Overview

HP ProBook 650 G5 Notebook PC

Left

1. **1.** Webcam (select models)
2. **2.** Internal microphones (2)
3. **3.** Camera Privacy Shutter
4. **4.** Webcam LED (select models)
5. **5.** Clickpad
6. **6.** Smart Card Reader (select models)
7. **7.** Optical Drive (select models)
8. **8.** Security lock slot (Lock sold separately.)
9. **9.** Power button

Overview

Right

1. Power connector
2. MicroSD card slot
3. Docking connector
4. VGA port (or Serial port)
5. Ethernet port
6. HDMI port (Cable not included)
7. USB 3.1 Gen 1 port
8. USB 3.1 Gen 1 charging port
9. USB Type-C™ charging port
10. Audio combo jack
11. HDD LED indicator
12. Fingerprint reader (Select models)

Overview

AT A GLANCE

- Windows 10 versions and FreeDOS
- Precision-crafted slim design with fingerprint resistant modern, fresh and comfortable natural silver finish
- Choice of 8th Generation Intel® Core™ processors, with integrated graphics or optional AMD Radeon™ 540X 64 bit Discrete Graphics
- HP Advanced keyboard, spill resistant with optional backlit design
- Large Clickpad with gestures support
- Enhanced security features including TPM2.0, HP Privacy Camera, Optional HP Sure View Gen3 (available Q3 2019), Optional Smart Card Reader, Optional Touch Finger Print Reader, HP Sure Sense[2] and HP Sure Start Gen5.
- LED-backlit display 39.6 cm (15.6"") diagonal HD, FHD, Touch FHD or FHD with HP Sure View Gen3 (available Q3 2019).
- Optional WWAN
- HDMI port for connecting to high-resolution displays
- Optional HD webcam with dual-microphone array for video conferencing
- Optional integrated ODD and Serial Port support
- Flexible wireless connectivity options, including 802.11 AX WLAN module and CAT9 WWAN module
- Battery hours up to 15 hours with fast charging technology
- Dual storage combines SSD fast boot up and app access with cost effective HDD mass storage
- Passed MIL-STD 810G test[1]
- Compliance with FCC (Class B)

1. MIL-STD-810G testing is not intended to demonstrate fitness of U.S. Department of Defense (DoD) contract requirements or for military use. Test results are not a guarantee of future performance under these test conditions. Accidental damage requires an optional HP Accidental Damage Protection Care Pack.
2. HP Sure Sense requires Windows 10. See product specifications for availability.

NOTE: See important legal disclosures for all listed specs in their respective features sections.

Technical Specifications

PRODUCT NAME

HP ProBook 650 G5 Notebook PC

OPERATING SYSTEM

Preinstalled Windows® 10 Pro 64[1]
Windows® 10 Pro 64 (National Academic License)[2]
Windows® 10 Home 64[1]
Windows® 10 Home Single Language 64[1]
Windows® 10 Enterprise 64 (Web Support)[1]
FreeDOS

1. 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/.

2. Some devices for academic use will automatically be updated to Windows 10 Pro Education with the Windows 10 Anniversary Update. Features vary; see https://aka.ms/ProEducation for Windows 10 Pro Education feature information.

PROCESSORS

Intel® Core™ i7-8665U vPro™ with Intel® UHD graphics 620 (1.9 GHz base frequency, up to 4.8 GHz with Intel® Turbo Boost Technology, 8 MB L3 cache, 4 cores)[3,4,5]
Intel® Core™ i7-8565U with Intel® UHD graphics 620 (1.8 GHz base frequency, up to 4.6 GHz with Intel® Turbo Boost Technology, 8 MB L3 cache, 4 cores)[3,4,5]
Intel® Core™ i5-8365U vPro™ with Intel® UHD Graphics 620 (1.6 GHz base frequency, up to 4.1 GHz with Intel® Turbo Boost Technology, 6 MB L3 cache, 4 cores)[3,4,5]
Intel® Core™ i5-8265U with Intel® UHD Graphics 620 (1.6 GHz base frequency, up to 3.9 GHz with Intel® Turbo Boost Technology, 6 MB L3 cache, 4 cores)[3,4,5]
Intel® Core™ i3-8145U with Intel® UHD Graphics 620 (2.1 GHz base frequency, up to 3.9 GHz with Intel® Turbo Boost Technology, 4 MB cache, 2 cores)[3,4,5]

Processor Family
8th Generation Intel® Core™ i7 processor (i7-8665U, i7-8565U models)[5]
8th Generation Intel® Core™ i5 processor (i5-8365U, i5-8265U models)[5]
8th Generation Intel® Core™ i3 processor (i3-8145U model)[5]

3. 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.
4. Processor speed denotes maximum performance mode; processors will run at lower speeds in battery optimization mode.
5. In accordance with Microsoft's support policy, HP does not support the Windows 8 or Windows 7 operating system on

products configured with Intel and AMD 7th generation and forward processors or provide any Windows 8 or Windows 7 drivers on http://www.support.hp.com.

CHIPSET

Chipset is integrated with processor

GRAPHICS

Integrated
Intel® UHD Graphics 620[6]

Discrete
AMD Radeon™ 540X (2 GB GDDR5 dedicated)[7]

Supports
Support HD decode, DX12, HDMI 1.4

6. HD content required to view HD images.
7. AMD Dynamic Switchable Graphics technology requires an Intel processor, plus an AMD Radeon™ discrete graphics configuration and is not available on FreeDOS and Linux OS. With AMD Dynamic Switchable Graphics technology, full enablement of all discrete graphics video and display features may not be supported on all systems (e.g. OpenGL applications will run on the integrated GPU or the APU as the case may be).

Technical Specifications

DISPLAY

Non-Touch HD

39.6 cm (15.6") diagonal HD SVA eDP anti-glare LED-backlit, 220 cd/m², 45% NTSC (1366 x 768)[6,8]
39.6 cm (15.6") diagonal HD SVA eDP anti-glare LED-backlit, 220 cd/m², 45% NTSC, for HD camera (1366 x 768)[6,8]
39.6 cm (15.6") diagonal HD SVA eDP anti-glare LED-backlit, 220 cd/m², 45% NTSC, for WWAN (1366 x 768)[6,8]
39.6 cm (15.6") diagonal HD SVA eDP anti-glare LED-backlit, 220 cd/m², 45% NTSC, for HD camera and WWAN (1366 x 768)[6,8]

Non-Touch FHD

39.6 cm (15.6") diagonal FHD IPS eDP anti-glare LED-backlit, 250 cd/m², 45% NTSC (1920 x 1080)[6,8]
39.6 cm (15.6") diagonal FHD IPS eDP anti-glare LED-backlit, 250 cd/m², 45% NTSC, for HD camera (1920 x 1080)[6,8]
39.6 cm (15.6") diagonal FHD IPS eDP anti-glare LED-backlit, 250 cd/m², 45% NTSC, for WWAN (1920 x 1080)[6,8]
39.6 cm (15.6") diagonal FHD IPS eDP anti-glare LED-backlit, 250 cd/m², 45% NTSC, for HD camera and WWAN (1920 x 1080)[6,8]

Touch FHD

39.6 cm (15.6") diagonal FHD IPS eDP LED-backlit touch screen, 250 cd/m², 45% NTSC, for HD camera and WWAN (1920 x 1080)[6,8]

Non-Touch FHD Privacy Panel

HP Sure View Gen3 Integrated Privacy Screen 39.6 cm (15.6") diagonal FHD IPS eDP anti-glare LED-backlit, 1000 cd/m², 72% NTSC, for HD camera and WWAN (1920 x 1080) (available Q3 2019)

6. HD content required to view HD images.
8. Resolutions are dependent upon monitor capability, and resolution and color depth settings.

Docking station model	Total number of supported displays (incl. the notebook display)	Max. resolutions supported	Dock Connectors	Technical limitations
HP UltraSlim Docking Station	3	Dual 2.5K @ 60Hz	2xDP, 1xVGA	Dual 2.5k only with both displays into DP
HP Thunderbolt Dock G2	3	Single 4K@60Hz (3840 x 2160)	2xDP, 1xVGA, 1xTB,1xUSB-C alt-mode	System will perform at USB 3.0 Gen1 speeds when connected to the dock (5Gbits) Thunderbolt port will function as a USB 2.0 port with data and power out (15W) only.
HP USB-C Dock G4	3	Dual 2K @ 60Hz Single 4K @ 60Hz (3840 x 1440)	1xHDMI, 2xDP	
HP USB-C Universal Dock	3	Dual 4K @ 60Hz Single 5K @ 60Hz	2xDP	
HP USB-C Travel Dock	2	Single 2K @ 60Hz	1xHDMI, 1xVGA	Single external display Only HDMI or VGA at the time
HP USB-C Mini Dock	2	Single 4K @ 30Hz	1xHDMI, 1xVGA	Single external display Only HDMI or VGA at the time

Technical Specifications

STORAGE AND DRIVES

Primary Storage
500 GB 7200 rpm SATA[9]
500 GB 7200 rpm SATA FIPS 140-2 SED[9]
1 TB 7200 rpm SATA[9]

Primary M.2 Storage
128 GB SATA-3 SS TLC[9]
256 GB PCIe® NVMe™ SS Value[9]
256 GB PCIe® Gen3x4 NVMe™ SS TLC[9]
256 GB SATA-3 TLC FIPS[9]
256 GB SATA-3 SS TLC (Opal 2)[9]
256GB QLC + 32 GB Optane Memory (Available Q3 2019)
512 GB PCIe® NVMe™ Value[9]
512 GB PCIe® Gen3x4 NVMe™ SS TLC[9]
512 GB PCIe® Gen3x4 NVMe™ SS TLC (Opal 2)[9]
512 GB SATA- 3 SS TLC (FIPS)[9]
512GB QLC + 32 GB Optane Memory (available Q3 2019)
1 TB PCIe® Gen3x4 NVMe™ SS TLC[9]

Cache Memory
16 GB PCIe® NVMe™ Intel® Optane™ Memory for storage acceleration[9]

9. For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 30 GB (for Windows 10) is reserved for system recovery software.

MEMORY

Maximum Memory
32 GB DDR4-2400 SDRAM[10]

Memory
4 GB Total System Memory (4 GB x 1)[10]
8 GB Total System Memory (4 GB x 2)[10]
8 GB Total System Memory (8 GB x 1)[10]
12 GB Total System Memory (8 GB + 4 GB)[10]
16 GB Total System Memory (16 GB x 1)[10]
16 GB Total System Memory (8 GB x 2)[10]
32 GB Total System Memory (16 GB x2)[10]

Memory Slots
2 SODIMM
Both slots are customer accessible / upgradeable
DDR4 SODIMMS, System runs at: 2400
Supports Dual Channel Memory

10. Due to the non-industry standard nature of some third-party memory modules, we recommend HP branded memory to ensure compatibility. If you mix memory speeds, the system will perform at the lower memory speed.

NETWORKING/COMMUNICATIONS

WLAN

Intel® Dual Band Wireless-AC 9560 802.11 ac (2x2) Wi-Fi® and Bluetooth® 5 Combo, vPro™[11]
Intel® Dual Band Wireless-AC 9560 802.11 ac (2x2) Wi-Fi® and Bluetooth® 5 Combo, non-vPro™[11]
Intel® Wi-Fi 6** AX200 + Bluetooth® 5 (802.11ax 2x2, vPro, supporting gigabit file transfer speeds)[11]
Intel® Wi-Fi 6** AX200 + Bluetooth® 5 (802.11ax 2x2, non-vPro, supporting gigabit file transfer speeds)[11]

WWAN

LTE CAT6: Fibocom Intel® XMM™ 7262 LTE-Advanced, LTE/HSPA+ w/GPS[12]
LTE CAT9: Fibocom Intel® XMM™ 7360 LTE-Advanced, LTE/HSPA+ w/GPS[12]

NFC

NXP NPC300 Near Field Communication Module [13]

WPAN Bluetooth®

BT 5.0 supported via all supported WLAN modules

Ethernet

Intel® Ethernet Connection I219-LM 10/100/1000 (vPro™)[14]
Intel® Ethernet Connection I219-V 10/100/1000 (Non-vPro™)[14]

[11] Wireless access point and Internet service required and sold separately. Availability of public wireless access points limited.
[12] WWAN module requires separately purchased service contract. Check with service provider for coverage and availability in your area. Connection speeds will vary due to location, environment, network conditions, and other factors. 4G LTE not available on all products, in all regions.
[13] Sold separately or as an optional feature.
[14] The term "10/100/1000" or "Gigabit" Ethernet indicates compatibility with IEEE standard 802.3ab for Gigabit Ethernet, and does not connote actual operating speed of 1 Gb/s. For high-speed transmission, connection to a Gigabit Ethernet server and network infrastructure is required.
**Wireless access point and internet service required and sold separately. Availability of public wireless access points limited. Wi-Fi 6 is backwards compatible with prior 802.11 specs. The specifications for Wi-Fi 6 (802.11ax) are draft and are not final. If the final specifications differ from the draft specifications, it may affect the ability of the notebook to communicate with other 802.11ax devices. Only available in countries where 802.11ax is supported.

Technical Specifications

AUDIO/MULTIMEDIA

Audio
2 Integrated stereo speakers
Integrated dual array microphone

Webcam
720p HD HP Privacy Camera[6,15,16]

Optical Drive
DVD-ROM (Defeatured Combo)[17]
DVD Writer SATA Drive[17]

[6]. HD content required to view HD images.
[15]. Sold separately or as an optional feature.
[16]. Internet access required.
[17]. DVD-Writer does not support DVD RAM. Don't copy copyright protected materials.

KEYBOARDS/POINTING DEVICES/BUTTONS & FUNCTION KEYS

Keyboard
HP Advanced Keyboard with Numeric Keypad

Pointing Device
ClickPad, Spill-resistant with drain
ClickPad, Spill-resistant with drain, DuraKeys & Backlit
Dual Point, Spill-resistant with drain, DuraKeys & Backlit
Dual Point Spill-resistant with drain, DuraKeys & Backlit Privacy

Function Keys
ESC: system information
F1 - Display Switching
F2 - Blank or Privacy
F3 - Brightness Down
F4 - Brightness Up
F5 - Speaker Mute
F6 - Volume Down
F7 – Volume Up
F8 - Mic Mute
F9 - Backlight Toggle (for backlit keyboard) or Blank
F10 – Blank
F11 – Wi-fi Toggle
F12 – Sleep

Clickpad requirements:
On/off control by driver
Taps enabled as default

Gestures:
(Win 10):
Disabled by default:
3 Finger Flick
2 Finger Rotate
Momentum Motion
1 Finger Vertical Scroll

Win 10:
Support PTP with Miniport driver
Settings enabled by default by MSFT:
2 Finger Scrolling
2 Finger Zoom (Pinch)
OSD (enable/disable)
3 finger tap – Cortana
3 finger flick –App switch
4 finger tap – Action Center

SOFTWARE AND SECURITY

Preinstalled Software

BIOS
HP BIOSphere Gen5[18]
HP Drive Lock & Automatic Drive Lock[19]
BIOS Update via Network
Master Boot Record Security
Power On Authentication
Secure Erase[20]
Absolute Persistence Module[21]
Pre-boot Authentication

Software
HP Native Miracast Support[22]
HP Connection Optimizer
HP Image Assistant
HP Hotkey Support
HP JumpStart
HP Support Assistant[23]
HP Noise Cancellation Software
Buy Office (sold separately)

Technical Specifications

Manageability Features

HP Driver Packs[24]
HP System Software Manager (SSM)
HP BIOS Config Utility (BCU)
HP Client Catalog
HP Manageability Integration Kit Gen3[25]

Client Security Software

HP Client Security Manager Gen5[26]
HP Fingerprint Sensor[27]
HP Power On Authentication
Windows Defender[28]

Security Management

Pre-boot Authentication
TPM 2.0 Embedded Security Chip shipped with Windows 10 (Common Criteria EAL4+ Certified)[29]
M2 SSD, SATA 1 port disablement (via BIOS)
Serial, USB enable/disable (via BIOS)
Power-on password (via BIOS)
Setup password (via BIOS)
Support for chassis padlocks and cable lock devices
HP Sure Click[30]
HP Sure Start Gen5[31]
HP Sure Sense[32]

Security
TPM

Model: Infineon SLB9670
Version: 7.85
Revision: TPM 2.0
FIPS 140-2 Compliant: Yes

Smartcard Reader

Model number: Alcor AU9560
FIPS 201 Compliant: Yes

IPv6 Compliance:

Yes

MD5 Hash: Please follow the instructions below to access MD5 Hash.

Log-on to http://hp.com/support, enter your product name, select software and drivers, select OS, select driver. After selecting the driver, click on “Associated files” and then click on “Download”. When opening the file, under “Purpose” you should see the appropriate “SOFTPAQ MD5:” Field

Is the BIOS on this notebook ISO/IEC 19678:2015 (formerly NIST 800-147) compliant?:

Yes
UEFI version: 2.6

18. HP BIOSphere Gen5 is available on select HP Pro and Elite PCs. See product specifications for details. Features may vary depending on the platform and configurations.
19. HP Drive Lock & Automatic Drive Lock is not supported on NVMe drives
20. 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™.
21. Absolute agent is shipped turned off, and will be activated when customers activate a purchased subscription. Subscriptions can be purchased for terms ranging multiple years. Service is limited, check with Absolute for availability outside the U.S. The Absolute Recovery Guarantee is a limited warranty. Certain conditions apply. For full details visit: http://www.absolute.com/company/legal/agreements/ computrace-agreement. Data Delete is an optional service provided by Absolute Software. If utilized, the Recovery Guarantee is null and void. In order to use the Data Delete service, customers must first sign a Pre-Authorization Agreement and either obtain a PIN or purchase one or more RSA SecurID tokens from Absolute Software.
22. Miracast is a wireless technology your PC can use to project your screen to TVs, projectors, and streaming.
23. HP Support Assistant requires Windows and Internet access.
24. HP Driver Packs not preinstalled, however available for download at http://www.hp.com/go/clientmanagement.
25. HP Manageability Integration Kit can be downloaded from http://www.hp.com/go/clientmanagement.
26. HP Client Security Manager Gen5 requires Windows and is available on the select HP Pro and Elite PCs. See product specifications for details.
27. HP Fingerprint Sensor sold separately or as an optional feature.
28. Windows Defender Opt in and internet connection required for updates.
29. Firmware TPM is version 2.0. Hardware TPM is v1.2, which is a subset of the TPM 2.0 specification version v0.89 as implemented by Intel Platform Trust Technology (PTT).re TPM is version 2.0. Hardware TPM is v1.2, which is a subset of the TPM 2.0 specification version v0.89 as implemented by Intel Platform Trust Technology (PTT).
30. HP Sure Click is available on most HP PCs and supports Microsoft® Internet Explorer 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.
31. HP Sure Start Gen5 is available on select HP PCs with Intel processors. See product specifications for availability.
32. HP Sure Sense requires Windows 10. See product specifications for availability.

POWER

Power Supply

HP Smart 45 W right angle 4.5 mm AC Adapter[33]
HP Smart 45 W right angle 4.5 mm AC Adapter - Argentina[33]
HP Smart 45 W right angle 4.5 mm AC Adapter 2-prong (Japan only) [33]
HP Smart 45 W USB Type-C™ adapter[33]
HP Smart 65 W right angle 4.5 mm AC Adapter[33]
HP Smart 65 W EM External AC power adapter[33]
HP Smart 65 W USB Type-C™ adapter[33]

Primary Battery

HP Long Life 3-cell, 48 Wh Li-ion[34]
HP Fast Charge Technology - 90% in 90minutes

Battery Life

Up to 15 hours[35]

Power Cord

2-wire plug (C7), 1.0m, Conventional
3-wire plug (C5), 1.0m, Conventional
3-wire plug (C5), 1.8m, Conventional

Duckhead power cord, 1.0m, Premium
Duckhead power cord, 1.8m, Premium

33. Availability may vary by country.
34. Battery is internal and not replaceable by customer. Serviceable by warranty.
35. Windows 10 MM14 battery life will vary depending on various factors including product model, configuration, loaded applications, features, use, wireless functionality, and power management settings. The maximum capacity of the battery will naturally decrease with time and usage. See www.bapco.com for additional details.

WEIGHTS & DIMENSIONS

Weight
Starting at 4.8 lb (non-touch); Starting at 5.29 lb (touch)[36]
Starting at 2.18 kg (non-touch); Starting at 2.4 kg (touch)[36]

Dimensions (W x D x H)
14.85 x 10.12 x 0.95 in (non-touch); 14.85 x 10.12 x 0.99 in (touch)
37.7 x 25.7 x 2.39 cm (non-touch); 37.7 x 25.7 x 2.49 cm (touch)

36. Weight will vary by configuration.

PORTS/SLOTS

Ports

2 USB 3.1 Gen 1 (1 charging)
1 USB 3.1 Type-C™ Gen1 (Power delivery, DisplayPort™)
1 HDMI 1.4[37]
1 RJ-45
1 VGA or Serial Port
1 headphone/microphone combo
1 AC power

Expansion Slots
1 docking connector
1 microSD (multi-format digital media reader)

37. HDMI cable sold separately.

SERVICE AND SUPPORT

HP Services offers 3-year and 1-year limited warranties and 90 day software support options depending on country and the SKU selected by the customer. Batteries have a default one year limited warranty except for Long Life batteries which will have same 1-year or 3-year limited warranty as the platform. On-site service and extended coverage is also available with

Technical Specifications

HP Care Pack Services, optional extended service contracts that go beyond the standard limited warranties. 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/cpc.[38]

[38] HP Care Packs are sold separately. Service levels and response times for HP Care Packs may vary depending on your geographic location. Service starts on date of hardware purchase. Restrictions and limitations apply. For details, visit http://www.hp.com/go/cpc. HP services are governed by the applicable HP terms and conditions of service provided or indicated to Customer at the time of purchase. Customer may have additional statutory rights according to applicable local laws, and such rights are not in any way affected by the HP terms and conditions of service or the HP Limited Warranty provided with your HP Product.

CERTIFICATION AND COMPLIANCE

ENERGY STAR® certified
EPEAT® 2019 Silver[39]
Low halogen[40]
TCO 5.0 Certified

[39] EPEAT® 2019 registered where applicable. EPEAT® registration varies by country. See http://www.epeat.net for registration status by country. According to IEEE 1680.1-2018.

[40] External power supplies, power cords, cables and peripherals are not Low Halogen. Service parts obtained after purchase may not be Low Halogen.

Technical Specifications

SYSTEM UNIT

Stand-Alone Power Requirements (AC Power)	**Nominal Operating Voltage**	19.5 V
	Average Operating Power	Win 10
	Integrated Graphics	11 W
	Discrete Graphics	16 W
	Max Operating Power	Discrete < 65W UMA < 45W
Temperature	**Operating**	32° to 95° F (0° to 35° C) (not writing optical)
	Non-operating	41° to 95° F (5° to 35° C) (writing optical)
Relative Humidity	**Operating**	10% to 90%, non-condensing
	Non-operating	5% to 95%, 101.6° F (38.7° C) maximum wet bulb temperature
Shock	**Operating**	40 G, 2 ms, half-sine
	Non-operating	200 G, 2 ms, half-sine
Random Vibration	**Operating**	0.75 grms
	Non-operating	1.50 grms
Altitude (unpressurized)	**Operating**	-50 to 10,000 ft (-15.24 to 3,048 m)
	Non-operating	-50 to 40,000 ft (-15.24 to 12,192 m)
Planned Industry Standard Certifications	**UL**	Yes
	CSA	Yes
	FCC Compliance	Yes
	ENERGY STAR®	Select models[41]
	EPEAT® 2019 Silver	Yes[42]
	ICES	Yes
	Australia / NZ A-Tick Compliance	Yes
	CCC	Yes
	Japan VCCI Compliance	Yes
	KC	Yes
	BSMI	Yes
	CE Marking Compliance	Yes
	BNCI or BELUS	Yes
	CIT	Yes
	GOST	Yes
	Saudi Arabian Compliance (ICCP)	Yes
	SABS	Yes

41. Configurations of the HP ProBook 650 G5 that are ENERGY STAR® qualified are identified as HP ProBook 650 G5 ENERGY STAR on HP websites and on http://www.energystar.gov.

42. EPEAT® 2019 registered where applicable. EPEAT® registration varies by country. See http://www.epeat.net for registration status by country. According to IEEE 1680.1-2018.

DISPLAYS

Panel LCD 15.6 inch diagonal FHD (1920 x 1080) Anti-Glare WLED UWVA 72 percent cg 1000 nits eDP 1.4+PSR2 flat Privacy NWBZ	**Outline Dimensions (W x H x D)**	349.52 x 204.79 mm (max)
	Active Area	344.16 x 193.59 mm (typ.)
	Weight	350 g (max)
	Diagonal Size	15.6 inch
	Thickness	2.6 mm (max)
	Interface	eDP 1.4 + PSR2 (4 lane)
	Surface Treatment	Anti-Glare
	Touch Enabled	No
	Contrast Ratio	2000:1 (typ.)
	Refresh Rate	60 Hz
	Brightness	1000 nits
	Pixel Resolution	1920 x 1080 (FHD)
	Format	RGB
	Backlight	LED
	Color Gamut Coverage	72%
	Color Depth	8 bits
	Viewing Angle	UWVA 85/85/85/85

Panel LCD 15.6 inch diagonal FHD (1920 x 1080) Anti-Glare WLED UWVA 45 percent cg 250 nits eDP 1.2 w/o PSR slim NWBZ	**Outline Dimensions (W x H x D)**	350.96 x 216.65 mm (max)
	Active Area	344.16 x 193.59 mm (typ.)
	Weight	370 g (max)
	Diagonal Size	15.6 inch
	Thickness	3.2 mm (max)
	Interface	eDP 1.2 (2 lane)
	Surface Treatment	Anti-Glare

Technical Specifications

	Touch Enabled	No
	Contrast Ratio	600:1 (typ.)
	Refresh Rate	60 Hz
	Brightness	250 nits
	Pixel Resolution	1920 x 1080 (FHD)
	Format	RGB
	Backlight	LED
	Color Gamut Coverage	45%
	Color Depth	6 bits
	Viewing Angle	UWVA 85/85/85/85

Panel LCD 15.6 inch diagonal FHD (1920 x 1080) Anti-Glare WLED UWVA 45 percent cg 250 nits eDP slim Touch on Panel NWBZ	**Outline Dimensions (W x H x D)**	350.96 x 216.75 mm (max)
	Active Area	344.16 x 193.59 mm (typ.)
	Weight	385 g (max)
	Diagonal Size	15.6 inch
	Thickness	3.2 mm (panel side) / 3.4 mm (PCBA Side) (max)
	Interface	eDP 1.2
	Surface Treatment	Anti-Glare On-cell
	Touch Enabled	No
	Contrast Ratio	600:1 (typ.)
	Refresh Rate	60 Hz
	Brightness	250 nits
	Pixel Resolution	1920 x 1080 (FHD)
	Format	RGB
	Backlight	LED
	Color Gamut Coverage	45%
	Color Depth	6 bits
	Viewing Angle	UWVA 85/85/85/85

Technical Specifications

15.6" diagonal HD SVA anti-glare LED-backlit non-touch; 220 cd/m²; 45% percent cg (1366 x 768)	**Outline Dimensions (W x H x D)**	360 x 224.3 (mm) max
	Active Area	344.2 x 193.5 (mm)
	Weight	370 g max
	Diagonal Size	15.6 (inch)
	Thickness	3.2 (mm) max
	Interface	eDP 1.2
	Surface Treatment	Anti-Glare (AG)
	Touch Enabled	None
	Contrast Ratio	300:1 (typical)
	Refresh Rate	60 Hz
	Brightness	220 nits
	Pixel Resolution	1366 x 768 (HD)
	Format	RGB
	Backlight	LED
	Color Gamut Coverage	45%
	Color Depth	6 bits + Hi FRC
	Viewing Angle	SVA 45/45/25/35

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

Technical Specifications

STORAGE

HDD 500 GB 7200 RPM 7mm SATA	**Drive Weight**	0.21 lbs (95 g)
	Rotation speed	7200 RPM
	Cache Buffer	Up to 32 MB
	Height	0.28 in (7 mm)
	Width	2.75 in (69.85 mm)
	Interface	ATA-8, SATA 3.0
	Transfer Rate	600 MB/s
	Seek Time	Single Track: 2 ~ 1.5 ms; Average: 11 ~ 13 ms; Maximum: 18 ~ 22 ms
	Logical Blocks	976,773,168
	Operating Temperature	32° to 140°F (0° to 60°C) [ambient temp]
	Security Features	ATA Security
	Features	S.M.A.R.T., NCQ, Ultra DMA

HDD 500 GB 7200 RPM 7mm FIPS SATA Opal2	**Drive Weight**	0.21 lbs (95 g)
	Rotation speed	7200 RPM
	Cache Buffer	Up to 32 MB
	Height	0.28 in (7 mm)
	Width	2.75 in (69.85 mm)
	Interface	ATA-8, SATA 3.0
	Transfer Rate	600 MB/s
	Seek Time	Single Track: 2 ~ 1.5 ms; Average: 11 ~ 13 ms; Maximum: 18 ~ 22 ms
	Logical Blocks	976,773,168
	Operating Temperature	32° to 140°F (0° to 60°C) [ambient temp]
	Security Features	ATA Security; TCG Opal 2.x, FIPS
	Features	S.M.A.R.T., NCQ, Ultra DMA

Technical Specifications

HDD 1 TB 7200 RPM 7mm SATA 2.5in	**Drive Weight**	90 g
	Rotation speed	7200 RPM
	Cache Buffer	128 MB
	Height	7.2mm Max.
	Width	69.85mm
	Interface	ATA-8, SATA 3.0
	Transfer Rate	600 MB/s
	Seek Time	Single Track: 1.5 ms Average: 13 ms Maximum: 32 ms
	Logical Blocks	1,953,525,168
	Operating Temperature	0~60°C
	Security Features	ATA Security
	Features	S.M.A.R.T., NCQ, Ultra DMA, TRIM

SSD 128 GB 2280 M2 SATA-3 TLC	**Drive Weight**	0.02 lb (10 g)
	Capacity	128 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	ATA-8, SATA 3.0
	Maximum Sequential Read	Up To 520 MB/s
	Maximum Sequential Write	Up To 450 MB/s
	Logical Blocks	250,069,680
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	DIPM; TRIM; DEVSLP

256 GB 2280 PCIe NVMe Value Solid State Drive	**Drive Weight**	0.02 lb (10 g)
	Capacity	256 GB
	NAND Type	MLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	Up To 1700 MB/s
	Maximum Sequential Write	Up To 600 MB/s
	Logical Blocks	703,282,608
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	TRIM; L1.2

SSD 256 GB 2280 M2 PCIe-3x4 SS NVMe TLC	**Drive Weight**	0.02 lb (10 g)
	Capacity	256 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	Up To 2600 MB/s
	Maximum Sequential Write	Up To 900 MB/s
	Logical Blocks	500,118,192
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	TRIM; L1.2

SSD 256 GB 2280 M2 SATA-3 Three Layer Cell Federal Information Processing Standard	**Form Factor**	M.2 2280
	Capacity	256 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	0.02 lb (10 g)
	Maximum Sequential Read	ATA-8, SATA 3.0
	Maximum Sequential Write	Up To 530 MB/s
	Logical Blocks	Up To 550 MB/s
	Operating Temperature	500,118,192

Technical Specifications

SSD 256 GB 2280 M2 SATA-3 Self Encrypted OPAL2 Three Layer Cell		
	Form Factor	M.2 2280
	Capacity	256 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Weight	0.02 lb (10 g)
	Interface	ATA-8, SATA 3.0
	Maximum Sequential Read	Around 530 ~ 560 MB/s
	Maximum Sequential Write	Around 500 ~ 530 MB/s
	Logical Blocks	500,118,192
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	ATA Security; TCG OPAL 2.0; DIPM; TRIM; DEVSLP

256 GB 2280 PCIe-3x2x2 NVMe+SSD 16 GB 3D Xpoint		
	Form Factor	M.2 2280
	Capacity	256 GB
	NAND Type	QLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Weight	0.02 lb (10 g)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	Up To 1450 MB/s
	Maximum Sequential Write	Up To 650 MB/s
	Logical Blocks	500,118,192
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	TRIM; L1.2, Optane Storage acceleration

SSD 512 GB 2280 PCIe NVMe Value		
	Form Factor	M.2 2280
	Capacity	512 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Weight	0.02 lb (10 g)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	Around 1500 ~ 1700 MB/s

	Maximum Sequential Write	Around 860 ~ 1500 MB/s
	Logical Blocks	1,000,215,215
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	ATA Security; TRIM; L1.2

SSD 512 GB 2280 M2 PCIe-3x4 SS NVMe TLC	**Drive Weight**	0.02 lb (10 g)
	Capacity	512 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	Up To 2600 MB/s
	Maximum Sequential Write	Up To 1400 MB/s
	Logical Blocks	1,000,215,216
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	TRIM; L1.2

SSD 512 GB 2280 PCIe-3x4 NVMe Self Encrypted OPAL2 Three Layer Cell	**Form Factor**	M.2 2280
	Capacity	512 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	0.02 lb (10 g)
	Maximum Sequential Read	PCIe NVMe Gen3X4
	Maximum Sequential Write	Around 3000 ~ 3400 MB/s
	Logical Blocks	Around 1800 ~ 2500 MB/s
	Operating Temperature	1,000,215,216
	Features	32° to 158°F (0° to 70°C) [ambient temp]

SSD 512 GB 2280 M2 SATA-3 TLC FIPS	**Drive Weight**	0.02 lb (10 g)
	Capacity	512 GB
	NAND Type	TLC

Technical Specifications

	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	ACS-3, SATA 3.2
	Maximum Sequential Read	Up To 530 MB/s
	Maximum Sequential Write	Up To 400 MB/s
	Logical Blocks	1,000,215,216
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	DIPM; TRIM; DEVSLP
SSD 512 GB 2280 PCIe-3x2x2 NVMe+SSD 32 GB 3D Xpoint	**Form Factor**	M.2 2280
	Capacity	512 GB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Weight	0.02 lb (10 g)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	Up To 2400 MB/s
	Maximum Sequential Write	Up To 1300 MB/s
	Logical Blocks	1,000,215,215
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	ATA Security, TRIM; L1.2
SSD 1 TB 2280 PCIe-3x4 NVMe TLC SS	**Drive Weight**	0.02 lb (10 g)
	Capacity	1 TB
	NAND Type	TLC
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	PCIe NVMe Gen3X4
	Maximum Sequential Read	2900
	Maximum Sequential Write	2000
	Logical Blocks	2000409263
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	TRIM; L1.2

SSD 16 GB 2280 PCIe-3x2 NVMe 3D Xpoint	**Drive Weight**	M.2 2280
	Capacity	16 GB
	NAND Type	Xpoint
	Height	0.09 in (2.3 mm)
	Width	0.87 in (22 mm)
	Interface	PCIe NVMe Gen3X2
	Maximum Sequential Read	1400
	Maximum Sequential Write	300
	Logical Blocks	28,181,188
	Operating Temperature	32° to 158°F (0° to 70°C) [ambient temp]
	Features	L1.2

NOTE: For storage drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 30 GB (for Windows 10) is reserved for system recovery software.

OPTICAL DRIVES

DVD-ROM Drive	**Access Times**	**Random**	<140ms CD (typical) < 160ms DVD (typical)
	Weight	150g max.	
	Max Data Transfer Rate	24X CD-ROM 8X DVD-ROM 5X DVD-RAM UDMA Mode 5	

DVD Writer SATA Drive	**Interface**	Gen 1 SATA	
	Supported Media (read)	CD-DA, CD-TEXT, CD-ROM, CD-ROM XA, MIXED MODE CD, CD-I, CD-I Bridge (Photo-CD, Video CD), Multisession CD (Photo-CD, CD-EXTRA, Portfolio, CD-R, CD-RW), CD-R, CD-RW, DVD-ROM (DVD-5, DVD-9, DVD-10, DVD-18), DVD-R, DVD-RW, DVD+R, DVD+RW, DVD-RAM	
	Max Media Capacity (read)	8.5 GB	
	Transport	Tray Loading	
	Access Times	**Random**	<140ms CD (typical)
			< 160ms DVD (typical)
	Weight	150g max.	
	Max Data Transfer Rate	24X CD-ROM 8X DVD-ROM 24X CD-R 10X CD-RW 8X DVD+R 8X DVD+RW 8X DVD-R 6X DVD-RW 6X - DVD+R Dual Layer 6X - DVD-R Dual Layer 5X DVD-RAM	
	Transfer Mode	UDMA Mode 5	
	Interface	Gen 1 SATA	
	Supported Media (read)	CD-DA, CD-TEXT, CD-ROM, CD-ROM XA, MIXED MODE CD, CD-I, CD-I Bridge (Photo-CD, Video CD), Multisession CD (Photo-CD, CD-EXTRA, Portfolio, CD-R, CD-RW), CD-R, CD-RW, DVD-ROM (DVD-5, DVD-9, DVD-10, DVD-18), DVD-R, DVD-RW, DVD+R, DVD+RW, DVD-RAM	
	Supported Media (write)	CD-R, CD-RW, DVD+R, DVD+RW, DVD-R, DVD-RW, DVD-RAM, DVD+R DL, DVD-R DL	
	Max Media Capacity (read)	8.5 GB	
	Max Media Capacity (write)	8.5 GB	
	Transport	Tray Loading	

NETWORKING

Intel® Wi-Fi® 6 AX200 + BT5 vPro**	**Wireless LAN Standards**	IEEE 802.11a IEEE 802.11b IEEE 802.11g

	IEEE 802.11n IEEE 802.11ac IEEE 802.11ax IEEE 802.11d IEEE 802.11e IEEE 802.11h IEEE 802.11i IEEE 802.11k IEEE 802.11r IEEE 802.11v
Interoperability	Wi-Fi® certified
Frequency Band	•802.11b/g/n/ax 2.402 – 2.482 GHz •802.11a/n/ac/ax 4.9 – 4.95 GHz (Japan) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.47 – 5.725 GHz 5.825 – 5.850 GHz
Data Rates	•802.11b: 1, 2, 5.5, 11 Mbps •802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11a: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11n: MCS 0 ~ MCS 15, (20MHz, and 40MHz) •802.11ac: MCS0 ~ MCS9, (1SS, and 2SS) (20MHz, 40MHz, 80MHz & 160MHz) •802.11ax: MCS0 ~ MCS11, (1SS and 2SS) (20MHz, 40MHz, 80MHz & 160MHz)
Modulation	Direct Sequence Spread Spectrum OFDM, BPSK, QPSK, CCK, 16-QAM, 64-QAM, 256-QAM , 1024QAM
Security[3]	•IEEE and Wi-Fi compliant 64 / 128 bit WEP encryption for a/b/g mode only •AES-CCMP: 128 bit in hardware •802.1x authentication •WPA, WPA2: 802.1x. WPA-PSK, WPA2-PSK, TKIP, and AES. •WPA2 certification •IEEE 802.11i •Cisco Certified Extensions, all versions through CCX4 and CCX Lite •WAPI
Network Architecture Models	Ad-hoc (Peer to Peer) Infrastructure (Access Point Required)
Roaming	IEEE 802.11 compliant roaming between access points
Output Power[2]	• 802.11b: +18.5dBm minimum • 802.11g: +17.5dBm minimum • 802.11a: +18.5dBm minimum • 802.11n HT20(2.4GHz): +15.5dBm minimum • 802.11n HT40(2.4GHz): +14.5dBm minimum • 802.11n HT20(5GHz): +15.5dBm minimum

	• 802.11n HT40(5GHz): +14.5dBm minimum • 802.11ac VHT80(5GHz): +11.5dBm minimum • 802.11ac VHT160(5GHz): +11.5dBm minimum • 802.11ax HT40(2.4GHz): +10dBm minimum • 802.11ax VHT160(5GHz): +10dBm minimum	
Power Consumption	•Transmit mode 2.0 W •Receive mode 1.6 W •Idle mode (PSP) 180 mW (WLAN Associated) •Idle mode 50 mW (WLAN unassociated) •Connected Standby 10 mW •Radio disabled 8 mW	
Power Management	ACPI and PCI Express compliant power management 802.11 compliant power saving mode	
Receiver Sensitivity[4]	•802.11b, 1Mbps: -93.5dBm maximum •802.11b, 11Mbps: -84dBm maximum • 802.11a/g, 6Mbps: -86dBm maximum • 802.11a/g, 54Mbps: -72dBm maximum • 802.11n, MCS07: -67dBm maximum • 802.11n, MCS15: -64dBm maximum • 802.11ac, MCS0: -84dBm maximum • 802.11ac, MCS9: -59dBm maximum •802.11ax, MCS11(HT40): -59dBm maximum •802.11ax, MCS11(VHT160): -58.5dBm maximum	
Antenna type	High efficiency antenna with spatial diversity, mounted in the display enclosure Two embedded dual band 2.4/5 GHz antennas are provided to the card to support WLAN MIMO communications and Bluetooth communications	
Form Factor	PCI-Express M.2 MiniCard	
Dimensions	1. Type 2230: 2.3 x 22.0 x 30.0 mm 2. Type 1216: 1.67 x 12.0 x 16.0 mm	
Weight	1. Type 2230: 2.8g 2. Type 126: 1.3g	
Operating Voltage	3.3v +/- 9%	
Temperature	**Operating**	14° to 158° F (–10° to 70° C)
	Non-operating	–40° to 176° F (–40° to 80° C)
Humidity	**Operating**	10% to 90% (non-condensing)
	Non-operating	5% to 95% (non-condensing)
Altitude	**Operating**	0 to 10,000 ft (3,048 m)
	Non-operating	0 to 50,000 ft (15,240 m)

HP Integrated Module with Bluetooth 4.0/4.1/4.2/5.0/5.1 Wireless Technology

Bluetooth Specification	4.0/4.1/4.2/5.0/5.1 Compliant
Frequency Band	2402 to 2480 MHz
Number of Available Channels	Legacy: 0~79 (1 MHz/CH) BLE: 0~39 (2 MHz/CH)

Signaling Data Rate	Legacy: 3 Mbps signaling data rate[1] 2.17 Mbps BLE: 1 Mbps signaling data rate[1] 0.2 Mbps 1. Actual throughput may vary. Legacy: Synchronous Connection Oriented links up to 3, 64 kbps, voice channels Legacy: Asynchronous Connection Less links 2178.1 kbps/177.1 kbps asymmetric (3-DH5) or 864 kbps symmetric (3-EV5)
Transmit Power	The Bluetooth component shall operate as a Class II Bluetooth device with a maximum transmit power of + 9.5 dBm for BR and EDR.
Power Consumption	Peak (Tx) 330 mW Peak (Rx) 230 mW Selective Suspend 17 mW
Bluetooth Software Supported	Microsoft Windows Bluetooth Software
Power Management	Microsoft Windows ACPI, and USB Bus Support
Certifications	FCC (47 CFR) Part 15C, Section 15.247 & 15.249
Power Management Certifications	ETS 300 328, ETS 300 826 Low Voltage Directive IEC950 UL, CSA, and CE Mark
Bluetooth Profiles Supported	BT4.1-ESR 5/6/7 Compliance LE Link Layer Ping LE Dual Mode LE Link Layer LE Low Duty Cycle Directed Advertising LE L2CAP Connection Oriented Channels Train Nudging & Interlaced Scan BT4.2 ESR08 Compliance LE Secure Connection- Basic/Full LE Privacy 1.2 –Link Layer Privacy LE Privacy 1.2 –Extended Scanner Filter Policies LE Data Packet Length Extension FAX Profile (FAX) Basic Imaging Profile (BIP)2 Headset Profile (HSP) Hands Free Profile (HFP) Advanced Audio Distribution Profile (A2DP)
Security & Manageability	Intel® vPro™ support with appropriate Intel® chipset components

1. Wireless access point and Internet service is required. Availability of public wireless access point is limited.
2. The FCC has declared as of September 1, 2014 products that utilize passive scanning on channel 12/13 and are capable of transmitting must fully comply with requirements of 15.247 or otherwise disable those channels.
3. Check latest software/driver release for updates on supported security features.
4. Receiver sensitivity is measured at a packet error rate of 8% for 802.11b (CKK modulation) and a packet error rate of 10% for 802.11a/g (OFDM modulation).

**Wireless access point and internet service required and sold separately. Availability of public wireless access points limited. Wi-Fi 6 is backwards compatible with prior 802.11 specs. The specifications for Wi-Fi 6 (802.11ax) are draft and are not final. If the final specifications differ from the draft specifications, it may affect the ability of the notebook to communicate with other 802.11ax devices. Only available in countries where 802.11ax is supported.

Intel® Wi-Fi® 6 AX200 + BT5 non-vPro**	**Wireless LAN Standards**	IEEE 802.11a IEEE 802.11b IEEE 802.11g IEEE 802.11n IEEE 802.11ac IEEE 802.11ax IEEE 802.11d IEEE 802.11e IEEE 802.11h IEEE 802.11i IEEE 802.11k IEEE 802.11r IEEE 802.11v
	Interoperability	Wi-Fi® certified
	Frequency Band	•802.11b/g/n/ax 2.402 – 2.482 GHz •802.11a/n/ac/ax 4.9 – 4.95 GHz (Japan) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.47 – 5.725 GHz 5.825 – 5.850 GHz
	Data Rates	•802.11b: 1, 2, 5.5, 11 Mbps •802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11a: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11n: MCS 0 ~ MCS 15, (20MHz, and 40MHz) •802.11ac: MCS0 ~ MCS9, (1SS, and 2SS) (20MHz, 40MHz, 80MHz & 160MHz) • 802.11ax: MCS0 ~ MCS11, (1SS and 2SS) (20MHz, 40MHz, 80MHz & 160MHz)
	Modulation	Direct Sequence Spread Spectrum OFDM, BPSK, QPSK, CCK, 16-QAM, 64-QAM, 256-QAM , 1024QAM
	Security[3]	•IEEE and WiFi compliant 64 / 128 bit WEP encryption for a/b/g mode only •AES-CCMP: 128 bit in hardware •802.1x authentication •WPA, WPA2: 802.1x. WPA-PSK, WPA2-PSK, TKIP, and AES •WPA2 certification •IEEE 802.11i •WAPI

Network Architecture Models	Ad-hoc (Peer to Peer) Infrastructure (Access Point Required)	
Roaming	IEEE 802.11 compliant roaming between access points	
Output Power[2]	• 802.11b: +18.5dBm minimum • 802.11g: +17.5dBm minimum • 802.11a: +18.5dBm minimum • 802.11n HT20(2.4GHz): +15.5dBm minimum • 802.11n HT40(2.4GHz): +14.5dBm minimum • 802.11n HT20(5GHz): +15.5dBm minimum • 802.11n HT40(5GHz): +14.5dBm minimum • 802.11ac VHT80(5GHz): +11.5dBm minimum • 802.11ac VHT160(5GHz): +11.5dBm minimum • 802.11ax HT40(2.4GHz): +10dBm minimum • 802.11ax VHT160(5GHz): +10dBm minimum	
Power Consumption	•Transmit mode 2.0 W •Receive mode 1.6 W •Idle mode (PSP) 180 mW (WLAN Associated) •Idle mode 50 mW (WLAN unassociated) •Connected Standby 10 mW •Radio disabled 8 mW	
Power Management	ACPI and PCI Express compliant power management 802.11 compliant power saving mode	
Receiver Sensitivity[4]	•802.11b, 1Mbps: -93.5dBm maximum •802.11b, 11Mbps: -84dBm maximum • 802.11a/g, 6Mbps: -86dBm maximum • 802.11a/g, 54Mbps: -72dBm maximum • 802.11n, MCS07: -67dBm maximum • 802.11n, MCS15: -64dBm maximum • 802.11ac, MCS0: -84dBm maximum • 802.11ac, MCS9: -59dBm maximum •802.11ax, MCS11(HT40): -59dBm maximum •802.11ax, MCS11(VHT160): -58.5dBm maximum	
Antenna type	High efficiency antenna with spatial diversity, mounted in the display enclosure Two embedded dual band 2.4/5 GHz antennas are provided to the card to support WLAN MIMO communications and Bluetooth communications	
Form Factor	PCI-Express M.2 MiniCard	
Dimensions	1. Type 2230: 2.3 x 22.0 x 30.0 mm 2. Type 1216: 1.67 x 12.0 x 16.0 mm	
Weight	1. Type 2230: 2.8g 2. Type 126: 1.3g	
Operating Voltage	3.3v +/- 9%	
Temperature	**Operating**	14° to 158° F (–10° to 70° C)
	Non-operating	–40° to 176° F (–40° to 80° C)

Technical Specifications

Humidity	**Operating**	10% to 90% (non-condensing)
	Non-operating	5% to 95% (non-condensing)
Altitude	**Operating**	0 to 10,000 ft (3,048 m)
	Non-operating	0 to 50,000 ft (15,240 m)

HP Integrated Module with Bluetooth 4.0/4.1/4.2/5.0/5.1 Wireless Technology

Bluetooth Specification	4.0/4.1/4.2/5.0/5.1 Compliant
Frequency Band	2402 to 2480 MHz
Number of Available Channels	Legacy: 0~79 (1 MHz/CH) BLE: 0~39 (2 MHz/CH)
Signaling Data Rate	Legacy: 3 Mbps signaling data rate[1] 2.17 Mbps BLE: 1 Mbps signaling data rate[1] 0.2 Mbps 1. Actual throughput may vary. Legacy: Synchronous Connection Oriented links up to 3, 64 kbps, voice channels Legacy: Asynchronous Connection Less links 2178.1 kbps/177.1 kbps asymmetric (3-DH5) or 864 kbps symmetric (3-EV5)
Transmit Power	The Bluetooth component shall operate as a Class II Bluetooth device with a maximum transmit power of + 9.5 dBm for BR and EDR.
Power Consumption	Peak (Tx) 330 mW Peak (Rx) 230 mW Selective Suspend 17 mW
Bluetooth Software Supported	Microsoft Windows Bluetooth Software
Power Management	Microsoft Windows ACPI, and USB Bus Support
Certifications	FCC (47 CFR) Part 15C, Section 15.247 & 15.249
Power Management Certifications	ETS 300 328, ETS 300 826 Low Voltage Directive IEC950 UL, CSA, and CE Mark
Bluetooth Profiles Supported	BT4.1-ESR 5/6/7 Compliance LE Link Layer Ping LE Dual Mode LE Link Layer LE Low Duty Cycle Directed Advertising LE L2CAP Connection Oriented Channels Train Nudging & Interlaced Scan BT4.2 ESR08 Compliance LE Secure Connection- Basic/Full LE Privacy 1.2 –Link Layer Privacy LE Privacy 1.2 –Extended Scanner Filter Policies LE Data Packet Length Extension FAX Profile (FAX) Basic Imaging Profile (BIP)2 Headset Profile (HSP) Hands Free Profile (HFP)

Advanced Audio Distribution Profile (A2DP)

1. Wireless access point and Internet service is required. Availability of public wireless access point is limited.
2. The FCC has declared as of September 1, 2014 products that utilize passive scanning on channel 12/13 and are capable of transmitting must fully comply with requirements of 15.247 or otherwise disable those channels.
3. Check latest software/driver release for updates on supported security features.
4. Receiver sensitivity is measured at a packet error rate of 8% for 802.11b (CKK modulation) and a packet error rate of 10% for 802.11a/g (OFDM modulation).

**Wireless access point and internet service required and sold separately. Availability of public wireless access points limited. Wi-Fi 6 is backwards compatible with prior 802.11 specs. The specifications for Wi-Fi 6 (802.11ax) are draft and are not final. If the final specifications differ from the draft specifications, it may affect the ability of the notebook to communicate with other 802.11ax devices. Only available in countries where 802.11ax is supported.

Intel® 9560 802.11a/b/g/n/ac (2 x 2) Wi-Fi® and Bluetooth® 5.0 Combo[1] vPro	**Wireless LAN Standards**	IEEE 802.11a IEEE 802.11b IEEE 802.11g IEEE 802.11n IEEE 802.11ac IEEE 802.11d IEEE 802.11e IEEE 802.11h IEEE 802.11i IEEE 802.11k IEEE 802.11r IEEE 802.11v
	Interoperability	Wi-Fi® certified
	Frequency Band	•802.11b/g/n 2.402 – 2.482 GHz •802.11a/n/ac 4.9 – 4.95 GHz (Japan) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.47 – 5.725 GHz 5.825 – 5.850 GHz
	Data Rates	•802.11b: 1, 2, 5.5, 11 Mbps •802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11a: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11n: MCS 0 ~ MCS 15, (20MHz, and 40MHz) •802.11ac: MCS0 ~ MCS9, (1SS, and 2SS) (20MHz, 40MHz, 80MHz & 160MHz)
	Modulation	Direct Sequence Spread Spectrum OFDM, BPSK, QPSK, CCK, 16-QAM, 64-QAM, 256-QAM
	Security[3]	•IEEE and WiFi compliant 64 / 128 bit WEP encryption for a/b/g mode only •AES-CCMP: 128 bit in hardware •802.1x authentication

	•WPA, WPA2: 802.1x. WPA-PSK, WPA2-PSK, TKIP, and AES •WPA2 certification •IEEE 802.11i •WAPI	
Network Architecture Models	Ad-hoc (Peer to Peer) Infrastructure (Access Point Required)	
Roaming	IEEE 802.11 compliant roaming between access points	
Output Power[2]	• 802.11b: +18.5dBm minimum • 802.11g: +17.5dBm minimum • 802.11a: +18.5dBm minimum • 802.11n HT20(2.4GHz): +15.5dBm minimum • 802.11n HT40(2.4GHz): +14.5dBm minimum • 802.11n HT20(5GHz): +15.5dBm minimum • 802.11n HT40(5GHz): +14.5dBm minimum • 802.11ac VHT80(5GHz): +11.5dBm minimum • 802.11ac VHT160(5GHz): +11.5dBm minimum	
Power Consumption	•Transmit mode 2.0 W •Receive mode 1.6 W •Idle mode (PSP) 180 mW (WLAN Associated) •Idle mode 50 mW (WLAN unassociated) •Connected Standby 10 mW •Radio disabled 8 mW	
Power Management	ACPI and PCI Express compliant power management 802.11 compliant power saving mode	
Receiver Sensitivity[4]	802.11b, 1Mbps: -93.5dBm maximum 802.11b, 11Mbps: -84dBm maximum 802.11a/g, 6Mbps: -86dBm maximum 802.11a/g, 54Mbps: -72dBm maximum 802.11n, MCS07: -67dBm maximum 802.11n, MCS15: -64dBm maximum 802.11ac, MCS0: -84dBm maximum 802.11ac, MCS9: -59dBm maximum	
Antenna type	High efficiency antenna with spatial diversity, mounted in the display enclosure Two embedded dual band 2.4/5 GHz antennas are provided to the card to support WLAN MIMO communications and Bluetooth communications	
Form Factor	PCI-Express M.2 MiniCard with CNVi Interface	
Dimensions	1. Type 2230: 2.3 x 22.0 x 30.0 mm 2. Type 1216: 1.67 x 12.0 x 16.0 mm	
Weight	1. Type 2230: 2.8g 2. Type 126: 1.3g	
Operating Voltage	3.3v +/- 9%	
Temperature	**Operating**	14° to 158° F (–10° to 70° C)
	Non-operating	–40° to 176° F (–40° to 80° C)

Humidity	**Operating**	10% to 90% (non-condensing)
	Non-operating	5% to 95% (non-condensing)
Altitude	**Operating**	0 to 10,000 ft (3,048 m)
	Non-operating	0 to 50,000 ft (15,240 m)
LED Activity	LED Amber – Radio OFF LED White – Radio ON	

HP Integrated Module with Bluetooth 4.0/4.1/4.2/5.0 Wireless Technology

Bluetooth Specification	4.0/4.1/4.2/5.0 Compliant
Frequency Band	2402 to 2480 MHz
Number of Available Channels	Legacy: 0~79 (1 MHz/CH) BLE: 0~39 (2 MHz/CH)
Signaling Data Rate	Legacy: 3 Mbps signaling data rate[1] 2.17 Mbps BLE: 1 Mbps signaling data rate[1] 0.2 Mbps 1. Actual throughput may vary. Legacy: Synchronous Connection Oriented links up to 3, 64 kbps, voice channels Legacy: Asynchronous Connection Less links 2178.1 kbps/177.1 kbps asymmetric (3-DH5) or 864 kbps symmetric (3-EV5)
Transmit Power	The Bluetooth component shall operate as a Class II Bluetooth device with a maximum transmit power of + 4 dBm for BR and EDR.
Power Consumption	Peak (Tx) 330 mW Peak (Rx) 230 mW Selective Suspend 17 mW
Bluetooth Software Supported	Microsoft Windows Bluetooth Software
Power Management	Microsoft Windows ACPI, and USB Bus Support
Certifications	FCC (47 CFR) Part 15C, Section 15.247 & 15.249
Power Management Certifications	ETS 300 328, ETS 300 826 Low Voltage Directive IEC950 UL, CSA, and CE Mark
Bluetooth Profiles Supported	BT4.1-ESR 5/6/7 Compliance LE Link Layer Ping LE Dual Mode LE Link Layer LE Low Duty Cycle Directed Advertising LE L2CAP Connection Oriented Channels Train Nudging & Interlaced Scan BT4.2 ESR08 Compliance LE Secure Connection- Basic/Full LE Privacy 1.2 –Link Layer Privacy LE Privacy 1.2 –Extended Scanner Filter Policies LE Data Packet Length Extension FAX Profile (FAX)

	Basic Imaging Profile (BIP)2 Headset Profile (HSP) Hands Free Profile (HFP) Advanced Audio Distribution Profile (A2DP)
Security & Manageability	Intel® vPro™ support with appropriate Intel® chipset components

1. Wireless access point and Internet service is required. Availability of public wireless access point is limited.
2. The FCC has declared as of September 1, 2014 products that utilize passive scanning on channel 12/13 and are capable of transmitting must fully comply with requirements of 15.247 or otherwise disable those channels.
3. Check latest software/driver release for updates on supported security features.
4. Receiver sensitivity is measured at a packet error rate of 8% for 802.11b (CKK modulation) and a packet error rate of 10% for 802.11a/g (OFDM modulation).

Intel® 9560 802.11a/b/g/n/ac (2 x 2) Wi-Fi® and Bluetooth® 5.0 Combo[1] non-vPro	**Wireless LAN Standards**	IEEE 802.11a IEEE 802.11b IEEE 802.11g IEEE 802.11n IEEE 802.11ac IEEE 802.11d IEEE 802.11e IEEE 802.11h IEEE 802.11i IEEE 802.11k IEEE 802.11r IEEE 802.11v
	Interoperability	Wi-Fi® certified
	Frequency Band	•802.11b/g/n 2.402 – 2.482 GHz •802.11a/n/ac 4.9 – 4.95 GHz (Japan) 5.15 – 5.25 GHz 5.25 – 5.35 GHz 5.47 – 5.725 GHz 5.825 – 5.850 GHz
	Data Rates	•802.11b: 1, 2, 5.5, 11 Mbps •802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11a: 6, 9, 12, 18, 24, 36, 48, 54 Mbps •802.11n: MCS 0 ~ MCS 15, (20MHz, and 40MHz) •802.11ac: MCS0 ~ MCS9, (1SS, and 2SS) (20MHz, 40MHz, 80MHz & 160MHz)
	Modulation	Direct Sequence Spread Spectrum BPSK, QPSK, CCK, 16-QAM, 64-QAM, 256-QAM
	Security[3]	•IEEE and WiFi compliant 64 / 128 bit WEP encryption for a/b/g mode only •AES-CCMP: 128 bit in hardware

	•802.1x authentication •WPA, WPA2: 802.1x. WPA-PSK, WPA2-PSK, TKIP, and AES •WPA2 certification •IEEE 802.11i •WAPI
Network Architecture Models	Ad-hoc (Peer to Peer) Infrastructure (Access Point Required)
Roaming	IEEE 802.11 compliant roaming between access points
Output Power[2]	• 802.11b: +18.5dBm minimum • 802.11g: +17.5dBm minimum • 802.11a: +18.5dBm minimum • 802.11n HT20(2.4GHz): +15.5dBm minimum • 802.11n HT40(2.4GHz): +14.5dBm minimum • 802.11n HT20(5GHz): +15.5dBm minimum • 802.11n HT40(5GHz): +14.5dBm minimum • 802.11ac VHT80(5GHz): +11.5dBm minimum • 802.11ac VHT160(5GHz): +11.5dBm minimum
Power Consumption	•Transmit mode: 2.0 W •Receive mode: 1.6 W •Idle mode (PSP) 180 mW (WLAN Associated) •Idle mode: 50 mW (WLAN unassociated) •Connected Standby/Modern Standby: 10mW •Radio disabled: 8 mW
Power Management	ACPI and PCI Express compliant power management 802.11 compliant power saving mode
Receiver Sensitivity[4]	802.11b, 1Mbps: -93.5dBm maximum 802.11b, 11Mbps: -84dBm maximum 802.11a/g, 6Mbps: -86dBm maximum 802.11a/g, 54Mbps: -72dBm maximum 802.11n, MCS07: -67dBm maximum 802.11n, MCS15: -64dBm maximum 802.11ac, MCS0: -84dBm maximum 802.11ac, MCS9: -59dBm maximum
Antenna type	High efficiency antenna with spatial diversity, mounted in the display enclosure Two embedded dual band 2.4/5 GHz antennas are provided to the card to support WLAN MIMO communications and Bluetooth communications
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Dimensions	1. Type 2230: 2.3 x 22.0 x 30.0 mm 2. Type 1216: 1.67 x 12.0 x 16.0 mm
Weight	1. Type 2230: 2.8g 2. Type 126: 1.3g
Operating Voltage	3.3v +/- 9%
Temperature	**Operating** 14° to 158° F (–10° to 70° C) **Non-operating** –40° to 176° F (–40° to 80° C)

Humidity	**Operating**	10% to 90% (non-condensing)
	Non-operating	5% to 95% (non-condensing)
Altitude	**Operating**	0 to 10,000 ft (3,048 m)
	Non-operating	0 to 50,000 ft (15,240 m)
LED Activity	LED Amber – Radio OFF LED White – Radio ON	

HP Integrated Module with Bluetooth 4.0/4.1/4.2/5.0 Wireless Technology

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Signaling Data Rate	Legacy: 3 Mbps signaling data rate[1] 2.17 Mbps BLE: 1 Mbps signaling data rate[1] 0.2 Mbps 1. Actual throughput may vary. Legacy: Synchronous Connection Oriented links up to 3, 64 kbps, voice channels Legacy: Asynchronous Connection Less links 2178.1 kbps/177.1 kbps asymmetric (3-DH5) or 864 kbps symmetric (3-EV5)
Transmit Power	The Bluetooth component shall operate as a Class II Bluetooth device with a maximum transmit power of + 4 dBm for BR and EDR.
Power Consumption	Peak (Tx) 330 mW Peak (Rx) 230 mW Selective Suspend 17 mW
Bluetooth Software Supported	Microsoft Windows Bluetooth Software
Power Management	Microsoft Windows ACPI, and USB Bus Support
Certifications	FCC (47 CFR) Part 15C, Section 15.247 & 15.249
Power Management Certifications	ETS 300 328, ETS 300 826 Low Voltage Directive IEC950 UL, CSA, and CE Mark
Bluetooth Profiles Supported	BT4.1-ESR 5/6/7 Compliance LE Link Layer Ping LE Dual Mode LE Link Layer LE Low Duty Cycle Directed Advertising LE L2CAP Connection Oriented Channels Train Nudging & Interlaced Scan BT4.2 ESR08 Compliance LE Secure Connection- Basic/Full LE Privacy 1.2 –Link Layer Privacy LE Privacy 1.2 –Extended Scanner Filter Policies LE Data Packet Length Extension FAX Profile (FAX)

Basic Imaging Profile (BIP)2
Headset Profile (HSP)
Hands Free Profile (HFP)
Advanced Audio Distribution Profile (A2DP)

1. Wireless access point and Internet service is required. Availability of public wireless access point is limited.
2. The FCC has declared as of September 1, 2014 products that utilize passive scanning on channel 12/13 and are capable of transmitting must fully comply with requirements of 15.247 or otherwise disable those channels.
3. Check latest software/driver release for updates on supported security features.
4. Receiver sensitivity is measured at a packet error rate of 8% for 802.11b (CKK modulation) and a packet error rate of 10% for 802.11a/g (OFDM modulation).

Intel® XMM™ 7360 LTE-Advanced CAT9[1]	**Technology/Operating bands**	FDD LTE: 2100 (Band 1), 1900 (Band 2), 1800 (Band 3), 1700/2100 (Band 4), 850 (Band 5), 2600 (Band 7), 900 (Band 8), 1400 (Band 11), 700 (Band 12 lower), 700 (Band 13 upper), 700 (Band 17 lower), 850 (Band 18 lower), 850 (Band 19 upper), 800 (Band 20), 1400 (Band 21), 850 (Band 26), 700 (Band 28), 700 (Band 29 RX only), 2300 (Band 30), 1700/2100 (Band 66). TDD LTE: 2600 (Band 38), 1900 (Band 39), 2400 (Band 40), 2500 (Band 41). HSPA+: 2100 (Band 1), 1900 (Band 2), 1700/2100 (Band 4), 850 (Band 5), 900 (Band 8) MHz
	Wireless protocol standards	3GPP Release 11 LTE Specification CAT.9, DL 60MHz BW throughput up to 450Mbps; UL 20MHz throughput up to 50Mbps WCDMA R99, 3GPP Release 5, 6, 7 and 8 UMTS Specification
	GPS	Standalone, A-GPS (MS-A, MS-B)
	GPS bands	1575.42 MHz ± 1.023 MHz, GLONASS 1596-1607MHz, Beidou 1561.098 MHz
	Maximum data rates	LTE: 450 Mbps (Download), 50 Mbps (Upload) DC-HSPA+: 42 Mbps (Download), 5.76 Mbps (Upload) HSPA+: 21Mbps (Download), 5.76 Mbps (Upload)
	Maximum output power	LTE: 23 dBm HSPA+: 23.5 dBm
	Maximum power consumption	LTE: 1,200 mA (peak); 900 mA (average) HSPA+: 1,100 mA (peak); 800 mA (average)
	Form Factor	M.2, 3042-S3 Key B
	Weight	5.8 g
	Dimensions	42 x 30 x 2.3 mm

1. Mobile Broadband is an optional feature and requires configuration at time of purchase. Connection requires wireless data service contract, network support, and is not available in all areas. Contact service provider to determine the coverage area and availability. Connection speeds will vary due to location, environment, network conditions, and other factors. 4G LTE not available on all products or in all countries.

Intel® XMM™ 7262 LTE-Advanced DL CAT6	**Technology/Operating bands**	FDD LTE: 2100 (Band 1), 1800 (Band 3), 850 (Band 5), 2600 (Band 7), 900 (Band 8), 800 (Band 20), 700 (Band 28), HSPA+: 2100 (Band 1), 850 (Band 5), 900 (Band 8)
	Wireless protocol standards	3GPP Release 11 LTE Specification CAT.6, DL 40MHz BW throughput up to 300Mbps; UL 20MHz throughput up to 50Mbps WCDMA R99, 3GPP Release 5, 6, 7 and 8 UMTS Specification
	GPS	Standalone, A-GPS (MS-A, MS-B and XTRA)
	GPS bands	1575.42 MHz ± 1.023 MHz, GLONASS 1596-1607MHz
	Maximum data rates	LTE: 300 Mbps (Download), 50 Mbps (Upload) DC-HSPA+: 42 Mbps (Download), 5.76 Mbps (Upload) HSPA+: 21Mbps (Download), 5.76 Mbps (Upload)
	Maximum output power	LTE: 23 dBm HSPA+: 23.5 dBm
	Maximum power consumption	LTE: 1,200 mA (peak); 830 mA (average) HSPA+: 1,100 mA (peak); 680 mA (average)
	Form Factor	M.2, 3042-S3 Key B
	Weight	6 g
	Dimensions	42 x 30 x 2.3 mm

1. Mobile Broadband is an optional feature and requires configuration at time of purchase. Connection requires wireless data service contract, network support, and is not available in all areas. Contact service provider to determine the coverage area and availability. Connection speeds will vary due to location, environment, network conditions, and other factors. 4G LTE not available on all products or in all countries.

Near Field Communications Controller (optional)	**Dimensions (L x W x H)**	Module 25 mm by 10 mm by 2.0 mm
	Chipset	NPC100
	System interface	I2C
	NFC RF standards	ISO/IEC 14443 A ISO/IEC 14443 B ISO/IEC 15693 ISO/IEC 18092 ECMA-340 NFCIP-1 Target and Initiator ECMA-320 NFCIP-2
	NFC Forum Support	Tag Type 1, Type 2, Type3 and Type 4, NFCIP-1 and NFCIP-2
	Reader (PCD-VCD) Mode[1]	ISO/IEC 14443 A ISO/IEC 14443 B ISO/IEC 15693 MIFARE 1K MIFARE 4K MIFARE DESFire FeliCa Jewel and Topaz cards
	Card Emulation (PICC-VICC) Mode[1]	ISO/IEC 14443 A ISO/IEC 14443 B and B’

		MIFARE FeliCa
	Frequency	13.56 MHz
	NFC Modes Supported	Reader/Writer, Peer-to-Peer
	Raw RF Data Rates	106, 212, 424, 848 kbps
	Operating temperature	0°C to 70°C
	Storage temperature	-20°C to 125°C
	Humidity	10-90% operating 5-95% non-operating
	Supply Operating voltage	4.35 to 5.25 Volts
	I/O Voltage	1.8V or 3.3V

Intel® i219LM 10/100/1000 Integrated NIC	**Connector**	RJ-45
	System Interface	PCI (Intel proprietary) + SMBus
	Data rates supported	10 Mbit/s operation (10BASE-T; IEEE 802.3i; IEEE 802.3 clauses 13-14) 100 Mbit/s operation (100BASE-TX; IEEE 802.3u; IEEE 802.3 clauses 21-30) 1000 Mbit/s operation (1000BASE-T; IEEE 802.3ab; IEEE 8023 clauses 40) Auto-Negotiation (Automatic Speed Selection) Full Duplex Operation at all Speeds, Half Duplex operation at 10 and 100 Mbit/s
	IEEE Compliance	IEEE 802.1p QoS (Quality of Service) Support IEEE 802.1q VLAN support IEEE 802.3x Flow Control (IEEE 802.3 clauses 31-32; configurable) IEEE 802.3az EEE (Energy Efficient Ethernet)
	Performance	TCP/IP/UDP Checksum Offload (configurable) Protocol Offload (ARP & NS) Large send offload and Giant send offload Receiving Side Scaling Jumbo Frame 9K
	Power consumption	Cable Disconnection: 25mW 100Mbps Full Run: 450mW 1000bp Full Run: 1000mW WoL Enable(S3/S4/S5): 50mW WoL Disable(S3/S4/S5): 25mW
	Power Management	ACPI compliant – multiple power modes Situation-sensitive features reduce power consumption Advanced link down power saving for reducing link down power consumption
	Management Interface	Auto MDI/MDIX Crossover cable detection

	IT Manageability	Wake-on-LAN from standby and hibernation (Magic Packet and Microsoft Wake-Up Frame); Wake-on-LAN from off (Magic Packet only) PXE 2.1 Remote Boot Statistics Gathering (SNMP MIB II, Ethernet-like MIB, Ethernet MIB (802.3x, clause 30)) Comprehensive diagnostic and configuration software suite Virtual Cable Doctor for Ethernet cable status
	Security & Manageability	Intel® vPro™ support with appropriate Intel® chipset components

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Intel® i219v 10/100/1000 Integrated NIC	**Connector**	RJ-45
	System Interface	PCI (Intel proprietary) + SMBus
	Data rates supported	10 Mbit/s operation (10BASE-T; IEEE 802.3i; IEEE 802.3 clauses 13-14) 100 Mbit/s operation (100BASE-TX; IEEE 802.3u; IEEE 802.3 clauses 21-30) 1000 Mbit/s operation (1000BASE-T; IEEE 802.3ab; IEEE 8023 clauses 40) Auto-Negotiation (Automatic Speed Selection) Full Duplex Operation at all Speeds, Half Duplex operation at 10 and 100 Mbit/s
	IEEE Compliance	IEEE 802.1p QoS (Quality of Service) Support IEEE 802.1q VLAN support IEEE 802.3x Flow Control (IEEE 802.3 clauses 31-32; configurable) IEEE 802.3az EEE (Energy Efficient Ethernet)
	Performance	TCP/IP/UDP Checksum Offload (configurable) Protocol Offload (ARP & NS) Large send offload and Giant send offload Receiving Side Scaling Jumbo Frame 9K
	Power consumption	Cable Disconnection: 25mW 100Mbps Full Run: 450mW 1000bp Full Run: 1000Mw WoL Enable(S3/S4/S5): 50mW WoL Disable(S3/S4/S5): 25mW
	Power Management	ACPI compliant – multiple power modes Situation-sensitive features reduce power consumption Advanced link down power saving for reducing link down power consumption
	Management Interface	Auto MDI/MDIX Crossover cable detection
	IT Manageability	Wake-on-LAN from standby and hibernation (Magic Packet and Microsoft Wake-Up Frame); Wake-on-LAN from off (Magic Packet only) PXE 2.1 Remote Boot

	Statistics Gathering (SNMP MIB II, Ethernet-like MIB, Ethernet MIB (802.3x, clause 30) Comprehensive diagnostic and configuration software suite Virtual Cable Doctor for Ethernet cable status
Security & Manageability	Intel® vPro™ support with appropriate Intel® chipset components

POWER

AC Adapter 45 Watt nPFC Wall Mount USB type C Straight 1.8m C6NS	**Dimensions**	62.0x62.0x28.5mm	
	Weight	unit: 220g +/- 10g	
	Input	**Input Efficiency**	Average Efficiency of 25%, 50%, 75%, 100% load condition with 115Vac/230Vac Spec: 5V: 81.5% 9V: 86.7% 10V: 87.5% 12V: 87.8% 15V: 87.8% 20V: 87.8%
		Input frequency range	47 ~ 63 Hz
		Input AC current	Max. 1.4 A at 90 Vac
	Output	**Output power**	Average Efficiency of 25%, 50%, 75%, 100% load condition with 115Vac/230Vac Spec:
		DC output	5V: 81.5%
		Hold-up time	9V: 86.7%
		Output current limit	10V: 87.5%
	Connector	Non-Standard C6	
	Environmental Design	**Operating temperature**	32°Fto 95°F (0°to 35°C)
		Non-operating (storage) temperature	-4°F to 185°F (-20°to 85°C)
		Altitude	0 to 16,400 ft (0 to 5000m)
		Humidity	5% to 95%
		Storage Humidity	5% to 95%
	EMI and Safety Certifications	Eg: *CE Mark - full compliance with LVD and EMC directives * Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE. * MTBF - over 200,000 hours at 25°C ambient condition.	

AC Adapter 45 Watt Smart nPFC Standard Barrel 4.5mm Right Angle 1.8m	**Dimensions**	95.0x40.0x26.5mm	
	Weight	unit: 200g +/- 10g	
	Input	**Input Efficiency**	87.74 % at 115 Vac and 88.4 % at 230Vac
		Input frequency range	47 ~ 63Hz

		Input AC current	Max. 1.4 A at 90 Vac
	Output	**Output power**	45W
		DC output	19.5V
		Hold-up time	5ms at 115 Vac input
		Output current limit	<8.0A
	Connector	C6	
	Environmental Design	**Operating temperature**	32°F to 95°F (0°to 35°C)
		Non-operating (storage) temperature	-4°F to 185°F (-20°to 85°C)
		Altitude	0 to 16,400 ft (0 to 5000m)
		Humidity	20% to 95%
		Storage Humidity	10% to 95%
	Safety Certifications	Eg: *CE Mark - full compliance with LVD and EMC directives * Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE. * MTBF - over 200,000 hours at 25°C ambient condition.	

AC Adapter 45 Watt Smart nPFC Standard Barrel 4.5mm Right Angle 1.8m Argentina	**Dimensions**	95.0 x 40.0 x 26.5 mm	
	Weight	unit: 200 g +/- 10 g	
	Input	**Input Efficiency**	87.74 % at 115 Vac and 88.4 % at 230Vac
		Input frequency range	47 ~ 63 Hz
		Input AC current	Max. 1.4 A at 90 Vac
	Output	**Output power**	45W
		DC output	19.5V
		Hold-up time	5ms at 115 Vac input
		Output current limit	<8.0A
	Connector	C6	
	Environmental Design	**Operating temperature**	32°F to 95°F (0°to 35°C)
		Non-operating (storage) temperature	-4°F to 185°F (-20°to 85°C)
		Altitude	0 to 16,400 ft (0 to 5000m)
		Humidity	20% to 95%
		Storage Humidity	10% to 95%
	Safety Certifications	CE Mark - full compliance with LVD and EMC directives Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE. MTBF - over 200,000 hours at 25°C ambient condition.	

AC Adapter 45 Watt Smart nPFC Standard Barrel 4.5mm Right Angle 1.8m 2prong	**Dimensions**	95.0x40.0x26.5mm	
	Weight	unit: 200g +/- 10g	
	Input		
		Input Efficiency	87.74 % at 115 Vac and 88.4 % at 230Vac
		Input frequency range	47 ~ 63 Hz
		Input AC current	Max. 1.4 A at 90 Vac
	Output	**Output power**	45W
		DC output	19.5V
		Hold-up time	5 msec at 115 VAC input
		Output current limit	<8.0A
	Connector	C6	
	Environmental Design	**Operating temperature**	32° to 95° F (0° to 35° C)
		Non-operating (storage) temperature	-4° to 185° F (-20° to 85° C)
		Altitude	0 to 16,400 ft (0 to 5,000 m)
		Humidity	20% to 95%
		Storage Humidity	10% to 95%
	Safety Certifications	Eg: *CE Mark - full compliance with LVD and EMC directives * Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE. * MTBF - over 200,000 hours at 25°C ambient condition.	

AC Adapter 65 Watt nPFC USB type C Straight 1.8m C6NS	**Dimensions**	74x74x28.5mm	
	Weight	unit: 245g +/- 10g	
	Input	**Input Efficiency**	81.5% min at 115 Vac/ 230Vac @ 5V/3A 86.7% min at 115 Vac/ 230Vac @ 9V/3A 88% min at 115 Vac/ 230Vac @ 10V/5A 88% min at 115 Vac/ 230Vac @ 12V/5A 89% min at 115 Vac/ 230Vac @ 15V/4.33A 89% min at 115 Vac/ 230Vac @ 20V/3.25A
		Input frequency range	47 ~ 63 Hz
		Input AC current	1.7 A at 90 VAC and maximum load
	Output	**Output power**	65W
		DC output	5V/9V/10V/12V/15V/20V
		Hold-up time	5ms at 115 Vac input
		Output current limit	<8.0A
	Connector	Non-Standard C6	
	Environmental Design	**Operating temperature**	32° to 95° F (0° to 35° C)
		Non-operating (storage) temperature	-4° to 185° F (-20° to 85° C)
		Altitude	0 to 16,400 ft (0 to 5000m)
		Humidity	5% to 95%
		Storage Humidity	5% to 95%
	Safety Certifications	Eg: *CE Mark - full compliance with LVD and EMC directives	

* Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE.
* MTBF - over 100,000 hours at 25°C ambient condition.

AC Adapter 65 Watt Smart nPFC EM Barrel 4.5mm New EM	**Dimensions**	102x55x30mm	
	Weight	unit: 250g +/- 10g	
	Input	**Input Efficiency**	88.0 % at 115 Vac and 89.0 % at 230Vac
		Input frequency range	47 ~ 63 Hz
		Input AC current	Max. 1.7 A at 90 Vac
	Output	**Output power**	65W
		DC output	19.5V
		Hold-up time	5ms at 115 Vac input
		Output current limit	<11.0A
	Connector	C6	
	Environmental Design	**Operating temperature**	0° to 35° C
		Non-operating (storage) temperature	-20° to 85° C
		Altitude	0 to 16,400 ft (0 to 5000m)
		Humidity	20% to 95%
		Storage Humidity	10% to 95%
	Safety Certifications	Eg: *CE Mark - full compliance with LVD and EMC directives * Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE. * MTBF - over 200,000 hours at 25°C ambient condition.	

AC Adapter 65 Watt Smart nPFC Standard Barrel 4.5mm Right Angle 1.8m	**Dimensions**	90.0x51x28.5mm	
	Weight	unit: 230g +/- 10g	
	Input	**Input Efficiency**	88.0 % at 115 Vac and 89.0 % at 230Vac
		Input frequency range	47 ~ 63 Hz
		Input AC current	Max. 1.7 A at 90 Vac
	Output	**Output power**	65W
		DC output	19.5V
		Hold-up time	5ms at 115 Vac input
		Output current limit	<11.0A
	Connector	C6	
	Environmental Design	**Operating temperature**	32°F to 95°F (0°to 35°C)
		Non-operating (storage) temperature	-4°F to 185°F (-20°to 85°C)
		Altitude	0 to 16,400 ft (0 to 5000m)
		Humidity	20% to 95%
		Storage Humidity	10% to 95%

Technical Specifications

	Safety Certifications	Eg: *CE Mark - full compliance with LVD and EMC directives * Worldwide safety standards - IEC60950, EN60950, UL60950, Class1, SELV; Agency approvals - C-UL-US, NORDICS, DENAN, EN55022 Class B, FCC Class B, CISPR22 Class B, CCC, NOM-1 NYCE. * MTBF - over 200,000 hours at 25°C ambient condition.	

HP 3-cell Long Life Li-Ion (48 WHr)	**Dimensions** (H x W x L)	8.05. x185.15x95 mm	
	Weight	0.26 kg	
	Cells/Type	3cell Lithium-Ion Polymer cell / 606072	
	Energy	**Voltage**	11.4V
		Amp-hour capacity	4.212Ah /4.0Ah
		Watt-hour capacity	48Wh
	Temperature	**Operating (Charging)**	32˚ to 113˚ F (0˚ to 45˚ C)
		Operating (Discharging)	14˚ to 122˚ F (-10˚ to 60˚ C)
	Warranty	3 years	
	Optional Travel Battery Available	No	

Technical Specifications

COUNTRY OF ORIGIN

China

Options and Accessories (sold separately and availability may vary by country)

Type	Description	Part #
Cases	HP Essential Top Load Case	H2W17AA#xxx
	HP Essential Backpack (up to 15.6")	H1D24AA
	HP Essential Messenger Case (up to 17.3")	H1D25AA
Docking	HP UltraSlim Docking Station	D9Y32AA#xxx
	HP UltraSlim Docking Station TAA US	E5C22AV#ABA
	HP Thunderbolt Dock 120W G2	2UK37AA
	HP Thunderbolt Dock 120W G2 TAA	2UK37AA
	HP TB Dock G2 w/ Combo Cable	3TR87AA
	HP TB Dock 120W G2 w/ Audio	3YE87AA#xxx
	HP USB-C Universal Dock	1MK33AA#xxx
	HP USB-C/A Universal Dock G2	5TW13AA#XXX
	HP USB-C Universal Dock w/4.5mm Adapter	2UF95AA
	HP USB-C Universal Dock NF	3DV65AA
	HP USB-C Dock G4	3FF69AA#xxx
	HP USB-C Dock G5	5TW10AA#XXX
	HP USB-C Mini Dock	1PM64AA#xxx
	HP USB-C Travel Dock	T0K29AA#xxx
	HP USB Travel Dock	T0K30AA#xxx
	HP TB Dock Audio Module	3AQ21AA
	HP TB Dock 120W G2 cable	3XB94AA
	HP TB Dock G2 combo cable	3XB96AA
	HP Adjustable Dual Display Stand	AW664AA#xxx
	HP Display and Notebook Stand II	E8G00AA#xxx
	HP USB-C Mini Dock	1PM64AA#xxx
Input/Output	HP Slim USB Keyboard and Mouse	T6T83AA#xxx
	HP Slim Wireless Keyboard and Mouse	T6L04AA#xxx
	HP USB Essential Keyboard and Mouse	H6L29AA
	HP Ultra Mobile Wireless Mouse	H6F25AA#xxx
	HP Comfort Grip Wireless Mouse	H2L63AA
	HP 3-Button USB Laser Mouse	H4B81AA
	HP USB Travel Mouse	G1K28AA
	HP Slim Bluetooth Mouse	F3J92AA#xxx
	HP Essential USB Mouse	2TX37AA#xxx
	HP Elite Presenter Mouse	2CE30AA#xxx
	HP HDMI to DVI Adapter	F5A28AA
	HP USB-C to DP	N9K78AA
	HP USB-C to HDMI 2.0	1WC36AA#xxx

Options and Accessories (sold separately and availability may vary by country)

	HP USB-C to USB-A Hub	Z6A00AA
	HP UC Wireless Mono Headset	W3K08AA
	HP UC Wireless Duo Headset	W3K09AA
	HP Stereo 3.5mm Headset	T1A66AA
	HP Stereo USB Headset	T1A67AA
	HP TB Dock Audio Module	3AQ21AA
	HP Thunderbolt 120W 1m cable	3AQ23AA
	HP Thunderbolt 1m combo cable	3AQ25AA
Power	HP 45W Smart AC Adapter 4.5mm	H6Y88AA#xxx
	HP 65W Smart AC Adapter	H6Y89AA#xxx
	HP 65W Slim AC Adapter	H6Y82AA#xxx
	HP 45W USB-C Power Adapter	1HE07AA#xxx
	HP 65W USB-C Power Adapter	1HE08AA#xxx
	HP 65W USB-C Slim Power Adapter (w/additional USB-A)	3PN48AA#xxx
	3-cell Prismatic Battery	TBD
	HP Power Bank	N9F71AA#xxx
	HP USB-C Notebook Power Bank	2NA10AA
	HP 65W USB-C Slim Power Adapter	3PN48AA
Storage	HP External USB Optical Drive	F2B56AA
	HP 256GB TLC PCIe 3x4 NVMe M.2 SSD	1FU87AA
	HP 512GB TLC PCIe 3x4 NVMe M.2 SSD	1FU88AA
	HP 500GB 7200rpm HDD	F3B97AA
Security	HP Essential Combination Lock	T0Y16AA
	HP Combination Lock	T0Y15AA
	HP Keyed Cable lock	T0Y14AA
	HP 15.6 Touchable Privacy Filter	3KP53AA
	HP Docking Station Cable Lock	AU656AA#XXX
	HP Keyed Cable Lock 10mm	T1A62AA
UCC	HP Conferencing Keyboard	K8P74AA#xxx
	HP Speaker Phone	K7V16AA
	HP Wired Headset	K7V17AA
Memory	HP 4GB 2666MHz DDR4 Memory	4VN05AA
	HP 8GB 2666MHz DDR4 Memory	4VN06AA
	HP 16GB 2666MHz DDR4 Memory	4VN07AA

Options and Accessories (sold separately and availability may vary by country)

Displays	HP ProDisplay P223 21.5-inch Monitor	X7R61AA
	HP ProDisplay P240va 23.8-inch Monitor	N3H14AA
	HP EliteDisplay E243 23.8-inch Monitor	1FH47AA

Summary of Changes

Date of change:	Version History:	Updated	Description of change:
	V1 to V2		