

# Lenovo ThinkPad P51

Version: 1 | July 16, 2018

## Section I: System Overview

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|                    |  |
|--------------------|--|
| <b>Description</b> | The ThinkPad P51 redefines the concept of power. The latest-generation Intel® processors, optional X-Rite® PANTONE® color calibration, Mil-Spec testing for durability, blazing-fast connection speeds, and unprecedented storage and memory make this workstation your go-to PC for getting the job done. |
|--------------------|--|

### Operating Systems

|                  |   |
|------------------|---|
| <b>Preloaded</b> | Genuine Windows 10® Professional 64-bit<br>Genuine Windows 10DG to 7® Professional 64-bit<br>Ubuntu Linux |
| <b>Supported</b> | Red Hat Enterprise Linux 7.3  |

### Motherboard

#### Form Factor

|                   |  |
|-------------------|--|
| <b>Board Size</b> |  |
| <b>Layout</b>     |  |

#### Motherboard Core

|                          |  |
|--------------------------|--|
| <b>Processor Support</b> |  |
| <b>Socket Type</b>       |  |
| <b>Memory Support</b>    |  |
| <b>QPI (GTPS)</b>        |  |
| <b>Voltage Regulator</b> |  |
| <b>Chipset (PCH)</b>     |  |
| <b>HW Monitor</b>        |  |
| <b>Flash</b>             |  |
| <b>Super I/O</b>         |  |
| <b>Clock</b>             |  |
| <b>Audio</b>             |  |
| <b>Ethernet</b>          |  |
| <b>SAS</b>               |  |

#### Memory

|                 |  |
|-----------------|--|
| <b>Slots</b>    |  |
| <b>Channels</b> |  |
| <b>Type</b>     |  |

|                          |  |
|--------------------------|--|
| <b>ECC Support</b>       |  |
| <b>Speed</b>             |  |
| <b>Max DIMM Size</b>     |  |
| <b>Max System Memory</b> |  |

#### Ethernet

|                   |  |
|-------------------|--|
| <b>Vendor</b>     |  |
| <b>Count</b>      |  |
| <b>EEPROM</b>     |  |
| <b>Speeds</b>     |  |
| <b>Functions</b>  |  |
| <b>Connectors</b> |  |

#### Audio

|   |  |
|---|--|
| <b>Vendor</b>                             |  |
| <b>Type</b>                               |  |
| <b>Internal Speaker</b>                   |  |
| <b>Connectors</b>                         |  |
| <b>Chipset</b>                            |  |
| <b>Stereo Conversion</b>                  |  |
| <b>High Definition Stereo Support</b>     |  |
| <b>Number of Channels</b>                 |  |
| <b>Number of Bits/Audio Resolution</b>    |  |
| <b>Sampling Rate (Recording/Playback)</b> |  |
| <b>Signal to Noise Ratio</b>              |  |
| <b>Wavetable Voices</b>                   |  |
| <b>Analog Audio</b>                       |  |
| <b>Dolby Digital</b>                      |  |
| <b>THX</b>                                |  |
| <b>Digital Out (S/PDIF)</b>               |  |
| <b>Speaker Power Rating</b>               |  |

#### Video

|                               |  |
|-------------------------------|--|
| <b>Onboard</b>                |  |
| <b>Adapter</b>                |  |
| <b>Multi-GPU Support</b>      |  |
| <b>Type</b>                   |  |
| <b>Bus Interface</b>          |  |
| <b>Display Interface</b>      |  |
| <b>Video Resolution (max)</b> |  |
| <b>Graphics Cover Name</b>    |  |

**Storage**

|        |  |
|--------|--|
| Floppy |  |
| IDE    |  |
| SATA   |  |
| eSATA  |  |

**Slots**

|        |  |
|--------|--|
| Slot 1 |  |
| Slot 2 |  |
| Slot 3 |  |
| Slot 4 |  |
| Slot 5 |  |
| Slot 6 |  |
| Slot 7 |  |
| Slot 8 |  |

**I/O Front Default Ports**

|                          |  |
|--------------------------|--|
| USB 3.0 Type A           |  |
| Headset                  |  |
| Headphone                |  |
| Microphone               |  |
| 9-in-1 Media Card Reader |  |

**I/O Front Optional Ports**

|                           |  |
|---------------------------|--|
| Flex Module               |  |
| 9-in-1 Media Card Reader  |  |
| 29-in-1 Media Card Reader |  |

**I/O Rear Default Ports**

|  |  |
|--|--|
| USB 2.0 Type A                                 |  |
| USB 3.0 Type A                                 |  |
| Display Port                                   |  |
| VGA Port                                       |  |
| 1 standard serial, 1 optional via punching out |  |
| Audio In                                       |  |
| Audio Out                                      |  |
| Microphone                                     |  |
| RJ45   |  |
| 2 PS/2   |  |

**I/O Rear Optional Ports**

|  |  |
|--|--|
| 2 PS/2   |  |
| 1 standard serial, 1 optional via punching out |  |

|                                    |  |
|------------------------------------|--|
| IEEE 1394                          |  |
| eSATA                              |  |
| Parallel Card                      |  |
| Dual USB 3.1 Type C Card           |  |
| Dual USB 2.0 Type A card           |  |
| Single/Dual Port Network Card      |  |
| Single/Dual/Quad Port Network Card |  |

#### Thermal

|              |  |
|--------------|--|
| Temp Sensors |  |
| Fans         |  |

#### Power Connectors

|              |  |
|--------------|--|
| Main         |  |
| Memory & CPU |  |
| Graphics     |  |

#### Security

|          |  |
|----------|--|
| TPM      |  |
| Asset ID |  |
| vPro     |  |

#### BIOS

|        |  |
|--------|--|
| Vendor |  |
|--------|--|

#### Chassis Information

|                   |  |
|-------------------|--|
| Format            |  |
| Color             | ThinkPad Business Black  |
| PSU               | 170W, 2pin   |
| Thermal Solutions | Dual Fan, 1 dedicated CPU, 1 dedicated GPU with connected heat sinks |
| Dimensions        | 24.50mm (0.96in) x 377.40mm (14.86in) x 252.30mm (9.93in)            |
| Weight            | Starting at 5.6lbs   |

#### Packaging Parameters without External Speaker

|               |  |
|---------------|--|
| Height (mm)   |  |
| Height (inch) |  |
| Width (mm)    |  |
| Width (inch)  |  |
| Depth (mm)    |  |
| Depth (inch)  |  |
| Weight (kgs)  |  |
| Weight (lbs)  |  |

## Security & Serviceability

|   |   |
|---|---|
| <b>Hardware Maintenance Manual</b>  | <a href="https://download.lenovo.com/pccbbs/mobiles_pdf/p51_hmm_en_sp40k88791_01.pdf">https://download.lenovo.com/pccbbs/mobiles_pdf/p51_hmm_en_sp40k88791_01.pdf</a>   |
| <b>Drivers &amp; Software</b>   | <a href="https://pcsupport.lenovo.com/us/en/products/laptops-and-netbooks/thinkpad-p-series-laptops/thinkpad-p51-type-20hh-20hj/downloads">https://pcsupport.lenovo.com/us/en/products/laptops-and-netbooks/thinkpad-p-series-laptops/thinkpad-p51-type-20hh-20hj/downloads</a> |
| <b>Access Panel</b>   | Bottom cover, 6 screws  |
| <b>Optical Drive</b>  |   |
| <b>Hard Drives</b>  | Screw, 1x   |
| <b>Expansion Cards</b>  |   |
| <b>Processor Socket</b>   |   |
| <b>Color coded User Touch Points</b>                                      |   |
| <b>Color-coordinated Cables and Connectors</b>                            |   |
| <b>Memory</b>   | Tool-less   |
| <b>System Board</b>   |   |
| <b>Green Color Power LED on Front of Computer</b>                         |   |
| <b>Restore CD/DVD/USB Set</b>   | Restore system to original factory shipping image - Can be obtained via Lenovo Support  |
| <b>Cable Lock Support</b>   | Yes, Optional Kensington Cable Lock   |
| <b>Serial, Parallel, USB, Audio, Network, Enable/Disable Port Control</b> | Yes   |
| <b>Power-On Password</b>  | Yes   |
| <b>Setup Password</b>   | Yes   |
| <b>NIC LEDs (integrated)</b>  | Yes   |
| <b>Security Chip</b>  | Yes, TCG dTPM 2.0   |
| <b>Access Panel Key Lock</b>  |   |
| <b>Boot Sequence Control</b>  | Yes   |
| <b>Padlock Support</b>  |   |
| <b>Boot without keyboard and/or mouse</b>                                 |   |

## Operating Environment

|                        |   |
|------------------------|---|
| <b>Air Temperature</b> |   |
| <b>Storage</b>         | *-20°C to 60°C (-4°F to 140°F)  |
| <b>Humidity</b>        | Operating 8% ~ 95% (non-condensing) Non-Operating 5% ~ 95%(non-condensing)  |
| <b>Altitude</b>        | 8,000ft (2438m) Operating without a drive installed: 5°C to 35°C (41°F to 95°F) Operating with a drive installed: 10°C to 35°C (50°F to 95°F) Non-operating: 5°C to 31.3°C (41°F to 88°F) 10000ft (3048m) Operating unpressurized Condition: 5°C to 31.3°C (41°F to 88°F) |
| <b>Vibration</b>       |   |
| <b>Shock</b>           |   |

## Regulations & Standards

### EMC & Safety

|               |  |
|---------------|--|
| <b>EMC</b>    |  |
| <b>Safety</b> |  |

**Environmentals**

|                             |  |
|-----------------------------|--|
| <b>Energy Star</b>          | Energy Star 6.1<br>EPEAT Gold<br>GreenGuard Gold<br>TCO 5.0  |
| <b>EPEAT</b>                |  |
| <b>ErP Lot-3 2013</b>       |  |
| <b>Hazardous Substances</b> | <p>Products do not contain more than; 0.1% lead, 0.01% cadmium, 0.1% mercury, 0.1% hexavalent chromium, 0.1% polybrominated biphenyls (PBB) or 0.1% polybrominated diphenol ethers (PBDE).</p> <p>Products do not contain Asbestos.</p> <p>Products do not contain Ozone Depleting Substances: Chlorofluorocarbons (CFC), hydrobromofluorocarbons (HBFC), hydrochlorofluorocarbons (HCFC), Halons, carbontetrachloride, 1,1,1-trichloroethane, methyl bromide.</p> <p>Products do not contain more than; 0.005% polychlorinated biphenyl (PCB), 0.005% polychlorinated terphenyl (PCT) in preparation.</p> <p>Products do not contain more than 0.1% short chain chloroparaffins (SCCP) with 10-13 carbon atoms in the chain containing at least 48% per mass of chlorine in the SCCP</p> <p>Parts with direct and prolonged skin contact do not release nickel in concentrations above 0.5 microgram/cm<sup>2</sup>/week.</p> |

**Section II: Supported Components**

|                              |   |
|------------------------------|---|
| <b>Processor</b>             |   |
| <b>Memory Specifications</b> | <p>Type SODIMM<br/>Speed 2133MHz<br/>Slots 4<br/>Generation DDR4<br/>Capacities - Non-ECC 8GB, 16GB<br/>Capacities - ECC (Only with Xeon CPUs) 8GB, 16GB<br/>Dual Channel Capable Yes</p> |
| <b>Notes</b>                 |   |

**Storage**

|   |  |
|---|--|
| <b>Notes</b>  | 2x 2.5" bays; 1 bay capable of 2x M.2 drives (either PCIe or SATA) or 1x 2.5" HDD, 1 bay capable of only 1x 2.5" HDD |
| <b>3.5" SATA Hard Disk Drive (HDD)</b>                        |  |
| <b>3.5" Enterprise SASA Hard Disk Drive (HDD)</b>             |  |
| <b>3.5" Hybrid Drive</b>                                      |  |
| <b>2.5" SAS Hard Disk Drive (HDD)</b>                         |  |
| <b>2.5" SATA Hard Disk Drive (HDD)</b>                        |  |
| <b>2.5" SATA Solid State Drive (SSD)</b>                      |  |
| <b>M.2 (NGFF) PCIe Solid State Drive (SSD)</b>                |  |
| <b>2.5" PCIe Solid State Drive (SSD)</b>                      |  |
| <b>PCIe Half Height / Half Length Solid State Drive (SSD)</b> |  |
| <b>Intel Optane Memory Technology</b>                         |  |

**RAID**

|  |  |
|--|--|
|  |  |
|--|--|

|   |   |
|---|---|
| <b>RAID</b>                                 | Supported RAID levels for a system will vary from the stated capabilities of the RAID controller due to dependencies on the number and capacity of physical disks in the system and on customer requirements for performance, fault tolerance, or data redundancy. Max support RAID 0,1 RAID levels and requirements: RAID 0 (striping) provides increased performance by writing data across multiple drives. RAID 1 (mirroring) provides fault tolerance by writing the data on two drives. |
| <b>RAID Levels and Requirements</b>         |   |
| <b>Optional Hard Disk Drive Controllers</b> |   |
| <b>Intel Virtual Raid</b>                   |   |

## Optical Drive/Removable Media

|   |   |
|---|---|
| <b>DVD-ROM Drive</b>                            |   |
| <b>DVD Burner/CD-RW Rambo Drive</b>             |   |
| <b>Blu-Ray Burner Drive</b>                     |   |
| <b>DVD Burner/CD-RW Rambo Drive (Slim SATA)</b> |   |
| <b>Slim 9.0mm DVD ROM</b>                       |   |
| <b>Media Card Reader</b>                        |   |
| <b>Keyboard</b>                                 | 6 row; spill resistant; Multimedia Fn keys, numeric keypad, optional LED backlight, 2.2mm key stroke, 19.05mm key pitch |
| <b>Pointing Devices</b>                         | Trackpoint with left/right click and scroll lock, Touchpad with left/middle/right click                                 |
| <b>Fingerprint Reader</b>                       | Touch Style, match-on-system  |
| <b>Color Calibrator</b>                         | X-Rite Pantone software, AMS RGB sensor   |

## Graphics Cards

|                                 |  |
|---------------------------------|--|
| <b>Integrated Graphics</b>      | Core CPU: Intel HD 630<br>Xeon CPU: Intel HD P630          |
| <b>Discrete Graphic Cards</b>   | NVIDIA M1200 with 4GB GDDR5<br>NVIDIA M2200 with 4GB GDDR5 |
| <b>NVIDIA Stereo 3D Bracket</b> |  |

## FLEX Components

|                        |  |
|------------------------|--|
| <b>Flex Components</b> |  |
|------------------------|--|

## PCIe Adapters

|                          |   |
|--------------------------|---|
| <b>Network</b>           | Connector: RJ-45 Model: Intel, I219-V, Intel, I219-LM                                     |
| <b>Thunderbolt</b>       | Intel Alpine Ridge controller, 1 port via USB Type C, max I/O of 40Gb/s                   |
| <b>IEE 1394</b>          |   |
| <b>USB</b>               | 4x USB Type A (1 powered), 1x USB Type C (support for Thunderbolt 3)                      |
| <b>Audio Devices</b>     | HD Audio, Realtek ALC3268 codec, Stereo speakers, 2x 1.5W                                 |
| <b>WIFI Cards</b>        | Intel Snowfield Peak 8265 2*2ac+BT4.1 vpro Intel Snowfield Peak 8265 2*2ac+BT4.1 non-vpro |
| <b>WWAN</b>              | US,CA: Sierra EM7455 LTE (HSPA+/GSM/EDGE) EU: Sierra EM7455 LTE (HSPA+/GSM/EDGE)          |
| <b>Express Card</b>      | 34mm  |
| <b>Chassis Materials</b> | A Cover - GFRP B Cover - PC/ABS C Cover - PC/ABS Roll Cage - Mg/Al D Cover - Mg/Al        |
| <b>Parallel Card</b>     |   |

|                                |  |
|--------------------------------|--|
| PCIe to M.2 Adapter Card       |  |
| Front Access Storage Enclosure |  |
| Type C                         |  |

**Section III: System Technical Specifications**

---

Power Supply Specifications

|  |  |
|--|--|
| Power Supply   |  |
| Power Efficiency   |  |
| Operating Voltage Range  |  |
| Rated Voltage Range  |  |
| Rated Line Frequency   |  |
| Operating Line Frequency Range   |  |
| Rated Input Current  |  |
| Power Supply Fan   |  |
| ENERGY STAR® qualified (Config Dependent)                                      |  |
| 80 PLUS Compliant  |  |
| Built-in Self Test (BIST) LED  |  |
| Surge Tolerant Full Ranging Power Supply (withstands power surges up to 2000V) |  |
| Aux Power Drop   |  |

ThinkStation Power Calculator

|                               |  |
|-------------------------------|--|
| ThinkStation Power Calculator |  |
|-------------------------------|--|

BIOS Specifications

Features

|  |  |
|--|--|
| WMI Support                                    |  |
| ROM-Based Setup Utility (F1)                   |  |
| Bootblock Recovery                             |  |
| Replicated Setup                               |  |
| Boot Control                                   |  |
| Memory Change Alert                            |  |
| Thermal Alert                                  |  |
| Asset Tag                                      |  |
| System/Emergency ROM Flash Recovery with Video |  |
| Remote Wakeup/Remote Shutdown                  |  |
| Quick Resume Time                              |  |
|  |  |



|  |  |
|--|--|
| <b>ROM Revision Level</b>              |  |
| <b>Keyboard-less Operation</b>         |  |
| <b>Per-port Control</b>                |  |
| <b>Adaptive Cooling</b>                |  |
| <b>Security</b>                        |  |
| <b>Intel(R) AMT (includes ASF 2.0)</b> |  |
| <b>Intel(R) TXT</b>                    |  |
| <b>Memory Modes</b>                    |  |
| <b>Windows 10 Ready</b>                |  |

#### Industry Standard Specification Support

|   |  |
|---|--|
| <b>UEFI</b>   |  |
| <b>ACPI (Advanced Configuration and power Management Interface)</b> |  |
| <b>ASF 2.0</b>  |  |
| <b>ATA (IDE)</b>  |  |
| <b>CD Boot</b>  |  |
| <b>EHCI</b>   |  |
| <b>PCI</b>  |  |
| <b>PCI Express</b>  |  |
| <b>SATA</b>   |  |
| <b>TPM</b>  |  |
| <b>UHCI</b>   |  |
| <b>USB</b>  |  |
| <b>SMBIOS</b>   |  |
| <b>XHCI</b>   |  |

#### Social and Environmental Responsibility

|   |   |
|---|---|
| <b>Quality Control</b>  | Lenovo is a member of an eco declaration system that enforces regular independent quality control   |
| <b>Hazardous Substances and Preparation</b>                         | <p>Products do comply with current European RoHS Directive.</p> <p>Products do not contain Asbestos</p> <p>Products do not contain Ozone Depleting Substances: Chlorofluorocarbons (CFC), hydrobromofluorocarbons (HBFC), hydrochlorofluorocarbons (HCFC), Halons, carbontetrachloride, 1,1,1-trichloroethane, methyl bromide</p> <p>Products do not contain more than; 0.005% polychlorinated biphenyl (PCB), 0.005% polychlorinated terphenyl (PCT) in preparation</p> <p>Products do not contain more than 0.1% short chain chloroparaffins (SCCP) with 10-13 carbon atoms in the chain containing at least 48% per mass of chlorine in the SCCP</p> <p>Parts with direct and prolonged skin contact do not release nickel in concentrations above 0,5 µg/cm2 /week</p> <p>REACH Article 33 information about substances in articles is available at (add URL or mail contact):<a href="http://www.lenovo.com/social_responsibility/us/en/materials.html">http://www.lenovo.com/social_responsibility/us/en/materials.html</a></p> |
| <b>Batteries</b>  | <p>If the product contains a battery or an accumulator, the battery/accumulator is labeled with the disposal symbol. Information on proper disposal is provided in user manual</p> <p>Button cells used in the product do not contain more than 2% by weight of mercury. Other batteries or accumulators do not contain more than 0.0005% of mercury or 0.002% of cadmium</p> <p>Batteries or accumulators do not contain more than 0,0005% of mercury or 0,002% of cadmium.</p> <p>Batteries and accumulators are readily removable.</p>   |
| <b>Safety, EMC Connection to the Telephone Network and Labeling</b> |   |

|                          |   |
|--------------------------|---|
| <b>Product Packaging</b> | <p>Packaging and packaging components do not contain more than 0,01% lead, mercury, cadmium and hexavalent chromium by weight of these together.</p> <p>The packaging materials are marked with abbreviations and numbers indicating the nature of the material(s) used.</p> <p>The product packaging material is free from ozone depleting substances as specified in the Montreal Protocol</p> <p>For more information on Lenovo social environmental practices visit:<br/> <a href="http://www.lenovo.com/social_responsibility/us/en/ThinkGreen_products.html#environment">http://www.lenovo.com/social_responsibility/us/en/ThinkGreen_products.html#environment</a></p> |
|--------------------------|---|

## Manageability

|  |   |
|--|---|
| <b>Industry Standard Specifications</b>        | This product meets the following industry standard specifications for manageability functionality:<br>Intel LAN with AMT  |
| <b>Remote Manageability Software Solutions</b> | Lenovo ThinkPad is supported on the following remote manageability software consoles:<br>Lenovo ThinkManagement Console<br>LANDesk Management Suite for ThinkVantage Technologies ( <a href="http://www.landesk.com/lenovo">www.landesk.com/lenovo</a> )<br>Microsoft System Center Configuration Manager   |
| <b>System Software Manager</b>                 | Lenovo ThinkPad supports software management tools from the ThinkVantage System Update suite:<br>System Update<br>Update Retriever<br>Thin Installer  |
| <b>Service, Support, and Warranty</b>          | On-site Warranty and Service: Up to four-years, limited warranty and service offering delivers on-site, next business-day service for parts and labor and includes free telephone support 8am - 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. |

## Section IV: Component Specifications

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### Display

|                             |                                       |
|-----------------------------|---------------------------------------|
|                             | <b>15.6" UHD/IPS</b>                  |
| <b>Model</b>                | 15.6" UHD/IPS                         |
| <b>Screen Size</b>          | 15.6"                                 |
| <b>Aspect Ratio</b>         | 16:09                                 |
| <b>Resolution</b>           | UHD (3840 x 2160)                     |
| <b>Outline Dimension</b>    | 352.2 x 217.7mm max                   |
| <b>With PCB (H x V)</b>     |                                       |
| <b>Without bracket</b>      |                                       |
| <b>Color gamut</b>          |                                       |
| <b>Brightness</b>           | 300 nits                              |
| <b>Brightness with TP</b>   |                                       |
| <b>Brightness w/o TP</b>    |                                       |
| <b>Contrast</b>             | 1000:01:00                            |
| <b>Viewing Angle (*1)</b>   | 85/85/85/85 degrees                   |
| <b>Panel Technology</b>     | IPS                                   |
| <b>Color Depth</b>          | Native 16M<br>(RGB 8-bit data driver) |
| <b>Interface</b>            | eDP 1.4a                              |
| <b>Panel ID Recognition</b> | EDID in BIOS table                    |
| <b>Weight</b>               | 365 grams max                         |
| <b>Weight w/o TP</b>        |                                       |

Weight w/ TP

## HDD Specifications

| 3.5" SATA Hard Disk Drive (HDD) | 3.5" Enterprise SATA Hard Disk Drive (HDD) | 3.5" Hybrid Drive | 2.5" SAS Hard Disk Drive (HDD) | 2.5" SATA HDD   |
|---------------------------------|--|-------------------|--------------------------------|---|
|                                 |  |                   |                                | 256 GB, PCIe NVMe, Gen3x4 (MLC), OPAL<br>512 GB, PCIe NVMe, Gen3x4 (MLC), OPAL<br>256 GB, PCIe NVMe, Gen3x4 (TLC), OPAL<br>512 GB, PCIe NVMe, Gen3x4 (TLC), OPAL<br>1TB, PCIe NVMe, Gen3x4 (TLC), OPA |

## Storage Device Specifications

Performance

Power Management

Dimensions

Temperature

Shock

## SSD Specifications

|  | M.2 PCIe & SATA SSD |
|--|---------------------|
| 2.5" SATA Solid State Drive (SSD)                      |                     |
| M.2 (NGFF) PCIe Solid State Drive (SSD)                |                     |
| M.2 PCIe & SATA SSD                                    |                     |
| PCIe Half Height / Half Length Solid State Drive (SSD) |                     |

## Solid State Storage Devices

|   | M.2 PCIe & SATA SSD |
|---|---------------------|
| Supported Types                           |                     |
| Dimensions inches/centimeters (W x D x H) |                     |
| Size                                      |                     |
| Interface Type                            |                     |
| Read/Write IOPS Specifications            |                     |
| Bandwidth Performance                     |                     |
| Power Consumption (Max)                   |                     |
| Active(AVG)                               |                     |
| Idle                                      |                     |
| Min MTBF                                  |                     |
| Min Sequential Read                       |                     |
| Min Sequential Write                      |                     |

|                                    |  |
|------------------------------------|--|
| <b>Min Random Read (8GB Span)</b>  |  |
| <b>Min Random Write (8GB Span)</b> |  |
| <b>Min Power - Active</b>          |  |
| <b>Min Power - Idle</b>            |  |
| <b>Min MTBF</b>                    |  |
| <b>Hardware Encryption</b>         |  |

**PCIe Add-on Storage Devices**

|   |                                |
|---|--------------------------------|
|   | <b>M.2 PCIe &amp; SATA SSD</b> |
| <b>Interface</b>                          |                                |
| <b>Capacity</b>                           |                                |
| <b>Power Consumption</b>                  |                                |
| <b>Sequential Read</b>                    |                                |
| <b>Sequential Write</b>                   |                                |
| <b>Random Read (100% Span)</b>            |                                |
| <b>Random Write (100% Span)</b>           |                                |
| <b>Latency - Read</b>                     |                                |
| <b>Latency - Write</b>                    |                                |
| <b>Power - Active</b>                     |                                |
| <b>Power - Idle</b>                       |                                |
| <b>Operating Temperature Range</b>        |                                |
| <b>Endurance Rating (Lifetime Writes)</b> |                                |
| <b>Mean Time Between Failures (MTBF)</b>  |                                |

HDD Controllers

Optical Drive Specifications

**Rates**

**Access Times**

**Power**

**Operating Systems Supported**

**Operating Environment**

Graphics Cards

|                         |             |              |              |
|-------------------------|-------------|--------------|--------------|
|                         | <b>P510</b> | <b>P3000</b> | <b>P4000</b> |
| <b># CUDA Cores</b>     |             |              |              |
| <b>Single Precision</b> |             |              |              |
| <b>PCIe Gen</b>         |             |              |              |
| <b>Memory Size</b>      |             |              |              |
| <b>Memory BW</b>        |             |              |              |
|                         |             |              |              |

|                                   |  |  |  |
|-----------------------------------|--|--|--|
| <b>Slots + Display Connectors</b> |  |  |  |
| <b>Display Support</b>            |  |  |  |
| <b>Advanced Display</b>           |  |  |  |
| <b>Board Power</b>                |  |  |  |
| <b>Max Power</b>                  |  |  |  |
| <b>Max Resolution</b>             |  |  |  |
| <b>SLI Support</b>                |  |  |  |
| <b>Form Factor</b>                |  |  |  |

|                                   |              |               |              |
|-----------------------------------|--------------|---------------|--------------|
|                                   | <b>P5100</b> | <b>M1000M</b> | <b>M1200</b> |
| <b># CUDA Cores</b>               |              |               |              |
| <b>Single Precision</b>           |              |               |              |
| <b>PCIe Gen</b>                   |              |               |              |
| <b>Memory Size</b>                |              |               |              |
| <b>Memory BW</b>                  |              |               |              |
| <b>Slots + Display Connectors</b> |              |               |              |
| <b>Display Support</b>            |              |               |              |
| <b>Advanced Display</b>           |              |               |              |
| <b>Board Power</b>                |              |               |              |
| <b>Max Power</b>                  |              |               |              |
| <b>Max Resolution</b>             |              |               |              |
| <b>SLI Support</b>                |              |               |              |
| <b>Form Factor</b>                |              |               |              |

|                                   |              |               |               |
|-----------------------------------|--------------|---------------|---------------|
|                                   | <b>M2200</b> | <b>M2000M</b> | <b>M3000M</b> |
| <b># CUDA Cores</b>               |              |               |               |
| <b>Single Precision</b>           |              |               |               |
| <b>PCIe Gen</b>                   |              |               |               |
| <b>Memory Size</b>                |              |               |               |
| <b>Memory BW</b>                  |              |               |               |
| <b>Slots + Display Connectors</b> |              |               |               |
| <b>Display Support</b>            |              |               |               |
| <b>Advanced Display</b>           |              |               |               |
| <b>Board Power</b>                |              |               |               |
| <b>Max Power</b>                  |              |               |               |
| <b>Max Resolution</b>             |              |               |               |
| <b>SLI Support</b>                |              |               |               |
| <b>Form Factor</b>                |              |               |               |

|                         |               |
|-------------------------|---------------|
|                         | <b>M4000M</b> |
| <b># CUDA Cores</b>     |               |
| <b>Single Precision</b> |               |
| <b>PCIe Gen</b>         |               |
| <b>Memory Size</b>      |               |

|                                   |  |
|-----------------------------------|--|
| <b>Memory BW</b>                  |  |
| <b>Slots + Display Connectors</b> |  |
| <b>Display Support</b>            |  |
| <b>Advanced Display</b>           |  |
| <b>Board Power</b>                |  |
| <b>Max Power</b>                  |  |
| <b>Max Resolution</b>             |  |
| <b>SLI Support</b>                |  |
| <b>Form Factor</b>                |  |

**Integrated Graphics Adapter**

|  | <b>P510</b>                 | <b>P3000</b>  | <b>P4000</b>  |
|--|-----------------------------|---|---|
| <b>Type</b>  |                             |   |   |
| <b>TGP (GPU + VRAM)</b>  | TDP 18W / TDP 2W            | 75W   | 100W  |
| <b>Bus Interface</b>   |                             |   |   |
| <b>Display Interface</b>   |                             |   |   |
| <b>Video Resolution (max)</b>  |                             |   |   |
| <b>Graphics Cover Name</b>   |                             |   |   |
| <b>Video Ram Max</b>   | 2GB                         | 6GB   | 8GB   |
| <b>Memory type</b>   | GDDR5                       | GDDR5   | GDDR5   |
| <b>Memory bit</b>  | 64 bits                     | 192 bits  | 256 bits  |
| <b>Memory Bandwidth</b>  | 40.1GB/s                    | 168GB/s   | 192GB/s   |
| <b>VRAM Type</b>   | 2GB                         | 4GB   | 8GB   |
| <b>GPU Cuda Cores</b>  |                             | 1280  | 1920  |
| <b>DisplayPort Max Resolution &amp; Color Depth</b>                                  |                             | Max: 8.1Gb/s, 4 lanes,36bpp<br>5120x3200 @ 60Hz(24bpp,<br>30bpp with 422) | Max: 8.1Gb/s, 4 lanes,36bpp<br>5120x3200 @ 60Hz(24bpp,<br>30bpp with 422) |
| <b>HDMI Max Resolution &amp; Color Depth</b>   | N/A                         | 4096x2160@60Hz RGB888   | 4096x2160@60Hz RGB888   |
| <b>DirectX</b>   | 12                          | 12  | 12  |
| <b>OpenGL</b>  | 4.5                         | 4.5   | 4.5   |
| <b>OpenCL</b>  | 1.1                         | 1.1   | 1.1   |
| <b>Optimus</b>   | Yes                         | Yes   | Yes   |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu | Win10, Win8.1, Win7, Ubuntu   | Win10, Win8.1, Win7, Ubuntu   |
| <b>Tribble Monitor Support</b>   |                             |   |   |
| <b>Display Rotation Support</b>  |                             |   |   |
| <b>3D Setup &amp; Render Engine</b>  |                             |   |   |
| <b>GPU Core Clock</b>  |                             |   |   |
| <b>Maximum Color Depth</b>   |                             |   |   |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |                             |   |   |
| <b>Type</b>  |                             |   |   |
| <b>Bus Interface</b>   |                             |   |   |

|   |  |  |  |
|---|--|--|--|
| Display Interface   |  |  |  |
| Graphics Chipset  |  |  |  |
| Memory clock frequency(MHz)   |  |  |  |
| Memory size   |  |  |  |
| Memory bit(bit)   |  |  |  |
| Memory BW   |  |  |  |
| Dual Monitor Support  |  |  |  |
| Display Rotation Support  |  |  |  |
| 3D Setup & Render Engine  |  |  |  |
| VRAM Type   |  |  |  |
| GPU Cuda Cores  |  |  |  |
| GPU Core frequency(MHz)   |  |  |  |
| Maximum Power Consumption   |  |  |  |
| Operating System<br>Graphics/Video API Support                                      |  |  |  |
| Supported Resolutions and Max<br>Refresh Rates(Hz) (Note: analog<br>and/or digital) |  |  |  |
| Thermal   |  |  |  |
| Dimension   |  |  |  |
| Advanced Display  |  |  |  |
| SLI Support   |  |  |  |

|   | P5100   | M1000M  | M1200   |
|---|---|---|---|
| Type  |   |   |   |
| TGP (GPU + VRAM)                            | 100W  | 45W   | 45W   |
| Bus Interface                               |   |   |   |
| Display Interface                           |   |   |   |
| Video Resolution (max)                      |   |   |   |
| Graphics Cover Name                         |   |   |   |
| Video Ram Max                               | 16GB  | 4GB   | 4GB   |
| Memory type                                 | GDDR5   | GDDR5   | GDDR5   |
| Memory bit                                  | 256 bits  | 128bits   | 128bits   |
| Memory Bandwidth                            | 192GB/s   | 80GB/s  | 80GB/s  |
| VRAM Type                                   | 8GB   | 4GB   | 4GB   |
| GPU Cuda Cores                              | 2304  | 512   | 640   |
| DisplayPort Max Resolution &<br>Color Depth | Max: 8.1Gb/s, 4 lanes,36bpp<br>5120x3200 @ 60Hz(24bpp,<br>30bpp with 422) | 3840x2160 @ 60Hz (30bpp)                                | 3840x2160 @ 60Hz (30bpp)                                |
| HDMI Max Resolution & Color<br>Depth        | 4096x2160@60Hz RGB888   | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) |
| DirectX                                     | 12  | 12  | 12  |
| OpenGL                                      | 4.5   | 4.4   | 4.4   |
| OpenCL                                      | 1.1   | 1.1   | 1.1   |
|   |   |   |   |

|  |                             |                             |                             |
|--|-----------------------------|-----------------------------|-----------------------------|
| <b>Optimus</b>   | Yes                         | Yes                         | Yes                         |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu | Win10, Win8.1, Win7, Ubuntu | Win10, Win8.1, Win7, Ubuntu |
| <b>Tribble Monitor Support</b>   |                             |                             |                             |
| <b>Display Rotation Support</b>  |                             |                             |                             |
| <b>3D Setup &amp; Render Engine</b>  |                             |                             |                             |
| <b>GPU Core Clock</b>  |                             |                             |                             |
| <b>Maximum Color Depth</b>   |                             |                             |                             |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |                             |                             |                             |
| <b>Type</b>  |                             |                             |                             |
| <b>Bus Interface</b>   |                             |                             |                             |
| <b>Display Interface</b>   |                             |                             |                             |
| <b>Graphics Chipset</b>  |                             |                             |                             |
| <b>Memory clock frequency(MHz)</b>   |                             |                             |                             |
| <b>Memory size</b>   |                             |                             |                             |
| <b>Memory bit(bit)</b>   |                             |                             |                             |
| <b>Memory BW</b>   |                             |                             |                             |
| <b>Dual Monitor Support</b>  |                             |                             |                             |
| <b>Display Rotation Support</b>  |                             |                             |                             |
| <b>3D Setup &amp; Render Engine</b>  |                             |                             |                             |
| <b>VRAM Type</b>   |                             |                             |                             |
| <b>GPU Cuda Cores</b>  |                             |                             |                             |
| <b>GPU Core frequency(MHz)</b>   |                             |                             |                             |
| <b>Maximum Power Consumption</b>   |                             |                             |                             |
| <b>Operating System Graphics/Video API Support</b>                                   |                             |                             |                             |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |                             |                             |                             |
| <b>Thermal</b>   |                             |                             |                             |
| <b>Dimension</b>   |                             |                             |                             |
| <b>Advanced Display</b>  |                             |                             |                             |
| <b>SLI Support</b>   |                             |                             |                             |
|  | <b>M2200</b>                | <b>M2000M</b>               | <b>M3000M</b>               |
| <b>Type</b>  |                             |                             |                             |
| <b>TGP (GPU + VRAM)</b>  | 55W                         | 55W                         | 75W                         |
| <b>Bus Interface</b>   |                             |                             |                             |
| <b>Display Interface</b>   |                             |                             |                             |
| <b>Video Resolution (max)</b>  |                             |                             |                             |
| <b>Graphics Cover Name</b>   |                             |                             |                             |
| <b>Video Ram Max</b>   | 4GB                         | 4GB                         | 4GB                         |
| <b>Memory type</b>   | GDDR5                       | GDDR5                       | GDDR5                       |
|  |                             |                             |                             |



|  |   |   |   |
|--|---|---|---|
| <b>Memory bit</b>  | 128 bits  | 128bits   | 192bits   |
| <b>Memory Bandwidth</b>  | 88GB/s  | 80GB/s  | 160GB/s   |
| <b>VRAM Type</b>   | 4GB   | 4GB   | 4GB   |
| <b>GPU Cuda Cores</b>  | 1024  | 630   | 1024  |
| <b>DisplayPort Max Resolution &amp; Color Depth</b>                                  | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) | 3840x2160 @ 60Hz (30bpp)                                | 3840x2160 @ 60Hz (30bpp)                                |
| <b>HDMI Max Resolution &amp; Color Depth</b>   | 4096x2160@60Hz RGB888                                   | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) |
| <b>DirectX</b>   | 12  | 12  | 12  |
| <b>OpenGL</b>  | 4.5   | 4.4   | 4.4   |
| <b>OpenCL</b>  | 1.1   | 1.1   | 1.1   |
| <b>Optimus</b>   | Yes   | Yes   | Yes   |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu                             | Win10, Win8.1, Win7, Ubuntu                             | Win10, Win8.1, Win7, Ubuntu                             |
| <b>Tribble Monitor Support</b>   |   |   |   |
| <b>Display Rotation Support</b>  |   |   |   |
| <b>3D Setup &amp; Render Engine</b>  |   |   |   |
| <b>GPU Core Clock</b>  |   |   |   |
| <b>Maximum Color Depth</b>   |   |   |   |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |   |   |   |
| <b>Type</b>  |   |   |   |
| <b>Bus Interface</b>   |   |   |   |
| <b>Display Interface</b>   |   |   |   |
| <b>Graphics Chipset</b>  |   |   |   |
| <b>Memory clock frequency(MHz)</b>   |   |   |   |
| <b>Memory size</b>   |   |   |   |
| <b>Memory bit(bit)</b>   |   |   |   |
| <b>Memory BW</b>   |   |   |   |
| <b>Dual Monitor Support</b>  |   |   |   |
| <b>Display Rotation Support</b>  |   |   |   |
| <b>3D Setup &amp; Render Engine</b>  |   |   |   |
| <b>VRAM Type</b>   |   |   |   |
| <b>GPU Cuda Cores</b>  |   |   |   |
| <b>GPU Core frequency(MHz)</b>   |   |   |   |
| <b>Maximum Power Consumption</b>   |   |   |   |
| <b>Operating System Graphics/Video API Support</b>                                   |   |   |   |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |   |   |   |
| <b>Thermal</b>   |   |   |   |
| <b>Dimension</b>   |   |   |   |
| <b>Advanced Display</b>  |   |   |   |
| <b>SLI Support</b>   |   |   |   |

|   |   |
|---|---|
|   | <b>M4000M</b>   |
| Type  |   |
| TGP (GPU + VRAM)  | 100W  |
| Bus Interface   |   |
| Display Interface   |   |
| Video Resolution (max)  |   |
| Graphics Cover Name   |   |
| Video Ram Max   | 4GB   |
| Memory type   | GDDR5   |
| Memory bit  | 256 bits  |
| Memory Bandwidth  | 160GB/s   |
| VRAM Type   | 8GB   |
| GPU Cuda Cores  | 1280  |
| DisplayPort Max Resolution & Color Depth                                      | 3840x2160 @ 60Hz (30bpp)                                |
| HDMI Max Resolution & Color Depth   | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) |
| DirectX   | 12  |
| OpenGL  | 4.4   |
| OpenCL  | 1.1   |
| Optimus   | Yes   |
| OS Support  | Win10, Win8.1, Win7, Ubuntu                             |
| Trible Monitor Support  |   |
| Display Rotation Support  |   |
| 3D Setup & Render Engine  |   |
| GPU Core Clock  |   |
| Maximum Color Depth   |   |
| Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital) |   |
| Type  |   |
| Bus Interface   |   |
| Display Interface   |   |
| Graphics Chipset  |   |
| Memory clock frequency(MHz)   |   |
| Memory size   |   |
| Memory bit(bit)   |   |
| Memory BW   |   |
| Dual Monitor Support  |   |
| Display Rotation Support  |   |
| 3D Setup & Render Engine  |   |
| VRAM Type   |   |
|   |   |

|  |  |
|--|--|
| <b>GPU Cuda Cores</b>  |  |
| <b>GPU Core frequency(MHz)</b>   |  |
| <b>Maximum Power Consumption</b>   |  |
| <b>Operating System<br/>Graphics/Video API Support</b>                                       |  |
| <b>Supported Resolutions and Max<br/>Refresh Rates(Hz) (Note: analog<br/>and/or digital)</b> |  |
| <b>Thermal</b>   |  |
| <b>Dimension</b>   |  |
| <b>Advanced Display</b>  |  |
| <b>SLI Support</b>   |  |

#### Discrete Graphics Adapter

|  | <b>P510</b>                 | <b>P3000</b>  | <b>P4000</b>  |
|--|-----------------------------|---|---|
| <b>Type</b>  |                             |   |   |
| <b>TGP (GPU + VRAM)</b>  | TDP 18W / TDP 2W            | 75W   | 100W  |
| <b>Bus Interface</b>   |                             |   |   |
| <b>Display Interface</b>   |                             |   |   |
| <b>Video Resolution (max)</b>  |                             |   |   |
| <b>Graphics Cover Name</b>   |                             |   |   |
| <b>Video Ram Max</b>   | 2GB                         | 6GB   | 8GB   |
| <b>Memory type</b>   | GDDR5                       | GDDR5   | GDDR5   |
| <b>Memory bit</b>  | 64 bits                     | 192 bits  | 256 bits  |
| <b>Memory Bandwidth</b>  | 40.1GB/s                    | 168GB/s   | 192GB/s   |
| <b>VRAM Type</b>   | 2GB                         | 4GB   | 8GB   |
| <b>GPU Cuda Cores</b>  |                             | 1280  | 1920  |
| <b>DisplayPort Max Resolution &amp;<br/>Color Depth</b>                                      |                             | Max: 8.1Gb/s, 4 lanes,36bpp<br>5120x3200 @ 60Hz(24bpp,<br>30bpp with 422) | Max: 8.1Gb/s, 4 lanes,36bpp<br>5120x3200 @ 60Hz(24bpp,<br>30bpp with 422) |
| <b>HDMI Max Resolution &amp; Color<br/>Depth</b>   | N/A                         | 4096x2160@60Hz RGB888   | 4096x2160@60Hz RGB888   |
| <b>DirectX</b>   | 12                          | 12  | 12  |
| <b>OpenGL</b>  | 4.5                         | 4.5   | 4.5   |
| <b>OpenCL</b>  | 1.1                         | 1.1   | 1.1   |
| <b>Optimus</b>   | Yes                         | Yes   | Yes   |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu | Win10, Win8.1, Win7, Ubuntu   | Win10, Win8.1, Win7, Ubuntu   |
| <b>Trible Monitor Support</b>  |                             |   |   |
| <b>Display Rotation Support</b>  |                             |   |   |
| <b>3D Setup &amp; Render Engine</b>  |                             |   |   |
| <b>GPU Core Clock</b>  |                             |   |   |
| <b>Maximum Color Depth</b>   |                             |   |   |
| <b>Supported Resolutions and Max<br/>Refresh Rates(Hz) (Note: analog<br/>and/or digital)</b> |                             |   |   |
| <b>Type</b>  |                             |   |   |

|  |  |  |  |
|--|--|--|--|
| <b>Bus Interface</b>   |  |  |  |
| <b>Display Interface</b>   |  |  |  |
| <b>Graphics Chipset</b>  |  |  |  |
| <b>Memory clock frequency(MHz)</b>   |  |  |  |
| <b>Memory size</b>   |  |  |  |
| <b>Memory bit(bit)</b>   |  |  |  |
| <b>Memory BW</b>   |  |  |  |
| <b>Dual Monitor Support</b>  |  |  |  |
| <b>Display Rotation Support</b>  |  |  |  |
| <b>3D Setup &amp; Render Engine</b>  |  |  |  |
| <b>VRAM Type</b>   |  |  |  |
| <b>GPU Cuda Cores</b>  |  |  |  |
| <b>GPU Core frequency(MHz)</b>   |  |  |  |
| <b>Maximum Power Consumption</b>   |  |  |  |
| <b>Operating System<br/>Graphics/Video API Support</b>                                       |  |  |  |
| <b>Supported Resolutions and Max<br/>Refresh Rates(Hz) (Note: analog<br/>and/or digital)</b> |  |  |  |
| <b>Thermal</b>   |  |  |  |
| <b>Dimension</b>   |  |  |  |
| <b>Advanced Display</b>  |  |  |  |
| <b>SLI Support</b>   |  |  |  |

|   | <b>P5100</b>  | <b>M1000M</b>   | <b>M1200</b>  |
|---|---|---|---|
| <b>Type</b>   |   |   |   |
| <b>TGP (GPU + VRAM)</b>                                 | 100W  | 45W   | 45W   |
| <b>Bus Interface</b>                                    |   |   |   |
| <b>Display Interface</b>                                |   |   |   |
| <b>Video Resolution (max)</b>                           |   |   |   |
| <b>Graphics Cover Name</b>                              |   |   |   |
| <b>Video Ram Max</b>                                    | 16GB  | 4GB   | 4GB   |
| <b>Memory type</b>                                      | GDDR5   | GDDR5   | GDDR5   |
| <b>Memory bit</b>                                       | 256 bits  | 128bits   | 128bits   |
| <b>Memory Bandwidth</b>                                 | 192GB/s   | 80GB/s  | 80GB/s  |
| <b>VRAM Type</b>  | 8GB   | 4GB   | 4GB   |
| <b>GPU Cuda Cores</b>                                   | 2304  | 512   | 640   |
| <b>DisplayPort Max Resolution &amp;<br/>Color Depth</b> | Max: 8.1Gb/s, 4 lanes,36bpp<br>5120x3200 @ 60Hz(24bpp,<br>30bpp with 422) | 3840x2160 @ 60Hz (30bpp)                                | 3840x2160 @ 60Hz (30bpp)                                |
| <b>HDMI Max Resolution &amp; Color<br/>Depth</b>        | 4096x2160@60Hz RGB888   | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) |
| <b>DirectX</b>  | 12  | 12  | 12  |
| <b>OpenGL</b>   | 4.5   | 4.4   | 4.4   |
|   |   |   |   |

|  |                             |                             |                             |
|--|-----------------------------|-----------------------------|-----------------------------|
| <b>OpenCL</b>  | 1.1                         | 1.1                         | 1.1                         |
| <b>Optimus</b>   | Yes                         | Yes                         | Yes                         |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu | Win10, Win8.1, Win7, Ubuntu | Win10, Win8.1, Win7, Ubuntu |
| <b>Trible Monitor Support</b>  |                             |                             |                             |
| <b>Display Rotation Support</b>  |                             |                             |                             |
| <b>3D Setup &amp; Render Engine</b>  |                             |                             |                             |
| <b>GPU Core Clock</b>  |                             |                             |                             |
| <b>Maximum Color Depth</b>   |                             |                             |                             |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |                             |                             |                             |
| <b>Type</b>  |                             |                             |                             |
| <b>Bus Interface</b>   |                             |                             |                             |
| <b>Display Interface</b>   |                             |                             |                             |
| <b>Graphics Chipset</b>  |                             |                             |                             |
| <b>Memory clock frequency(MHz)</b>   |                             |                             |                             |
| <b>Memory size</b>   |                             |                             |                             |
| <b>Memory bit(bit)</b>   |                             |                             |                             |
| <b>Memory BW</b>   |                             |                             |                             |
| <b>Dual Monitor Support</b>  |                             |                             |                             |
| <b>Display Rotation Support</b>  |                             |                             |                             |
| <b>3D Setup &amp; Render Engine</b>  |                             |                             |                             |
| <b>VRAM Type</b>   |                             |                             |                             |
| <b>GPU Cuda Cores</b>  |                             |                             |                             |
| <b>GPU Core frequency(MHz)</b>   |                             |                             |                             |
| <b>Maximum Power Consumption</b>   |                             |                             |                             |
| <b>Operating System Graphics/Video API Support</b>                                   |                             |                             |                             |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |                             |                             |                             |
| <b>Thermal</b>   |                             |                             |                             |
| <b>Dimension</b>   |                             |                             |                             |
| <b>Advanced Display</b>  |                             |                             |                             |
| <b>SLI Support</b>   |                             |                             |                             |
|  | <b>M2200</b>                | <b>M2000M</b>               | <b>M3000M</b>               |
| <b>Type</b>  |                             |                             |                             |
| <b>TGP (GPU + VRAM)</b>  | 55W                         | 55W                         | 75W                         |
| <b>Bus Interface</b>   |                             |                             |                             |
| <b>Display Interface</b>   |                             |                             |                             |
| <b>Video Resolution (max)</b>  |                             |                             |                             |
| <b>Graphics Cover Name</b>   |                             |                             |                             |
| <b>Video Ram Max</b>   | 4GB                         | 4GB                         | 4GB                         |
|  |                             |                             |                             |

|  |   |   |   |
|--|---|---|---|
| <b>Memory type</b>   | GDDR5   | GDDR5   | GDDR5   |
| <b>Memory bit</b>  | 128 bits  | 128bits   | 192bits   |
| <b>Memory Bandwidth</b>  | 88GB/s  | 80GB/s  | 160GB/s   |
| <b>VRAM Type</b>   | 4GB   | 4GB   | 4GB   |
| <b>GPU Cuda Cores</b>  | 1024  | 630   | 1024  |
| <b>DisplayPort Max Resolution &amp; Color Depth</b>                                  | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) | 3840x2160 @ 60Hz (30bpp)                                | 3840x2160 @ 60Hz (30bpp)                                |
| <b>HDMI Max Resolution &amp; Color Depth</b>   | 4096x2160@60Hz RGB888                                   | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) |
| <b>DirectX</b>   | 12  | 12  | 12  |
| <b>OpenGL</b>  | 4.5   | 4.4   | 4.4   |
| <b>OpenCL</b>  | 1.1   | 1.1   | 1.1   |
| <b>Optimus</b>   | Yes   | Yes   | Yes   |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu                             | Win10, Win8.1, Win7, Ubuntu                             | Win10, Win8.1, Win7, Ubuntu                             |
| <b>Tribble Monitor Support</b>   |   |   |   |
| <b>Display Rotation Support</b>  |   |   |   |
| <b>3D Setup &amp; Render Engine</b>  |   |   |   |
| <b>GPU Core Clock</b>  |   |   |   |
| <b>Maximum Color Depth</b>   |   |   |   |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |   |   |   |
| <b>Type</b>  |   |   |   |
| <b>Bus Interface</b>   |   |   |   |
| <b>Display Interface</b>   |   |   |   |
| <b>Graphics Chipset</b>  |   |   |   |
| <b>Memory clock frequency(MHz)</b>   |   |   |   |
| <b>Memory size</b>   |   |   |   |
| <b>Memory bit(bit)</b>   |   |   |   |
| <b>Memory BW</b>   |   |   |   |
| <b>Dual Monitor Support</b>  |   |   |   |
| <b>Display Rotation Support</b>  |   |   |   |
| <b>3D Setup &amp; Render Engine</b>  |   |   |   |
| <b>VRAM Type</b>   |   |   |   |
| <b>GPU Cuda Cores</b>  |   |   |   |
| <b>GPU Core frequency(MHz)</b>   |   |   |   |
| <b>Maximum Power Consumption</b>   |   |   |   |
| <b>Operating System Graphics/Video API Support</b>                                   |   |   |   |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |   |   |   |
| <b>Thermal</b>   |   |   |   |
| <b>Dimension</b>   |   |   |   |
| <b>Advanced Display</b>  |   |   |   |

|  |   |  |  |
|--|---|--|--|
| <b>SLI Support</b>   |   |  |  |
|  | <b>M4000M</b>   |  |  |
| <b>Type</b>  |   |  |  |
| <b>TGP (GPU + VRAM)</b>  | 100W  |  |  |
| <b>Bus Interface</b>   |   |  |  |
| <b>Display Interface</b>   |   |  |  |
| <b>Video Resolution (max)</b>  |   |  |  |
| <b>Graphics Cover Name</b>   |   |  |  |
| <b>Video Ram Max</b>   | 4GB   |  |  |
| <b>Memory type</b>   | GDDR5   |  |  |
| <b>Memory bit</b>  | 256 bits  |  |  |
| <b>Memory Bandwidth</b>  | 160GB/s   |  |  |
| <b>VRAM Type</b>   | 8GB   |  |  |
| <b>GPU Cuda Cores</b>  | 1280  |  |  |
| <b>DisplayPort Max Resolution &amp; Color Depth</b>                                  | 3840x2160 @ 60Hz (30bpp)                                |  |  |
| <b>HDMI Max Resolution &amp; Color Depth</b>   | Max: 5.4Gb/s ,4 lanes,36bpp<br>3840x2160 @ 24Hz (30bpp) |  |  |
| <b>DirectX</b>   | 12  |  |  |
| <b>OpenGL</b>  | 4.4   |  |  |
| <b>OpenCL</b>  | 1.1   |  |  |
| <b>Optimus</b>   | Yes   |  |  |
| <b>OS Support</b>  | Win10, Win8.1, Win7, Ubuntu                             |  |  |
| <b>Tribble Monitor Support</b>   |   |  |  |
| <b>Display Rotation Support</b>  |   |  |  |
| <b>3D Setup &amp; Render Engine</b>  |   |  |  |
| <b>GPU Core Clock</b>  |   |  |  |
| <b>Maximum Color Depth</b>   |   |  |  |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |   |  |  |
| <b>Type</b>  |   |  |  |
| <b>Bus Interface</b>   |   |  |  |
| <b>Display Interface</b>   |   |  |  |
| <b>Graphics Chipset</b>  |   |  |  |
| <b>Memory clock frequency(MHz)</b>   |   |  |  |
| <b>Memory size</b>   |   |  |  |
| <b>Memory bit(bit)</b>   |   |  |  |
| <b>Memory BW</b>   |   |  |  |
| <b>Dual Monitor Support</b>  |   |  |  |
| <b>Display Rotation Support</b>  |   |  |  |
| <b>3D Setup &amp; Render Engine</b>  |   |  |  |
|  |   |  |  |

|  |  |
|--|--|
| <b>VRAM Type</b>   |  |
| <b>GPU Cuda Cores</b>  |  |
| <b>GPU Core frequency(MHz)</b>   |  |
| <b>Maximum Power Consumption</b>   |  |
| <b>Operating System Graphics/Video API Support</b>                                   |  |
| <b>Supported Resolutions and Max Refresh Rates(Hz) (Note: analog and/or digital)</b> |  |
| <b>Thermal</b>   |  |
| <b>Dimension</b>   |  |
| <b>Advanced Display</b>  |  |
| <b>SLI Support</b>   |  |

## Networking

|                   | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
|-------------------|----------------------------|-----------------------------|
| <b>Connector</b>  |                            |                             |
| <b>Controller</b> |                            |                             |

## Intel® Ethernet Connections

|   | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
|---|----------------------------|-----------------------------|
| <b>Data Rates Supported</b>                     |                            |                             |
| <b>Controller Details</b>                       |                            |                             |
| <b>Controller bus architecture</b>              |                            |                             |
| <b>Integrated memory</b>                        |                            |                             |
| <b>Data transfer mode</b>                       |                            |                             |
| <b>Power consumption</b>                        |                            |                             |
| <b>IEEE Standards Compliance</b>                |                            |                             |
| <b>Boot ROM Support</b>                         |                            |                             |
| <b>Network Transfer Mode (Full/Half Duplex)</b> |                            |                             |
| <b>Network Transfer Rate</b>                    |                            |                             |
| <b>Operating System Driver Support</b>          |                            |                             |
| <b>Manageability</b>                            |                            |                             |
| <b>Manageability Capabilities Alerting</b>      |                            |                             |
| <b>Lithography</b>                              |                            |                             |
| <b>TDP</b>                                      |                            |                             |
| <b>Operating Temperature Range</b>              |                            |                             |
| <b># of Ports</b>                               |                            |                             |
| <b>Data Rate Per Port</b>                       |                            |                             |
| <b>System Interface Type</b>                    |                            |                             |
| <b>NC Sideband Interface</b>                    |                            |                             |
| <b>Jumbo Frames Supported</b>                   |                            |                             |



|                             |  |  |
|-----------------------------|--|--|
| <b>1000Base-T</b>           |  |  |
| <b>MACsec IEEE 802.1 AE</b> |  |  |
| <b>IEEE 1588</b>            |  |  |
| <b>Supported Under vPro</b> |  |  |

#### Ethernet

|   | <b>RJ-45 Intel, I219-V</b>  | <b>RJ-45 Intel, I219-LM</b>   |
|---|---|---|
| <b>Connector</b>  | RJ-45   | RJ-45   |
| <b>Model</b>  | Intel, I219-V   | Intel, I219-LM  |
| <b>Website</b>  | <a href="https://ark.intel.com/products/82186/Intel-Ethernet-Connection-I219-V">https://ark.intel.com/products/82186/Intel-Ethernet-Connection-I219-V</a> | <a href="https://ark.intel.com/products/82185/Intel-Ethernet-Connection-I219-LM">https://ark.intel.com/products/82185/Intel-Ethernet-Connection-I219-LM</a> |
| <b>10BASE-T (IEEE 802.3 specification conformance)</b>              | X   | X   |
| <b>100BASE-TX (IEEE 802.3 specification conformance)</b>            | X   | X   |
| <b>1000BASE-T (IEEE 802.3 specification conformance)</b>            | X   | X   |
| <b>Auto-Negotiation (IEEE 802.3u)</b>                               | X   | X   |
| <b>Intel® vPro™ 2 technology</b>                                    |   | X   |
| <b>Intel® Stable Image Platform Program (SIPP)</b>                  |   | X   |
| <b>Intel® Standard Manageability</b>                                | X   | X   |
| <b>Power optimizer platform low-power management systems</b>        | X   | X   |
| <b>Energy Efficient Ethernet1 (IEEE 802.3az)</b>                    | X   | X   |
| <b>TCP/UDP checksum and segmentation offload (IPv4 and IPv6)</b>    | X   | X   |
| <b>Receive Side Scaling</b>   | X   | X   |
| <b>Dual Tx and Rx queues</b>  | X   | X   |
| <b>Jumbo Frames (up to 9 KB)</b>                                    | X   | X   |
| <b>Teaming</b>  | X   | X   |
| <b>Integrated Auto Connect Battery Saver (ACBS) battery savings</b> | X   | X   |
| <b>Timing and Synchronization (802.1as / 1588)</b>                  | X   | X   |
| <b>Integrated Switched Voltage Regulator (iSVR)</b>                 | X   | X   |
| <b>Shared Flash with system BIOS</b>                                | X   | X   |
| <b>Wake from Deep Sx</b>  | X   | X   |
| <b>Server operating system support</b>                              |   | X   |
| <b>Network proxy/ARP support</b>                                    | X   | X   |
| <b>32 wake filter support</b>                                       | X   | X   |

#### WLAN

|  | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
|--|----------------------------|-----------------------------|
|  |                            |                             |

|   |  |  |
|---|--|--|
| <b>Model</b>                                  |  |  |
| <b>Dimensions</b>                             |  |  |
| <b>Weight</b>                                 |  |  |
| <b>Antenna Diversity</b>                      |  |  |
| <b>Radio ON/OFF Control</b>                   |  |  |
| <b>Connector interface</b>                    |  |  |
| <b>Operating Temperature (Adapter Shield)</b> |  |  |
| <b>Humidity Non-Operating</b>                 |  |  |
| <b>Operating Systems</b>                      |  |  |
| <b>Wi-Fi Alliance</b>                         |  |  |
| <b>IEEE WLAN Standard</b>                     |  |  |
| <b>Roaming</b>                                |  |  |
| <b>Bluetooth*</b>                             |  |  |
| <b>Authentication</b>                         |  |  |
| <b>Authentication Protocols</b>               |  |  |
| <b>Encryption</b>                             |  |  |
| <b>Regulatory</b>                             |  |  |
| <b>US Government</b>                          |  |  |
| <b>Product Safety</b>                         |  |  |

**WWAN**

|              |                            |                             |
|--------------|----------------------------|-----------------------------|
|              | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
| <b>Model</b> |                            |                             |

**4G LTE**

|                        |                            |                             |
|------------------------|----------------------------|-----------------------------|
|                        | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
| <b>Category</b>        |                            |                             |
| <b>Frequency Bands</b> |                            |                             |

**3G**

|                        |                            |                             |
|------------------------|----------------------------|-----------------------------|
|                        | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
| <b>Frequency Bands</b> |                            |                             |

**Data Speed**

|                           |                            |                             |
|---------------------------|----------------------------|-----------------------------|
|                           | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
| <b>Peak Download Rate</b> |                            |                             |
| <b>Peak Upload Rate</b>   |                            |                             |

**Location Solution**

|                          |                            |                             |
|--------------------------|----------------------------|-----------------------------|
|                          | <b>RJ-45 Intel, I219-V</b> | <b>RJ-45 Intel, I219-LM</b> |
| <b>Satellite Systems</b> |                            |                             |

Audio Codecs

|                | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|----------------|---------------------|----------------------|
| <b>PCM/125</b> |                     |                      |

USB Drivers

|                           | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|---------------------------|---------------------|----------------------|
| <b>Windows 7, 8.1, 10</b> |                     |                      |
| <b>Linus</b>              |                     |                      |
| <b>Android RIL</b>        |                     |                      |

Interfaces

|                              | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|------------------------------|---------------------|----------------------|
| <b>USB</b>                   |                     |                      |
| <b>SIM Interface 1.8V/3V</b> |                     |                      |

Control Options

|                          | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|--------------------------|---------------------|----------------------|
| <b>APIs, AT Commands</b> |                     |                      |

Hardware

|                  | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|------------------|---------------------|----------------------|
| <b>Dimension</b> |                     |                      |

Antenna

|  | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|--|---------------------|----------------------|
| <b>Connector: Main, Aux/GNSS, GNSS</b> |                     |                      |
| <b>Diversity</b>                       |                     |                      |
| <b>MIMO</b>                            |                     |                      |
| <b>GNSS Bian</b>                       |                     |                      |

Temperature Range

|                         | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|-------------------------|---------------------|----------------------|
| <b>Industrial Grade</b> |                     |                      |

Approvals

|                   | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|-------------------|---------------------|----------------------|
| <b>Regulatory</b> |                     |                      |
| <b>Carrier</b>    |                     |                      |

Cloud Services

|  | RJ-45 Intel, I219-V | RJ-45 Intel, I219-LM |
|--|---------------------|----------------------|
|  |                     |                      |

|                                       |  |  |
|---------------------------------------|--|--|
| <b>Free Unlimited FOTA Upgrades</b>   |  |  |
| <b>Device Management Option</b>       |  |  |
| <b>Application Enablement Option</b>  |  |  |
| <b>Connectivity Management Option</b> |  |  |

## Other

### **Media Card Reader**

### **PCIe Add-on Cards**

IEEE 1394a (Firewire-400) PCI Express x1 Adapter (1 internal port, 1 external port)

### **Intel® Ethernet Adapters**

### **Acoustics**

Configuration Information

Machine Types

Acoustic Noise Emissions Declaration

### **Color Calibrator**

Colorimetric Accuracy

### **Camera**