Technical white paper

HP Z2 Mini G3 Workstation

New functionalities and technologies in the HP Z2 Mini G3 Workstation

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System highlights

The HP Z2 Mini G3 Workstation offers professionals the ability to bundle all the features of a workstation in a compelling form factor.
Below we will discuss the attributes of the third-generation HP Z2 Mini Workstation (HP Z2 Mini G3) system highlights and updates.

System architecture

The HP Z2 Mini G3 Workstation features the Intel® Xeon® processor E3-1200 v5 family and 6th, 7th generation Intel® Core™ processors based on the new Intel® micro-architecture. Upgraded ME11 manageability, Intel®-integrated USB 3.0, delivers improved productivity and stability.

New technologies

New Intel® Processor micro-architecture[2]

The HP Z2 Mini G3 supports the latest quad core Intel® Xeon® processor E3-1200 v5 Product Family and the 6th and 7th generation Intel® Core™ processors (dual-core Intel® Core™ i3 and quad-core Intel® Core™ i5 and Intel® Core™ i7 processors) are supported. The Intel® C236 PCH (platform controller hub) chipset complements the HP Z2 Mini G3's core architecture.

Intel®'s 6th and 7th generation Core™ and Xeon® cadence of innovation delivers new microarchitecture enhancements on 14nm process technology that help deliver faster compute performance, with low energy consumption.

Intel® Software Guard Extensions (SGX)

Intel® Software Guard Extensions (SGX) is a processor enhancement designed to help protect application integrity and confidentiality of secrets, and withstands software and certain hardware attacks.

Software Guard Extensions (SGX) features a memory encryption engine that both encrypt enclave memory as well as protect it from corruption and replay attacks.

For more information, refer to the Intel® SGX website.

Intel® HD Graphics 530/630/P530

The processor graphics is based on Gen 9 (generation 9) graphics core architecture that enables substantial gains in performance and lower-power consumption over prior generations. The Gen 9 architecture supports up to 72 Execution Units (EUs) with On-Package Cache depending on the different processor SKU.

The display engine supports display standards such as eDP 1.3, DP 1.2, HDMI 1.4; HW support for blend, scale, rotate, compress, high PPI support, and advanced SRD2 display power management.

The Intel® Gen 9 graphics core implements a high-performance and low-power HW acceleration for video decoding operations for multiple video codecs.

The HW decode is exposed by the graphics driver using the following APIs:

• Direct3D12 Video API

• DirectX 3D 2015 version, OGL 4.4, OpenGL ES 3.0, OpenCL 2.1

• Intel® Media SDK

• MFT (Media Foundation Transform) filters

The Intel® Gen 9 graphics core supports full HW accelerated video decoding for AVC/VC1/MPEG2/HEVC*/VP8/JPEG.

* HEVC – 8 bit support only.

DDR4-2400 (PC4-2400) - Fourth-Generation Double Data Rate SDRAM Memory Technology

The HP Z2 Mini G3 supports standard DDR4 2400 MHz ECC and non-ECC unbuffered SO-DIMMs. 1.2V DIMMs are supported. The Intel® 6th and 7th generation Core™ and Xeon® E3-1200v5 family processor with Integrated Memory Controller (IMC) supports DDR4/-RS* protocols with two independent, 64-bit wide channels. Memory speed is controlled by the processors, which is 2400 MHz for this generation.

DDR4/-RS supports lower power voltage and higher bus bandwidth than DDR3 SDRAM. The theoretical maximum memory bandwidth is up to 37.5 GB/s in dual-channel mode, assuming 2400 MT/s.

* RS - Reduced Standby Power.

Intel® USB 3.0

The Intel® C236 PCH has a USB 3.0 hub integrated into the PCH and provides up to six total USB 3.0 ports on the HP Z2 Mini G3. The Intel® C236 USB 3.0 controller provides cost-effective support for greater I/O bandwidth on USB Type-A and Type-C ports. More information about USB 3.0 Technology and Performance measurements can be found in the "Resources, contacts, or additional links" section below.

USB Charging ability

The HP Z2 Mini G3 equips the lower of the side USB 3.0 ports with power charging ability. The port is able to provide fast charge (up to 1.5A) to a portable device in the following states: System On, System Sleep, System Hibernate, and System Off. It does not support charging in the ErP (Max S5 Power Savings) state. The port supports USB Battery Charging Specification 1.2. The port is marked by the battery charging icon shown here. More information on USB Charging technology can be found in the "Resources, contacts, or additional links" section below.
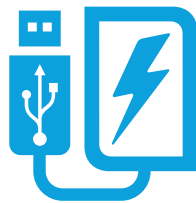
I/O and storage

Internal I/O

The HP Z2 Mini G3 has one internal M.2 Key M slot. The slot supports PCIe NVMe and AHCI SSDs in sizes 2280-D5-M. The interface is PCIe G3x4, supporting up to 32 Gbps, (4000 MB/s) Max transfer rate on NVMe SSDs. The HP Z2 Mini G3 supports an optional M.2 Key A/E 2230 WLAN/Bluetooth® card. The HP Z2 Mini G3 provides one 6 Gbps SATA port for 2.5" SFF HDD or SSD. The HP Z2 Mini G3 is also equipped with internal mono-channel 1.5W speakers.

Storage

The HP Z2 Mini G3's 6 Gbps SATA port support one 2.5" SFF hard drive or SSD. The HP Z2 Mini G3 supports M.2 PCIe NVMe or AHCI SSDs.

The HP Z2 Mini G3 supports a maximum of two drives: one x 2.5" SFF/SSD plus one x M.2 PCIe Key M SSD.

Intel® Rapid Storage Technology (Intel® RST) is supported on the HP Z2 Mini G3. This technology improves the performance of disk intensive applications and boot times.

External I/O

On the side I/O area, the HP Z2 Mini G3 provides two USB 3.0 ports (one supports battery charging), one audio port (HP Z2 Mini G3 is equipped with a headset (CTIA) Mic/HP Combo, retaskable to HP, LO, LI, MIC).

In the rear I/O area, the HP Z2 Mini G3 provides Gb LAN, 4x DisplayPort™ (Performance), 3x DisplayPort™ (Entry) and 2x USB 3.0 ports. There are two Type-C ports (Performance) that support USB 3.0.

Graphics and display

The HP Z2 Mini G3 supports Intel® HD Graphics on the Entry model and both Intel® HD Graphics and NVIDIA® Quadro® Professional graphics on the Performance model. The NVIDIA® Professional graphics or the Intel® HD Graphics can drive the various DisplayPort™ 1.2 routes in the HP Z2 Mini G3 system. The performance model comes pre-enabled with only the discrete NVIDIA® Quadro® graphics, however, a BIOS option is provided to allow the system to be configured to use both the NVIDIA® Quadro® GPU and the Intel® HD graphics simultaneously. Refer to the Display Configurations section below for further details on greater than four display configurations.

NVIDIA® Quadro® professional graphics

The Performance model of the HP Z2 Mini G3 is configured with the NVIDIA® Quadro® M620 GPU with 2GB of GDDR5 memory. The M620 GPU can drive up to four independent displays each at a resolution of 4k on the four available DisplayPort™ 1.2 ports. In addition to supporting the M620 GPU, the Performance model can also be configured to use both the NVIDIA Quadro® and Intel® HD graphics simultaneously to allow configurations of greater than four displays. Refer to the Display Configurations section below for further details on greater than four display configurations.

Intel® HD Graphics

Intel® fully supports Intel® HD Graphics 530/630 (Intel® Core™ processors) and Intel® HD Graphics P530 (Intel® Xeon® processors) with the C236 chipset. The ISV workstation application certifications for the Intel® Xeon® processor E3-1200 v5 family apply to the HP Z2 Mini G3. Intel® Quick Sync is supported on all Intel® processor SKUs with Intel® HD Graphics. This feature provides faster video transcoding.

Intel® HD Graphics supports three independent and simultaneous displays and supports Clone, Extended, and Collage modes for the displays. In the case of three simultaneous displays, two High Definition Audio streams over the digital display interfaces are supported. The HP Z2 Mini G3 Entry system can drive a single display from each of the three DisplayPort™ 1.2 ports on the rear of the system at a maximum resolution of 4096x2160@60Hz.

DisplayPort™ connections

Each DisplayPort™ 1.2 port on the system is capable of driving a single display at a resolution of 4096x2160 @ 60Hz. DisplayPort™ 1.2 Multi-Stream Transport (MST) can also be used to drive multiple lower-resolution displays from a single port. This functionality requires displays which support MST or an MST hub. MST configurations are described in detail in the section below title Display Configurations.

Multiple displays support

The HP Z2 Mini G3 Entry model can support up to three independent displays, each at a maximum resolution of 4096x2160@ 60Hz.

The HP Z2 Mini Performance model can be configured to use only the NVIDIA® Quadro® GPU or both the NVIDIA® Quadro® GPU and the Intel® HD Graphics simultaneously. When configured to use only the NVIDIA® Quadro® GPU, the Performance system can be configured with up to four independent displays each at a maximum resolution of 4096x2160 @ 60Hz. The ability to use both the NVIDIA® Quadro® and Intel® HD Graphics simultaneously allows the system to be configured with greater than four displays. Refer to the Display Configurations section below for further details on greater than four display configurations. *If supported by the selected processor.

	HP Z2 Mini G3 Performance	HP Z2 Mini G3 Entry
Operating system	Windows 10 Pro 64-bit[5]	Windows 10 Pro 64-bit[5]
	Windows Pro 64-bit downgrade to Windows 7 Pro 64-bit[6]	Windows Pro 64-bit downgrade to Windows 7 Pro 64-bit[6]
Processors	Intel® Xeon® E3-1200v5	6th, 7th generation Intel® Core™ i7/i5/i3 Processors
	6th, 7th generation Intel® Core™ i7/i5/i3 Processors	
New instruction set	SGX	SGX
Integrated graphics		
Intel® Xeon® Processor	Xeon®: Intel® HD Graphics P530	None
Intel® Core™ i7 Processor	Core™-i7: Intel® HD Graphics 530/630	Core™-i7: Intel® HD Graphics 530
Intel® Core™ i5 Processor	Core™-i5: Intel® HD Graphics 530/630	Core™-i5: Intel® HD Graphics 530
Intel® Core™ i3 Processor	Core™-i3: Intel® HD Graphics 530/630	Core™-i3: Intel® HD Graphics 530
Discrete graphics NVIDIA® professional graphics	Quadro® M620	None
Display ability	4 x external DisplayPort™ 1.2	3 x external DisplayPort™ 1.2a
USB enhancement	All 4 USB-A ports are 5 Gbps USB 3.0 enabled; USB Type-C rear I/O ports are USB 3.0 5 Gbps	All 4 USB-A ports are 5 Gbps USB 3.0 enabled
PSU efficiency	89%	89%
Manageability	Intel® ME11.0/AMT11, Intel® vPro™*	Intel® ME11.0/AMT11, Intel® vPro™*

*If supported by the selected processor. Higher CPU performance.
Table 1. HP Z2 Mini G3 Performance vs. HP Z2 Mini G3 Entry feature comparison.

Workstation advantages over HP Desktop PCs

Higher CPU performance

The workstation quad core Intel® Xeon® processor E3-1200 v5 series includes models up to a 3.5 GHz base frequency, while the 7th generation Intel® Core™ i7 processors for desktop PCs reach up to 3.6 GHz. The Intel® Xeon® E3 processors also offer several models with Hyper-Threading and larger 8 MB cache compared to their Intel® Core™ counterparts.

Name	Cores	Clock Speed (GHz)	Intel® Turbo Boost Technology[1]	Cache (MB)	Memory Speed (MHz)	Hyper-Threading	Integrated Graphics	Featuring Intel® vPro™ Technolog	TDP (W)
Z2 Mini G3 Performance base unit									
Intel® Xeon® processor E3-1245v5	4	3.5	3.9	8	2133	Y	Intel® HD Graphics P530	Y	80 W
Intel® Xeon® processor E3-1225v5	4	3.3	3.7	8	2133	N	Intel® HD Graphics P530	Y	80 W
Intel® Core™ i7-7700 processor	4	3.6	4.2	8	2400	Y	Intel® HD Graphics 630	Y	65 W
Intel® Core™ i5-7500 processor	4	3.4	3.8	6	2400	N	Intel® HD Graphics 630	Y	65 W
Intel® Core™ i3-7100 processor	2	3.9	N/A	3	2400	N	Intel® HD Graphics 630	N	51 W
Intel® Core™ i7-6700 processor	4	3.4	4.0	8	2133	Y	Intel® HD Graphics 530	Y	65 W
Intel® Core™ i5-6500 processor	4	3.2	3.6	6	2133	N	Intel® HD Graphics 530	Y	65 W
Intel® Core™ i3-6100 processor	2	3.7	N/A	3	2133	N	Intel® HD Graphics 530	N	51 W
HP Z2 Mini G3 Entry base unit									
Intel® Core™ i7-7700 processor	4	3.6	4.2	8	2400	Y	Intel® HD Graphics 630	Y	65 W
Intel® Core™ i5-7500 processor	4	3.4	3.8	6	2400	N	Intel® HD Graphics 630	Y	65 W
Intel® Core™ i3-7100 processor	2	3.9	N/A	3	2400	N	Intel® HD Graphics 630	N	51 W
Intel® Core™ i7-6700 processor	4	3.4	4.0	8	2133	Y	Intel® HD Graphics P530	Y	65 W
Intel® Core™ i5-6500 processor	4	3.2	3.6	6	2133	N	Intel® HD Graphics 530	Y	65 W
Intel® Core™ i3-6100 processor	2	3.7	N/A	3	2133	N	Intel® HD Graphics 530	N	51 W

Figure 1. HP Z2 Mini G3: Processor line-up

ECC

Error Correcting Code (ECC) memory is supported on workstation Intel® Xeon® SKUs and on Intel® Core™ i SKUs, thereby improving data integrity. If ECC memory is used in conjunction with a non-ECC processor SKU, ECC protection is not available and the DIMMs will appear to the system as non-ECC memory. Desktop PCs do not typically support ECC.
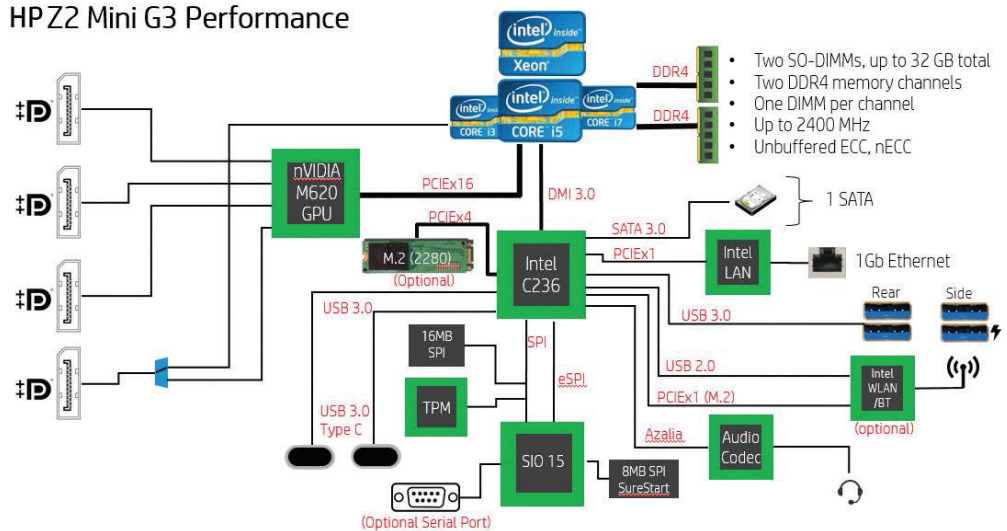
200W Power supply (For Performance)

External power supply, DoE VI efficient, compatible with ENERGY STAR® Version 6.1 requirements.

135W Power supply (For Entry)

External power supply, DoE VI efficient, compatible with ENERGY STAR® Version 6.1 requirements.
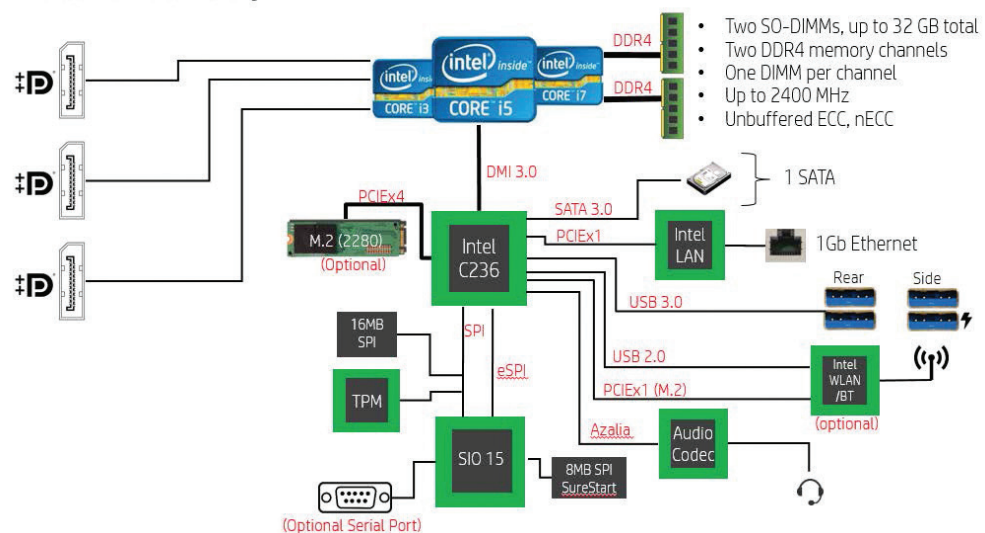
Figure 2. HP Z2 Mini G3 block diagram

Storage

Below is information on common storage features and new features specific to the HP Z2 Mini G3 Workstation.

Storage features

• One – 6 Gbps SATA connectors for 2.5" SFF HDDs or SSDs

• One - PCIe M.2 Key M socket for PCIe NVMe or AHCI SSDs

• Intel® Rapid Storage Technology drivers, RAID configuration Option ROM, and management GUI (Graphical User Interface)

AHCI and RAID[3] technology

The HP Z2 Mini G3 Workstation does not support RAID.

AHCI (Advanced Host Controller Interface)

AHCI is a technical standard developed by Intel® for the hardware mechanism that allows software to communicate with SATA (Serial ATA) devices. It is enumerated as a PCI device and transfers data between system memory and SATA devices.

AHCI provides many benefits over the legacy IDE (Integrated Drive Electronics) hard drive interface. Some of the benefits include:

• Elimination of master/slave handling

• Native Command Queuing (NCQ) that allows a SATA device to internally optimize the order of command execution for increased performance

• Trim command support for SSDs that keeps track of files that have been deleted but not erased on the drive—this improves performance of the drive and helps extend the life of the SSD by preventing unnecessary writes

Memory configurations and optimization

Below is an overview of the memory configurations for the HP Z2 Mini G3 Workstation and recommendations to optimize performance.

Supported memory modules

The types of memory supported on a HP Z2 Mini G3 are:

• 4 GB, 8 GB, and 16 GB PC4-2400U 2400 MHz DDR4 Unbuffered non-ECC SO-DIMMs

• 8 GB and 16 GB PC4-2400E 2400 MHz DDR4 Unbuffered ECC SO-DIMMs

• Single and dual rank 4 Gb and 8 Gb based SO-DIMMs

See the white paper, DDR4 Memory Technology on HP Z Workstations, for additional technical information.

Processor	Supports non-ECC memory	Supports ECC memory	Notes
Intel® Core™ i3-61xx	•	•	
Intel® Core™ i3-7xxx	•	•	
Intel® Core™ i5-65xx	•		*
Intel® Core™ i5-75xx	•		*
Intel® Core™ i7-67xx	•		*
Intel® Core™ i7-7xxx	•		*
Intel® Xeon® E3-12xx v5	•	•	
Intel® Xeon® E3-12xx v6	•	•	

* If ECC memory is added to the system, the ECC function is disabled and the DIMMs will appear to the system as non-ECC memory.

Table 2. Processor and memory support

Platform capabilities

Maximum capacity: 32 GB

• HP Z2 Mini G3 has a total of two SO-DIMM memory sockets

• Two channels per CPU, one socket per channel

Speed

• 2400 MHz DIMMs are supported

• Memory will operate at the speed of the slowest rated installed processor or DIMM

Memory features

ECC is supported on Unbuffered ECC DIMMs

• Single-bit errors are automatically corrected

• Multi-bit errors are detected and will cause the system to immediately reboot and halt with an F1 prompt error message

Although HP does support non-ECC memory on this platform as a lower cost option, it should be noted that non-ECC memory does not detect or correct single-bit or multi-bit errors which can cause instability or corruption of data in the platform. See the white paper, DDR4 Memory Technology on HP Z Workstations, for more information.

Optimizing performance

Generally, maximum memory performance is achieved by evenly distributing total desired memory capacity across all operational channels. Proper individual DIMM capacity selection is essential to maximizing performance. Refer to the Optimal Memory Configuration table below for more information.

Total capacity	DIMM1	DIMM2	Performance rating
4 GB	4 GB		Good
8 GB	4 GB	4 GB	Best
16 GB	8 GB	8 GB	Best
32 GB	16 GB	16 GB	Best

* For 32-bit operating systems, there is a memory limit of 4 GB.
~ Although supported, these configurations are not factory configurable at this time.

Note: This table does not include all available factory installed configurations

Loading rules

• Each channel includes one DIMM sockets. First load the memory in the memory sockets furthest away from the CPU and then load the memory slots closest to the CPU.

• Load the memory modules in order of size, starting with the largest module and finishing with the smallest module.

 See Figure 3 for loading order.

Loading order
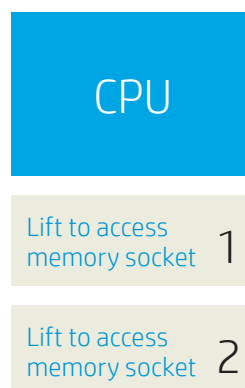
Figure 3. Memory modules loading order

General I/O Layout

Front View
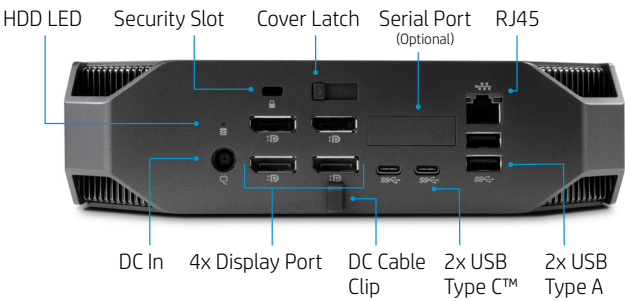
A power button with power status LED in the front.

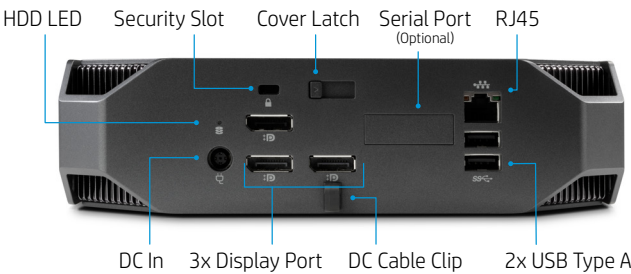## Side I/O

Two USB Type A and one combo headset.


Rear I/O

Performance

HDD LED   Security Slot   Cover Latch   Serial Port   RJ45
(Optional)

DC In   4x Display Port   DC Cable   2x USB   2x USB
Clip   Type C™   Type A

Entry

HDD LED   Security Slot   Cover Latch   Serial Port   RJ45
(Optional)

DC In   3x Display Port   DC Cable Clip   2x USB Type A

Battery charging technology

The USB Battery Charging Specification v1.2 (USB BC 1.2*) defines a special USB port that will allow some devices to charge (tablets) and other devices to charge faster (cell phones). This USB port is called a Charging port and supports at least 1.5A of charging current under normal operation, sleep, hibernate, and shutdown modes. The USB charging port can be identified by the lightning bolt icon shown below.

Charging Port icons
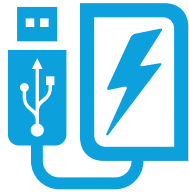
For USB 3.0 Battery Charging Ports

Charging modes

A USB Port that supports Battery Charging can be placed into one of three modes:

• Standard Downstream Port (SDP)

  SDP allows the USB port to work as a traditional USB port that supplies 500 mA (USB 2.0) or 900 mA (USB 3.0).

  USB communication is supported in this mode. This mode will allow some devices to charge slowly.

• Charging Downstream Port (CDP)

  CDP allows the USB port to follow the USB BC 1.2 Specification. This allows the USB port to supply up to 1.5A for charging and provides USB communication simultaneously in this mode.

• Dedicated Charging Port (DCP)

  DCP allows the USB port to follow the USB BC 1.2 Specification and provides up to 1.5A. Dedicated Charging Port does not support USB communication.

Operating mode	Charging mode	Maximum current	Data communication
Normal Operation	CDP*	1.5 A	Yes
Sleep	DCP	1.5 A	No
Hibernate	DCP	1.5 A	No
Shutdown	DCP	1.5 A	No

*The portable device will communicate with the on-board charger automatically for mode setup. If the portable device doesn't accept or support CDP mode then the charger will go into general SDP mode. Some tablets might show no charge under this condition.
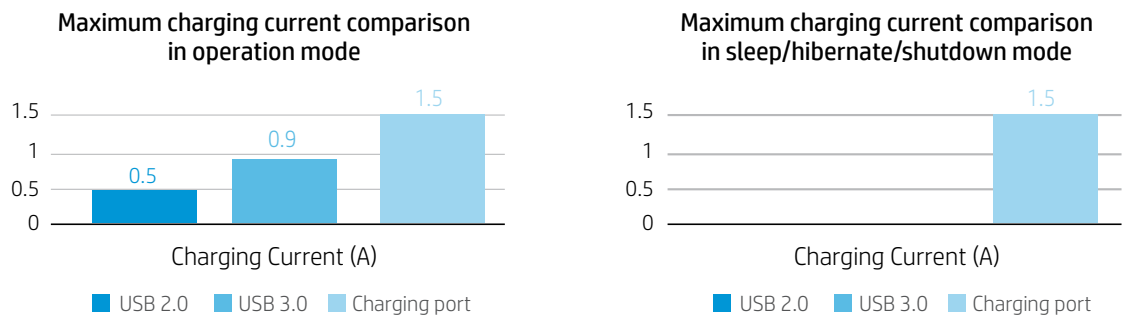
Table 4. Modes setup

Performance

Maximum charging current comparison in operation mode

Charging Current (A)

USB 2.0: 0.5
USB 3.0: 0.9
Charging port: 1.5

■ USB 2.0 ■ USB 3.0 ■ Charging port

Maximum charging current comparison in sleep/hibernate/shutdown mode

Charging Current (A)

Charging port: 1.5

■ USB 2.0 ■ USB 3.0 ■ Charging port

Table 5. Maximum charging comparison tables

HP Workstations implementation and recommended use

The charging port on select HP Workstations can supply up to 1.5A. It also supports the USB BC 1.2* specification as well as the Chinese Telecommunications Industry Standard YD/T 1591-2009. It is recommended to use this port with devices that support battery charging (typically portable devices like cell phones and tablets)*. It is a safe and efficient charging solution that provides more current and better over-current protection than a general USB port. Devices are able to talk to the on-board charger and select a suitable charging mode and current based on real application needs through a common communication protocol.

* See product manual/datasheet to verify USB charging support.

Remote Power On

The HP Z2 Mini G3 Workstation provides the feature Remote Power On at USB charging port that allows USB keyboard/mouse to wake system from Hibernate or Shutdown. This feature provides easier way to wake system by USB keyboard/mouse instead of power button.

Benefits

Make it easier to power-on system by USB keyboard/mouse in some use scenarios. Support wired/wireless, USB low speed/full speed keyboards and mouses. Easy setup in BIOS menu. Support waking from both S4 (Hibernate) and S5 (Shutdown).

Limitations

Support only at USB charging port, which is the only port supplying USB power in S4/S5. Waking from S4/S5 is limited to only via keyboard/mouse device.

Location of Charging Port

USB 3.0 charging port

How to enable Remote Power On?

Steps

1. Boot to BIOS menu by F10.
2. Check "*Allow waking from S4/S5 via keyboard/mouse*" in *Advanced\Port Options*. (Default is disabled)
3. Save and reboot the system.
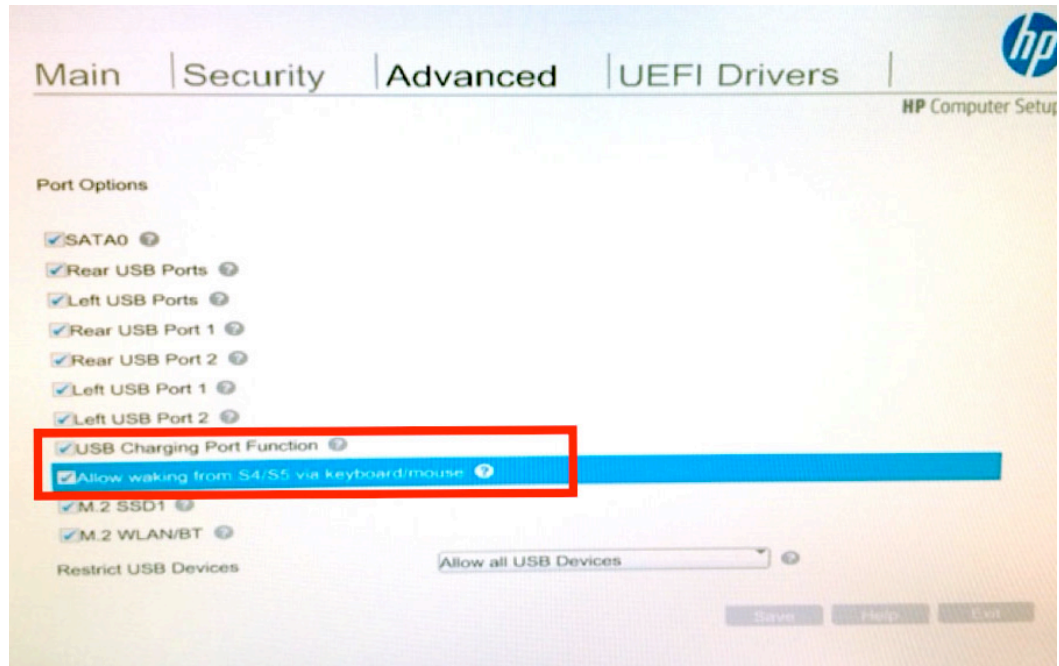
How to wake system from S4/S5 via keyboard/mouse?

Steps

1. Connect USB keyboard/mouse to USB charging port.
2. System must recognize USB keyboard/mouse in S0 first. (USB full speed keyboard/mouse, such as wireless keyboard/ mouse or Smart card keyboard need to connect to system over 60 seconds in S0 to be recognized.)
3. Shut down the system.
4. Wake system by any key on keyboard or clicking/movement* on mouse.

* If mouse has the capability to wake system by movement.

Frequently Asked Questions

Can customers program the system to wake from specific key on USB keyboard?
No, customers cannot program the system to wake from specific key on HP USB keyboard. It depends on keyboard vendor's design to support to wake from specific key or not. Most of keyboards support waking from any key.

Can customers program to wake the system by click only, not by mouse movement if the mouse has ability to wake the system by either click or movement?
No, users cannot disable one of them if their mouse has ability to wake system by either click or movement. It depends on mouse controller design to trigger USB wake event by movement or not. Some mouse controllers can be modified trigger method by FW update, but there is no SW application to modify setting in FW for end users so far. FW was fixed in mouse production line before shipping. Which means users have no way to modify FW to disable mouse movement only to trigger wake event.

How users could avoid to wake the system by mouse movement if their mouse has ability to wake the computer by either click or movement?
• Uncheck "Allow this device to wake the computer" in mouse properties in Device Manager. It will make the mouse cannot wake the computer by neither click nor movement. Users still can wake the computer by keyboard if it is checked in keyboard properties in Device Manager.

• Change the mouse to another one that only has ability to wake computer by click.

Display Configurations

The HP Z2 Mini G3 comes in two distinct models: The Entry system, featuring Intel® HD Graphics integrated into the CPU, and the Performance system, which is configured with an NVIDIA® Quadro® M620 GPU.

Entry System

The Entry model can be configured with Intel® Core™ and Intel® Xeon® E3 processors. The Intel® Core™ processors feature Intel® HD 530 Graphics while the Intel® Xeon® E3 CPU features Intel® HD P530 Graphics for professional application performance. Both of these graphics solutions offer the capability to drive up to three independent displays.

The Entry system is configured with three DisplayPort™ 1.2 ports. Each DisplayPort™ 1.2 port can drive a single display up to a maximum resolution of 4096x2160@60Hz or multiple displays daisy-chained together using DisplayPort™ 1.2 MST. When daisy-chaining displays together all displays in the chain will share the available DisplayPort™ 1.2 bandwidth. As such, the displays will be resolution limited to the resolutions shown in Table 6 below.
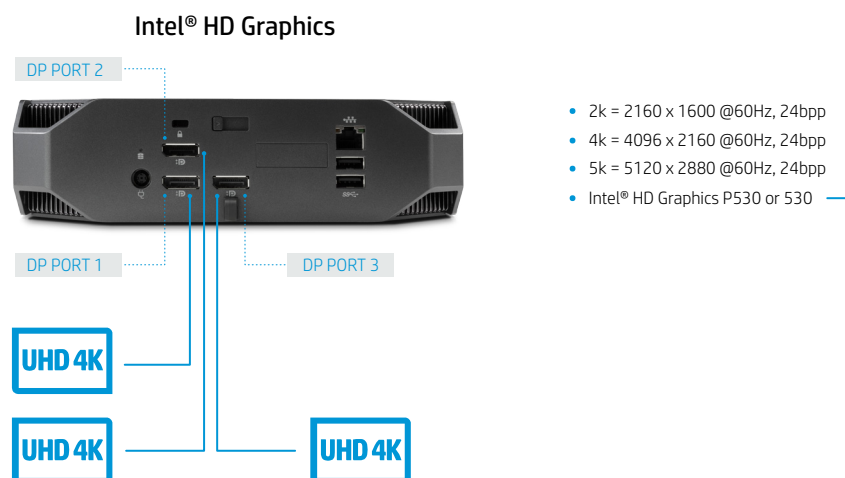
Number of MST Displays based on DisplayPort™ 1.2 Bandwidth	Display Resolution (60 Hz refresh rate, 24 bits-per-pixel)
1	4096 x 2160
2	2560 x 1600
3	2@ 2560x1600 + 1@ 1920x1200

Table 6. Entry System: DisplayPort™ 1.2 Daisy-Chained Displays vs. Resolution
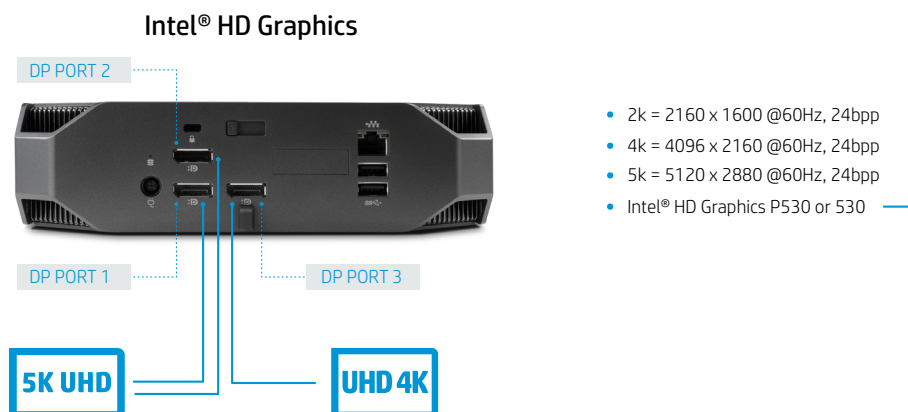
Figures 11 and 12 below show the two most common HP Z2 Mini G3 Entry display configurations. Other configurations are possible, but the total number of supported displays attached to the system is limited by the Intel® HD Graphics to a maximum of three displays, regardless of the resolution or configuration of the displays.

HP Z2 Mini G3, Entry Model

Intel® HD Graphics

- 2k = 2160 x 1600 @60Hz, 24bpp
- 4k = 4096 x 2160 @60Hz, 24bpp
- 5k = 5120 x 2880 @60Hz, 24bpp
- Intel® HD Graphics P530 or 530 ——

Figure 11. Display Setup: Entry Model: 3x 4k Displays

HP Z2 Mini G3, Entry Model

Intel® HD Graphics

- 2k = 2160 x 1600 @60Hz, 24bpp
- 4k = 4096 x 2160 @60Hz, 24bpp
- 5k = 5120 x 2880 @60Hz, 24bpp
- Intel® HD Graphics P530 or 530 ——

Figure 12. Display Setup: Entry Model: 1x 5k + 1x 4k Display

Performance System

The HP Z2 Mini G3 Performance system is configured with an NVIDIA® Quadro® M620 GPU. The M620 GPU can drive up to four displays each at a resolution of 4k on the available four DisplayPort 1.2 ports. In addition to supporting the M620 GPU, the Performance system can also be configured to use both the NVIDIA® Quadro® and Intel® HD Graphics simultaneously to allow configurations of greater than four displays.

NVIDIA® Quadro® Only Mode

Use Case: Maximum performance on up to four displays.

The default configuration for the Performance system is to use the NVIDIA® Quadro® M620 GPU on all of the four available DisplayPort™ 1.2 ports. This configuration offers the best performance, but does limit the system to supporting a maximum of four displays each at a maximum resolution of 4k, or two displays each at a maximum resolution of 5k.

Each DisplayPort™ 1.2 port can drive a single display up to a maximum resolution of 4096x2160@60Hz or multiple displays daisy-chained together using DisplayPort™ 1.2 MST. When daisy-chaining displays together all displays in the chain will share the available DisplayPort™ 1.2 bandwidth. As such, the displays will be resolution limited to the resolutions shown in Table 7 below. Regardless of display resolutions or configurations, the NVIDIA® Quadro® M620 GPU is limited to four simultaneous displays.

Number of MST Displays based on DisplayPort 1.2 Bandwidth	Display Resolution (60 Hz refresh rate, 24 bits-per-pixel)
1	4096 x 2160
2	2560 x 1600
3	2@ 2560x1600 + 1@ 1920x1200
4	1920 x 1200

Table 7. Performance System: DisplayPort™ 1.2 Daisy-Chained Displays vs. Resolution

HP Z2 Mini G3, Performance Model
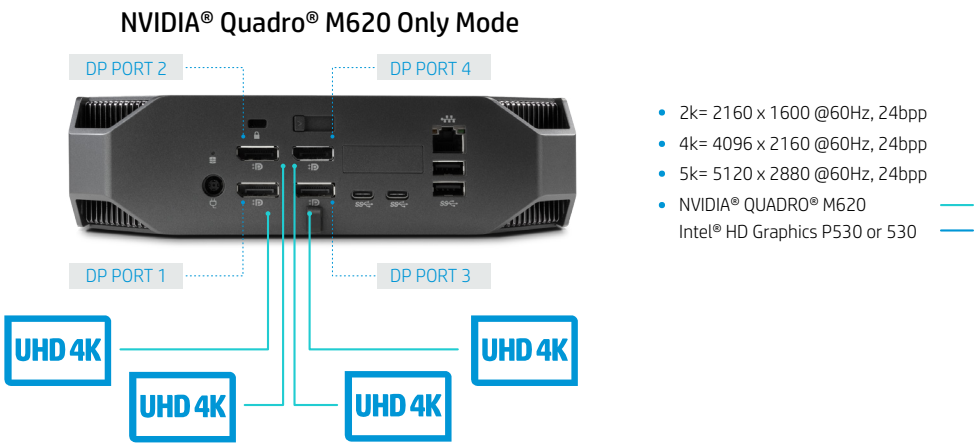
Figure 13. Display Setup: Performance Model: 4x 4k Displays

HP Z2 Mini G3, Performance Model

NVIDIA® Quadro® M620 Only Mode

DP PORT 2   DP PORT 4

DP PORT 1   DP PORT 3

5K UHD   **5K UHD**

- 2k = 2160 x 1600 @60Hz, 24bpp
- 4k = 4096 x 2160 @60Hz, 24bpp
- 5k = 5120 x 2880 @60Hz, 24bpp
- NVIDIA® QUADRO® M620
  Intel® HD Graphics P530 or 530

Figure 14. Display Setup: Performance Model: 2x 5k Displays

NVIDIA® Quadro® + Intel® HD Mode

Use Case: Configurations of greater than four displays

Since the HP Z2 Mini G3 contains Intel® HD Graphics on all of the configurable processors, the HP Z2 Mini G3 Performance system has been designed such that it can leverage both the NVIDIA® Quadro® M620 and the Intel® HD Graphics simultaneously. This allows the system to be configured with a maximum supported configuration of six displays. In this configuration, four displays are driven by the NVIDIA® Quadro® GPU and two displays are driven by the Intel® HD Graphics. However, since the system is configured with only four DisplayPort™ 1.2 ports, two of these DisplayPort™ 1.2 ports will each need to daisy-chain two displays to achieve the six-display configuration. This display configuration is shown in Figure 15 below. To obtain this configuration it is necessary to switch DisplayPort #4 to be driven by the Intel® HD Graphics. An option in the system BIOS has been provided to allow for DisplayPort™ #4 to switch between the NVIDIA® and Intel® GPUs. Refer to the System BIOS Setup section below for additional details on the system BIOS setup for this display configuration.

It should be noted that applications running on displays connected to the Intel® HD Graphics can have degraded performance when compared to applications running on the displays connected directly to the NVIDIA® Quadro® GPU. For best performance, your primary displays should always be connected to the NVIDIA® Quadro® GPU and high performance apps should be run on a display connected directly to the NVIDIA® Quadro® GPU. Refer to the Windows Software Setup below for additional performance details.

HP Z2 Mini G3, Performance Model

6 Display Configuration with MST Displays

DP PORT 2   DP PORT 4

DP PORT 1   DP PORT 3

2K — **2K**   **2K** — **2K**

UHD 4K — **UHD 4K**

- 2k = 2160 x 1600 @60Hz, 24bpp
- 4k = 4096 x 2160 @60Hz, 24bpp
- 5k = 5120 x 2880 @60Hz, 24bpp
- NVIDIA® QUADRO® M620
  Intel® HD Graphics P530 or 530
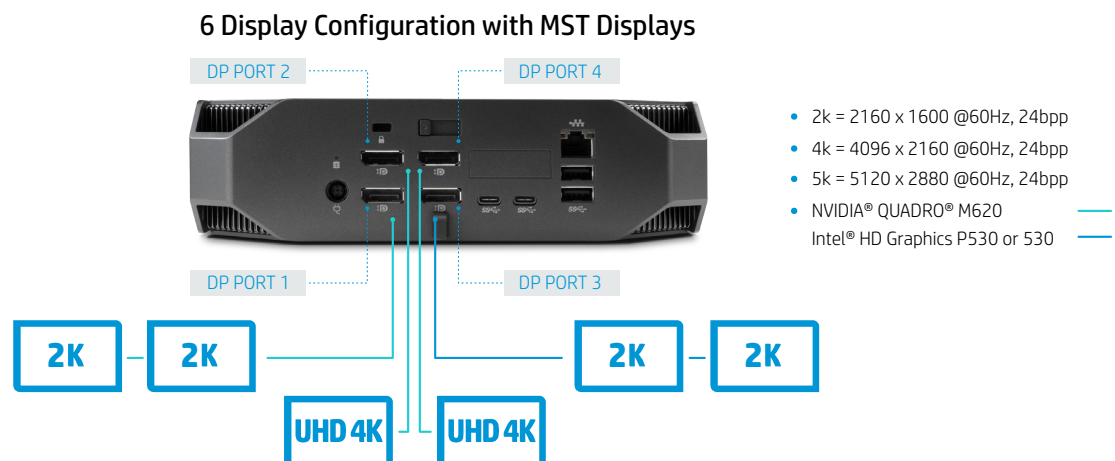
Figure 15. Display Setup: Performance Model: 6x Displays using MST Displays

NVIDIA® Quadro® and Intel® HD Graphics mode: BIOS Setup

The BIOS menu is entered by pressing the F10 key at startup. Once inside the BIOS menu, the DisplayPort™ #4 switch can be found under Advanced -> Built-In Device Options -> Enable Intel® Graphics on DisplayPort™ #4. Once this box is checked a message will prompt the user with details on DisplayPort™ #4 being driven by the Intel® HD Graphics.

Enable Intel® Graphics on DisplayPort™ #4

When this option is enabled, the DisplayPort™ port boxed in the image switches to the the Intel® on integrated graphics device but does not output graphics until starts the operathing system.

Figure 16. BIOS Prompt for Enabling Intel® HD Graphics on Display Port™ #4

NVIDIA® Quadro® and Intel® HD Graphics mode: Windows Software Setup

When configured to use both the NVIDIA® Quadro® M620 and the Intel® HD graphics, Windows will be able to see all of the displays connected to the systems, however the NVIDIA® Control Panel and Intel® HD Graphics Control Panel will only show the displays which are connected to the respective GPUs. Due to this, the Windows Display Settings menu is the best option for arranging the displays while advanced features such as NVIDIA®s mosaic will be limited to the displays connected to the NVIDIA® Quadro® GPU.
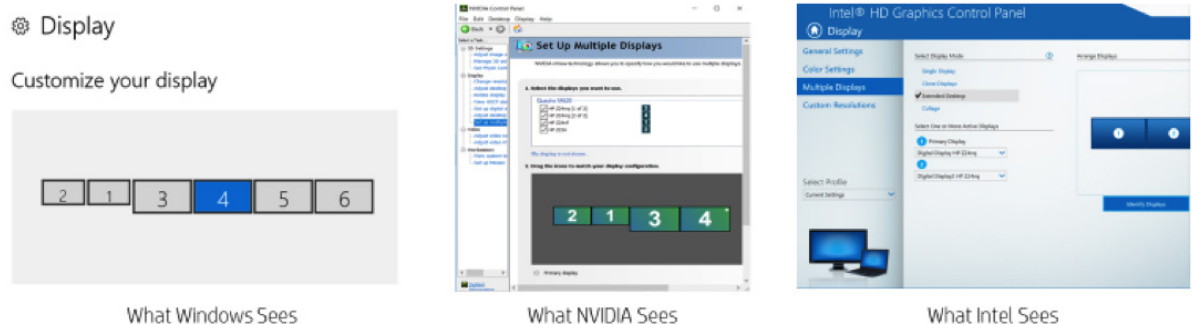
Figure 17. Windows vs. NVIDIA® vs. Intel® Control Panels

When a system is configured with multiple GPUs, Windows will use the GPU connected to the main display as the rendering GPU. As shown in Figure 18, Windows Display Settings has an option to choose which display is the main display, and thus the primary GPU. For maximum performance, always use a display connected to the NVIDIA® Quadro® GPU as the main display.
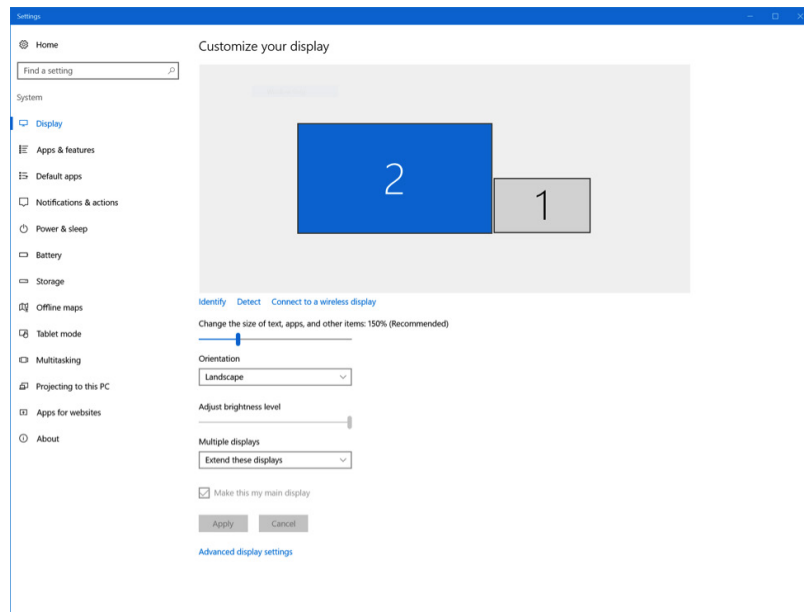
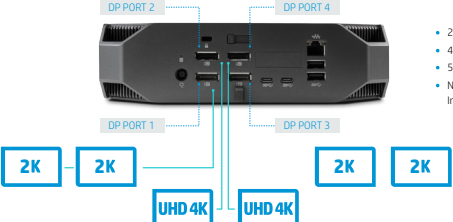**Figure 18.** Selecting the Main Display in Windows Display Settings
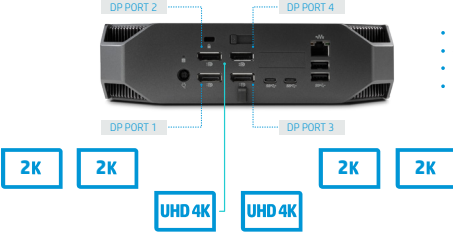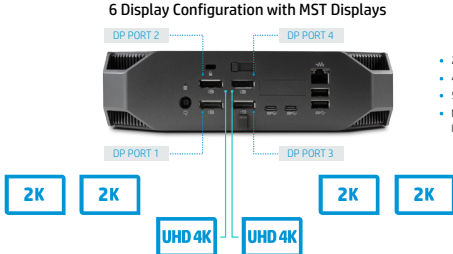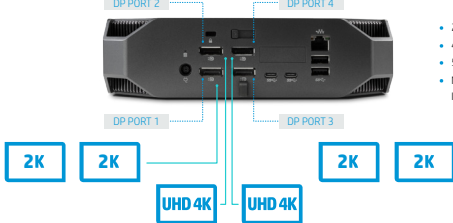
To discover which GPU is running a given display without following the DisplayPort™ cables from the system to the displays, the Windows Display Settings can be used. From the Display Settings window select the display in question and choose "Advanced display settings" and then "Display adapter properties". This will bring up a properties menu for the respective GPU. Figure 19 below shows what this properties menu looks like for each GPU. Both menus are shown, but each display will have exactly one of these menus which corresponds to the driving GPU.
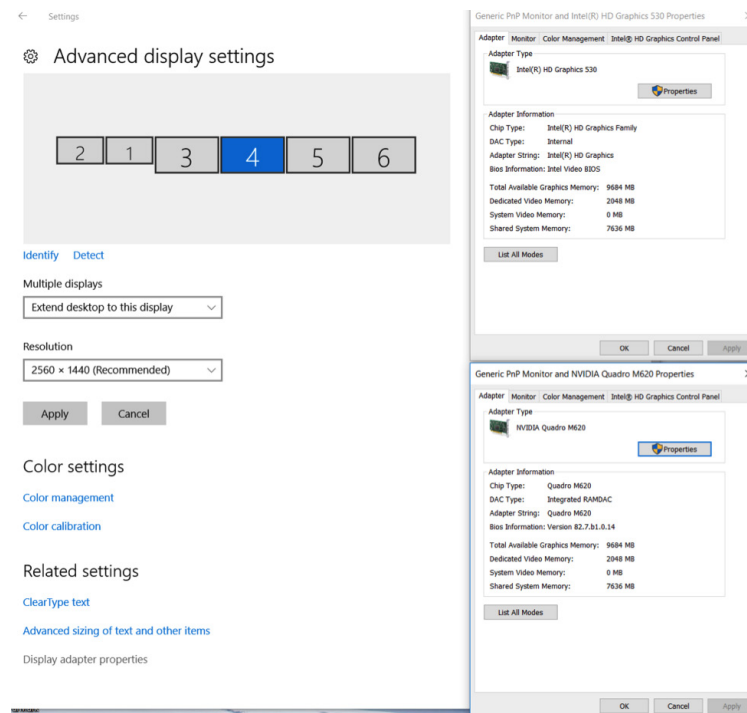
Figure 19. Determining which GPU is on which Display via Display Adapter Properties

NVIDIA® Quadro® and Intel® HD Graphics mode: Troubleshooting Common Issues

Six-Display Configurations

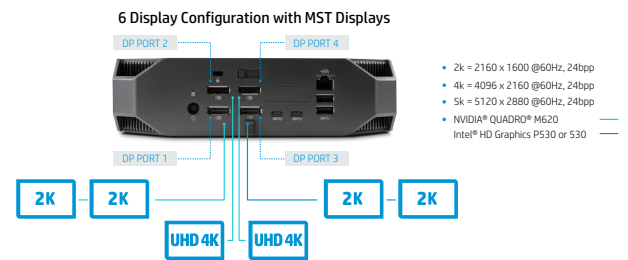| Step	Description	Diagram
1	Connect a single display to DisplayPort™ #1. Connect power, keyboard, and mouse to the system and boot into the system BIOS.	 **HP Z2 Mini G3, Performance Model** 6 Display Configuration with MST Displays
2	Follow the instructions above under the section titled System BIOS Setup for steps to configure the system to use both the NVIDIA® Quadro® and Intel® HD GPUs. This is required for greater than four display configurations.	
3	Boot into the Windows OS.	
4	Once booted into the Windows OS, connect a display to DisplayPort™ #3. Open Windows Display Settings and verify that Windows can see each of the connected displays and that each display can be configured as expected. If issues are found, try another display, another DisplayPort™ cable, and/or DisplayPort™ #2. Ensure correct operation before continuing.	 **HP Z2 Mini G3, Performance Model** 6 Display Configuration with MST Displays
5	Connect an MST capable display to DisplayPort™ #2. Open Windows Display Settings and verify that Windows can see each of the connected displays and that each display can be configured as expected. If issues are found, try another display and/or another DisplayPort™ cable. Ensure correct operation before continuing.	 **HP Z2 Mini G3, Performance Model** 6 Display Configuration with MST Displays
6	Connect an additional display to the display connected to DisplayPort™ #2. This will create a two-display MST daisy-chain off of DisplayPort™ #2. Open Windows Display Settings and verify that Windows can see each of the connected displays and that each display can be configured as expected. If issues are found, try another display and/or another DisplayPort™ cable. Ensure correct operation before continuing.	 **HP Z2 Mini G3, Performance Model** 6 Display Configuration with MST Displays

7   Connect an MST capable display to DisplayPort™ #4.

Open Windows Display Settings and verify that Windows can see each of the connected displays and that each display can be configured as expected.

If issues are found, try another display and/or another DisplayPort™ cable. Ensure correct operation before continuing.

HP Z2 Mini G3, Performance Model

6 Display Configuration with MST Displays

- 2k = 2160 x 1600 @60Hz, 24bpp
- 4k = 4096 x 2160 @60Hz, 24bpp
- 5k = 5120 x 2880 @60Hz, 24bpp
- NVIDIA® QUADRO® M620
  Intel® HD Graphics P530 or 530

8   Connect an additional display to the display connected to DisplayPort™ #4. This will create a two-display MST daisy-chain off of DisplayPort™ #4.

Open Windows Display Settings and verify that Windows can see each of the connected displays and that each display can be configured as expected.

If issues are found, try another display and/or another DisplayPort™ cable.

HP Z2 Mini G3, Performance Model

6 Display Configuration with MST Displays

- 2k = 2160 x 1600 @60Hz, 24bpp
- 4k = 4096 x 2160 @60Hz, 24bpp
- 5k = 5120 x 2880 @60Hz, 24bpp
- NVIDIA® QUADRO® M620
  Intel® HD Graphics P530 or 530

MST Displays are only duplicating one another (not extending)

1. Consult the documentation for each of the displays and ensure that all of the displays which are driving other displays (through MST) are operating in DisplayPort™ 1.2 mode.
2. Ensure that all displays are visible in the Windows Display Settings window and that both displays are in Extended Display mode.

No display output from DP #4 in pre-OS environment

This is expected behavior when configured to use both the NVIDIA® Quadro® and Intel® HD Graphics simultaneously. In this configuration, the NVIDIA® Quadro® GPU is the active GPU during boot and DP #4 is dedicated to the Intel® HD Graphics which is inactive until the system OS has been loaded.

VESA Mount for HP Z Displays

The HP Z2 Mini G3 Workstation can be placed on a desk or mounted under a desk, arms, walls and is designed for VESA mounting to HP Z Display, 3rd party mounts.

Remove bottom system feet to access threaded VESA holes

VESA mounting for "n" series HP Z Displays

Part #: N6N00AA

Displays supported
• HP Z22n, Z23n, Z24n, Z24nf, Z24nq, Z24s, Z25n, Z27n, Z27q, Z32s, Z32x, E240c, E272, HC240, HC270.
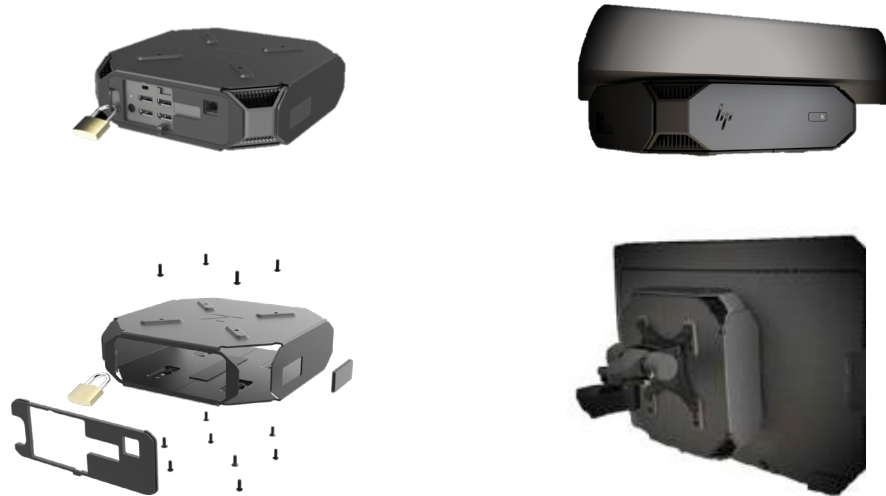
VESA mounting for "i" series HP Z Displays

Part #: E5J35AA

Displays supported
• HP Z24i, Z24x, Z27i, Z27s, Z27x, Z30i.

VESA Mount for arms, walls, and under desks

Ultimate flexibility with mounting accessory sleeve.

Part #: Y7B1AA (AMO Only)

Additional resources
hp.com/go/whitepapers
hp.com/support
hp.com/go/Z2 Mini

¹ Thunderbolt™ is new technology. Thunderbolt™ cable and Thunderbolt™ device (sold separately) must be compatible with Windows. To determine whether your device is Thunderbolt™ Certified for Windows, see thunderbolttechnology.net/products.

² Multi-core is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. Performance and clock frequency will vary depending on application workload and your hardware and software configurations. Intel®'s numbering is not a measurement of higher performance.

³ SATA hardware RAID is not supported on Linux® systems. The Linux® kernel, with built-in software RAID, provides excellent functionality and performance. It is a good alternative to hardware-based RAID. Please visit h20000.www2.hp.com/bc/docs/support/SupportManual/c00060684/c00060684.pdf for RAID capabilities with Linux®.

⁴ Intel® Xeon® E3 and Intel® Core™ i3 processors can support either ECC or non-ECC memory. Intel® Core™ i5/i7 processors only support non-ECC memory.

⁵ 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.windows.com.

⁶ This system is preinstalled with Windows 7 Professional software and also comes with a license and media for Windows 10 Pro software. You may only use one version of the Windows software at a time. Switching between versions will require you to uninstall one version and install the other version. You must back up all data (files, photos, etc.) before uninstalling and installing operating systems to avoid loss of your data.

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