Management capabilities: WOL, PXE 2.1 and AMT 16
	<b>External SATA (eSATA)</b>	None
	<b>IDE connector</b>	None
	<b>Floppy connector</b>	None
	<b>Serial</b>	1 internal header (requires optional Serial Port and PS/2 Combo Kit with PCIe bracket)
	<b>2nd Serial</b>	1 internal header (requires optional Serial Port Adapter Kit)
<b>Connector(s)</b>	<b>Front</b>	2 Type-A SuperSpeed USB 10Gbps signaling rate port (charge supports up to 5V/2.1A); 2 Type-A SuperSpeed USB 10Gbps signaling rate port; 1 Type-C® SuperSpeed USB 20Gbps signaling rate port (charge supports up to 5V/3A)
	<b>Rear</b>	3 High-speed USB 480Mbps signaling rate port; 3 Type-A SuperSpeed USB 5Gbps signaling rate port; Flex I/O option: 1 SuperSpeed USB Type-C® 10Gbps signaling rate (Power Delivery 15W, Alt Mode DisplayPort); 1 Dual SuperSpeed USB Type-A 5Gbps signaling rate
	<b>Internal</b>	1 High-speed USB 480Mbps signaling rate header for SD Card Reader
<b>HD Integrated Audio</b>	Realtek ALC3252	
<b>Flash ROM</b>	Yes	
<b>CPU Fan Header</b>	Yes	
<b>Memory Fan Header</b>	None	
<b>Chassis Fan Header</b>	1 Rear System Chassis Fan Header, 1 Graphic chassis Fan Header.	
<b>Front PCI Fan Header</b>	None	

### System Technical Specifications

<b>Front Control Panel/Speaker Header</b>	Yes
<b>CMOS Battery Holder - Lithium</b>	Yes
<b>Integrated Trusted Platform Module</b>	Integrated TPM 2.0 (Infineon SLB9672) Convertible to FIPS 140-2 Certified mode through firmware v15.21
<b>Power Supply Headers</b>	Yes
<b>Power Switch, Power LED &amp; Hard Drive LED Header</b>	Yes

<b>Clear Password Jumper</b>	None
<b>Keyboard/Mouse</b>	USB or PS/2 Mouse (option)
<b>Power Supply</b>	260W EPA92, 450W EPA90 and 550W EPA92

<sup>1</sup>Maximum memory capacities assume 64-bit operating systems, such as Genuine Windows® 10 Professional 64 bit, Red Hat Linux 64-bit. 32-bit Windows Operating Systems support up to 4 GB.

<sup>2</sup>M.2 storage supports compatible devices up to 80mm

### PROCESSORS

Name	Ghz P-Core Base Frequency	Ghz E-Core Base Frequency	Up to x P-Core Max Turbo Freq	Up to x GHz E-Core Max Turbo Frequency	L3 Cache (MB)	P-Cores	E-Cores	Total Cores	Processor Threads	Memory Speed (MT/s) (DDR5) <sup>4</sup>	ECC Supported <sup>5</sup>	Integrated Graphics	Featuring Intel® vPro® Technology <sup>3</sup>	TDP (W)	Max Turbo Frequency (GHz) <sup>2</sup>
<b>Intel 13<sup>th</sup> Generation Processors</b>															
Intel® Core™ i9-13900K	3	2.20	5.4	4.3	36	8	16	24	32	5600	Y	Intel® UHD Graphics 770	Y	125	5.8
Intel® Core™ i9-13900	2	1.50	5.2	4.2	36	8	16	24	32	5600	Y	Intel® UHD Graphics 770	Y	65	5.6
Intel® Core™ i7-13700K	3.4	2.50	5.3	4.2	30	8	8	16	24	5600	Y	Intel® UHD Graphics 770	Y	125	5.8
Intel® Core™ i7-13700	2.1	1.50	5.1	4.10	30	8	8	16	24	5600	Y	Intel® UHD Graphics 770	Y	65	5.2
Intel® Core™ i5-13600K	3.5	2.60	5.1	3.9	24	6	8	14	20	5600	Y	Intel® UHD Graphics 770	Y	65	5.1
Intel® Core™ i5-13600	2.7	2.00	5.0	3.7	24	6	8	14	20	4800	Y	Intel® UHD Graphics 770	Y	65	5.0
Intel® Core™ i5-13500	2.5	1.80	4.8	3.5	24	6	8	14	20	4800	Y	Intel® UHD Graphics 770	Y	65	4.8
Intel® Core™ i5-13400	2.5	1.80	4.6	3.3	20	6	4	10	16	4800	N	Intel® UHD Graphics 730	N/A	65	4.6
<b>Intel 12<sup>th</sup> Generation Processors</b>															
Intel® Core™ i9-12900K	3.2	2.4	5.1	3.9	30	8	8	16	24	4800	Y	Intel® UHD Graphics 770	Y	125	5.2
Intel® Core™ i9-12900	5	1.8	5.0	3.8	30	8	8	16	24	4800	Y	Intel® UHD Graphics 770	Y	65	5.1
Intel® Core™ i7-12700K	3.6	2.7	4.9	3.8	25	8	4	12	20	4800	Y	Intel® UHD Graphics 770	Y	125	5.0

### System Technical Specifications

Intel® Core™ i7-12700	2.1	1.6	4.8	3.6	25	8	4	12	20	4800	Y	Intel® UHD Graphics 770	Y	65	4.9
Intel® Core™ i5-12600K	3.7	2.8	4.9	3.6	20	6	4	10	16	4800	Y	Intel® UHD Graphics 770	Y	125	4.9
Intel® Core™ i5-12600	3.3	N/A	4.8	N/A	18	6	0	6	12	4800	Y	Intel® UHD Graphics 770	Y	65	4.8
Intel® Core™ i5-12500	3	N/A	4.6	N/A	18	6	0	6	12	4800	Y	Intel® UHD Graphics 770	Y	65	4.6
Intel® Core™ i5-12400	2.5	N/A	4.4	N/A	18	6	0	6	12	4800	N	Intel® UHD Graphics 730	N/A	65	4.4
Intel® Core™ i3-12300	3.5	N/A	4.4	N/A	12	4	0	4	8	4800	N	Intel® UHD Graphics 730	N/A	60	4.4
Intel® Core™ i3-12100	3.3	N/A	4.3	N/A	12	4	0	4	8	4800	N	Intel® UHD Graphics 730	N/A	60	4.3

<sup>1</sup> Multicore 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, branding and/or naming is not a measurement of higher performance.

<sup>2</sup> Intel Turbo Boost performance varies depending on hardware, software and overall system configuration. See <http://www.intel.com/technology/turboboost> for more information.

<sup>3</sup> Intel vPro® requires Windows 10 Pro 64 bit or higher, a vPro supported processor, vPro enabled chipset, vPro enabled wired LAN and/or Wi-Fi 6E WLAN and TPM 2.0. Some functionality requires additional 3rd party software in order to run. Features of vPro® Essentials and Enterprise vary. See <http://intel.com/vpro>

<sup>4</sup> Memory will run at 4400 speed (MT/s) if there is one DIMM per channel. 2 DIMMS per channel will run 4000 speed (MT/s). DIMMs must be the same, either 8GB or 16GB DIMMs. 32GB DIMMs run at 3200 MT/s.

<sup>5</sup> Error Correction Memory

### System Configurations

<b>HP Z2 G9 SFF Workstation Desktop PC Configuration #1</b>	<b>Processor Info</b>	Core i5-12500,6C 3.0G 65W
	<b>Memory Info</b>	2 x 8G DDR5 4800 UDIMM NECC
	<b>Graphics Info</b>	NVIDIA T400 4GB
	<b>Disks/Optical/Floppy</b>	512GB SSD Z Turbo
	<b>PSU</b>	260W
	<b>Other</b>	NA

Energy Consumption (Watts)	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	16.907		16.195		16.452	
Windows short Idle (S0)	17.323		17.742		17.245	
Windows Busy Typ(S0)	165.717		168.913		164.628	
Windows Busy Max (S0)	187.903		183.393		186.965	
Sleep (S3)	1.001	0.991	1.033	1.001	0.991	1.033
Off (S5)	0.657	0.631	0.672	0.657	0.631	0.672
Zero Power Mode (ErP)	0.229		0.237		0.224	

### Heat Dissipation

	115 VAC	230 VAC	100 VAC

### System Technical Specifications

(Btu/hr)

	LAN Enabled	LAN Disabled	LAN Enabled	LAN Enabled	LAN Enabled	LAN Enabled
Windows long Idle (S0)	57.687		55.257		56.134	
Windows short Idle (S0)	59.106		60.536		58.84	
Windows Busy Typ(S0)	565.426		576.331		561.711	
Windows Busy Max (S0)	641.125		625.737		637.925	
Sleep (S3)	3.415	3.381	3.525	3.415	3.381	3.525
Off (S5)	2.242	2.153	2.293	2.242	2.153	2.293
Zero Power Mode (ErP)	0.781		0.809		0.764	

HP Z2 G9 SFF Workstation  
Desktop PC Configuration  
#2

<b>Processor Info</b>	Core i7-12700,12C 2.1G 65W
<b>Memory Info</b>	2 x 8G DDR5 4800 UDIMM NECC
<b>Graphics Info</b>	NVIDIA T1000 8GB
<b>Disks/Optical/Floppy</b>	512GB SSD Z Turbo
<b>PSU</b>	450W
<b>Other</b>	NA

Energy Consumption  
(Watts)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	19.136		19.335		19.211	
Windows short Idle (S0)	20.404		21.197		20.32	
Windows Busy Typ(S0)	245.533		239.257		242.62	
Windows Busy Max (S0)	268.903		247.683		266.482	
Sleep (S3)	1.132	1.101	1.211	1.132	1.101	1.211
Off (S5)	0.735	0.722	0.744	0.735	0.722	0.744
Zero Power Mode (ErP)	0.265		0.268		0.252	

Heat Dissipation  
(Btu/hr)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Enabled	LAN Enabled	LAN Enabled
Windows long Idle (S0)	65.292		65.971		65.548	
Windows short Idle (S0)	69.618		72.324		69.332	
Windows Busy Typ(S0)	837.759		816.345		827.819	
Windows Busy Max (S0)	917.497		845.094		909.237	
Sleep (S3)	3.862	3.757	4.132	3.862	3.757	4.132
Off (S5)	2.508	2.463	2.539	2.508	2.463	2.539
Zero Power Mode (ErP)	0.904		0.914		0.86	

HP Z2 G9 SFF Workstation  
Desktop PC Configuration  
#3

<b>Processor Info</b>	Core i7-12700K,12C 3.6G 125W
<b>Memory Info</b>	2 x 16G DDR5 4800 UDIMM ECC
<b>Graphics Info</b>	NVIDIA RTX A2000
<b>Disks/Optical/Floppy</b>	512GB SSD Z Turbo
<b>PSU</b>	450W
<b>Other</b>	NA

Energy Consumption  
(Watts)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	21.043		20.428		20.228	
Windows short Idle (S0)	23.125		22.638		22.444	
Windows Busy Typ(S0)	258.063		253.127		256.521	
Windows Busy Max (S0)	274.25		263.977		268.45	

### System Technical Specifications

Sleep (S3)	1.302	1.221	1.411	1.302	1.221	1.411
Off (S5)	0.705	0.691	0.725	0.705	0.691	0.725
Zero Power Mode (ErP)	0.238		0.242		0.239	

#### Heat Dissipation (Btu/hr)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	71.799		69.700		69.018	
Windows short Idle (S0)	78.903		77.241		76.579	
Windows Busy Typ(S0)	880.511		863.669		875.25	
Windows Busy Max (S0)	935.741		900.69		915.951	
Sleep (S3)	4.442	4.166	4.814	4.442	4.166	4.814
Off (S5)	2.405	2.358	2.474	2.405	2.358	2.474
Zero Power Mode (ErP)	0.812		0.826		0.815	

#### HP Z2 G9 SFF Workstation Desktop PC Configuration #4

<b>Processor Info</b>	Core i7-12700K, 12C 3.6G 125W
<b>Memory Info</b>	4 x 16G DDR5 4800 UDIMM NECC
<b>Graphics Info</b>	NVIDIA RTX A2000
<b>Disks/Optical/Floppy</b>	1T SSD Z Turbo
<b>PSU</b>	550W
<b>Other</b>	NA

#### Energy Consumption (Watts)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	16.118		16.525		16.022	
Windows short Idle (S0)	17.591		17.935		17.485	
Windows Busy Typ(S0)	166.23		166.157		165.652	
Windows Busy Max (S0)	215.6		214.207		213.633	
Sleep (S3)	1.023	0.968	1.215	1.023	0.968	1.215
Off (S5)	0.654	0.642	0.678	0.654	0.642	0.678
Zero Power Mode (ErP)	0.248		0.252		0.248	

#### Heat Dissipation (Btu/hr)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	54.995		56.383		54.667	
Windows short Idle (S0)	60.020		61.194		59.659	
Windows Busy Typ(S0)	567.177		566.928		565.205	
Windows Busy Max (S0)	735.627		730.874		728.916	
Sleep (S3)	3.491	3.303	4.146	3.491	3.303	4.146
Off (S5)	2.231	2.191	2.313	2.231	2.191	2.313
Zero Power Mode (ErP)	0.846		0.86		0.846	

#### HP Z2 G9 SFF Workstation Desktop PC Configuration #5

<b>Processor Info</b>	Core i9-12900K, 16C 3.2G 125W
<b>Memory Info</b>	4 x 32G DDR5 4800 UDIMM ECC
<b>Graphics Info</b>	NVIDIA RTX A4000
<b>Disks/Optical/Floppy</b>	1T SSD Z Turbo
<b>PSU</b>	550W
<b>Other</b>	NA

#### Energy Consumption (Watts)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled

### System Technical Specifications

Windows long Idle (S0)	32.725		32.709		32.711	
Windows short Idle (S0)	33.525		35.083		33.432	
Windows Busy Typ(S0)	392.633		392.11		390.621	
Windows Busy Max (S0)	419.361		406.324		414.845	
Sleep (S3)	1.929	1.862	2.142	1.929	1.862	2.142
Off (S5)	0.776	0.749	0.825	0.776	0.749	0.825
Zero Power Mode (ErP)	0.213		0.219		0.208	

### Heat Dissipation (Btu/hr)

	115 VAC		230 VAC		100 VAC	
	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled	LAN Enabled	LAN Disabled
Windows long Idle (S0)	111.658		111.603		111.61	
Windows short Idle (S0)	114.387		119.703		114.07	
Windows Busy Typ(S0)	1339.664		1337.879		1332.799	
Windows Busy Max (S0)	1430.86		1386.377		1415.451	
Sleep (S3)	6.582	6.353	7.309	6.582	6.353	7.309
Off (S5)	2.648	2.556	2.815	2.648	2.556	2.815
Zero Power Mode (ErP)	0.727		0.747		0.71	

**NOTE:** The Power Supply Efficiency report may be found at the following links:  
<https://www.plugloadsolutions.com/80PlusPowerSuppliesDetail.aspx?id=0&type=2>

### Declared Noise Emissions

<b>System Configuration</b> (Entry level, Lowprofile)	<b>Processor Info</b>	Intel® CPU Core i5-12400 6C LGA 2.50G 18 MB 65W (Intel - Alder Lake-S)	
	<b>Memory Info</b>	1* 32GB 4800 SK hynix memory	
	<b>Graphics Info</b>	Intel® UHD	
	<b>Disks/Optical/Floppy</b>	1*2TB Samsung M.2	
	<b>Power Supply</b>	LITE-ON 450W	

<b>Declared Noise Emissions</b> (in accordance with ISO 7779 and ISO 9296)		<b>Sound Power</b> (LWAd, bels)	<b>Deskside Sound Pressure</b> (LpAm, decibels)
	<b>Idle</b>	3.1	15.2
	<b>Hard drive Operating</b> (Drive Random Seek)	3.4	23.9
	<b>Hard drive Operating</b> (Active mode)	3.05	14.8

<b>System Configuration</b> (Mid-level, Lowprofile)	<b>Processor Info</b>	Intel® CPU Core i9-12900 16C LGA 2.40G 30 MB 65W ECC (Intel - Alder Lake-S)	
	<b>Memory Info</b>	4* 32GB 4800 SK hynix memory	
	<b>Graphics Info</b>	NVIDIA® T1000	
	<b>Disks/Optical/Floppy</b>	2*WD 2TB 7200RPM SATA HDD; 3*2TB Samsung M.2	
	<b>Power Supply</b>	LITE-ON 450W	

<b>Declared Noise Emissions</b> (in accordance with ISO 7779 and ISO 9296)		<b>Sound Power</b> (LWAd, bels)	<b>Deskside Sound Pressure</b> (LpAm, decibels)
	<b>Idle</b>	3.35	23.4
	<b>Hard drive Operating</b> (Drive Random Seek)	3.48	24.9



### System Technical Specifications

	<b>Hard drive Operating (Active mode)</b>	4.34	30.5
<b>System Configuration (High-end, Lowprofile)</b>	<b>Processor Info</b>	Intel® Core i9-12900K 16C 3.20G LGA 30 MB 125W ECC (Intel - Alder Lake-S)	
	<b>Memory Info</b>	4* 32GB 4800 SK hynix memory	
	<b>Graphics Info</b>	NVIDIA® T1000	
	<b>Disks/Optical/Floppy</b>	2*WD 2TB 7200RPM SATA HDD; 3*2TB Samsung M.2	
	<b>Power Supply</b>	LITE-ON 450W	
<b>Declared Noise Emissions</b> (in accordance with ISO 7779 and ISO 9296)		<b>Sound Power (LWAd, bels)</b>	<b>Deskside Sound Pressure (LpAm, decibels)</b>
	<b>Idle</b>	3.37	23.1
	<b>Hard drive Operating (Drive Random Seek)</b>	3.45	24.7
	<b>Hard drive Operating (Active mode)</b>	4.35	33.0
<b>System Configuration (Entry level, Riser)</b>	<b>Processor Info</b>	Intel® Core i5-12400 6C LGA 2.50G 18 MB 65W (Intel - Alder Lake-S)	
	<b>Memory Info</b>	1* 32GB 4800 SK hynix memory	
	<b>Graphics Info</b>	Intel® UHD	
	<b>Disks/Optical/Floppy</b>	1*2TB Samsung M.2	
	<b>Power Supply</b>	Liteon 550W EPA92	
<b>Declared Noise Emissions</b> (in accordance with ISO 7779 and ISO 9296)		<b>Sound Power (LWAd, bels)</b>	<b>Deskside Sound Pressure (LpAm, decibels)</b>
	<b>Idle</b>	3.01	12.0
	<b>Hard drive Operating (Drive Random Seek)</b>	3.37	23.1
	<b>Hard drive Operating (Active mode)</b>	3.09	15.5

### Environmental Requirements

<b>Temperature</b>	Operating: 5° to 35° C (40° to 95° F) Non-operating: -40° to 60° C (-40° to 140° F) Maximum rate of change: 10°C/hr
<b>Humidity</b>	Operating: 10% to 85% RH, non-condensing, 35° C maximum wet bulb Non-operating: 10% to 90% RH, non-condensing, 35° C maximum wet bulb
<b>Maximum Altitude</b>	Operating (with Rotational Hard Drives): 3,048 m (10,000 feet) Operating (with only Solid-State Drives): 5,000 m (16,404 feet) Non-operating: 12,192 m (40,000 feet) Maximum operating temperature is reduced as altitude increases. See Cooling for details.
<b>Dynamic</b>	Shock Operating: ½-sine: 40g, 2-3ms (~62 cm/sec) Non-operating: ½-sine: 160 cm/s, 2-3ms (~105g) square: 422 cm/s, 20g  Vibration Operating random: 0.5g (rms), 5-300 Hz, up to 0.0025g <sup>2</sup> /Hz Non-operating random: 2.0g (rms), 5-500 Hz, up to 0.0150 g <sup>2</sup> /Hz

### System Technical Specifications

**Cooling**

Above 1524 m (5,000 feet) altitude, the maximum operating temperature is reduced by 1° C (1.8° F) for every 305 m (1,000 feet) increase in elevation, up to 3048 m (10,000 feet)

**NOTE:**

System enduring or operating beyond the environmental requirement range is not recommended and may compromise system reliability permanently.

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### System Technical Specifications

#### Physical Security and Serviceability

<b>Access Panel</b>	Tool-less Includes support information
<b>Optical Drive</b>	Tool-less, except for Screw-In carrier
<b>Hard Drives</b>	Tool-less, except for internal/external bay
<b>Expansion Cards</b>	Tool-less
<b>Processor Socket</b>	Tool-less, except for the processor heatsink
<b>Blue User Touch Points</b>	Yes, on tool-less internal chassis mechanisms
<b>Color-coordinated Cables and Connectors</b>	Yes
<b>Memory</b>	Tool-less
<b>System Board</b>	Screw-In
<b>Padlock Support</b>	Yes (optional): Locks side cover and secures chassis from theft 0.22-in diameter padlock loop at rear of system
<b>Cable Lock Support</b>	Yes, Kensington Cable Lock (optional): Locks side cover and secures chassis from theft 3 mm x 7 mm slot at rear of system
<b>Universal Chassis Clamp Lock Support</b>	Yes (optional): Locks side cover and locks cables to chassis. Secures chassis from theft and allows multiple units to be chained together when used with optional cable Threaded feature at rear of system
<b>Solenoid Lock and Hood Sensor</b>	Yes (optional) The Solenoid Hood Lock eliminates the need for a physical key by making the chassis lockable through software and a password. You can also lock and unlock the chassis remotely over the network. The Sensor Kit detects when the access panel has been removed.
<b>Keyboard/Mouse/Video Cable Lock</b>	No
<b>CPUs and Heatsinks</b>	A T-15 Torx or flat blade screwdriver is needed to remove the CPU heatsink before the CPU can be removed. CPU removal is tool-less
<b>Internal Speaker</b>	Yes
<b>Power Supply Fans</b>	70mm x 70mm x 25mm 4-wire PWM (non-serviceable)
<b>Access Panel Key Lock</b>	No
<b>Integrated Chassis Handles</b>	No
<b>Power Supply</b>	Requires T15 Torx or flat blade screwdriver
<b>PCI Card Retention</b>	Yes, rear (all), middle (optional), front (none)

### System Technical Specifications

#### Service, Support, and Warranty

On-site Warranty and Service<sup>1</sup>: Three-years, limited warranty and service offering delivers on-site, next business-day<sup>2</sup> service for parts and labor and includes free telephone support<sup>3</sup> 8am - 5pm. Global coverage<sup>2</sup> ensures that any product purchased in one country and transferred to another, non-restricted country will remain fully covered under the original warranty and service offering. 24/7 operation will not void the HP warranty. Storage devices are not covered under warranty for 24/7 operation except for Enterprise class HDDs.

**NOTE 1:** Terms and conditions may vary by country. Certain restrictions and exclusions apply.

**NOTE 2:** On-site service may be provided pursuant to a service contract between HP and an authorized HP third-party provider, and is not available in certain countries. Global service response times are based on commercially reasonable best effort and may vary by country.

**NOTE 3:** Technical telephone support applies only to HP-configured, HP and HP-qualified, third-party hardware and software.

Toll-free calling and 24x7 support service may not be available in some countries.

HP Care Pack Services extend service contracts beyond the standard warranties. Service starts from date of hardware purchase.

To choose the right level of service for your HP product, use the HP Care Pack Services Lookup Tool at:

<http://www.hp.com/go/lookuptool>. Service levels and response times for HP Care Packs may vary depending on your geographic location.

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#### Certification and Compliance

Environmental Sustainability questions concerning:

- Ecolabels (EPEAT, TCO, etc.)
- ENERGY STAR, California Energy Commission (CEC)
- Compliance with Environmental legislation (EU ErP, China CECP, EU RoHS and other countries)
- Supply Chain Social Environmental Responsibility (SER) (conflict minerals; human rights, etc.)
- Product specific environmental features (material content, packaging content, recycled content, etc.)
- China Energy Label (CEL)
- 

Please contact [sustainability@hp.com](mailto:sustainability@hp.com)

For country specific Regulatory Compliance approval documents or Regulatory and Safety questions concerning:

- Declarations of Conformity (for self-service, go to [https://www.hp.com/uk-en/certifications/technical/regulations-certificates.html?jumpid=ex\\_r135\\_uk/en/any/corp/hpuk-mu\\_chev/certificates](https://www.hp.com/uk-en/certifications/technical/regulations-certificates.html?jumpid=ex_r135_uk/en/any/corp/hpuk-mu_chev/certificates))
- GS Certificates
- Product Safety Certificates (UL, CB, BIS, etc.)
- EMC Certificates, Declarations of Conformity, or Certificates of Conformity (CE, FCC, ICES, etc.)
- CCC Certificates
- Ergonomics
- 

Please contact [techregshelp@hp.com](mailto:techregshelp@hp.com)

### System Technical Specifications

#### BIOS

<b>BIOS 64-bit Services</b>	BIOS supports 64-bit Operating systems only.
<b>PCI 3.0 Support</b>	Full BIOS support for PCI Express through industry standard interfaces.
<b>ATAPI</b>	ATAPI Removable Media Device BIOS Specification Version 1.0.
<b>BBS</b>	BIOS Boot Specification v1.01.(Not Support)
<b>WMI Support</b>	WMI is Microsoft's implementation of Web-Based Enterprise Management (WBEM) for Windows. WMI is fully compliant with the Distributed Management Task Force (DMTF) Common Information Model (CIM) and WBEM specifications.
<b>BIOS Boot Spec 1.01+</b>	Provides more control over how and from what devices the workstation will boot.
<b>BIOS Power On</b>	Users can define a specific date and time for the system to power on.
<b>ROM Based Computer Setup Utility (F10)</b>	Review and customize system configuration settings controlled by the BIOS.
<b>System/Emergency ROM Flash Recovery with Video</b>	Recovers system BIOS in corrupted Flash ROM.
<b>Replicated Setup</b>	Saves BIOS settings to USB flash device in human readable file (HpSetup.txt). BiosConfigurationUtility.exe utility can then replicate these settings on machines being deployed without entering Computer Configuration Utility (F10 Setup).
<b>SMBIOS</b>	System Management BIOS Reference Specification, Version 3.4 External BIOS simulator found at: <a href="http://csrsm1.itcs.hp.com/">http://csrsm1.itcs.hp.com/</a>
<b>Boot Control</b>	Disables the ability to boot from removable media on supported devices.
<b>Memory Change Alert</b>	Alerts management console if memory is removed or changed.
<b>Thermal Alert</b>	Monitors the temperature state within the chassis. Three modes: <ul style="list-style-type: none"> <li>• NORMAL - normal temperature ranges.</li> <li>• ALERTED - excessive temperatures are detected. Raises a flag so action can be taken to avoid shutdown or provide for a smoother system shutdown.</li> <li>• SHUTDOWN - excessive temperatures are encountered. Automatically shuts down the computer without warning before hardware component damage occurs.</li> </ul>
<b>Remote ROM Flash</b>	Provides secure, fail-safe ROM image management from a central network console.
<b>ACPI (Advanced Configuration and Power Management Interface)</b>	Allows the system to enter and resume from low power modes (sleep states). Enables an operating system to control system power consumption based on the dynamic workload. Makes it possible to place individual cards and peripherals in a low-power or powered-off state without affecting other elements of the system. Supports ACPI 6.0 for full compatibility with 64-bit operating systems.
<b>Ownership Tag</b>	A user-defined string stored in non-volatile memory that is displayed in the BIOS splash screen.
<b>Remote Wakeup/Remote Shutdown</b>	System administrators can power on, restart, and power off a client computer from a remote location.
<b>Instantly Available PC (Suspend to RAM - ACPI sleep state S3)</b>	Allows for very low power consumption with quick resume time.
<b>Remote System Installation via F12 (PXE 2.1) (Remote Boot from Server)</b>	Allows a new or existing system to boot over the network and download software, including the operating system.
<b>ROM revision levels</b>	Reports the system BIOS revision level in Computer Configuration Utility (F10 Setup). Version is available through an industry standard interface (SMBIOS and WMI) so that management SW applications can use and report this information.
<b>System board revision level</b>	Allows management SW to read revision level of the system board. Revision level is digitally encoded into the HW and cannot be modified.
<b>Start-up Diagnostics (Power-on Self-Test)</b>	Assesses system health at boot time with selectable levels of testing.

### System Technical Specifications

<b>Auto Setup when new hardware installed</b>	System automatically detects addition of new hardware.
<b>Keyboard-less Operation</b>	The system can be booted without a keyboard.
<b>Localized ROM Setup</b>	Common BIOS image supports System Configuration Utility (F10 Setup) menus in 14 languages with local keyboard mappings.
<b>Asset Tag</b>	The user or MIS to set a unique tag string in non-volatile memory.
<b>Per-slot Control</b>	Allows I/O slot parameters (option ROM enable/disable, bus latency) to be configured individually.
<b>Adaptive Cooling</b>	Control parameters are set according to detected hardware configuration for optimal acoustics.
<b>Pre-boot Diagnostics</b>	(Pre-video) critical errors are reported via beeps and blinks on the power LED.
<b>UEFI Specification Revision</b>	2.7
<b>ACPI</b>	Advanced Configuration and Power Management Interface, Version 6.0
<b>ATA (IDE)</b>	AT Attachment 6 with Packet Interface (ATA/ATAPI-6), Revision 3b
<b>CD Boot</b>	"El Torito" Bootable CD-ROM Format Specification Version 1.0
<b>EDD</b>	Enhanced Disk Drive Specification Version 1.1 BIOS Enhanced Disk Drive Specification Version 3.0(Not support)
<b>EHCI</b>	Enhanced Host Controller Interface for Universal Serial Bus, Revision 1.0
<b>PCI</b>	PCI Local Bus Specification, Revision 2.3 PCI Power Management Specification, Revision 1.1 PCI Firmware Specification, Revision 3.0, Draft .7
<b>PCI Express</b>	PCI Express Base Specification, Revision 2.0 PCI Express Base Specification, Revision 3.0 PCI Express Base Specification, Revision 4.0
<b>PMM</b>	POST Memory Manager Specification, Version 1.01(Not support)
<b>SATA</b>	Serial ATA Specification, Revision 1.0a Serial ATA 3 Gb/s: Serial ATA Specification, Revision 2.5 Serial ATA 6 Gb/s: Serial ATA Specification, Revision 3.0
<b>SPD</b>	JEDEC JESD300-5
<b>TPM</b>	Trusted Computing Group TPM Specification Version 2.0 (Infineon SLB 9670). Common Criteria EAL4+ certified. FIPS 140-2 Certification TCG TPM Certified products list: <a href="http://www.trustedcomputinggroup.org/certification/tpm-certified-products/">http://www.trustedcomputinggroup.org/certification/tpm-certified-products/</a>
<b>UHCI</b>	Universal Host Controller Interface Design Guide, Revision 1.1
<b>USB</b>	Universal Serial Bus Revision 1.1 Specification Universal Serial Bus Revision 2.0 Specification Universal Serial Bus Revision 3.1 Specification
<b>SMBIOS</b>	System Management BIOS Reference Specification, Version 3.2  External BIOS simulator found at: <a href="http://csrsm1.itcs.hp.com/">http://csrsm1.itcs.hp.com/</a>

### Social and Environmental Responsibility

<b>Eco-Label Certifications &amp; Declarations</b>	This product has received or is in the process of being certified to the following approvals and may be labeled with one or more of these marks: <ul style="list-style-type: none"><li>• This product is low halogen except for power cords, cables, and peripherals. Service parts obtained after purchase may not be Low Halogen.</li><li>• IT ECO declaration</li><li>• US ENERGY STAR®</li><li>• US Federal Energy Management Program (FEMP)</li><li>• EPEAT<sup>®</sup> Gold registered in the United States. See <a href="http://www.epeat.net">http://www.epeat.net</a> for registration status in your country.</li></ul>
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### System Technical Specifications

#### Sustainable Impact Specifications

- TCO Certified
- China Energy Conservation Program (CECP)
- China State Environmental Protection Administration (SEPA)
- Taiwan Green Mark
- Korea Eco-label
- Japan PC Green label\*
- Ocean-bound plastic in System FAN, CPU FAN and Speaker
- 45% post-consumer recycled plastic
- Low halogen
- Outside Box and corrugated cushions are 100% sustainably sourced and recyclable
- Molded Paper Pulp Cushion inside box is 100% sustainably sourced and recyclable
- Bulk packaging available

#### System Configuration

The configuration used for the Energy Consumption and Declared Noise Emissions data for the Notebook model is based on a “Typically Configured Notebook”.

#### Energy Consumption (in accordance with US ENERGY STAR® test method)

	115VAC, 60Hz	230VAC, 50Hz	100VAC, 50Hz
Normal Operation (Sort idle)	45.62 W	45.60 W	45.63 W
Normal Operation (Long idle)	41.46 W	41.62 W	41.57 W
Sleep	2.34 W	2.34 W	2.39 W
Off	0.89 W	0.91 W	0.90 W

#### NOTE:

Energy efficiency data listed is for an ENERGY STAR® compliant product if offered within the model family. HP computers marked with the ENERGY STAR® Logo are compliant with the applicable U.S. Environmental Protection Agency (EPA) ENERGY STAR® specifications for computers. If a model family does not offer ENERGY STAR® compliant configurations, then energy efficiency data listed is for a typically configured PC featuring a hard disk drive, a high efficiency power supply, and a Microsoft Windows® operating system.

#### Heat Dissipation\*

	115VAC, 60Hz	230VAC, 50Hz	100VAC, 50Hz
Normal Operation (Short idle)	156 BTU/hr	156 BTU/hr	156.1 BTU/hr
Normal Operation (Long idle)	141.8 BTU/hr	142.3 BTU/hr	142.2 BTU/hr
Sleep	8 BTU/hr	8 BTU/hr	8.2 BTU/hr
Off	3 BTU/hr	3.1 BTU/hr	3.1 BTU/hr

\*NOTE: Heat dissipation is calculated based on the measured watts, assuming the service level is attained for one hour.

#### Declared Noise Emissions

##### (in accordance with ISO 7779 and ISO 9296)

	Sound Power (L <sub>WA</sub> , bels)	Sound Pressure (L <sub>pAm</sub> , decibels)
Typically Configured – Idle	3.37	23.1
Fixed Disk – Random writes	3.45	24.7

### System Technical Specifications

Optical Drive – Sequential reads 4.35 33.0

**Longevity and Upgrading** This product can be upgraded, possibly extending its useful life by several years. Upgradeable features and/or components contained in the

Spare parts are available throughout the warranty period and or for up to “5” years after the end of production.

**Batteries** This battery in this product complies with EU Directive 2006/66/EC  
 Battery size: CR2032 (coin cell)  
 Battery type: Lithium Metal

The battery in this product does not contain:

- Mercury greater than 5ppm by weight
- Cadmium greater than 10ppm by weight
- Lead greater than 40 ppm by weight
- This product is in compliance with the Restrictions of Hazardous Substances (RoHS) directive - 2011/65/EC.
- This HP product is designed to comply with the Waste Electrical and Electronic Equipment (WEEE) Directive – 2002/96/EC.
- This product is in compliance with California Proposition 65 (State of California; Safe Drinking Water and Toxic Enforcement Act of 1986).
- This product is in compliance with the IEEE 1680 (EPEAT) standard at the Gold level, see [www.epeat.net](http://www.epeat.net)
- Plastics parts weighing over 25 grams used in the product are marked per ISO11469 and ISO1043.
- This product is 93.5% recycle-able when properly disposed of at end of life.

<b>Packaging Materials</b>	<b>External:</b>	PAPER/Corrugated	1204 g
		PAPER/Molded Pulp	722 g
	<b>Internal:</b>	PLASTIC/Polyethylene low density - LDPE	40 g

The plastic packaging material contains at least 0.0% recycled content.

The corrugated paper packaging materials contains at least 35% recycled content.

**RoHS Compliance** HP Inc. complies fully with materials regulations. We were among the first companies to extend the restrictions in the European Union (EU) Restriction of Hazardous Substances (RoHS) Directive to our products worldwide through the HP GSE. HP has contributed to the development of related legislation in Europe, as well as China, India, and Vietnam.

We believe the RoHS directive and similar laws play an important role in promoting industry-wide elimination of substances of concern. We have supported the inclusion of additional substances—including PVC, BFRs, and certain phthalates—in future RoHS legislation that pertains to electrical and electronics products.

We met our voluntary objective to achieve worldwide compliance with the new EU RoHS requirements for virtually all relevant products by July 2013, and we will continue to extend the scope of the commitment to include further restricted substances as regulations continue to evolve.

To obtain a copy of the HP RoHS Compliance Statement, see [HP RoHS position statement](#).



### System Technical Specifications

#### Material Usage

This product does not contain any of the following substances in excess of regulatory limits (refer to the HP General Specification for the Environment at [http://www.hp.com/hpinfo/globalcitizenship/environment/supplychain/gen\\_specifications.html](http://www.hp.com/hpinfo/globalcitizenship/environment/supplychain/gen_specifications.html)):

- Asbestos
- Certain Azo Colorants
- Certain Brominated Flame Retardants – may not be used as flame retardants in plastics
- Cadmium
- Chlorinated Hydrocarbons
- Chlorinated Paraffins
- Bis(2-Ethylhexyl) phthalate (DEHP)
- Benzyl butyl phthalate (BBP)
- Dibutyl phthalate (DBP)
- Diisobutyl phthalate (DIBP)
- Formaldehyde
- Halogenated Diphenyl Methanes
- Lead carbonates and sulfates
- Lead and Lead compounds
- Mercuric Oxide Batteries
- Nickel – finishes must not be used on the external surface designed to be frequently handled or carried by the user.
- Ozone Depleting Substances
- Polybrominated Biphenyls (PBBs)
- Polybrominated Biphenyl Ethers (PBBEs)
- Polybrominated Biphenyl Oxides (PBBOs)
- Polychlorinated Biphenyl (PCB)
- Polychlorinated Terphenyls (PCT)
- Polyvinyl Chloride (PVC) – except for wires and cables, and certain retail packaging has been voluntarily removed from most applications.
- Radioactive Substances
- Tributyl Tin (TBT), Triphenyl Tin (TPT), Tributyl Tin Oxide (TBTO)

#### Packaging Usage

HP follows these guidelines to decrease the environmental impact of product packaging:

- Eliminate the use of heavy metals such as lead, chromium, mercury and cadmium in packaging materials.
- Eliminate the use of ozone-depleting substances (ODS) in packaging materials.
- Design packaging materials for ease of disassembly.
- Maximize the use of post-consumer recycled content materials in packaging materials.
- Use readily recyclable packaging materials such as paper and corrugated materials.
- Reduce size and weight of packages to improve transportation fuel efficiency.
- Plastic packaging materials are marked according to ISO 11469 and DIN 6120 standards.

#### End-of-life Management and Recycling

HP offers end-of-life HP product return and recycling programs in many geographic areas. To recycle your product, please go to: <http://www.hp.com/go/reuse-recycle> or contact your nearest HP sales office. Products returned to HP will be recycled, recovered or disposed of in a responsible manner.

The EU WEEE directive (2002/95/EC) requires manufacturers to provide treatment information for each product type for use by treatment facilities. This information (product disassembly instructions) is posted on the Hewlett Packard web site at: <http://www.hp.com/go/recyclers>. These

### System Technical Specifications

instructions may be used by recyclers and other WEEE treatment facilities as well as HP OEM customers who integrate and re-sell HP equipment.

#### HP, Inc. Corporate Environmental Information

For more information about HP's commitment to the environment:

Global Citizenship Report

<http://www.hp.com/hpinfo/globalcitizenship/gcreport/index.html>

Eco-label certifications

<http://www8.hp.com/us/en/hp-information/environment/ecolabels.html>

ISO 14001 certificates:

<http://h20195.www2.hp.com/V2/GetDocument.aspx?docname=c04755842>

and

<http://www.hp.com/hpinfo/globalcitizenship/environment/pdf/cert.pdf>

#### footnotes

- Percentage of ocean-bound plastic contained in each component varies by product
- Recycled plastic content percentage is based on the definition set in the IEEE 1680.1-2018 standard.
- External power supplies, WWAN modules, power cords, cables and peripherals excluded.
- 100% outer box packaging and corrugated cushions made from sustainably sourced certified and recycled fibers.
- Fiber cushions made from 100% recycled wood fiber and organic materials.

### Technical Specifications - Hard Drives

<b>SATA Hard Drives for HP Workstations</b>	<b>500GB SATA 7200 rpm 6Gb/s 3.5" HDD</b>	<b>Capacity</b>	500GB
		<b>Protocol</b>	SATA
		<b>Form Factor</b>	3.5"
		<b>Controller</b>	AHCI
		<b>Height</b>	1 in; 2.54 cm
		<b>Width</b>	<b>Media Diameter</b> 3.5 in; 8.9 cm
			<b>Physical Size</b> 4 in; 10.17 cm
		<b>Interface</b>	Serial ATA (6.0Gb/s), NCQ enabled
		<b>Synchronous Transfer Rate (Maximum)</b>	Up to 600MB/s *
		<b>Buffer</b>	32MB
		<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b> 2 ms *
			<b>Average</b> 11 ms *
			<b>Full Stroke</b> 21 ms *
		<b>Rotational Speed</b>	7,200 rpm
	<b>Logical Blocks</b>	976,773,168	
	<b>Operating Temperature</b>	41° to 131° F (5° to 55° C)	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>1TB SATA 7200 rpm 6Gb/s 3.5" HDD</b>	<b>Capacity</b>	1TB
	<b>Protocol</b>	SATA
	<b>Form Factor</b>	3.5"
	<b>Controller</b>	AHCI
	<b>Height</b>	1 in; 2.54 cm
	<b>Width</b>	<b>Media Diameter</b> 3.5 in; 8.9 cm
		<b>Physical Size</b> 4 in; 10.17 cm
	<b>Interface</b>	Serial ATA (6.0Gb/s), NCQ enabled
	<b>Synchronous Transfer Rate (Maximum)</b>	Up to 600 MB/s *
	<b>Buffer</b>	64MB
	<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b> 2 ms *
		<b>Average</b> 11 ms *
		<b>Full Stroke</b> 21 ms *
	<b>Rotational Speed</b>	7,200 rpm
<b>Logical Blocks</b>	1,953,525,168	
<b>Operating Temperature</b>	41° to 131° F (5° to 55° C)	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>2TB SATA 7200 rpm 6Gb/s 3.5" HDD</b>	<b>Capacity</b>	2TB
	<b>Protocol</b>	SATA
	<b>Form Factor</b>	3.5"
	<b>Controller</b>	AHCI

### Technical Specifications - Hard Drives

<b>Annualized Failure Rate (based on Rated POH)</b>	<0.62%	
<b>Height</b>	1 in; 2.54 cm	
<b>Width</b>	<b>Media Diameter</b>	3.5 in; 8.9 cm
	<b>Physical Size</b>	4 in; 10.17 cm
<b>Interface</b>	Serial ATA (6.0 Gb/s), NCQ Enabled	
<b>Synchronous Transfer Rate (Maximum)</b>	Up to 600MB/s *	
<b>Buffer</b>	64MB	
<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b>	2.0 ms *
	<b>Average</b>	11 ms *
	<b>Full Stroke</b>	21 ms *
<b>Rotational Speed</b>	7,200 rpm	
<b>Logical Blocks</b>	3,907,029,168	
<b>Operating Temperature</b>	41° to 131° F (5° to 55° C)	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

#### 1TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)

<b>Capacity</b>	1TB	
<b>Height</b>	1 in; 2.54 cm	
<b>Protocol</b>	SATA	
<b>Form Factor</b>	3.5"	
<b>Controller</b>	AHCI	
<b>Reliability</b>	2.0M hours	
<b>Rated Power On Hours</b>	8760/yr	
<b>Annualized Failure Rate (based on Rated POH)</b>	<0.62%	
<b>Width</b>	<b>Media Diameter</b>	3.5 in; 8.9 cm
	<b>Physical Size</b>	4 in; 10.17 cm
<b>Interface</b>	Serial ATA (6.0 Gb/s), NCQ Enabled	
<b>Synchronous Transfer Rate (Maximum)</b>	Up to 600MB/s *	
<b>Buffer</b>	128MB	
<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b>	0.32ms*
	<b>Average</b>	7.45ms*
	<b>Full Stroke</b>	14.2ms*
<b>Rotational Speed</b>	7,200 rpm	
<b>Operating Temperature</b>	41° to 140° F (5° to 60° C)	
<b>Performance</b>	<b>Sequential Read</b>	up to 226MB/s*
	<b>Sequential Write</b>	up to 226MB/s*
<b>Enterprise Class Features</b>	High Reliability	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>Capacity</b>	2TB
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### Technical Specifications - Hard Drives

<b>2TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)</b>	<b>Protocol</b>	SATA		
	<b>Form Factor</b>	3.5"		
	<b>Controller</b>	AHCI		
	<b>Reliability (MTBF)</b>	2.0M hours		
	<b>Rated Power On Hours</b>	8760/yr		
	<b>Annualized Failure Rate</b> (based on Rated POH)	<0.62%		
	<b>Rated for 24/7/365 Operation</b>			
	<b>Physical Size (Height)</b>	1 in; 2.54 cm		
	<b>Physical Size (Width)</b>	4 in; 10.17 cm		
	<b>Media Diameter</b>	3.5 in; 8.9 cm		
	<b>Interface</b>	Serial ATA (6Gb/s), NCQ enabled		
	<b>Synchronous Transfer Rate (Maximum)</b>	Up to 600MB/s*		
	<b>Buffer</b>	128MB		
	<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b>	0.7ms*	
		<b>Average</b>	8.5ms*	
		<b>Full Stroke</b>	15.7ms*	
	<b>Rotational Speed</b>	7,200 rpm		
	<b>Operating Temperature</b>	41° to 131° F (5° to 55° C)		
	<b>Performance</b>	<b>Sequential Read</b>	up to 226MB/s*	
	<b>Sequential Write</b>	up to 226MB/s*		
<b>Enterprise Class Features</b>	High Reliability			

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>4TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)</b>	<b>Capacity</b>	4TB	
	<b>Protocol</b>	SATA	
	<b>Form Factor</b>	3.5"	
	<b>Controller</b>	AHCI	
	<b>Reliability</b>	2.0M hours	
	<b>Rated Power On Hours</b>	8760/yr	
	<b>Annualized Failure Rate</b> (based on Rated POH)	<0.62%	
	<b>Rated for 24/7/365 Operation</b>		
	<b>Physical Size (Height)</b>	1 in; 2.54 cm	
	<b>Physical Size (Width)</b>	4 in; 10.17 cm	
	<b>Media Diameter</b>	3.5 in; 8.9 cm	
	<b>Physical Size</b>	4 in; 10.17 cm	
	<b>Interface</b>	Serial ATA (6Gb/s), NCQ enabled	
	<b>Synchronous Transfer Rate (Maximum)</b>	Up to 600MB/s*	
<b>Buffer</b>	256MB		

### Technical Specifications - Hard Drives

<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b>	0.7ms*
	<b>Average</b>	8.5ms*
	<b>Full Stroke</b>	15.7ms*
<b>Rotational Speed</b>	7,200 rpm	
<b>Operating Temperature</b>	41° to 131° F (5° to 55° C)	
<b>Performance</b>	<b>Sequential Read</b>	up to 226MB/s*
	<b>Sequential Write</b>	up to 226MB/s*
<b>Enterprise Class Features</b>	High Reliability	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

#### 8TB SATA 7200 rpm 6Gb/s 3.5" HDD (Enterprise Class)

<b>Capacity</b>	8TB	
<b>Protocol</b>	SATA	
<b>Form Factor</b>	3.5"	
<b>Controller</b>	AHCI	
<b>Reliability</b>	2.0M hours	
<b>Width</b>	<b>Media Diameter</b>	3.5 in; 8.9 cm
	<b>Physical Size</b>	4 in; 10.17 cm
<b>Interface</b>	Serial ATA (6.0Gb/s), NCQ enabled	
<b>Synchronous Transfer Rate</b> (Maximum)	Up to 600MB/s [1]	
<b>Buffer</b>	256MB	
<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Single Track</b>	0.7ms*
	<b>Average</b>	8.5ms*
	<b>Full Stroke</b>	15.7ms*
<b>Rotational Speed</b>	7,200 rpm	
<b>Operating Temperature</b>	41° to 140° F (5° to 60° C)	
<b>Performance</b>	<b>Sequential Read</b>	up to 226MB/s <sup>1</sup>
	<b>Sequential Write</b>	up to 226MB/s <sup>1</sup>
<b>Enterprise Class Features</b>	High Reliability	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

#### 500GB SATA 7.2K SED 2.5" HDD

<b>Capacity</b>	500GB	
<b>Protocol</b>	SATA	
<b>Form Factor</b>	2.5"	
<b>Height</b>	0.275 in; 0.7 cm	
<b>Width</b>	<b>Media Diameter</b>	2.5 in; 6.36 cm
	<b>Physical Size</b>	2.75 in; 6.99 cm
<b>Interface</b>	Serial ATA (6.0Gb/s), NCQ enabled	
<b>Synchronous Transfer Rate</b> (Maximum)	Up to 600MB/s*	
<b>Buffer</b>	64MB	
	<b>Single Track</b>	1ms*

### Technical Specifications - Hard Drives

<b>Seek Time</b> (typical reads, includes controller overhead, including settling)	<b>Average Full Stroke</b>	4.2ms*
<b>Rotational Speed</b>		7,200 rpm
<b>Operating Temperature</b>		32° to 131° F (0° to 60° C)
<b>Self-Encrypting Drive Support</b>		Yes

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv PCIe-4X4 512GB TLC PCIe SSD (Z2G9)</b>	<b>Capacity</b>	512GB							
	<b>Protocol</b>	PCIe							
	<b>Form Factor</b>	M.2 in native Slot on motherboard							
	<b>Controller</b>	NVMe							
	<b>NAND Type</b>	3D TLC							
	<b>Endurance</b>	300TBW (TB Written)							
	<b>Reliability (MTBF)</b>	1.5M hours							
	<b>Interface</b>	PCI Express 4.0 x4 electrical							
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)							
	<b>Performance</b>	<table> <tr> <td><b>Sequential Read</b></td> <td>6400MB/s*</td> </tr> <tr> <td><b>Sequential Write</b></td> <td>3400MB/s*</td> </tr> <tr> <td><b>Random Read</b></td> <td>600K IOPS*</td> </tr> <tr> <td><b>Random Write</b></td> <td>600K IOPS*</td> </tr> </table>	<b>Sequential Read</b>	6400MB/s*	<b>Sequential Write</b>	3400MB/s*	<b>Random Read</b>	600K IOPS*	<b>Random Write</b>
<b>Sequential Read</b>	6400MB/s*								
<b>Sequential Write</b>	3400MB/s*								
<b>Random Read</b>	600K IOPS*								
<b>Random Write</b>	600K IOPS*								

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv PCIe-4X4 1TB TLC PCIe SSD (Z2G9)</b>	<b>Capacity</b>	1TB							
	<b>Protocol</b>	PCIe							
	<b>Form Factor</b>	M.2 in native Slot on motherboard							
	<b>Controller</b>	NVMe							
	<b>NAND Type</b>	3D TLC							
	<b>Endurance</b>	400TBW (TB Written)							
	<b>Reliability</b>	1.5M Hours							
	<b>Interface</b>	PCI Express 4.0 x4 electrical							
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)							
	<b>Performance</b>	<table> <tr> <td><b>Sequential Read</b></td> <td>6500MB/s*</td> </tr> <tr> <td><b>Sequential Write</b></td> <td>5000MB/s*</td> </tr> <tr> <td><b>Random Read</b></td> <td>800K IOPS*</td> </tr> <tr> <td><b>Random Write</b></td> <td>800K IOPS*</td> </tr> </table>	<b>Sequential Read</b>	6500MB/s*	<b>Sequential Write</b>	5000MB/s*	<b>Random Read</b>	800K IOPS*	<b>Random Write</b>
<b>Sequential Read</b>	6500MB/s*								
<b>Sequential Write</b>	5000MB/s*								
<b>Random Read</b>	800K IOPS*								
<b>Random Write</b>	800K IOPS*								

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>Capacity</b>	2TB
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### Technical Specifications - Hard Drives

<b>HP Z Turbo Drv PCIe-4X4 2TB TLC PCIe SSD (Z2G9)</b>	<b>Protocol</b>	PCIe	
	<b>Form Factor</b>	M.2 in native Slot on motherboard	
	<b>Controller</b>	NVMe	
	<b>NAND Type</b>	3D TLC	
	<b>Endurance</b>	500TBW (TB Written)	
	<b>Reliability</b>	1.5M Hours	
	<b>Interface</b>	PCI Express 4.0 x4 electrical	
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)	
	<b>Performance</b>	<b>Sequential Read</b>	6500MB/s*
		<b>Sequential Write</b>	5000MB/s*
<b>Random Read</b>		800K IOPS*	
<b>Random Write</b>		800K IOPS*	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv PCIe-4X4 4TB TLC PCIe SSD</b>	<b>Capacity</b>	4TB
	<b>Protocol</b>	PCIe
	<b>Form Factor</b>	M.2 in native Slot on motherboard
	<b>Controller</b>	NVMe
	<b>NAND Type</b>	3D TLC
	<b>Endurance</b>	600TBW (TB Written)
	<b>Reliability (MTBF)</b>	1.5M Hours
	<b>Interface</b>	PCI Express 4.0 x4 electrical
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)
	<b>Performance</b>	<b>Sequential Read</b>
<b>Sequential Write</b>		5000MB/s*
<b>Random Read</b>		700K IOPS*
<b>Random Write</b>		700K IOPS*

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv PCIe Gen4x4 4TB TLC PCIe SED OPAL2</b>	<b>Capacity</b>	4TB	
	<b>Protocol</b>	PCIe	
	<b>Form Factor</b>	M.2 in native Slot on motherboard	
	<b>Controller</b>	NVMe	
	<b>NAND Type</b>	3D TLC	
	<b>Endurance</b>	600TBW (TB Written)	
	<b>Interface</b>	PCI Express 4.0 x4 electrical	
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)	
	<b>Performance</b>	<b>Sequential Read</b>	6500MB/s*
		<b>Sequential Write</b>	5000MB/s*
<b>Random Read</b>		700K IOPS*	
<b>Random Write</b>		700K IOPS*	



### Technical Specifications - Hard Drives

#### Self-Encrypting Drive Support

OPAL2

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv 512GB TLC PCIe SED OPAL2 (Z2G9)</b>	<b>Capacity</b>	512GB
	<b>Protocol</b>	PCIe
	<b>Form Factor</b>	M.2 in native Slot on motherboard
	<b>Controller</b>	NVMe
	<b>NAND Type</b>	3D TLC
	<b>Endurance</b>	300TBW (TB Written)
	<b>Reliability</b>	1.5M Hours
	<b>Interface</b>	PCI Express 4.0 x4 electrical
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)
	<b>Performance</b>	<b>Sequential Read</b> 6400MB/s*
		<b>Sequential Write</b> 3400MB/s*
	<b>Random Read</b> 600K IOPS*	
	<b>Random Write</b> 600K IOPS*	
	<b>Self-Encrypting Drive Support</b>	OPAL2

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv 1TB TLC PCIe SED OPAL2 (Z2G9)</b>	<b>Capacity</b>	1TB
	<b>Protocol</b>	PCIe
	<b>Form Factor</b>	M.2 in native Slot on motherboard
	<b>Controller</b>	NVMe
	<b>NAND Type</b>	3D TLC
	<b>Endurance</b>	400TBW (TB Written)
	<b>Reliability</b>	1.5M Hours
	<b>Interface</b>	PCI Express 4.0 x4 electrical
	<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)
	<b>Performance</b>	<b>Sequential Read</b> 6500MB/s*
		<b>Sequential Write</b> 5000MB/s*
	<b>Random Read</b> 800K IOPS*	
	<b>Random Write</b> 800K IOPS*	
	<b>Self-Encrypting Drive Support</b>	OPAL2

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>HP Z Turbo Drv 2TB TLC PCIe SED OPAL2 (Z2G9)</b>	<b>Capacity</b>	2TB
	<b>Protocol</b>	PCIe
	<b>Form Factor</b>	M.2 in native Slot on motherboard

### Technical Specifications - Hard Drives

<b>Controller</b>	NVMe	
<b>NAND Type</b>	3D TLC	
<b>Endurance</b>	500TBW (TB Written)	
<b>Reliability</b>	1.5M Hours	
<b>Interface</b>	PCI Express 4.0 x4 electrical	
<b>Operating Temperature</b>	32° to 178° F (0° to 81° C)	
<b>Performance</b>	<b>Sequential Read</b>	6500MB/s*
	<b>Sequential Write</b>	5000MB/s*
	<b>Random Read</b>	800K IOPS*
	<b>Random Write</b>	800K IOPS*
<b>Self-Encrypting Drive Support</b>	OPAL2	

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>256GB 2280 PCIe-4x4 Value M.2 SSD</b>	<b>Capacity</b>	256GB	
	<b>Protocol</b>	PCIe	
	<b>Form Factor</b>	M.2 in native Slot on motherboard	
	<b>Controller</b>	NVMe	
	<b>NAND Type</b>	3D TLC	
	<b>Endurance</b>	150TBW (TB Written)	
	<b>Reliability</b>	1.5M Hours	
	<b>Interface</b>	PCI Express 4.0 x4 electrical	
	<b>Operating Temperature</b>	32° to 158° F (0° to 70° C)	
	<b>Performance</b>	<b>Sequential Read</b>	3100MB/s*
		<b>Sequential Write</b>	1400MB/s*
		<b>Random Read</b>	200K IOPS*
		<b>Random Write</b>	400K IOPS*

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>512GB 2280 PCIe-4x4 Value M.2 SSD</b>	<b>Capacity</b>	512GB	
	<b>Protocol</b>	PCIe	
	<b>Form Factor</b>	M.2 in native Slot on motherboard	
	<b>Controller</b>	NVMe	
	<b>NAND Type</b>	3D TLC	
	<b>Endurance</b>	300TBW (TB Written)	
	<b>Reliability</b>	1.5M Hours	
	<b>Interface</b>	PCI Express 4.0 x4 electrical	
	<b>Operating Temperature</b>	32° to 158° F (0° to 70° C)	
	<b>Performance</b>	<b>Sequential Read</b>	3400MB/s*
		<b>Sequential Write</b>	2500MB/s*
		<b>Random Read</b>	380K IOPS*
		<b>Random Write</b>	430K IOPS*

### Technical Specifications - Hard Drives

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

<b>1TB 2280 PCIe-4x4 Value M.2 SSD</b>	<b>Capacity</b>	1TB	
	<b>Protocol</b>	PCIe	
	<b>Form Factor</b>	M.2 in native Slot on motherboard	
	<b>Controller</b>	NVMe	
	<b>NAND Type</b>	3D TLC	
	<b>Endurance</b>	400TBW (TB Written)	
	<b>Reliability</b>	1.5M Hours	
	<b>Interface</b>	PCI Express 4.0 x4 electrical	
	<b>Operating Temperature</b>	32° to 158° F (0° to 70° C)	
	<b>Performance</b>	<b>Sequential Read</b>	3400MB/s*
		<b>Sequential Write</b>	2500MB/s*
		<b>Random Read</b>	500K IOPS*
		<b>Random Write</b>	440K IOPS*

\*Actual performance may vary.

**NOTE:** For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36GB of system disk (for Windows) is reserved for system recovery software.

### Technical Specifications - Graphics

<b>AMD Radeon™ Pro W6600 8GB Graphics</b>	<b>Form Factor</b>	Single slot, full-height, 9.5" length
	<b>Graphics Controller</b>	Navi23 architecture Power: 122 Watts Cooling Solution: Active Fan Heatsink
	<b>Bus Type</b>	PCI Express 4.0 x8
	<b>Memory</b>	8GB GDDR6 Memory Memory Bandwidth: 224 GB/s Memory Interface: 128 bit
	<b>Connectors</b>	4x DisplayPort™ 1.4 with DSC - HDR Ready - Supports Multi-Stream Transport (MST)
	<b>Max simultaneous displays</b>	@ 60Hz with HDR Enabled 4x @ 3840x2160px (4K) 4x @ 5120x2880px (5K) 1x @ 7680x4320px (8K)
	<b>Shading Architecture</b>	DirectX 12 Shader Model 6.5
	<b>Supported Graphics APIs</b>	DirectX®12 Ultimate OpenGL® 4.6 OpenCL™ 2.1 Vulkan™ 1.2
	<b>Available Graphics Drivers</b>	Windows 10 64-bit Windows 11 64-bit Linux® 64-bit (selected Enterprise distributions)
		HP qualified drivers may be preloaded or available from the HP support Web site: <a href="http://welcome.hp.com/country/us/en/support.html">http://welcome.hp.com/country/us/en/support.html</a>

<b>NVIDIA® T400 2GB Graphics</b>	<b>Form Factor</b>	Single Slot, Low Profile (2.7" H x 6.1" L)
	<b>Graphics Controller</b>	Turing architecture Max Power: 30 Watts Cooling Solution: Active fan heatsink
	<b>Bus Type</b>	PCI Express 3.0 x16
	<b>Memory</b>	2GB GDDR6 Memory Memory Bandwidth: 80 GB/s Memory Interface: 64 bit
	<b>Connectors</b>	3x mDP (Mini DisplayPort™) 1.4 Connectors
	<b>Max simultaneous displays</b>	- 3x 3840 x 2160 @ 120Hz - 3x 5120 x 2880 @ 60Hz - supports Multi-Stream Transport (MST)
	<b>Shading Architecture</b>	DirectX 12 Shader Model 5.1
	<b>Supported Graphics APIs</b>	OpenGL 4.6 DirectX 12 Vulkan 1.2 API support includes: CUDA, OpenCL 1.2
	<b>Available Graphics Drivers</b>	Windows 10 64-bit Windows 11 64-bit Linux® 64-bit (selected Enterprise distributions)

### Technical Specifications - Graphics

HP qualified drivers may be preloaded or available from the HP support Web site:  
<http://welcome.hp.com/country/us/en/support.html>

#### **NVIDIA® T400 4GB Graphics**

<b>Form Factor</b>	Single Slot, Low Profile (2.7" H x 6.1" L)
<b>Graphics Controller</b>	Turing architecture Max Power: 30 Watts Cooling Solution: Active fan heatsink
<b>Bus Type</b>	PCI Express 3.0 x16
<b>Memory</b>	4GB GDDR6 Memory Memory Bandwidth: 80 GB/s Memory Interface: 64 bit
<b>Connectors</b>	3x mDP (Mini DisplayPort™) 1.4 Connectors
<b>Max simultaneous displays</b>	- 3x 3840 x 2160 @ 120Hz - 3x 5120 x 2880 @ 60Hz - supports Multi-Stream Transport (MST)
<b>Shading Architecture</b>	DirectX 12 Shader Model 5.1
<b>Supported Graphics APIs</b>	OpenGL 4.6 DirectX 12 Vulkan 1.2 API support includes: CUDA, OpenCL 1.2
<b>Available Graphics Drivers</b>	Windows 10 64-bit Windows 11 64-bit Linux® 64-bit (selected Enterprise distributions)

HP qualified drivers may be preloaded or available from the HP support Web site:  
<http://welcome.hp.com/country/us/en/support.html>

#### **NVIDIA® T600 4GB Graphics**

<b>Form Factor</b>	Single Slot, Low Profile (2.7" H x 6.1" L)
<b>Graphics Controller</b>	Turing architecture Max Power: 40 Watts Cooling Solution: Active fan heatsink
<b>Bus Type</b>	PCI Express 3.0 x16
<b>Memory</b>	4GB GDDR6 Memory Memory Bandwidth: 160 GB/s Memory Interface: 128 bit
<b>Connectors</b>	4x mDP (Mini DisplayPort™) 1.4 Connectors
<b>Max simultaneous displays</b>	- 4x 3840 x 2160 @ 120Hz - 4x 5120 x 2880 @ 60Hz - 2x 7680 x 4320 @ 60Hz - supports Multi-Stream Transport (MST)
<b>Shading Architecture</b>	DirectX 12 Shader Model 5.1
<b>Supported Graphics APIs</b>	OpenGL 4.6 DirectX 12 Vulkan 1.2

### Technical Specifications - Graphics

<b>Available Graphics Drivers</b>	<p>API support includes:            CUDA, OpenCL 1.2</p> <p>Windows 10 64-bit            Windows 11 64-bit            Linux® 64-bit (selected Enterprise distributions)</p> <p>HP qualified drivers may be preloaded or available from the HP support Web site:  <a href="http://welcome.hp.com/country/us/en/support.html">http://welcome.hp.com/country/us/en/support.html</a></p>
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<b>NVIDIA® T1000 4GB Graphics</b>	<b>Form Factor</b>	Single Slot, Low Profile (2.7" H x 6.1" L)
	<b>Graphics Controller</b>	Turing architecture Max Power: 50 Watts Cooling Solution: Active fan heatsink
	<b>Bus Type</b>	PCI Express 3.0 x16
	<b>Memory</b>	4GB GDDR6 Memory Memory Bandwidth: 160 GB/s Memory Interface: 128 bit
	<b>Connectors</b>	4x mDP (Mini DisplayPort™) 1.4 Connectors
	<b>Max simultaneous displays</b>	<ul style="list-style-type: none"> <li>- 4x 3840 x 2160 @ 120Hz</li> <li>- 4x 5120 x 2880 @ 60Hz</li> <li>- 2x 7680 x 4320 @ 60Hz</li> <li>- supports Multi-Stream Transport (MST)</li> </ul>
	<b>Shading Architecture</b>	DirectX 12 Shader Model 5.1
<b>Supported Graphics APIs</b>	OpenGL 4.6 DirectX 12 Vulkan 1.2 API support includes: CUDA, OpenCL 1.2	
<b>Available Graphics Drivers</b>	<p>Windows 10 64-bit            Windows 11 64-bit            Linux® 64-bit (selected Enterprise distributions)</p> <p>HP qualified drivers may be preloaded or available from the HP support Web site:  <a href="http://welcome.hp.com/country/us/en/support.html">http://welcome.hp.com/country/us/en/support.html</a></p>	

<b>NVIDIA® T1000 8GB Graphics</b>	<b>Form Factor</b>	Single Slot, Low Profile (2.7" H x 6.1" L)
	<b>Graphics Controller</b>	Turing architecture Max Power: 50 Watts Cooling Solution: Active fan heatsink
	<b>Bus Type</b>	PCI Express 3.0 x16
	<b>Memory</b>	8GB GDDR6 Memory Memory Bandwidth: 160 GB/s Memory Interface: 128 bit
	<b>Connectors</b>	4x mDP (Mini DisplayPort™) 1.4 Connectors
	<b>Max simultaneous displays</b>	<ul style="list-style-type: none"> <li>- 4x 3840 x 2160 @ 120Hz</li> <li>- 4x 5120 x 2880 @ 60Hz</li> </ul>

### Technical Specifications - Graphics

		- 2x 7680 x 4320 @ 60Hz - supports Multi-Stream Transport (MST)
<b>Shading Architecture</b>		DirectX 12 Shader Model 5.1
<b>Supported Graphics APIs</b>		OpenGL 4.6 DirectX 12 Vulkan 1.2 API support includes: CUDA, OpenCL 1.2
<b>Available Graphics Drivers</b>		Windows 10 64-bit Windows 11 64-bit Linux® 64-bit (selected Enterprise distributions)
		HP qualified drivers may be preloaded or available from the HP support Web site: <a href="http://welcome.hp.com/country/us/en/support.html">http://welcome.hp.com/country/us/en/support.html</a>

#### NVIDIA® RTX™ A2000 12GB Graphics

<b>Form Factor</b>		Low-Profile Double Slot (2.7" H x 6.1" L)
<b>Graphics Controller</b>		Ampere architecture Power: 70 Watts Cooling: Active Fan Heatsink
<b>Bus Type</b>		PCI Express 4.0 x16
<b>Memory</b>		12GB GDDR6 memory Memory Bandwidth: 288 GB/s Memory Interface: 192 bit Support Error-correcting code (ECC)
<b>Connectors</b>		4x mDP (Mini DisplayPort™) 1.4 Connectors
<b>Max simultaneous displays</b>		4x 4096 x 2160 @ 120 Hz, 4x 5120 x 2880 @ 60 Hz 2x 7680 x 4320 @ 60 Hz
<b>Shading Architecture</b>		Shader Model 6.5
<b>Supported Graphics APIs</b>		OpenGL 4.6 DirectX 12 Vulkan 1.2 API support includes: CUDA, OpenCL 1.2
<b>Available Graphics Drivers</b>		Windows 10 64-bit Windows 11 64-bit Linux® 64-bit (selected Enterprise distributions)
		HP qualified drivers may be preloaded or available from the HP support Web site: <a href="http://welcome.hp.com/country/us/en/support.html">http://welcome.hp.com/country/us/en/support.html</a>

#### HP 9.5mm Slim DVD Writer

<b>Description</b>		9.5mm height, tray-load
<b>Mounting Orientation</b>		Either horizontal or vertical
<b>Interface Type</b>		SATA/ATAPI
<b>Dimensions (WxHxD)</b>		128 x 9.5 x 127mm
<b>Supported Media Types</b>		DVD+R DVD+RW

### Technical Specifications - Graphics

	DVD+R DL DVD-R DL DVD-R DVD-RW CD-R CD-RW	
<b>Disc Capacity</b>	<b>DVD-ROM</b>	8.5 GB DL or 4.7 GB standard
<b>Access Times</b>	<b>Full Stroke DVD</b>	< 200 ms (seek)
	<b>Full Stroke CD</b>	< 200 ms (seek)
<b>Maximum Data Transfer Rates</b>	<b>CD ROM Read</b>	CD-ROM, CD-R Up to 24X CD-RW Up to 24X
	<b>DVD ROM Read</b>	DVD+RW Up to 8X DVD-RW Up to 8X DVD+R DL Up to 8X DVD-R DL Up to 8X DVD-ROM Up to 8X DVD-ROM DL Up to 8X DVD+R Up to 8X DVD-R Up to 8X
<b>Power</b>	<b>Source</b>	SATA DC power receptacle
	<b>DC Power Requirements</b>	5 VDC ± 5%-100 mV ripple p-p
	<b>DC Current</b>	5 VDC -< 800 mA typical, <1600 mA maximum
<b>Operating Environmental</b> (all conditions non-condensing)	<b>Temperature</b>	41° to 122° F (5° to 50° C)
	<b>Relative Humidity</b>	10% to 80%
	<b>Maximum Wet Bulb Temperature</b>	84° F (29° C)
<b>Operating Systems Supported</b>	Windows 10, Windows 7 Professional 32-bit and 64-bit, Windows Vista Business 64*, Windows Vista Business 32*, Windows Vista Home Basic 32*, Windows 2000, Windows XP Professional or Windows XP Home 32*. Linux®	
	No driver is required for this device. Native support is provided by the operating system.	
<b>Kit Contents</b>	HP SATA DVD Writer drive, installation guide.	
<b>Approvals</b>	USB-IF, WHQL, Compliant with USB Mass Storage Class Bulk only Transport Specification Rev. 1.0, Compliant Intel Front Panel I/O Connectivity Design Guide V. 1.3, FCC, CE, BSMI, C-Tick, VCCI, MIC, cUL, TUVT	

<b>HP 9.5mm Slim DVD-ROM Drive</b>	<b>Description</b>	9.5mm height, tray-load
	<b>Mounting Orientation</b>	Either horizontal or vertical
	<b>Interface Type</b>	SATA / ATAPI
	<b>Dimensions (WxHxD)</b>	128 x 9.5 x 127mm
	<b>Disc Capacity</b>	<b>DVD-ROM</b>



### Technical Specifications - Graphics

<b>Access Times</b>	<b>DVD-ROM Single Layer</b>	< 110 me (typical)
	<b>CD-ROM Mode 1</b>	< 110 ms (typical)
	<b>Full Stroke DVD</b>	< 230 ms (typical)
	<b>Full Stroke CD</b>	< 220 ms (typical)
<b>Power</b>	<b>Source</b>	SATA DC power receptacle
	<b>DC Power Requirements</b>	5 VDC ± 5%-100 mV ripple p-p
	<b>DC Current</b>	5 VDC – <800mA typical, < 1600 mA maximum
<b>Operating Environmental</b> (all conditions non-condensing)	<b>Temperature</b>	41° to 122° F (5° to 50° C)
	<b>Relative Humidity</b>	10% to 80%
	<b>Maximum Wet Bulb Temperature</b>	84° F (29° C)
<b>Operating Systems Supported</b>	Windows 10, Windows 7 Professional 32-bit and 64-bit, Windows Vista Business 64*, Windows Vista Business 32*, Windows Vista Home Basic 32*, Windows 2000, Windows XP Professional or Windows XP Home 32*. Linux®	
	No driver is required for this device. Native support is provided by the operating system.	
<b>Kit Contents</b>	9.5mm Slim DVD-ROM Drive, slim SATA data/power cable, installation guide	
<b>Approvals</b>	USB-IF, WHQL, Compliant with USB Mass Storage Class Bulk only Transport Specification Rev. 1.0, Compliant Intel Front Panel I/O Connectivity Design Guide V. 1.3, FCC, CE, BSMI, C-Tick, VCCI, MIC, cUL, TUVT	

<b>HP SD Media Card Reader</b>	<b>Description</b>	USB3.0-SD4.0 <b>NOTE: actual throughput is USB2.0.</b>
	<b>Interface Type</b>	<ul style="list-style-type: none"> <li>Support USB 2.0 LPM function</li> <li>Support USB 3.0 U1/U2/U3 Power saving mode</li> <li>Support USB 3.0 LTM function.</li> </ul>
	<b>Dimensions (WxHxD)</b>	Dedicated slot in front bezel (orderable option)
	<b>Supported Media Types</b>	<ol style="list-style-type: none"> <li>Secure Digital Card (SD)</li> <li>Secure Digital Support up to 2TB</li> <li>Secure Digital HC (SDHC)</li> <li>Secure Digital XC (SDXC)</li> <li>Support SD UHS50 mode</li> <li>miniSD *1</li> <li>miniSDHC*1</li> <li>MicroSD*1</li> <li>MicroSDHC*1</li> <li>MicroSDXC*1</li> </ol> <p><b>NOTE: “*1” means Adapter Needed</b></p>
	<b>Operating Systems Supported</b>	No driver is required for this device. Native support is provided by the operating system.

### Technical Specifications - Graphics

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 <http://www.microsoft.com>.

See <http://www.microsoft.com/windows/windows-7/> for details.

### Technical Specifications - Networking and Communications

<b>Integrated Intel® I219LM PCIe GbE Controller (Intel® vPro® with Intel® AMT 16.0<sup>1</sup>)</b>	<b>Connector</b>	RJ-45
	<b>Cabling</b>	Twisted pair up to 100m
	<b>Controller</b>	Intel® I219LM GbE platform LAN connect networking controller
	<b>Memory</b>	3 KB Tx and 3KB Rx FIFO packet buffer memory
	<b>Data Rates Supported</b>	10/100/1000 Mbps
	<b>Compliance</b>	802.1as/1588, 802.1p, 802.1Q, 802.3, 802.3ab, 802.3az, 802.3i, 802.3u, 802.3z
	<b>Bus Architecture</b>	PCI Express and SMBus
	<b>Data Transfer Mode</b>	PCIe-based interface for active state operation (S0 state) and SMBus for host and management traffic (Sx low power state)
	<b>Power Requirement</b>	Requires 3.3V (integrated regulators for core Vdc)
	<b>Boot ROM Support</b>	Yes
	<b>Network Transfer Mode</b>	Full-duplex; Half-duplex
	<b>Network Transfer Rate</b>	10BASE-T (half-duplex) 10 Mbps 10BASE-T (full-duplex) 20 Mbps 100BASE-TX (half-duplex) 100 Mbps 100BASE-TX (full-duplex) 200 Mbps 1000BASE-T (full-duplex) 2000 Mbps
	<b>Management Capabilities</b>	vPro®, WOL, auto MDI crossover, PXE, Multi-port teaming, RSS, ACPI, Advanced cable diagnostic, loopback modes, AMT 16.0 support, Circuit Breaker, VLAN, Multicast Listener Discovery (MLD)

<sup>1</sup>Requires activation and a system with a corporate network connection, an Intel® AMT enabled chipset, and network hardware and software. For notebooks, Intel AMT may be unavailable or limited over a host OS-based VPN, when connecting wirelessly, on battery power, sleeping, hibernating, or powered off. Results dependent upon hardware, setup, and configuration. For more information, visit: <https://www.intel.com/content/www/us/en/architecture-and-technology/intel-active-management-technology.html>

<b>HP 1-Port 1GbE Flex IO NIC</b>	<b>Connector</b>	RJ-45
	<b>Cabling</b>	1GbE over Category 5e (or better) up to 100m
	<b>Controller</b>	Realtek RTL8153
	<b>Data Rates Supported</b>	10/100/1000 Mbps
	<b>Compliance</b>	802.3 (LAN) 802.3u (100BASE-TX) 802.3ab (1000BASE-T) 802.3x (Ethernet Flow Control) 802.1Q (Virtual LAN) 802.3az (Energy Efficient Ethernet)
	<b>Bus Architecture</b>	USB
	<b>Power Requirement</b>	Requires 3.3V (integrated regulators for core Vdc)
	<b>Boot ROM Support</b>	Yes
	<b>Network Transfer Mode</b>	Full-duplex; Half-duplex
	<b>Network Transfer Rate</b>	10BASE-T (half-duplex) 10 Mbps 10BASE-T (full-duplex) 20 Mbps 100BASE-TX (half-duplex) 100 Mbps

### Technical Specifications - Networking and Communications

	100BASE-TX (full-duplex) 200 Mbps
	1000BASE-T (full-duplex) 2000 Mbps
<b>Operating Temperature</b>	32° to 131° F (0° to 55° C)
<b>Dimensions (HxW)</b>	1.5 in x 1.5 in. x 0.75 in (3.81 cm x 3.81 cm x 1.9 cm)
<b>Operating System Driver Support</b>	Windows 11 Windows 10 Linux®

<b>Intel® X550-T2 2-Port 10GbE NIC</b>	<b>Connector</b>	Dual-port RJ-45
	<b>Cabling</b>	10GbE: Cat6a (or better) up to 100m 5GbE and below: Cat5e (or better) up to 100m
	<b>Controller</b>	Intel® Ethernet Controller X550
	<b>Network Transfer Rates Supported</b>	10GbE, 5GbE, 2.5GbE, 1GbE, 100MbE
	<b>Data Path Width</b>	PCIe Gen3x4
	<b>Power Requirement</b>	11.2W (typical) 13.0 (Maximum)
	<b>Operating Temperature</b>	32° to 131° F (0° to 55° C)
	<b>Dimensions (HxW)</b>	5.1 x 2.7 in (without brackets)
	<b>Operating System Driver Support</b>	Windows 11 64-Bit Windows 10 64-bit Linux®
	<b>Kit Contents</b>	<ul style="list-style-type: none"> <li>• Intel® X550-T2 2-Port 10GbE NIC with standard height bracket attached</li> <li>• Low-profile bracket</li> <li>• Product Literature</li> </ul>

<b>NVIDIA Mellanox ConnectX-6 DX Dual Port 10/25GbE SFP28 NIC</b>	<b>Connector</b>	Dual-port SFP28
	<b>Cabling</b>	Transceiver with Multi-Mode Fiber OM3 or OM4)
	<b>Controller</b>	ConnectX-6 Dx
	<b>Network Transfer Rates Supported</b>	1/10/25 GbE
	<b>Data Path Width</b>	PCIe Gen4x8
	<b>Power Requirement</b>	19.74W Maximum power available through SFP28 port: 2.5W (each port)
	<b>Operating Temperature</b>	32° to 131° F (0° to 55° C)
	<b>Dimensions (HxW)</b>	6.22in. x 2.67in (158mm x 68mm)
	<b>Operating System Driver Support</b>	Windows 11 64-Bit Windows 10 64-bit Linux®
	<b>Kit Contents</b>	<ul style="list-style-type: none"> <li>• NVIDIA Mellanox ConnectX-6 SFP28 25GbE NIC with standard height bracket attached</li> <li>• Low-profile bracket</li> <li>• Product Literature</li> </ul>

**NOTE:** The NVIDIA Mellanox ConnectX-6 DX network adapter requires either a PCIeG4 x4 or PCIeG4 x8 slot (electrical connection) to have full performance with two 25GbE SFP28 transceivers installed in the network adapter. When the network adapter is installed in a PCIeG3 x4 slot, the performance will

### Technical Specifications - Networking and Communications

be limited when installing two 25GbE SFP28 transceivers or installing a 25GbE SFP28 transceiver plus a 10GbE SFP+ transceiver

<b>NVIDIA Mellanox 25GbE SFP28 Transceiver</b>	<b>Operating Temperature</b>	32°F to 158°F (0°C to 70°C)
	<b>Operating Humidity</b>	5% to 85%, noncondensing
	<b>Dimensions (HxWxD)</b>	0.47 x 0.54 x 2.22 inches
	<b>Kit Contents</b>	NVIDIA Mellanox 25GbE SFP28 Transceiver
<b>NVIDIA Mellanox 10GbE SFP+ SR Transceiver</b>	<b>Operating Temperature</b>	32°F to 158°F (0°C to 70°C)
	<b>Operating Humidity</b>	5% to 85%, noncondensing
	<b>Dimensions (HxWxD)</b>	0.47 x 0.54 x 2.22 inches
	<b>Kit Contents</b>	NVIDIA Mellanox 10GbE SFP+ SR Transceiver
<b>Intel® I350-T4 4-Port 1GbE NIC</b>	<b>Connector</b>	4 RJ-45
	<b>Cabling</b>	Cat5e (or better) up to 100m
	<b>Controller</b>	Intel® Ethernet I350 Controller
	<b>Network Transfer Rates Supported</b>	1GbE, 100MbE, 10MbE
	<b>Data Path Width</b>	PCIe Gen2.1x4
	<b>Power Requirement</b>	5W (typical)
	<b>Operating Temperature</b>	32° to 131° F (0° to 55° C)
	<b>Dimensions (HxW)</b>	2.75 x 5.5 inches (without brackets)
	<b>Operating System Driver Support</b>	Windows 11 Windows 10 Linux®
	<b>Kit Contents</b>	<ul style="list-style-type: none"> <li>Intel® I350-T4 4-Port 1GbE NIC with standard height bracket attached</li> <li>Low-profile bracket</li> <li>Product Literature</li> </ul>
<b>HP Flex 1GbE Fiber LC Single Port</b>	<b>Connector</b>	Fiber
	<b>Cabling</b>	1GbE over Category OM1 (or better) up to 100m
	<b>Controller</b>	Microchip LAN7801
	<b>Data Rates Supported</b>	100/1000 Mbps
	<b>Compliance</b>	IEEE 802.1p priority encoding/tagging (QoS, CoS) IEEE 802.1q VLAN tagging IEEE 802.3x flow control
	<b>Bus Architecture</b>	USB
	<b>Power Requirement</b>	Requires 3.3V (integrated regulators for core Vdc)
	<b>Boot ROM Support</b>	Yes
	<b>Network Transfer Mode</b>	Full-duplex; Half-duplex
	<b>Network Transfer Rate</b>	100BASE-X (half-duplex) 100 Mbps 1000BASE-X (half-duplex) 1000 Mbps 1000BASE-X (full-duplex) 2000 Mbps

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<b>Operating Temperature</b>	32° to 158° F (0°C to 70°C)
<b>calvin</b>	1.5 in x 1.7 in. x 0.75 in (3.84 cm x 4.3 cm x 1.9 cm)
<b>Operating System Driver Support</b>	Windows 11 64-Bit Windows 10 64-bit Linux®

<b>Intel® I225-T1 1-Port 2.5GbE NIC</b>	<b>Connector</b>	RJ-45
	<b>Cabling</b>	Cat5e (or better) up to 85m
	<b>Controller</b>	Intel® Ethernet I225 Controller
	<b>Network Transfer Rates Supported</b>	2.5GbE, 1GbE, 100MbE, 10MbE
	<b>Data Path Width</b>	PCIe Gen3.1x1
	<b>Power Requirement</b>	1.9W (typical)
	<b>Operating Temperature</b>	32° to 158° F (0°C to 70°C)
	<b>Dimensions (HxW)</b>	2.7 in x 2.57 in. (68.7mm x 65.3mm)
	<b>Operating System Driver</b>	Windows 11 64-Bit Windows 10 64-bit Linux®
	<b>Kit Contents</b>	<ul style="list-style-type: none"> <li>• Intel® I225-T1 1-Port 2.5GbE NIC with standard height bracket attached</li> <li>• Low-profile bracket</li> <li>• Product Literature</li> </ul>

<b>Intel® Wi-Fi 6E* AX211 802.11ax, BT 5.3, M.2 With Internal Antenna</b>	<b>WLAN Standards</b>	802.11abgn+acR2+axR2(Pre-Standard) MIMO 2x2 High performance, low power dual band Pre-Standard-802.11ax R2 2x2, both with 160MHz channel support – Wi-Fi 6E
	<b>Antenna</b>	2x2 Dual- Band (internal)
	<b>Bluetooth Standards</b>	5.2
	<b>Operating Temperature</b>	32° to 176° F (0° to 80° C)
	<b>Interface</b>	M.2 CNVio2
	<b>Dimensions</b>	M.2 2230
	<b>NOTE:</b> The AX211 with internal antenna only support WIFI 6	

\*Wi-Fi 6E requires a Wi-Fi 6E router, sold separately, to function in the 6GHz band. Availability of public wireless access points limited. Wi-Fi 6E is backwards compatible with prior 802.11 specs. And available in countries where Wi-Fi 6E is supported.

<b>Intel® Wi-Fi 6E* AX211 802.11ax, BT 5.3, M.2 With External Antenna</b>	<b>WLAN Standards</b>	802.11abgn+acR2+axR2(Pre-Standard) MIMO 2x2 High performance, low power dual band Pre-Standard-802.11ax R2 2x2, both with 160MHz channel support – Wi-Fi 6E
	<b>Antenna</b>	2x2 Dual- Band (External)
	<b>Bluetooth Standards</b>	5.2
	<b>Operating Temperature</b>	32° to 176° F (0° to 80° C)
	<b>Interface</b>	M.2 CNVio2
	<b>Dimensions</b>	M.2 2230
	<b>NOTE:</b> The AX211 with external antenna support WIFI 6E	

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\*Wi-Fi 6E requires a Wi-Fi 6E router, sold separately, to function in the 6GHz band. Availability of public wireless access points limited. Wi-Fi 6E is backwards compatible with prior 802.11 specs. And available in countries where Wi-Fi 6E is supported.

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### Summary of Changes

<b>Date of change:</b>	<b>Version History:</b>		<b>Description of change:</b>
March 8, 2022	From v1 to v2	Changed	Format
March 16, 2022	From v2 to v3	Changed	Social and Environmental Responsibility section
May 6, 2022	From v3 to v4	Changed	Processors, Graphics, Networking and Communications sections
May 19, 2022	From v4 to v5	Changed	Overview section in Packaged Dimensions subsection
June 1, 2022	From v5 to v6	Changed	Operating Systems and SATA Hard Drives sections
June 15, 2022	From v6 to v7	Changed	Networking and Communications section
July 1, 2022	From v7 to v8	Changed	Declared Noise Emissions section
August 1, 2022	From v8 to v9	Changed	Format pages 1-3, Overview section and Supported Components
August 4, 2022	From v9 to v10	Changed	Format
September 1, 2022	From v10 to v11	Changed	Graphics, Optical and Removable Storage Networking and Communications sections
October 1, 2022	From v11 to v12	Changed	Graphics, Networking and Communications sections
December 12, 2022	From v12 to v13	Changed	Format page 3
January 1, 2023	From v13 to v14	Changed	Networking and Communications section
February 1, 2023	From v14 to v15	Added	AMD Radeon Pro WX 3200 4GB (4)mDP GFX, w/2 mDP-to-DP adapters to Graphics section
March 1, 2023	From v15 to v16	Changed	Manageability section
March 30, 2023	From v16 to v17	Changed	Processors section
April 1, 2023	From v17 to v18	Changed	Networking and Communications section
April 25, 2023	From v18 to v19	Changed	Social and Environmental Responsibility section
May 1, 2023	From v19 to v20	Changed	Miscellaneous section



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