

# Lenovo ThinkPad P52

Version: 1 | 06/17/2020

## DOWNLOADS

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|                             |  |
|-----------------------------|--|
| Hardware Maintenance Manual | <a href="#">P52 HMM</a>                    |
| Drivers & Software          | <a href="#">P52 Drivers &amp; Software</a> |

## SECTION I: SYSTEM OVERVIEW

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|             |   |
|-------------|---|
| Description | <p>The ThinkPad® P52 sets the standard for mobile workstations, combining the legacy of ThinkPad build-quality and cutting-edge technology. Flexible and powerful enough to offer increased performance within traditional ISV workflows, AR and VR content creation, or deployment of mobile AI, users now have legendary ThinkPad build-quality combined with pioneering technology. The addition of the new NVIDIA® Quadro® P3200 GPU and Intel® Xeon® hexa-core CPU, along with a 100% Adobe color gamut 4K UHD display, double the memory and increased PCIe storage, delivers next-level power and performance in a compact 15-inch chassis.</p> <p>The ThinkPad® P52 protects your work and your investment by adding multiple layers of both biometric and encryption security enhancements.</p> <p>With a mix of ports supporting all your needs, the addition of a second Thunderbolt port supports the display of 8K video and now allows users to take advantage of the ThinkPad® Thunderbolt Workstation Dock.</p> |
|-------------|---|

## CPU

|                   |   |
|-------------------|---|
| Processor Support | Intel 8th gen Coffee Lake H Series Core i7<br>Intel 8th gen Coffee Lake H Series Core i9<br>Intel 8th gen Coffee Lake H Series Xeon |
| Socket Type       | BGA   |

## Operating Systems

|           |   |
|-----------|---|
| Preloaded | Windows 10 Pro 64-bit for Workstations<br>Windows 10 Pro 64-bit<br>Windows 10 Home 64-bit<br>Windows 10 Single Language Home 64-bit<br>Windows 10 Home Chinese Language Edition 64-bit<br>Ubuntu Linux<br>No Operating System |
| Supported | Windows 10 Pro 64-bit for Workstations<br>Windows 10 Pro 64-bit<br>Windows 10 Home 64-bit<br>Windows 10 Single Language Home 64-bit<br>Windows 10 Home Chinese Language Edition 64-bit<br>Ubuntu Linux<br>No Operating System |

## Memory

|                      |   |
|----------------------|---|
| Number of DIMM Slots | Up to 4 DIMM sockets: Top x2; Bot x2              |
| Channels             | Single Channel w/ 1DIMM<br>Dual Channel w/ 2DIMMs |
| Type                 | DDR4, SO-DIMM, ECC non-ECC                        |
| ECC Support          | Yes   |
| Speed                | Up to 2666 MHz                                    |
| Max DIMM Size        | 32GB  |
| Max System Memory    | 128GB   |
| Min System Memory    | 8GB   |
| Soldered Memory      | None  |

## Storage

|                                      |   |
|--------------------------------------|---|
| Storage Slots                        | 3 slots   |
| SATA                                 | 1x 2.5" SATA HDD  |
| PCIe                                 | Solid State Drive, OPAL2 PCIe-NVMe M.2 2280-S3 - TLC  |
| SAS                                  | HDD<br>500GB 7200<br>1TB 7200<br>2TB 5400<br>SSD<br>256GB OPAL2 TLC PCIe-NVMe<br>512GB OPAL2 TLC PCIe-NVMe<br>1024GB OPAL2 TLC PCIe-NVMe<br>512GB OPAL2 MLC PCIe-NVMe<br>16GB Optane PCIe M.2 |
| Interface                            | 500GB FIPS140-2 7200rpm 7mm   |
| Security                             | Optional, Selectable in BIOS  |
| Optional Hard Disk Drive Controllers | RAID 0/1  |

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## Video

|                     |   |
|---------------------|---|
| Integrated Graphics | For Intel® i7-8750H<br>Processor Graphics Intel® UHD Graphics 630<br>Utilized via “Hybrid Mode” in BIOS<br>For Intel® i7-8850H<br>Processor Graphics Intel® UHD Graphics 630<br>Utilized via “Hybrid Mode” in BIOS<br>For Intel® i9-8950HK<br>Processor Graphics Intel® UHD Graphics 630<br>Utilized via “Hybrid Mode” in BIOS<br>For Intel® Xeon® E-2176M Processor<br>Processor Graphics Intel® UHD Graphics P630<br>Utilized via “Hybrid Mode” in BIOS |
| Discrete Graphics   | NVIDIA Quadro P1000, P2000, P3200   |
| Adapter             | None  |
| Bus Interface       | PEG   |

## Display

|             |           |
|-------------|-----------|
| Resolutions | FHD / UHD |
|-------------|-----------|

## Camera

|                   |                     |
|-------------------|---------------------|
| Resolution        | HD 720p / IR Camera |
| Frames per Second | 30 fps              |
| Focus             | Fixed 50cm          |
| Camera Interface  | USB 2.0             |
| IR Camera         | Yes                 |

## Keyboard

|                       |  |
|-----------------------|--|
| Number of Keys        | US : 105 / UK : 106 / JP : 110                   |
| Numpad                | Yes  |
| Size                  | 100% ISO   |
| Function Key Features | Yes  |
| Backlit               | Yes  |
| Keyboard size         | Como 2018 Full size KB with NumPad (Top loading) |
| Key stroke            | 1.8mm  |
| Key pitch             | 19.05 mm(Vertical & Horizontal)                  |
|                       |  |

|                    |          |
|--------------------|----------|
| Keyboard backlight | Optional |
| Keyboard thickness | 4.55mm   |

## Touchpad / Fingerprint Reader

|                             |                                  |
|-----------------------------|----------------------------------|
| TrackPoint Details          | COMO TrackPoint module (t5.55mm) |
| Finger Print Reader Model   | Synaptics Metallica 8x8 FPR, MoC |
| Multi-Touch                 | Yes                              |
| Resolution                  | 1000 ppi                         |
| TouchPad/Trackpad thickness | 0.8mm +/- 0.1mm                  |
| TouchPad/Trackpad type      | TouchPad                         |
| Trackpad size               | 99mm x 58.4mm                    |
| Trackpad material/finish    | Mylar surface                    |

## I/O - Ports and Connectors

|                   |  |
|-------------------|--|
| USB               | 3 x USB 3.0 (1x Powered)                     |
| Thunderbolt       | Thunderbolt 3, 2 ports (USB Type-C)          |
| HDMI              | 1x HDMI (2.0), DP1.4                         |
| Audio Combo Jack  | 1x Microphone & Headphone Combo Jack (3.5mm) |
| Media Card Reader | Dedicated Media Card Reader (UHS-II)         |
| Smart Card Reader | 1x Smart Card Reader                         |
| Power Connector   | DC-In  |
| Docking Port      | Docking Via Thunderbolt 3 / USB-C            |
| VirtualLink       | None   |
| Network adapter   | Gigabit Ethernet (RJ45)                      |

## Power Connector

|       |                                |
|-------|--------------------------------|
| Main  | DC-In                          |
| USB-C | 2x Thunderbolt 3 (USB-C/DP/PD) |

## Ethernet

|        |       |
|--------|-------|
| Vendor | Intel |
| Count  | x1    |

|            |   |
|------------|---|
| EEPROM     | BIOS/MEFW SPI ROM<br>TBT FW SPI ROM                                   |
| Speeds     | 10/100/1000 Mbps  |
| Functions  | Wake On LAN<br>MAC Address Pass Through<br>PXE Boot<br>Flash Over LAN |
| Connectors | RJ45  |

## WWAN

|       |  |
|-------|--|
| Model | M.2 3042 S3 (optional)<br>Fibocom L850 LTE, UMTS/HSPA+<br>US,CA: Sierra EM7565 LTE (HSPA+/GSM/EDGE)<br>EMEA: Sierra EM7565 LTE (HSPA+/GSM/EDGE)<br>ANZ: Sierra EM7565 LTE (HSPA+/GSM/EDGE) |
|-------|--|

## Near Field Communications

|       |                                     |
|-------|-------------------------------------|
| Model | Foxconn P/N T77H747.01 (NXP NPC300) |
|-------|-------------------------------------|

## Audio

|                                    |  |
|------------------------------------|--|
| Vendor                             | Realtek  |
| Type                               | Intel High Definition Audio (2 channel)            |
| Internal Speaker                   | 2 channel  |
| Connectors                         | Microphone & Headphone Combo Jack (3.5mm)          |
| Chipset                            | ALC3286  |
| Number of Channels                 | 4-channel DAC, 4-channel ADC                       |
| Number of Bits/Audio Resolution    | 16/20/24-bit PCM format                            |
| Sampling Rate (Recording/Playback) | 44.1K/48K/96K/192KHz sample rate                   |
| Signal to Noise Ratio              | Mic In: 95dB FSA<br>Headphone Out@32ohm: 100dB FSA |
| Analog Audio                       | None   |
| Dolby Digital                      | Dolby DAX3   |
| Digital Out (S/PDIF)               | No   |
| Speaker Power Rating               | 2W@4ohm/ch   |

## Power adapter

|               |                       |
|---------------|-----------------------|
| Type          | 170W AC Adapter       |
| Dimensions    | 350cc (155 x 76 x 30) |
| Input Voltage | 100-240V              |

## Security

|          |                   |
|----------|-------------------|
| TPM      | Version 2.0       |
| Asset ID | Yes               |
| vPro     | Intel vPro for WS |

## Chassis Information

|                   |  |
|-------------------|--|
| Format            | Clamshell  |
| Color             | Midnight Black   |
| Thermal Solutions | Internal Dual FAN, Intelligent Cooling   |
| Dimensions        | Length<br>14.86 inches<br>377.4 millimeters<br>Width<br>9.93 inches<br>252.3 millimeters<br>Height<br>0.96 inches (front)<br>24.5mm (front)<br>1.16 inches (rear)<br>29.4mm (rear)<br>1.29 (rear w/ feet)<br>32.7mm (rear w/ feet) |
| Weight            | with 6 cell 90WHr Battery, Min 5.4 lbs / 2.45kg Max 5.98 lbs/2.715 kg  |

## Packaging Parameters

|             |     |
|-------------|-----|
| Height (mm) | 341 |
| Width (mm)  | 97  |
| Depth (mm)  | 493 |

## Security & Serviceability

|                      |   |
|----------------------|---|
| Self Healing BIOS    | No  |
| Access Panel         | Removeable bottom cover   |
| Number of Screws     | See Hardware Maintenance Manual for Details                           |
| Swappable Components | Bottom cover, memory module, M.2 solid-state drive, speaker assembly, |

|                        |  |
|------------------------|--|
|                        | coin-cell battery, TrackPoint pointing cap, keyboard, WLAN Card, WWAN Card, Power Button Cable, Hinge Caps, LCD Unit, Chassis Assembly, Dummy Smart Card Reader, System Board, |
| Storage Slots          | 3 slots  |
| Memory                 | 4 SODIMM slots   |
| Restore CD/DVD/USB Set | None, Restore Media available via Lenovo Customer Support Center   |
| Cable Lock Support     | Security-lock slot, Optional Kensington Cable Lock   |
| Power-On Password      | Yes  |
| Hard Disk Password     | Yes; User and Master hard disk password  |
| Supervisor Password    | Yes  |
| NIC LEDs (integrated)  | None   |
| Security Chip          | Yes (for TMP 2.0)  |
| Access Panel Key Lock  | Bottom Cover Tamper Detection  |
| Boot Sequence Control  | Yes  |

## Operating Environment

|                                 |  |
|---------------------------------|--|
| Operating - Air Temperature     | At altitudes up to 2438 m (8000 ft)<br>- Operating: 5°C to 35°C (41°F to 95°F)                                     |
| Non Operating - Air Temperature | At altitudes up to 2438 m (8000 ft)<br>- Storage: 5°C to 43°C (41°F to 109°F)                                      |
| Humidity                        | Operating: 8% to 95% at wet-bulb temperature 23°C (73°F)<br>Storage: 5% to 95% at wet-bulb temperature 27°C (81°F) |
| Corrosive Gas                   | G1   |
| Particulates                    | P1   |

## SECTION II: SUPPORTED COMPONENTS

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### Supported Components

|                    |  |
|--------------------|--|
| Processor          | Intel® Core™ i7-8750H processor (2.2 GHz/6 Core/9M)<br>Intel® Core™ i7-8850H vPro processor (2.6 GHz/6 Core/9M/V-Pro)<br>Intel® Core™ i9-8950HK processor (2.9 GHz/6 Core/12M/)<br>Intel® Xeon™ E-2176M v7 vPro processor (2.7 GHz/6 Core/12M/V-Pro) |
| Memory Support     | DDR4 2666MHz SO-DIMM   |
| Chipset (PCH)      | Mobile Intel® CM246 Chipset  |
| Size of BIOS Flash | 8MB for Non-vPro model, 16MB for vPro model  |
| Super I/O          | None   |
| Clock              | Crystal  |

|          |                                 |
|----------|---------------------------------|
| Audio    | Realtek High Definition Audio   |
| Ethernet | Intel® Ethernet Connection I219 |

## Memory

|                             |  |
|-----------------------------|--|
| System Capacity Options     | 8GB<br>16GB<br>32GB<br>64GB<br>128GB   |
| non-ECC                     | 8GB DDR4 2666 SoDIMM<br>16GB DDR4 2666 SoDIMM<br>32GB DDR4 2666 non-ECC SoDIMM     |
| Brand of non-ECC Memory     | Samsung<br>SK Hynix<br>Micron  |
| ECC                         | 8GB DDR4 2666 ECC SoDIMM<br>16GB DDR4 2666 ECC SoDIMM<br>32GB DDR4 2666 ECC SoDIMM |
| Brand of ECC Memory         | SK Hynix<br>Samsung  |
| Memory clock frequency(MHz) | 2666 MHz   |

## Storage

|   |  |
|---|--|
| 2.5" SAS Hard Disk Drive (HDD)          | None   |
| 2.5" SATA Hard Disk Drive (HDD)         | 500GB 7200rpm 7mm HDD<br>1TB 7200rpm 7mm HDD<br>2TB 5400rpm 7mm HDD<br>500GB FIPS140-2 7200rpm 7mm   |
| 2.5" SATA Solid State Drive (SSD)       | None   |
| M.2 (NGFF) PCIe Solid State Drive (SSD) | 256GB SATA (M.2 2280)<br>256GB Opal 2 PCIe TLC NVMe 3X2 (M.2 2280)<br>512GB Opal 2 PCIe TLC NVMe 3X2 (M.2 2280)<br>512GB Opal 2 PCIe MLC NVMe 3X2 (M.2 2280)<br>1TB Opal 2 PCIe TLC NVMe 3X2 (M.2 2280)<br>2TB Opal 2 PCIe TLC NVMe 3X2 (M.2 2280) |
| 2.5" PCIe Solid State Drive (SSD)       | None   |
| Brand of Drive                          | Seagate<br>Samsung<br>Toshiba<br>Intel   |
| Intel Optane Storage Technology         | None   |
| RAID                                    | Optional, Selectable in BIOS   |
| RAID Level and Requirements             | RAID-0/1   |



## Removeable Media

|                                  |        |
|----------------------------------|--------|
| Media Card Reader Specifications | UHS-II |
|----------------------------------|--------|

## SECTION III: Supported Component Detail

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### CPU Specifications

|                          |   |  |  |   |
|--------------------------|---|--|--|---|
| CPU                      | Intel® Core™ i7-8750H processor (2.2 GHz/6 Core/9M) | Intel® Core™ i7-8850H vPro processor (2.6 GHz/6 Core/9M/V-Pro) | Intel® Core™ i9-8950HK processor (2.9 GHz/6 Core/12M/) | Intel® Xeon™ E-2176M v7 vPro processor (2.7 GHz/6 Core/12M/V-Pro) |
| Integrated Graphics      | Intel® UHD Graphics 630                             | Intel® UHD Graphics 630  | Intel® UHD Graphics 630                                | Intel® UHD Graphics 630   |
| # of Cores               | 6   | 6  | 6  | 6   |
| # of Threads             | 12  | 12   | 12   | 16  |
| Processor Base Frequency | 2.20 GHz  | 2.60 GHz   | 2.90 GHz   | 2.70 GHz  |
| Max Turbo Frequency      | 4.10 GHz  | 4.30 GHz   | 4.80 GHz   | 4.40 GHz  |
| Cache                    | 9 MB  | 9 MB   | 12 MB  | 12 MB   |
| TDP                      | 35 - 45 W   | 35 - 45 W  | 45 W   | 35 - 45 W   |
| Intel ARK Spec Link      | <a href="#">Intel Core i7-8750H</a>                 | <a href="#">Intel Core i7-8850H</a>                            | <a href="#">Intel Core i9-8950HK</a>                   | <a href="#">Intel Xeon E-2176M</a>                                |

### Display Specifications

|                    |                           |                             |
|--------------------|---------------------------|-----------------------------|
| Model              | FHD                       | UHD with Touch              |
| Resolution         | FHD (1920 x 1080)         | 4K UHD (3840 x 2160)        |
| Diagonal           | 15.6"                     | 15.6"                       |
| Aspect Ratio       | Ratio 16:9                | Ratio 16:9                  |
| Backlight          | LED                       | LED                         |
| PPI                | FHD : 141                 | UHD : 282                   |
| Active Area        | FHD : 344.16mm x 193.59mm | UHD : 344.2176mm x 193.6224 |
| Refresh Rate       | Max 60Hz                  | Max 60Hz                    |
| Contrast Ratio     | FHD : Typ 700             | UHD : Typ 1000              |
| Viewing Angle (*1) | FHD: 80/80/80/80 degree   | UHD: 85/85/85/85 degree     |
|                    |                           |                             |

|                      |                                    |   |
|----------------------|------------------------------------|---|
| Color gamut          | FHD 72% NTSC                       | UHD 100% Adobe  |
| Brightness           | 250 nits for FHD w/o touch         | 300 nits for UHD w/ touch (LCD itself brightness is 400 nits)       |
| Color Depth          | FHD: Native 262K (RGB 6-bit + FRC) | UHD: Native 16M (RGB 8-bit data driver)                             |
| Interface            | FHD: eDP 1.2                       | UHD: eDP 1.3  |
| Panel ID Recognition | EDID in BIOS Table                 | EDID in BIOS Table  |
| Weight               | FHD: 360g                          | UHD: 370g   |
| Color Calibrator     | None                               | None  |
| Panel Technology     | IPS, Matte                         | IPS, Anti-Glare   |
| Touch Panel          | None                               | 10-Finger Touch Panel with Pen Controller, Wacom. Pen Tilt support. |

## HDD Specifications

|                                 |     |
|---------------------------------|-----|
| 2.5" SATA Hard Disk Drive (HDD) | Yes |
|---------------------------------|-----|

## HDD Storage Device Specifications

|                        |         |
|------------------------|---------|
| Connector              | SATA    |
| Transfer Rate (Gb/sec) | 6.0Gb/s |

## HDD Performance

|   |  |
|---|--|
| Spindle Speed(RPM)                                | 5400RPM&7200RPM  |
| Power off to Spindle Stop(sec)                    | 10 max   |
| DC Power to Drive Ready(sec)                      | No Power to ATA Command Accept(seconds)<br>500G/1TB(1 Platter) - 3<br>2TB(2 Platter) - 4 |
| Receipt of Start Unit Command to Drive Ready(sec) | Standby to Ready(seconds) 3 Max<br>Unloaded to Ready(seconds) 1 Max                      |
| Average Latency(msec)                             | 10 Max   |

## HDD Power Management

|                 |  |
|-----------------|--|
| Input (VDC)     | 12V                                    |
| Typical (Watts) | 5400-> 5.0, 7200-> 5.5 (Spind up)(Max) |

|              |                                  |
|--------------|----------------------------------|
| Idle (Watts) | 5400-> 1.1, 7200-> 1.3 (Typcial) |
|--------------|----------------------------------|

## HDD Dimensions

|                   |                                      |
|-------------------|--------------------------------------|
| Height (mm - Max) | 7.0 +/- 0.2                          |
| Width (mm)        | 69.85 +/- 0.25                       |
| Depth (mm - Max)  | 100.2 +/- 0.25                       |
| Weight (grams)    | 5400rpm - 95 Max<br>7200rpm - 95 Max |

## HDD Temperature

|                           |   |
|---------------------------|---|
| Operating(C) Ambient      | 0 to 55   |
| Operating(C) Base Casting | Surface Temperature (disk enclosure side):<br>60C for 5400RPM<br>63C for 7200RPM<br>Surface Temperature (card side of device):<br>63C |
| Non-Operating(C) Ambient  | -40 to 65   |
| Gradient(C per Hour)      | 20 max  |

## HDD Shock

|                         |                 |
|-------------------------|-----------------|
| Operating(Gs @ 2ms)     | 350             |
| Non-Operating(Gs @ 2ms) | N/A (1000G/1ms) |

## SSD Specifications

|   |                         |
|---|-------------------------|
| 2.5" SATA Solid State Drive (SSD)       | N/A                     |
| M.2 (NGFF) PCIe Solid State Drive (SSD) | 2x M.2 2280 PCIe & SATA |
| 2.5" PCIe Solid State Drive (SSD)       | N/A                     |
| Intel Optane Storage Technology         | N/A                     |

## Solid State Storage Devices

|                 |     |
|-----------------|-----|
| Supported Types | M.2 |
|-----------------|-----|

|   |   |
|---|---|
| Dimensions inches/centimeters (W x D x H) | 22.0 (+-0.15) x 80.0 (+-0.15) x 2.3 (max)   |
| Size                                      | M.2 2280  |
| Interface Type                            | PCIe NVMe   |
| Read/Write IOPS Specifications            | Read: 250K (512GB/1TB/2TB), 200K (256GB)<br>Write: 240K (512GB/1TB/2TB), 190K (256GB)<br>IOPS, 4K Random, 32 q depth, 4 threads |
| Bandwidth Performance                     | PCIe Gen3x4 (8Gb/S)   |
| Power Consumption (Max)                   | 5.0W  |
| Active(AVG)                               | 5.0W (Sequential read)  |
| Idle                                      | 5mW (Low power state)   |
| Min MTBF                                  | 2,000,000 (h)   |
| Min Sequential Read                       | 3000MB/s (512GB/1TB/2TB), 2900MB/s (256GB)  |
| Min Sequential Write                      | 1600MB/s (512GB/1TB/2TB), 900MB/s (256GB)   |
| Hardware Encryption                       | Yes   |

## Discrete Graphics Adapter

| GPU Name                                   | Quadro P1000 | Quadro P2000 | Quadro P3200 |
|--|--------------|--------------|--------------|
| CUDA Processing Cores                      | 512          | 768          | 1792         |
| GPU Memory                                 | 4 GB         | 4 GB         | 6 GB         |
| Memory Bandwidth                           | 96 GBps      | 96 GBps      | 169 GBps     |
| Memory Type                                | GDDR5        | GDDR5        | GDDR5        |
| Memory Interface                           | 128-bit      | 128-bit      | 192-bit      |
| TGP Max Power Consumption                  | 40W          | 50W          | 78W          |
| Display Port                               | 1.4          | 1.4          | 1.4          |
| OpenGL                                     | 4.5          | 4.5          | 4.5          |
| Shader Model                               | 5            | 5            | 5.1          |
| DirectX                                    | 12           | 12           | 12           |
| PCIe Generation                            | 3            | 3            | 3            |
| Floating-Point Performance                 | 1.6          | 2.4          | 5.3          |
| VR Ready                                   | No           | No           | Yes          |
| Simultaneous Multi-Projection              | Yes          | Yes          | Yes          |
| NVIDIA FXAA/TXAA Antialiasing              | Yes          | Yes          | Yes          |
| NVIDIA nView Display Management Technology | Yes          | Yes          | Yes          |
| GPU Direct for Video                       | No           | No           | No           |
| Vulkan Support                             | Yes          | Yes          | Yes          |
| NVIDIA Optimus                             | Yes          | Yes          | Yes          |

# WLAN

|  |   |
|--|---|
| Model                                  | Intel Wireless AC-9560 (2x2 11ac w/ 160MHz channels) and Bluetooth 5.0 vPro   |
| Connector: Main, Aux/GNSS, GNSS        | ANT1: Wi-Fi (chain A) + BT; ANT2: Wi-Fi (chain B)   |
| Antenna Diversity                      | Supported   |
| MIMO                                   | Supported   |
| GNSS Bian                              | N/A   |
| Radio ON/OFF Control                   | Supported   |
| Connector interface                    | M.2 CNVio   |
| Operating Temperature (Adapter Shield) | 0c to +80c  |
| Humidity Non-Operating                 | 50%~90% Rh non condensing (at temperatures of 25c to 35c)   |
| Operating Systems                      | Microsoft Windows 10*, Linux*(limited feature support), Chrome*   |
| Wi-Fi Alliance                         | Wi-Fi CERTIFIED* a/b/g/n/ac with wave 2 features, WMM*, WMM-PS*, WPA*, WPA2*, WPS2*, Protected Management Frames, Wi-Fi Miracast* as Source, and Wi-Fi Direct (For Microsoft Windows* only) |
| IEEE WLAN Standard                     | IEEE 802.11a/b/g/n/ac, 802.11d,802.11e, 802.11h, 802.11i, 802.11w, 802.11r, 802.11k, 802.11v, pending OS support; Fine Timing Measurement based on 802.11-2016                              |
| Roaming                                | Support seamless roaming between access points  |
| Bluetooth*                             | BT5.0   |
| Authentication                         | WPA* and WPA2*, 802.1X (EAP-TLS, TTLS, PEAP, EAP-SIM, EAP-AKA, EAP-AKA')  |
| Authentication Protocols               | PAP, CHAP, TLS, MS-CHAP*, MS-CHAPv2   |
| Encryption                             | 64-bit and 128-bit WEP, TKIP, 128-bit AES-CCMP, 128-bit and 256-bit AES-GCMP  |
| Regulatory                             | All compliance  |
| US Government                          | FIPS12, FISMA   |
| Product Safety                         | UL,C-UL,CB (IEC 60950-1)  |

# Battery

|                           |   |
|---------------------------|---|
| Dimension                 | L: 82.4mm*W: 206mm*T 17.73mm  |
| Weight                    | MAX 460g  |
| Type (Chemistry and Cell) | Li-Polymer (3S2P), 6-cell   |
| Voltage                   | 11.25V  |
| Battery Life              | Up to 6.1 Hr+ MM14 Max battery life (dGPU mode, max battery config.)<br>Up to 8.9 Hr+ MM14 Max battery life (Optimus mode, max battery config.) |
| Battery Capacity          | 90Wh  |
| Charging Time             | No Quick charge capability<br>On Charge Time (0-100%) * 131min  |

|                             |  |
|-----------------------------|--|
|                             | Off Charge Time (0 - 80%) ** 65 min<br>Off Charge Time (0 - 100%) ** 125 min |
| Operating Temperature Range | between 10°C (50°F) and 35°C (95°F)  |
| Warranty                    | 1 Year   |
| Coin Cell Battery (Model)   | CR2032-J056(MHLF)  |

## SECTION IV: BIOS / Certifications / Standards / Environmental

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### BIOS Specifications

|  |  |
|--|--|
| WMI Support                                    | Yes, if it is BIOS Setup change by WMI.  |
| ROM-Based Setup Utility (F1)                   | Yes  |
| Bootblock Recovery                             | N/A  |
| Replicated Setup                               | Yes, it supported with SRSETUP tool.   |
| Boot Control                                   | Yes, it means Boot order change.   |
| Discrete Mode                                  | Yes  |
| Memory Change Alert                            | N/A  |
| Thermal Alert                                  | N/A  |
| Asset Tag                                      | Yes  |
| System/Emergency ROM Flash Recovery with Video | N/A  |
| Remote Wakeup/Remote Shutdown                  | Yes, if Remote wakeup is Wake on LAN from S4/S5. I don't know the Remote shutdown situation. |
| Keyboard-less Operation                        | N/A  |
| Per-port Control                               | Yes, if it is I/O port enable/disable by BIOS Setup.   |
| Adaptive Cooling                               | Yes, if it is thermal & fan control.   |
| Security                                       | Yes, BIOS password / Hard disk password / Finger print                                       |
| Intel(R) AMT (includes ASF 2.0)                | Yes. If you select vPro model  |
| Intel(R) TXT                                   | Yes. If you select vPro model  |
| Memory Modes                                   | N/A  |

### EMC & Safety

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|        |  |
|--------|--|
| EMC    | <p>Published, Certified Existing Reports</p> <p>EMC - Australia<br/> EMC - Belarus<br/> EMC - Canada<br/> EMC - China<br/> EMC - EU/EFTA<br/> EMC - Japan<br/> EMC - Kazakhstan<br/> EMC - New Zealand<br/> EMC - Russia<br/> EMC - South Korea<br/> EMC - Taiwan<br/> EMC - USA/Territories</p> <p>Not Applicable / Not Required</p> <p>EMC - Israel<br/> EMC - Moldova<br/> EMC - Serbia<br/> EMC - Turkey<br/> EMC - Uzbekistan<br/> EMC - Vietnam</p>  |
| Safety | <p>To access the latest User Guide and Safety and Warranty Guide, go to: <a href="https://support.lenovo.com">https://support.lenovo.com</a></p> <p>Low Halogen Declaration of Conformance<br/> TNOT-2017-0040</p> <p>Section 9 - Low Halogen Scorecard<br/> Izod Test - EPEAT Compliant<br/> Homologation PCRB Compliant</p> <p>In the following countries: Albania, Algeria, Andorra, Angola, Antigua and Barbuda, Argentina, Armenia, Aruba, Australia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bermuda, Bolivia, Botswana, Burkina Faso, Burundi, Cambodia, Cameroon, Canada, Cape Verde, Cayman Islands, Central African Republic, Chad, China, Colombia, Comoros, Congo, Costa Rica, Djibouti, Dominican Republic, Egypt, El Salvador, Eritrea, Ethiopia, EU/EFTA, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Haiti, Honduras, Hong Kong, India, Indonesia, Israel, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Kuwait, Laos, Lebanon, Liberia, Macau, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Nepal, New Zealand, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Russia, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, South Africa, South Korea, Sri Lanka, Swaziland, Taiwan, Tajikistan, Tanzania, Thailand, Togo, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, United Arab Emirates, Uruguay, USA/Territories, Uzbekistan, Venezuela, Vietnam, Zambia, Zimbabwe, Brazil - Inmetro 170 Govt Bids, Guinea-Bissau, Lesotho</p> |

## Environmentals

|                      |   |
|----------------------|---|
| Energy Star          | <p>ENERGY STAR® Version 7.0</p> <p>For more information about ENERGY STAR, go to: <a href="https://www.energystar.gov">https://www.energystar.gov</a></p>   |
| EPEAT                | EPEAT Certification Available on select models  |
| IT ECO declaration   | <p>The latest environmental information about Lenovo products is available at: <a href="https://www.lenovo.com/ecodeclaration">https://www.lenovo.com/ecodeclaration</a></p>  |
| Hazardous Substances | <p>The latest environmental information about Lenovo products is available at: <a href="https://www.lenovo.com/ecodeclaration">https://www.lenovo.com/ecodeclaration</a></p> <p>European Union RoHS</p> <p>This Lenovo product, with included parts (cables, cords, and so on) meets the requirements of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment ("RoHS recast" or "RoHS 2").</p> <p>For more information about Lenovo worldwide compliance on RoHS, go</p> |

to:  
<https://www.lenovo.com/rohs-communication>

## Manageability

|   |   |
|---|---|
| Industry Standard Specifications        | This product meets the following industry standard specifications for manageability functionality:  |
| Remote Manageability Software Solutions | Lenovo ThinkManagement Console<br>Microsoft System Center Configuration Manager<br>LANDesk Management Suite for Lenovo Vantage Technologies<br>( <a href="http://www.landesk.com/lenovo">www.landesk.com/lenovo</a> )   |
| System Software Manager                 | Lenovo ThinkStation supports software management tools from the ThinkVantage System Update suite:<br>System Update<br>Update Retriever  |
| Service, Support, and Warranty          | On-site Warranty and Service: Three-years, limited warranty and service offering delivers on-site, next business-day service for parts and labor and includes free telephone support 8am to 5pm. Global coverage ensures that any product purchased in one country and transferred to another, non-restricted country will remain fully covered under the original warranty and service offering. |