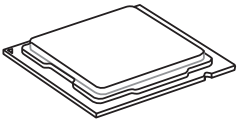
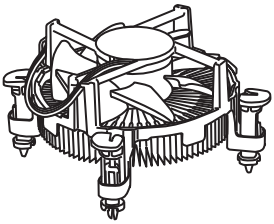
# Quick Start

Thank you for purchasing the MSI® **MPG Z390 GAMING PLUS** motherboard. This Quick Start section provides demonstration diagrams about how to install your computer. Some of the installations also provide video demonstrations. Please link to the URL to watch it with the web browser on your phone or tablet. You may have even link to the URL by scanning the QR code.

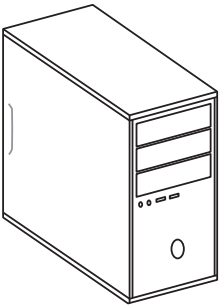
## Preparing Tools and Components



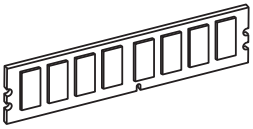
Intel® LGA 1151 CPU



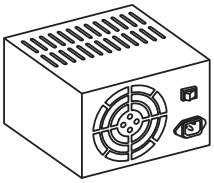
CPU Fan



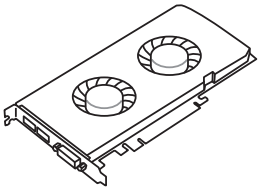
Chassis



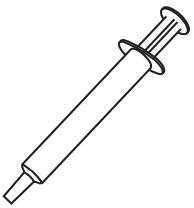
DDR4 Memory



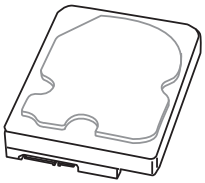
Power Supply Unit



Graphics Card



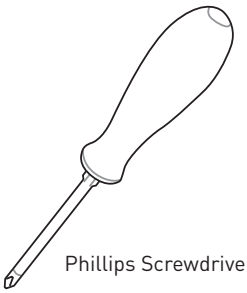
Thermal Paste



SATA Hard Disk Drive



SATA DVD Drive



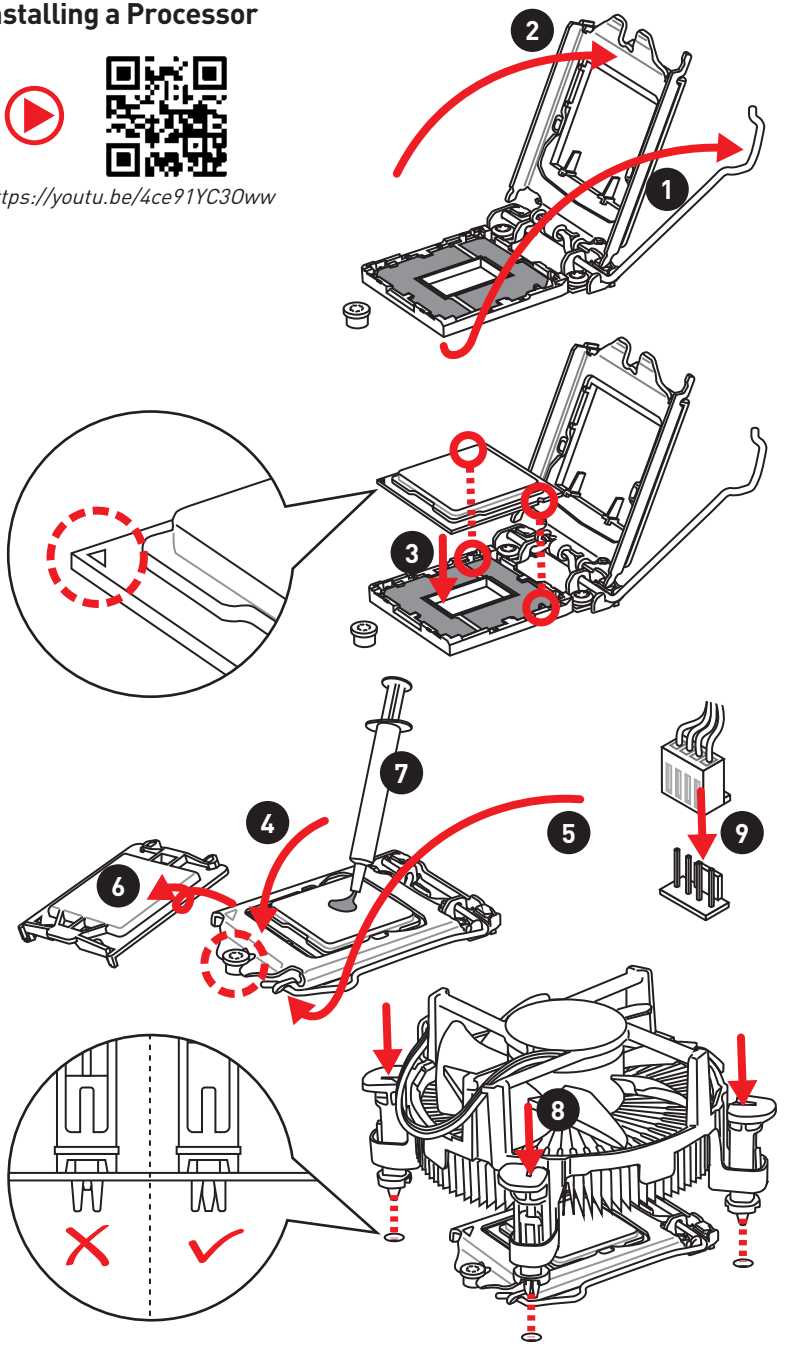
Phillips Screwdriver



A Package of Screws

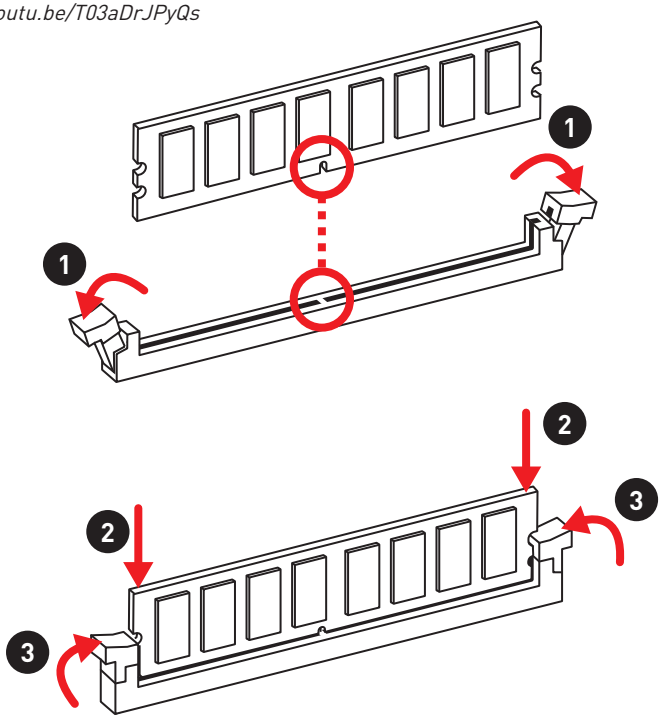
## Installing a Processor

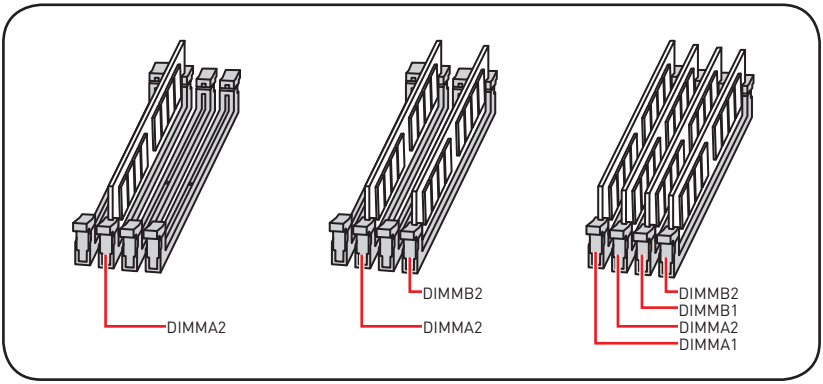
*https://youtu.be/4ce91YC30ww*



## Installing DDR4 memory

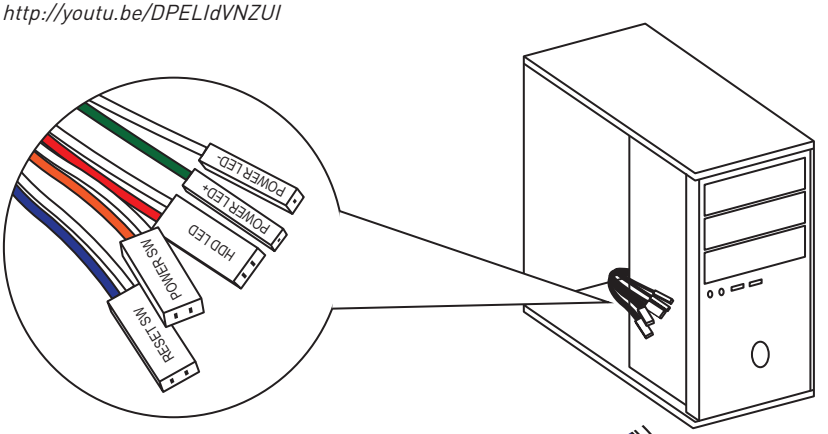
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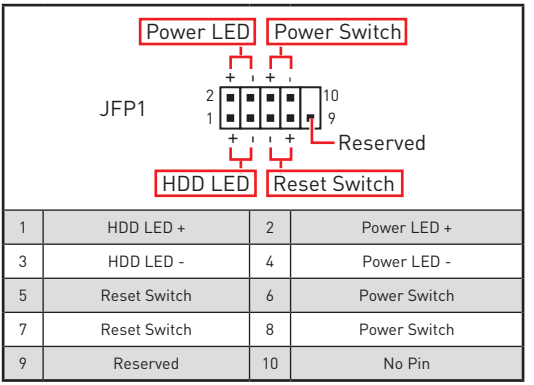


## Connecting the Front Panel Header

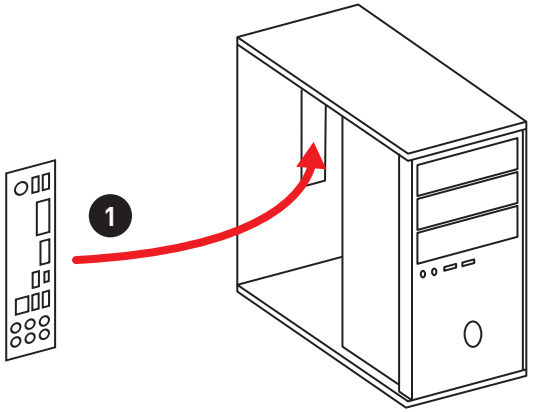
*http://youtu.be/DPELIdVNZUI*

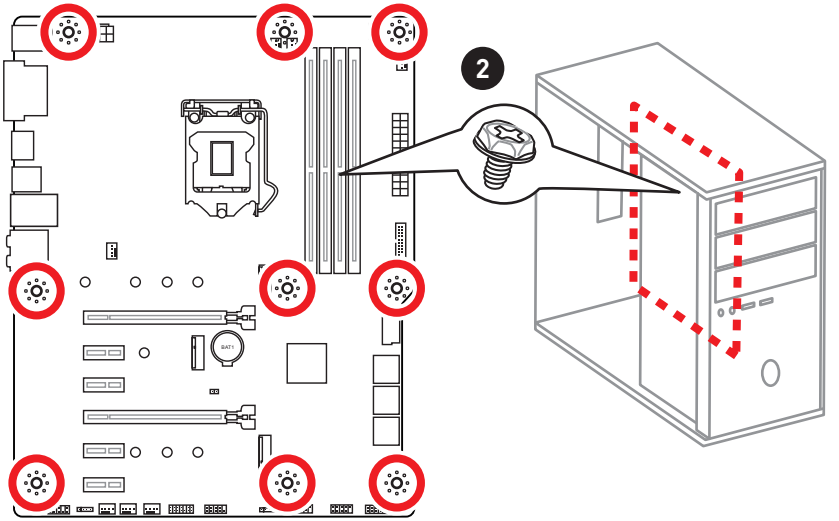



| | | | |
|---|---|---|---|
| 1 | HDD LED + | 2 | Power LED + |
| 3 | HDD LED - | 4 | Power LED - |
| 5 | Reset Switch | 6 | Power Switch |
| 7 | Reset Switch | 8 | Power Switch |
| 9 | Reserved | 10 | No Pin |

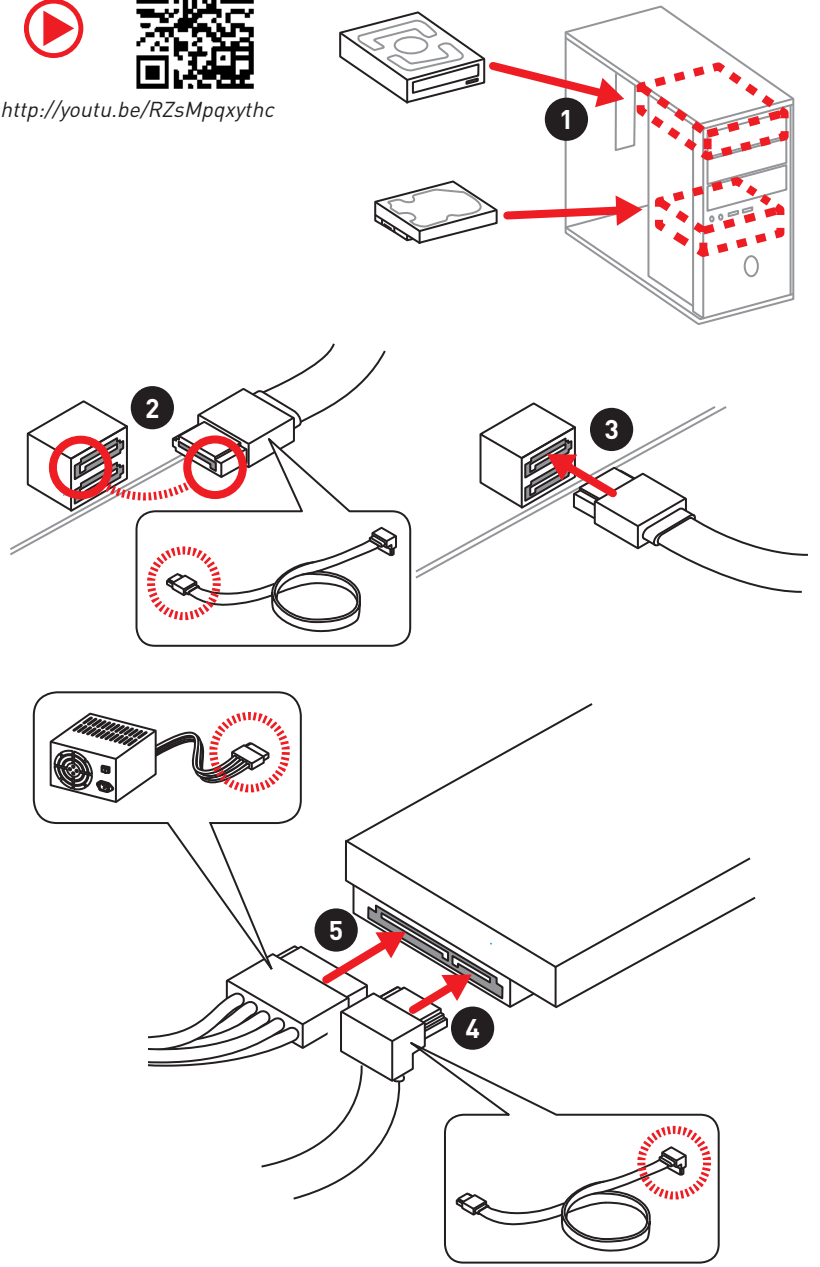
## Installing the Motherboard



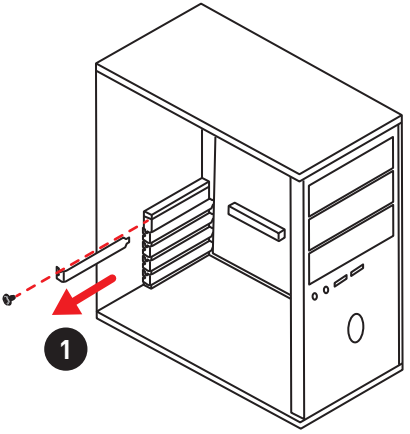
## Installing SATA Drives

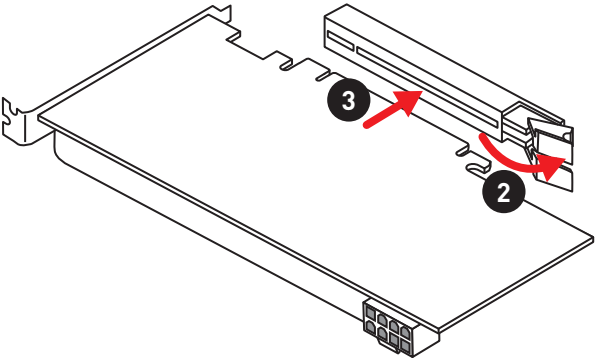
*http://youtu.be/RZsMpqxythc*

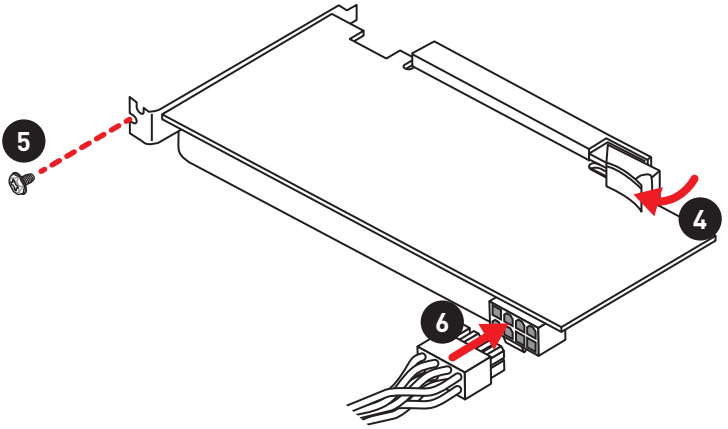


## Installing a Graphics Card

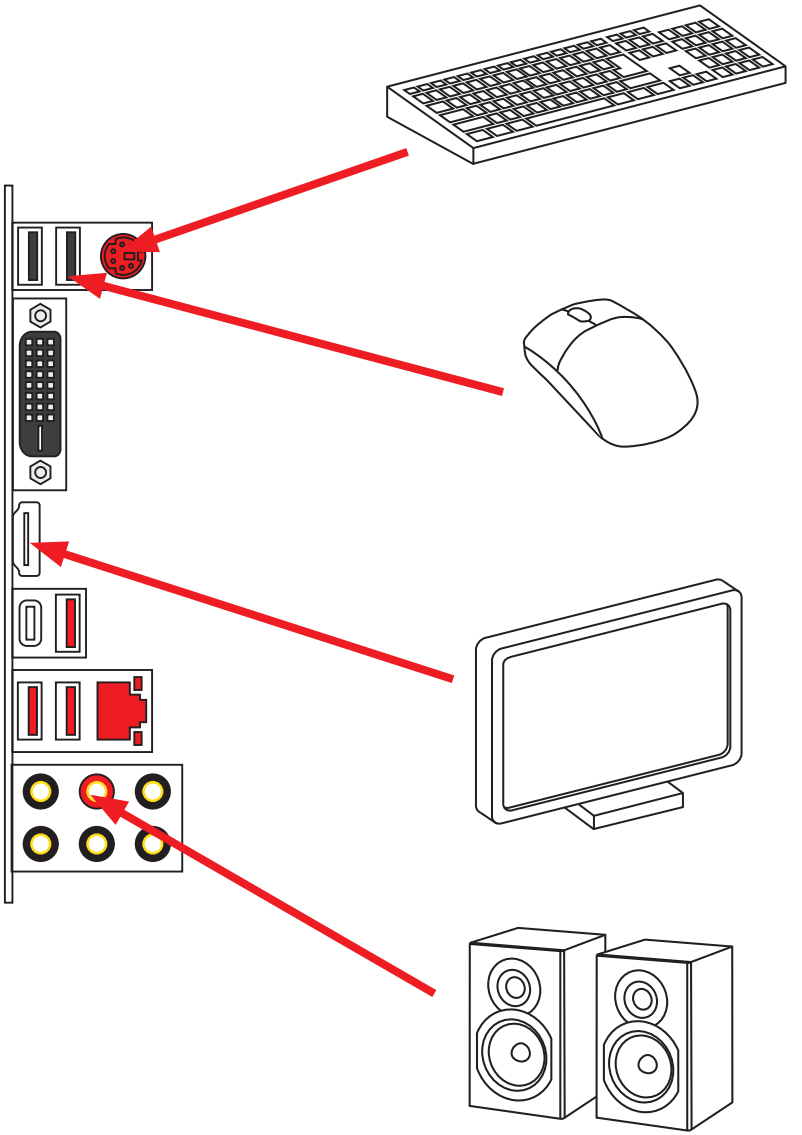
*http://youtu.be/mG0GZpr9w_A*



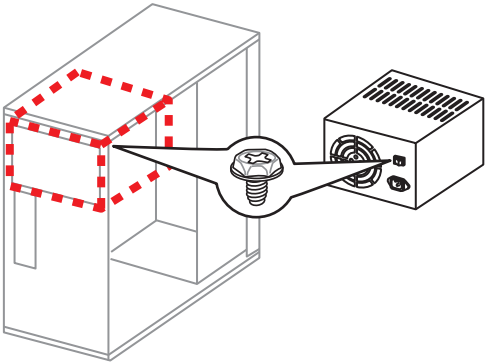



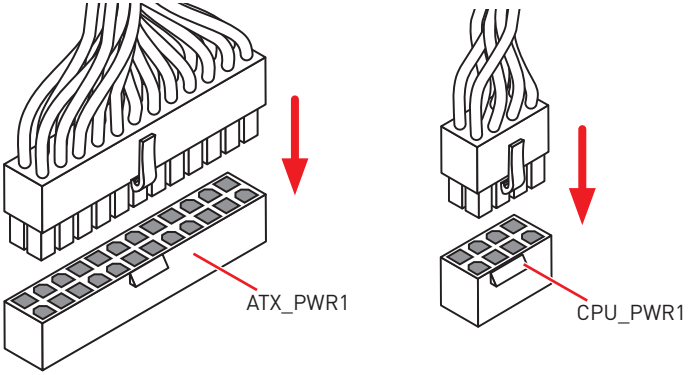
## Connecting Peripheral Devices



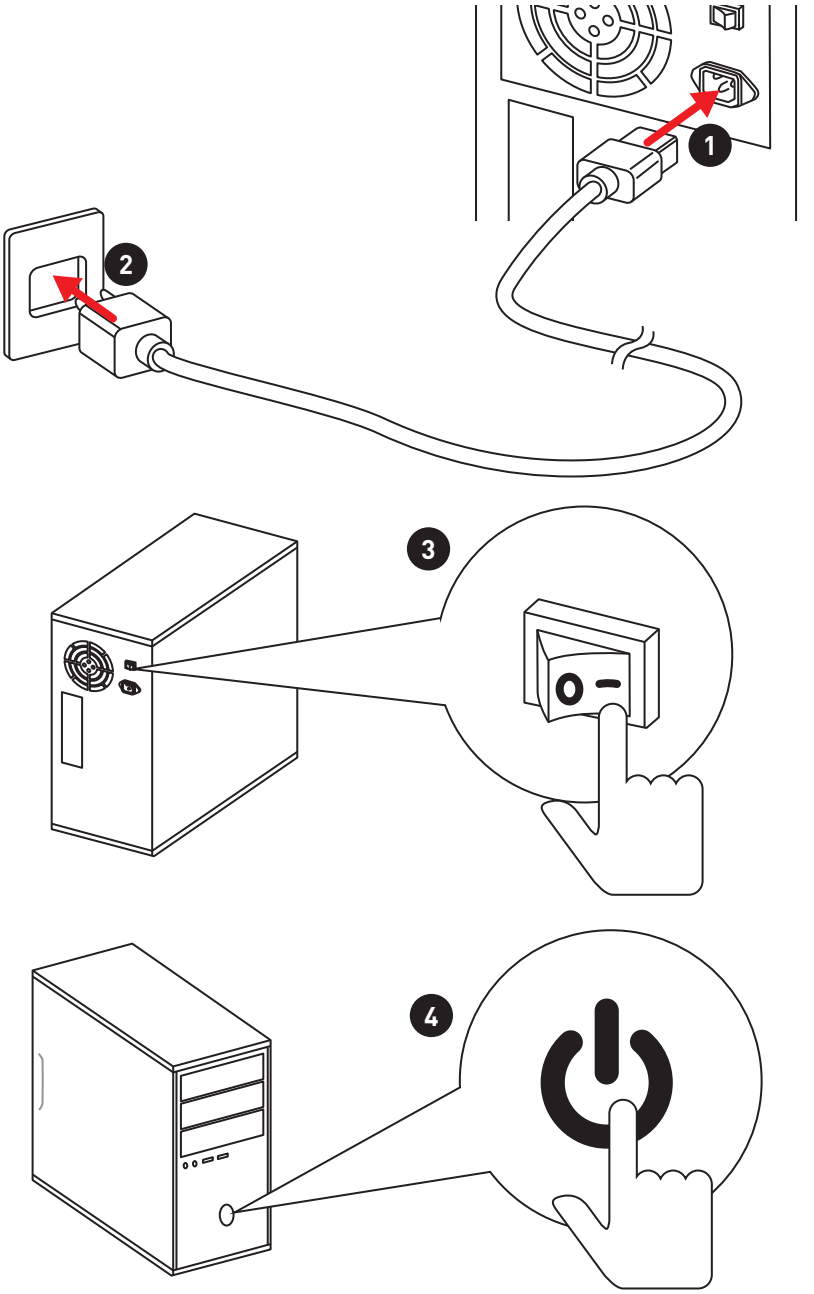
## Connecting the Power Connectors

*http://youtu.be/gkDYyR_83I4*





## Power On



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# Specifications

| | |
|---|---|
| **CPU** | Supports Intel® Core™ 9000 Series family/ 8th Gen Intel® Core™ / Pentium® Gold / Celeron® processors for LGA 1151 socket<br>* Please go to www.intel.com for more compatibility information. |
| **Chipset** | Intel® Z390 Chipset |
| **Memory** | • 4x DDR4 memory slots, support up to 64GB*<br>• Supports DDR4 4400(OC)/ 4300(OC)/ 4266(OC)/ 4200(OC)/ 4133(OC)/ 4000(OC)/ 3866(OC)/ 3733(OC)/ 3600(OC)/ 3466(OC)/ 3400(OC)/ 3333(OC)/ 3300(OC)/ 3200(OC)/ 3000(OC) / 2800(OC)/ 2666/ 2400/ 2133 MHz*<br>• Supports Dual-Channel mode<br>• Supports non-ECC, un-buffered memory<br>• Supports Intel® Extreme Memory Profile (XMP)<br>* Please refer www.msi.com for more information on compatible memory. |
| **Expansion Slot** | • 2x PCIe 3.0 x16 slots<br>• 4x PCIe 3.0 x1 slots<br>• 1x M.2 slot (Key E) for an Intel® CNVi wireless module only |
| **Onboard Graphics** | • 1x HDMI™ port, supports a maximum resolution of 4096x2160@24Hz<br>• 1x DVI-D port, supports a maximum resolution of 1920x200@60Hz |
| **Multi-GPU** | • Supports 2-Way AMD® CrossFire™ Technology |
| **Storage** | Intel® Z390 Chipset<br>• 6x SATA 6Gb/s ports*<br>• 2x M.2 slots (Key M)*<br>▪ M2_1 supports up to PCIe 3.0 x4 and SATA 6Gb/s, 2242/ 2260/ 2280/ 22110 storage devices<br>▪ M2_2 supports up to PCIe 3.0 x4 and SATA 6Gb/s, 2242/ 2260/ 2280 storage devices<br>▪ Intel® Optane™ Memory Ready**<br>* M.2 slots and SATA ports share the bandwidth. Please refer to page 28 for details.<br>** Before using Intel® Optane™ memory modules, please ensure that you have updated the drivers and BIOS to the latest version from MSI website. |

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| | |
|---|---|
| **RAID** | Intel® Z390 Chipset<br>• Supports RAID 0, RAID1, RAID 5 and RAID 10 for SATA storage devices<br>• Supports RAID 0, RAID 1 for M.2 PCIe storage devices |
| **LAN** | • 1x Intel® I219-V Gigabit LAN controller |
| **USB** | • Intel® Z390 Chipset<br>▪ 2x USB 3.1 Gen2 (SuperSpeed USB 10Gbps) ports (1 Type-A port and 1 Type-C port) on the back panel<br>▪ 6x USB 3.1 Gen1 (SuperSpeed USB) ports (2 Type-A ports on the back panel, 4 ports available through the internal USB 3.1 connectors)<br>▪ 6x USB 2.0 (High-speed USB) ports (2 Type-A ports on the back panel, 4 ports available through the internal USB 2.0 connectors)*<br>* The CNVI_1 and JUSB2 share the same bandwidth. Please refer to page 31 for details. |
| **Audio** | • Realtek® ALC892/ ALC897 Codec<br>▪ 7.1-Channel High Definition Audio |
| **Back Panel Connectors** | • 1x PS/2 keyboard/ mouse combo port<br>• 2x USB 2.0 Type-A ports<br>• 1x DVI-D port<br>• 1x HDMI port<br>• 1x USB 3.1 Gen2 Type-A port<br>• 1x USB 3.1 Gen2 Type-C port<br>• 1x LAN (RJ45) port<br>• 2x USB 3.1 Gen1 Type-A ports<br>• 6x OFC audio jacks |

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| | |
|---|---|
| **Internal Connectors** | • 1x 24-pin ATX main power connector<br>• 1x 8-pin ATX 12V power connector<br>• 6x SATA 6Gb/s connectors<br>• 3x M.2 slots (2 M-Key slots,1 E-Key slot)<br>• 2x USB 3.1 Gen1 connectors (supports additional 4 USB 3.1 Gen1 ports)<br>• 2x USB 2.0 connectors (supports additional 4 USB 2.0 ports)<br>• 1x 4-pin CPU fan connector<br>• 1x 4-pin Water Pump connector<br>• 5x 4-pin system fan connectors<br>• 1x Front panel audio connector<br>• 2x System panel connectors<br>• 1x Chassis Intrusion connector<br>• 1x TPM module connector<br>• 2x 4-pin RGB LED connectors<br>• 1x Serial Port connector<br>• 1x Clear CMOS jumper |
| **I/O Controller** | NUVOTON NCT6797 Controller Chip |
| **Hardware Monitor** | • CPU/System temperature detection<br>• CPU/System fan speed detection<br>• CPU/System fan speed control |
| **Form Factor** | • ATX Form Factor<br>• 12 in. x 9.6 in. (30.5 cm x 24.4 cm) |
| **BIOS Features** | • 1x 128 Mb flash<br>• UEFI AMI BIOS<br>• ACPI 6.1, SMBIOS 2.8<br>• Multi-language |

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| | |
|---|---|
| **Software** | • Drivers<br>• DRAGON CENTER<br>• MYSTIC LIGHT<br>• Open Broadcaster Software (OBS)<br>• CPU-Z MSI GAMING<br>• Intel® Extreme Tuning Utility<br>• Google Chrome™ ,Google Toolbar, Google Drive<br>• Norton™ Internet Security Solution |
| **Dragon Center Features** | • GAME OPTIMIZATION<br>• OC Performance<br>• Hardware Monitor<br>• Eyerest<br>• LAN Manager<br>• Live Update<br><br>Please refer to http://download.msi.com/manual/mb/DRAGONCENTER2.pdf for more details. |

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| | |
|---|---|
| **Special Features** | • Audio<br>▪ Audio Boost<br>• Network<br>▪ GAMING LAN with GAMING LAN Manager<br>▪ Intel CNVi Ready<br>• Storage<br>▪ Twin Turbo M.2<br>• Cooling<br>▪ Extended Heastink Design<br>▪ Pump Fan<br>▪ GAMING Fan Control<br>• LED<br>▪ Mystic Light Extension (RGB)<br>▪ Mystic Light Sync<br>▪ EZ DEBUG LED<br>• Protection<br>▪ PCI-E Steel Armor<br>▪ PCI-E Steel Slot<br>• Performance<br>▪ Multi GPU-CrossFire Technology<br>▪ DDR4 Boost<br>▪ Core Boost<br>▪ GAME Boost<br>▪ USB with type A+C<br>▪ Intel Turbo USB 3.1 Gen2<br>• VR<br>▪ VR Ready<br>• Gamer Experience<br>▪ GAMING HOTKEY<br>▪ GAMING MOUSE Control<br>▪ APP Player<br>• BIOS<br>▪ Click BIOS 5 |

# Package contents

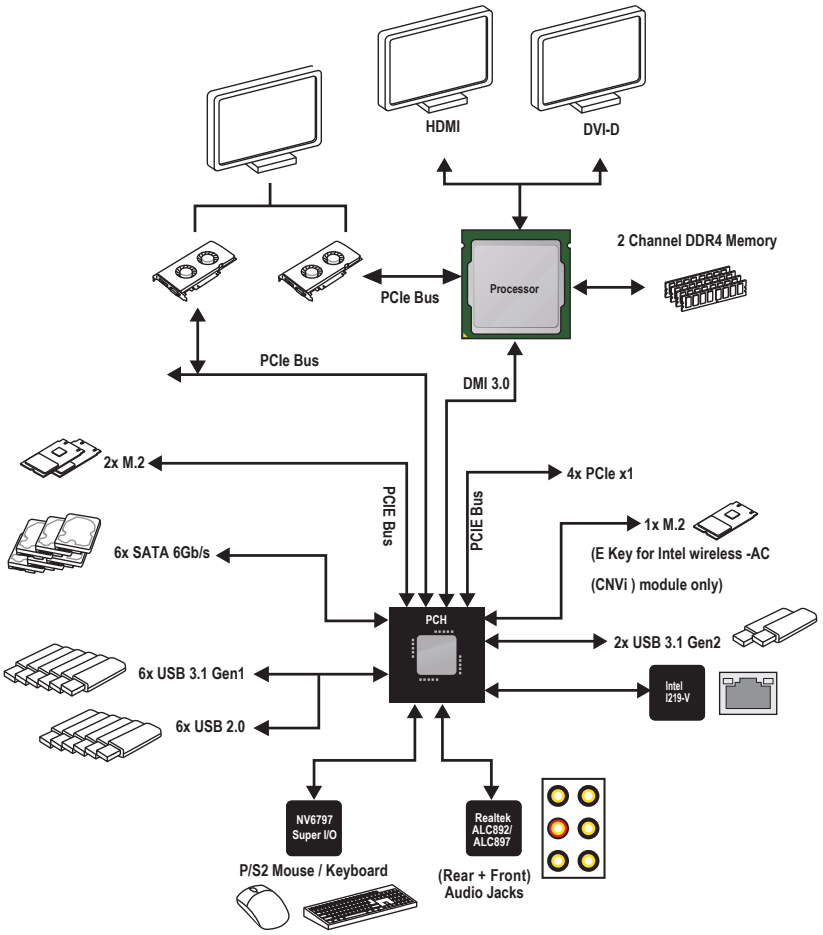
Please check the contents of your motherboard package. It should contain:

| | | |
|---|---|---|
| Motherboard | MPG Z390 GAMING PLUS | |
| Cable | SATA 6Gb/s Cables | 2 |
| Accessories | M.2 Screw | 2 |
| | I/O Shield | 1 |
| | Case Badge | 1 |
| | VIP Card | 1 |
| Application DVD | Driver DVD | 1 |
| Documentation | User Manual | 1 |
| | Quick Installation Guide | 1 |

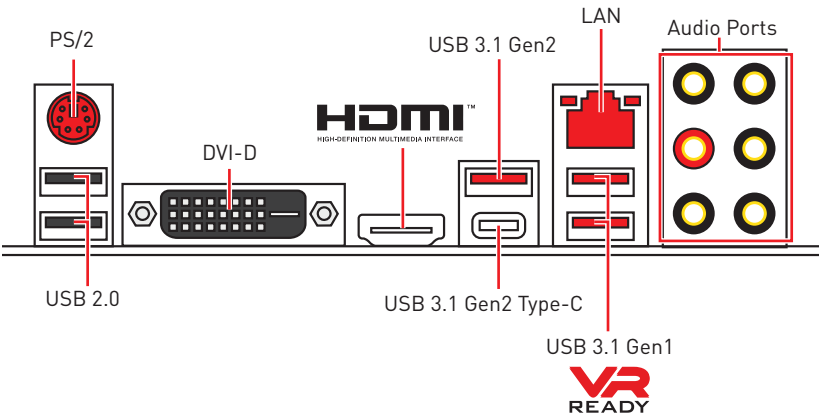
***Important***

*If any of the above items are damaged or missing, please contact your retailer.*

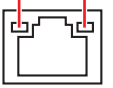
# Block Diagram



# Rear I/O Panel



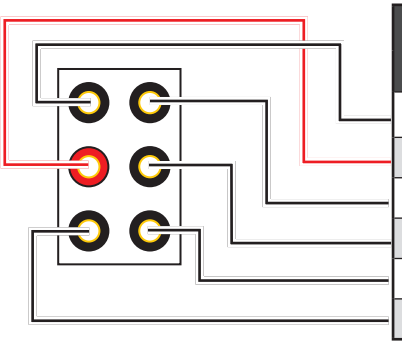

## LAN Port LED Status Table



| Link/ Activity LED | |
|---|---|
| **Status** | **Description** |
| Off | No link |
| Yellow | Linked |
| Blinking | Data activity |

| Speed LED | |
|---|---|
| **Status** | **Description** |
| Off | 10 Mbps connection |
| Green | 100 Mbps connection |
| Orange | 1 Gbps connection |

## Audio Ports Configuration

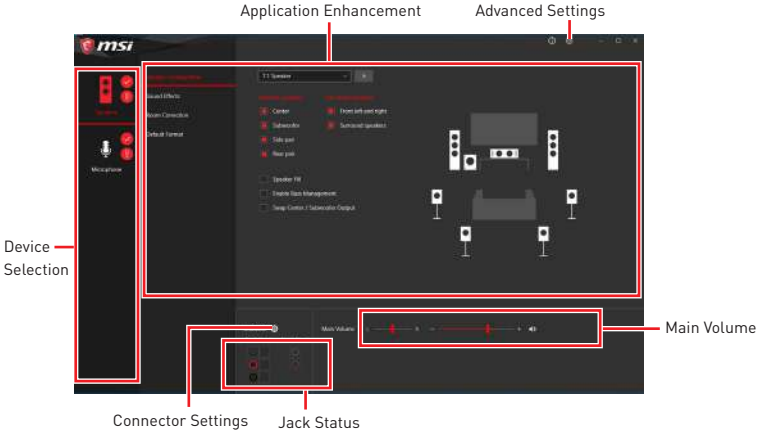


| Audio Ports | Channel | | | |
|---|---|---|---|---|
| | 2 | 4 | 6 | 8 |
| Line-In | | | | |
| Line-Out/ Front Speaker Out | ● | ● | ● | ● |
| Rear Speaker Out | | ● | ● | ● |
| Center/ Subwoofer Out | | | ● | ● |
| Side Speaker Out | | | | ● |
| Mic In | | | | |

(●: connected, **Blank**: empty)

## Realtek Audio Console

After Realtek Audio Console is installed. You can use it to change sound settings to get better sound experience.




• **Device Selection** - allows you to select a audio output source to change the related options. The **check** sign indicates the devices as default.

• **Application Enhancement** - the array of options will provide you a complete guidance of anticipated sound effect for both output and input device.

• **Main Volume** - controls the volume or balance the right/left side of the speakers that you plugged in front or rear panel by adjust the bar.

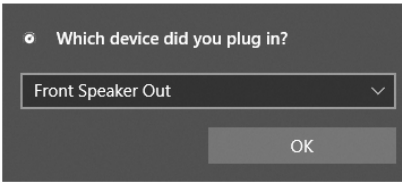
• **Advanced Settings** - provides the mechanism to deal with 2 independent audio streams.

• **Jack Status** - depicts all render and capture devices currently connected with your computer.

• **Connector Settings** - configures the connection settings.

### Auto popup dialog

When you plug into a device at an audio jack, a dialogue window will pop up asking you which device is current connected.

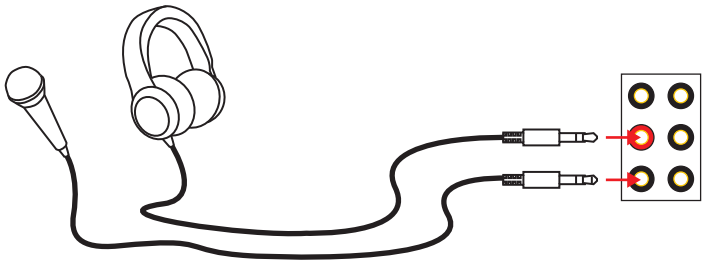



Each jack corresponds to its default setting as shown on the next page.

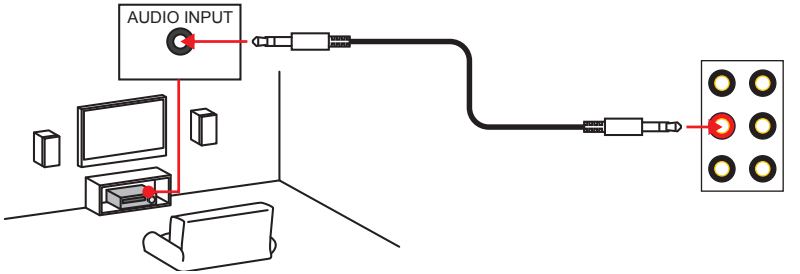
***Important***

*The pictures above for reference only and may vary from the product you purchased.*

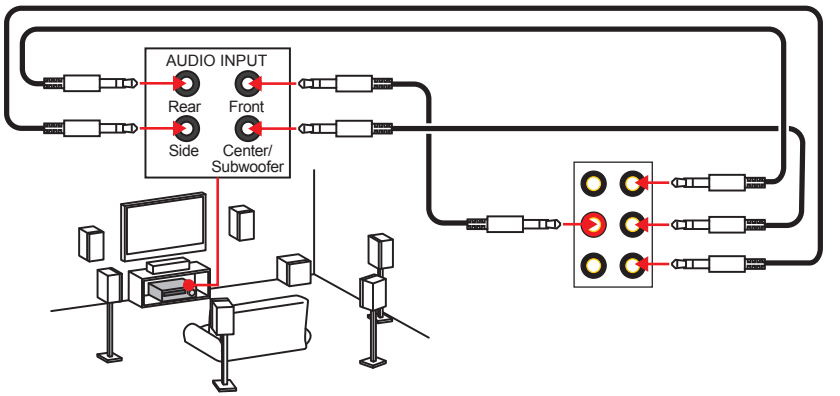
**Audio jacks to headphone and microphone diagram**



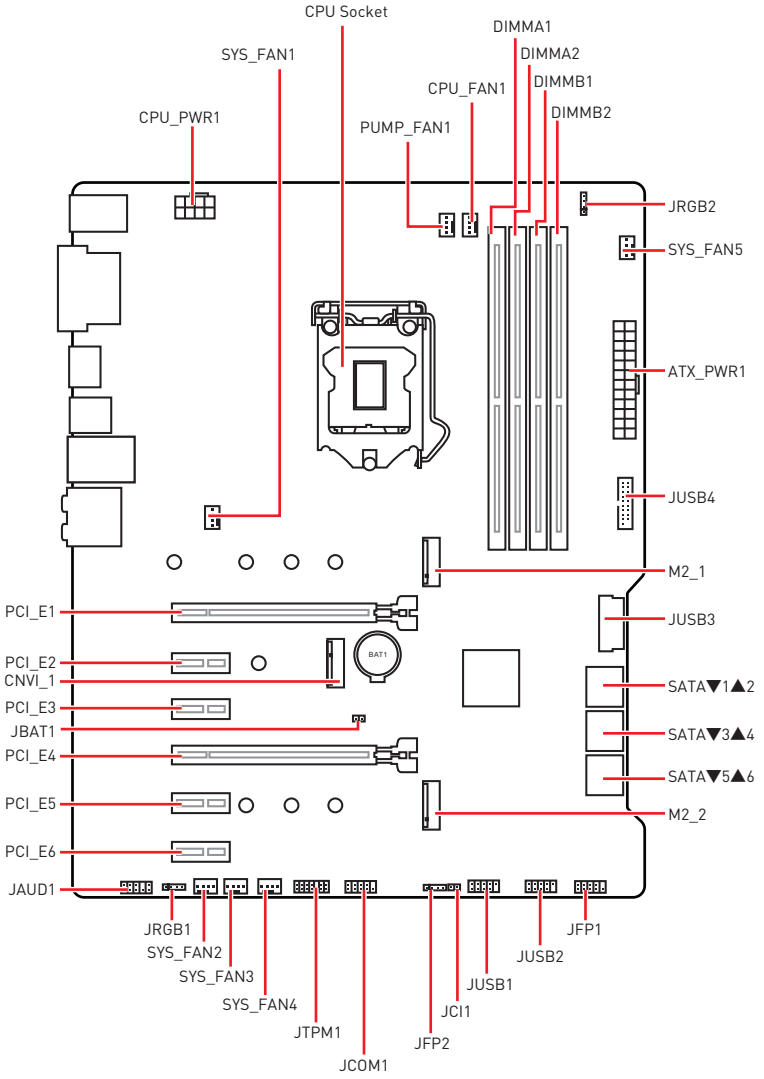
**Audio jacks to stereo speakers diagram**




**Audio jacks to 7.1-channel speakers diagram**



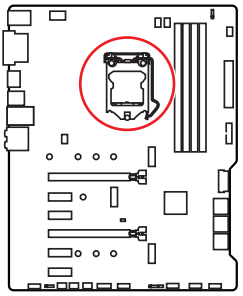
# Overview of Components

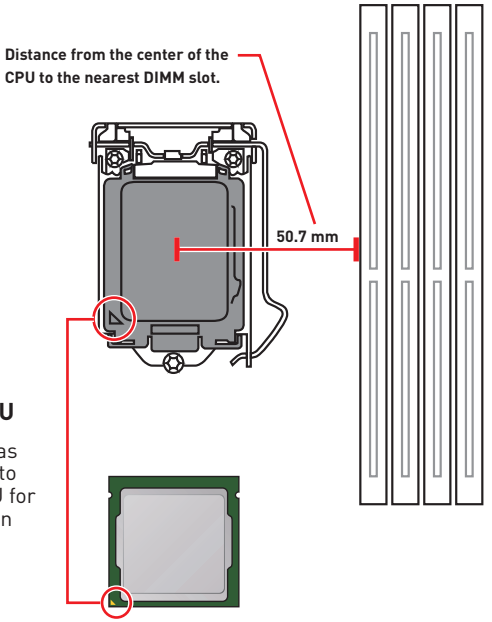


## Component Contents

| Port Name | Port Type | Page |
|---|---|---|
| CPU_FAN1, PUMP_FAN1, SYS_FAN1~5 | Fan Connectors | 32 |
| CPU_PWR1, ATX_PWR1 | Power Connectors | 30 |
| CPU Socket | LGA1151 CPU Socket | 25 |
| DIMMA1/A2/B1/B2 | DIMM Slots | 26 |
| JAUD1 | Front Audio Connector | 33 |
| JBAT1 | Clear CMOS Jumper | 34 |
| JCI1 | Chassis Intrusion Connector | 33 |
| JCOM1 | Serial Port Connector | 29 |
| JFP1, JFP2 | Front Panel Connectors | 29 |
| JRGB1, JRGB2 | RGB LED connectors | 35 |
| JTPM1 | TPM Module Connector | 34 |
| JUSB1~2 | USB 2.0 Connectors | 31 |
| JUSB3~4 | USB 3.1 Gen1 Connectors | 31 |
| M2_1~2 | M.2 Slots (Key M) | 28 |
| PCI_E1~6 | PCIe Expansion Slots | 27 |
| SATA1~6 | SATA 6Gb/s Connectors | 27 |

## CPU Socket





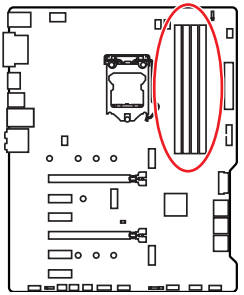

### Introduction to the LGA 1151 CPU

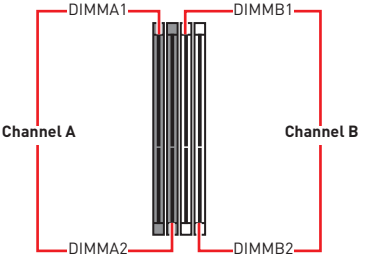
The surface of the LGA 1151 CPU has two **notches** and a **golden triangle** to assist in correctly lining up the CPU for motherboard placement. The golden triangle is the Pin 1 indicator.

***Important***

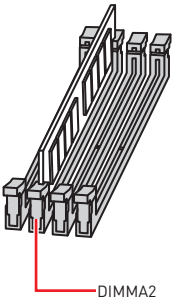
- *Always unplug the power cord from the power outlet before installing or removing the CPU.*
- *Please retain the CPU protective cap after installing the processor. MSI will deal with Return Merchandise Authorization (RMA) requests if only the motherboard comes with the protective cap on the CPU socket.*
- *When installing a CPU, always remember to install a CPU heatsink. A CPU heatsink is necessary to prevent overheating and maintain system stability.*
- *Confirm that the CPU heatsink has formed a tight seal with the CPU before booting your system.*
- *Overheating can seriously damage the CPU and motherboard. Always make sure the cooling fans work properly to protect the CPU from overheating. Be sure to apply an even layer of thermal paste (or thermal tape) between the CPU and the heatsink to enhance heat dissipation.*
- *Whenever the CPU is not installed, always protect the CPU socket pins by covering the socket with the plastic cap.*
- *If you purchased a separate CPU and heatsink/ cooler, Please refer to the documentation in the heatsink/ cooler package for more details about installation.*
- *This motherboard is designed to support overclocking. Before attempting to overclock, please make sure that all other system components can tolerate overclocking. Any attempt to operate beyond product specifications is not recommended. MSI® does not guarantee the damages or risks caused by inadequate operation beyond product specifications.*

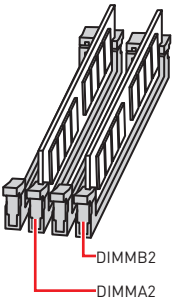
## DIMM Slots

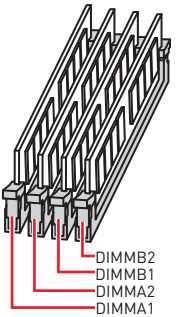





### Memory module installation recommendation



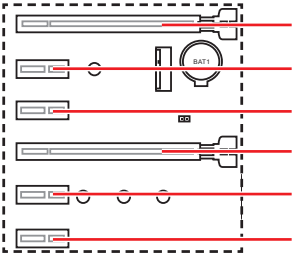




***Important***

- *Always insert memory modules in the **DIMMA2** slot first.*
- *Due to chipset resource usage, the available capacity of memory will be a little less than the amount of installed.*
- *Based on CPU specification, the Memory DIMM voltage below 1.35V is suggested to protect the CPU.*
- *Please note that the maximum capacity of addressable memory is 4GB or less for 32-bit Windows OS due to the memory address limitation. Therefore, we recommended that you to install 64-bit Windows OS if you want to install more than 4GB memory on the motherboard.*
- *Some memory may operate at a lower frequency than the marked value when overclocking due to the memory frequency operates dependent on its Serial Presence Detect (SPD). Go to BIOS and find the **Memory Try It!** to set the memory frequency if you want to operate the memory at the marked or at a higher frequency.*
- *It is recommended to use a more efficient memory cooling system for full DIMMs installation or overclocking.*
- *The stability and compatibility of installed memory module depend on installed CPU and devices when overclocking.*

## PCI_E1~6: PCIe Expansion Slots




**PCI_E1**: PCIe 3.0 x16 (CPU lanes)

**PCI_E2**: PCIe 3.0 x1 (PCH lanes)

**PCI_E3**: PCIe 3.0 x1 (PCH lanes)

**PCI_E4**: PCIe 3.0 x4 (PCH lanes)

**PCI_E5**: PCIe 3.0 x1 (PCH lanes)

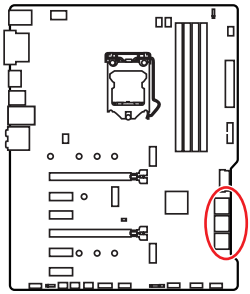
**PCI_E6**: PCIe 3.0 x1 (PCH lanes)

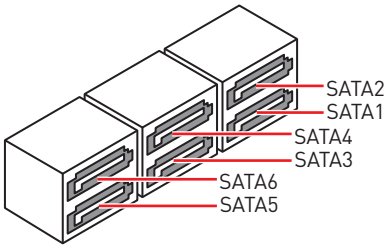
***Important***

- *If you install a large and heavy graphics card, you need to use a tool such as **MSI Gaming Series Graphics Card Bolster** to support its weight and to prevent deformation of the slot.*
- *For a single PCIe x16 expansion card installation with optimum performance, using the **PCI_E1** slot is recommended.*
- *When adding or removing expansion cards, always turn off the power supply and unplug the power supply power cable from the power outlet. Read the expansion card' s documentation to check for any necessary additional hardware or software changes.*

## SATA1~6: SATA 6Gb/s Connectors

These connectors are SATA 6Gb/s interface ports. Each connector can connect to one SATA device.

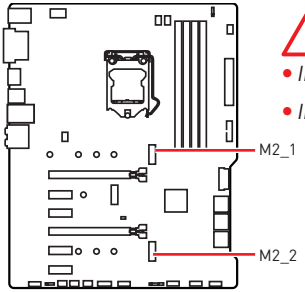





***Important***

- *Please do not fold the SATA cable at a 90-degree angle. Data loss may result during transmission otherwise.*
- *SATA cables have identical plugs on either sides of the cable. However, it is recommended that the flat connector be connected to the motherboard for space saving purposes.*
- *The SATA2 will be unavailable when installing M.2 SATA device into M2_1 slot.*
- *The SATA5 & SATA6 will be unavailable when installing M.2 PCIe/ SATA device into M2_2 slot.*

## M2_1~2: M.2 Slots (Key M)




**Important**

- *Intel® RST only supports PCIe M.2 SSD with UEFI ROM.*
- *Intel® Optane™ Memory Ready.*

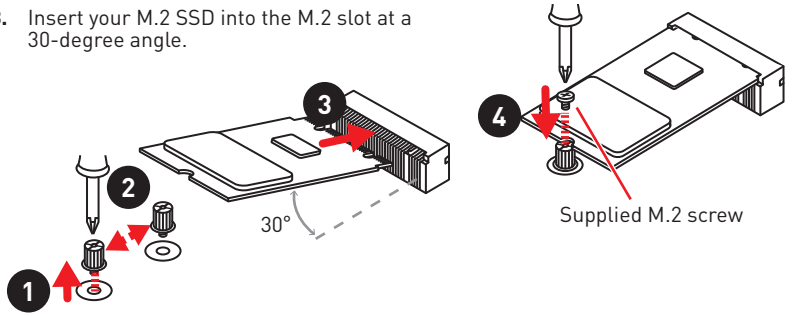
**Video Demonstration**

*Watch the video to learn how to Install M.2 module.*

*http://youtu.be/JCTFABytrYA*

### Installing M.2 device

1. Loosen the M.2 riser screw from the motherboard.
2. Move and fasten the M.2 riser screw to the appropriate location for your M.2 SSD.
3. Insert your M.2 SSD into the M.2 slot at a 30-degree angle.
4. Secure the M.2 SSD in place with the supplied M.2 screw.



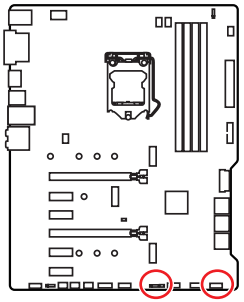

### M.2 and SATA combination table

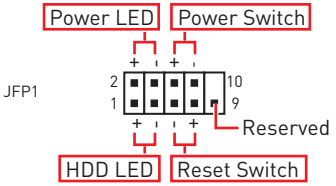
| Slot | Available SATA/ M.2 Connectors | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| M2_1 | PCIe | | | SATA | | | Empty | | |
| M2_2 | PCIe | SATA | Empty | PCIe | SATA | Empty | PCIe | SATA | Empty |
| SATA1 | ✓ | | | ✓ | | | ✓ | | |
| SATA2 | ✓ | | | — | | | ✓ | | |
| SATA3 | ✓ | | | ✓ | | | ✓ | | |
| SATA4 | ✓ | | | ✓ | | | ✓ | | |
| SATA5 | — | | ✓ | — | | ✓ | — | | ✓ |
| SATA6 | — | | ✓ | — | | ✓ | — | | ✓ |

(**SATA**: M.2 SATA SSD, **PCIe**: M.2 PCIe SSD, ✓: available, —: unavailable)

## JFP1, JFP2: Front Panel Connectors

These connectors connect to the switches and LEDs on the front panel.





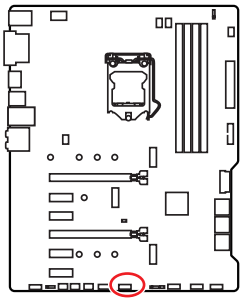

| | | | |
|---|---|---|---|
| 1 | HDD LED + | 2 | Power LED + |
| 3 | HDD LED - | 4 | Power LED - |
| 5 | Reset Switch | 6 | Power Switch |
| 7 | Reset Switch | 8 | Power Switch |
| 9 | Reserved | 10 | No Pin |




| | | | |
|---|---|---|---|
| 1 | Speaker - | 2 | Buzzer + |
| 3 | Buzzer - | 4 | Speaker + |

## JCOM1: Serial Port Connector

This connector allows you to connect the optional serial port with bracket.

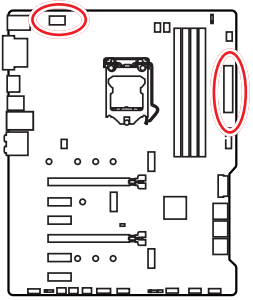





| | | | |
|---|---|---|---|
| 1 | DCD | 2 | SIN |
| 3 | SOUT | 4 | DTR |
| 5 | Ground | 6 | DSR |
| 7 | RTS | 8 | CTS |
| 9 | RI | 10 | No Pin |

## CPU_PWR1, ATX_PWR1: Power Connectors

These connectors allow you to connect an ATX power supply.



8 5
4 1 CPU_PWR1

| | | | |
|---|---|---|---|
| 1 | Ground | 5 | +12V |
| 2 | Ground | 6 | +12V |
| 3 | Ground | 7 | +12V |
| 4 | Ground | 8 | +12V |

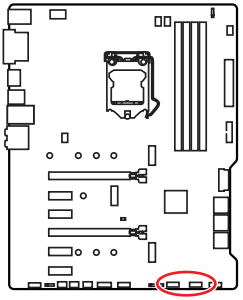
12 24
ATX_PWR1
1 13

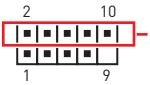
| | | | |
|---|---|---|---|
| 1 | +3.3V | 13 | +3.3V |
| 2 | +3.3V | 14 | -12V |
| 3 | Ground | 15 | Ground |
| 4 | +5V | 16 | PS-ON# |
| 5 | Ground | 17 | Ground |
| 6 | +5V | 18 | Ground |
| 7 | Ground | 19 | Ground |
| 8 | PWR OK | 20 | Res |
| 9 | 5VSB | 21 | +5V |
| 10 | +12V | 22 | +5V |
| 11 | +12V | 23 | +5V |
| 12 | +3.3V | 24 | Ground |

***Important***

*Make sure that all the power cables are securely connected to a proper ATX power supply to ensure stable operation of the motherboard.*

## JUSB1~2: USB 2.0 Connectors






| | | | |
|---|---|---|---|
| 1 | VCC | 2 | VCC |
| 3 | USB0- | 4 | USB1- |
| 5 | USB0+ | 6 | USB1+ |
| 7 | Ground | 8 | Ground |
| 9 | No Pin | 10 | NC |

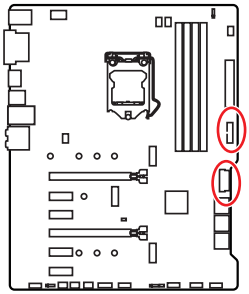
Note : For JUSB2, the set of pins is unavailable when a Intel wireless-AC (CNVi) module is installed in the CNVI_1 slot.

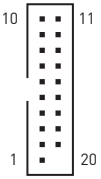
***Important***

- *Note that the VCC and Ground pins must be connected correctly to avoid possible damage.*
- *In order to recharge your iPad,iPhone and iPod through USB ports, please install MSI Dragon Center utility.*
- *The CNVI_1 and JUSB2 share the same bandwidth. And one USB port connecting to JUSB2 is unavailable when the CNVI_1 slot has been installed.*

## JUSB3~4: USB 3.1 Gen1 Connectors

These connectors allow you to connect USB 3.1 Gen1 ports on the front panel.





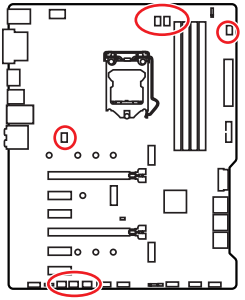

| | | | |
|---|---|---|---|
| 1 | Power | 11 | USB2.0+ |
| 2 | USB3_RX_DN | 12 | USB2.0- |
| 3 | USB3_RX_DP | 13 | Ground |
| 4 | Ground | 14 | USB3_TX_C_DP |
| 5 | USB3_TX_C_DN | 15 | USB3_TX_C_DN |
| 6 | USB3_TX_C_DP | 16 | Ground |
| 7 | Ground | 17 | USB3_RX_DP |
| 8 | USB2.0- | 18 | USB3_RX_DN |
| 9 | USB2.0+ | 19 | Power |
| 10 | GND | 20 | No Pin |

***Important***

*Note that the Power and Ground pins must be connected correctly to avoid possible damage.*

## CPU_FAN1, PUMP_FAN1, SYS_FAN1~5: Fan Connectors

Fan connectors can be classified as PWM (Pulse Width Modulation) Mode or DC Mode. PWM Mode fan connectors provide constant 12V output and adjust fan speed with speed control signal. DC Mode fan connectors control fan speed by changing voltage. You can follow the instruction below to adjust the fan connector to PWM or DC Mode.



### Default PWM Mode fan connectors




CPU_FAN1/ PUMP_FAN1

### Default DC Mode fan connectors




SYS_FAN1 & 5




SYS_FAN2, 3, 4

### Switching fan mode and adjusting fan speed

You can switch between PWM mode and DC mode and adjust fan speed in **BIOS > HARDWARE MONITOR**.

Select **PWM** mode or **DC** mode




There are gradient points of the fan speed that allow you to adjust fan speed in relation to CPU temperature.

***Important***

*Make sure fans are working properly after switching the PWM/ DC mode.*

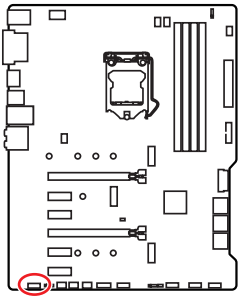
### Pin definition of fan connectors

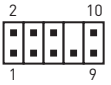
| PWM Mode pin definition | | | |
|---|---|---|---|
| 1 | Ground | 2 | +12V |
| 3 | Sense | 4 | Speed Control Signal |

| DC Mode pin definition | | | |
|---|---|---|---|
| 1 | Ground | 2 | Voltage Control |
| 3 | Sense | 4 | NC |

## JAUD1: Front Audio Connector

This connector allows you to connect audio jacks on the front panel.

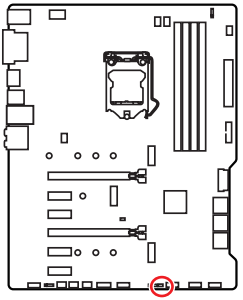





| | | | |
|---|---|---|---|
| 1 | MIC L | 2 | Ground |
| 3 | MIC R | 4 | NC |
| 5 | Head Phone R | 6 | MIC Detection |
| 7 | SENSE_SEND | 8 | No Pin |
| 9 | Head Phone L | 10 | Head Phone Detection |

## JCI1: Chassis Intrusion Connector

This connector allows you to connect the chassis intrusion switch cable.





Normal

(default)



Trigger the chassis intrusion event

### Using chassis intrusion detector

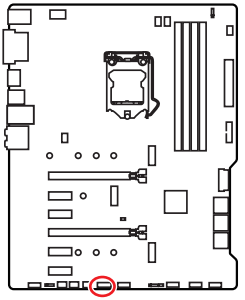
1. Connect the **JCI1** connector to the chassis intrusion switch/ sensor on the chassis.
2. Close the chassis cover.
3. Go to **BIOS > SETTINGS > Security > Chassis Intrusion Configuration**.
4. Set **Chassis Intrusion** to **Enabled**.
5. Press **F10** to save and exit and then press the **Enter** key to select **Yes**.
6. Once the chassis cover is opened again, a warning message will be displayed on screen when the computer is turned on.

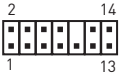
### Resetting the chassis intrusion warning

1. Go to **BIOS > SETTINGS > Security > Chassis Intrusion Configuration**.
2. Set **Chassis Intrusion** to **Reset**.
3. Press **F10** to save and exit and then press the **Enter** key to select **Yes**.

## JTPM1: TPM Module Connector

This connector is for TPM (Trusted Platform Module). Please refer to the TPM security platform manual for more details and usages.

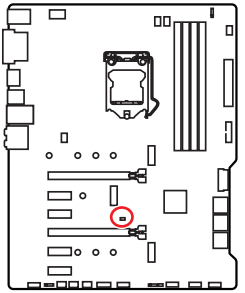





| | | | |
|---|---|---|---|
| 1 | LPC Clock | 2 | 3V Standby power |
| 3 | LPC Reset | 4 | 3.3V Power |
| 5 | LPC address & data pin0 | 6 | Serial IRQ |
| 7 | LPC address & data pin1 | 8 | 5V Power |
| 9 | LPC address & data pin2 | 10 | No Pin |
| 11 | LPC address & data pin3 | 12 | Ground |
| 13 | LPC Frame | 14 | Ground |

## JBAT1: Clear CMOS (Reset BIOS) Jumper

There is CMOS memory onboard that is external powered from a battery located on the motherboard to save system configuration data. If you want to clear the system configuration, set the jumpers to clear the CMOS memory.





Keep Data

(default)



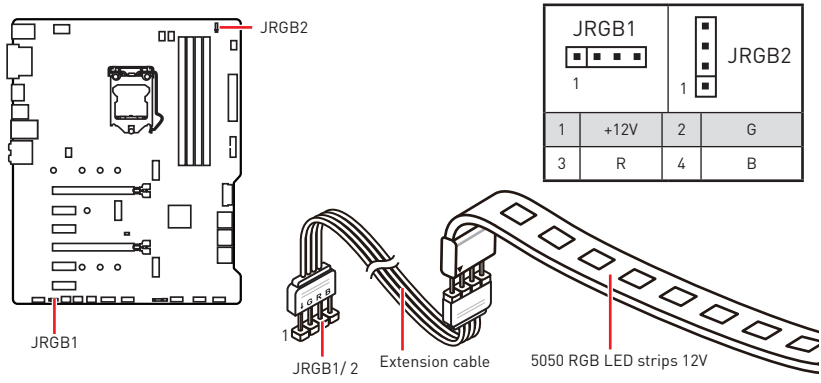
Clear CMOS/
Reset BIOS

### Resetting BIOS to default values

1. Power off the computer and unplug the power cord.
2. Use a jumper cap to short **JBAT1** for about 5-10 seconds.
3. Remove the jumper cap from **JBAT1**.
4. Plug the power cord and Power on the computer.

## JRGB1, JRGB2: RGB LED connectors

The JRGB1/ JRGB2 connector allows you to connect the 5050 RGB LED strips 12V.

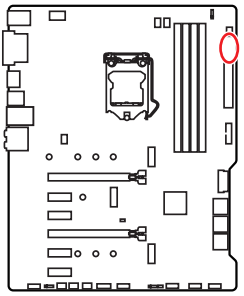



***Important***

- *The JRGB1 & JRGB2 connectors support 5050 RGB LED strip (12V/G/R/B) with the maximum power rating of 3A (12V).*
- *Please keeping the LED strip shorter than 2 meters to prevent dimming.*
- *Always turn off the power supply and unplug the power cord from the power outlet before installing or removing the LED strip.*
- *Please use MSI's software to control the extended LED strip.*

## EZ Debug LED

These LEDs indicate the debug status of the motherboard.



- **CPU** - indicates CPU is not detected or fail.
- **DRAM** - indicates DRAM is not detected or fail.
- **VGA** - indicates GPU is not detected or fail.
- **BOOT** - indicates the booting device is not detected or fail.

# Installing OS, Drivers & Utilities

Please download and update the latest utilities and drivers at www.msi.com

## Installing Windows® 10

1. Power on the computer.
2. Insert the Windows® 10 installation disc/USB into your computer.
3. Press the **Restart** button on the computer case.
4. Press **F11** key during the computer POST (Power-On Self Test) to get into Boot Menu.
5. Select the Windows® 10 installation disc/USB from the Boot Menu.
6. Press any key when screen shows **Press any key to boot from CD or DVD...** message.
7. Follow the instructions on the screen to install Windows® 10.

## Installing Drivers

1. Start up your computer in Windows® 10.
2. Insert MSI® Driver Disc into your optical drive.
3. Click the **Select to choose what happens with this disc** pop-up notification, then select **Run DVDSetup.exe** to open the installer. If you turn off the AutoPlay feature from the Windows Control Panel, you can still manually execute the **DVDSetup.exe** from the root path of the MSI Driver Disc.
4. The installer will find and list all necessary drivers in the **Drivers/Software** tab.
5. Click the **Install** button in the lower-right corner of the window.
6. The drivers installation will then be in progress, after it has finished it will prompt you to restart.
7. Click **OK** button to finish.
8. Restart your computer.

## Installing Utilities

Before you install utilities, you must complete drivers installation.

1. Open the installer as described above.
2. Click the **Utilities** tab.
3. Select the utilities you want to install.
4. Click the **Install** button in the lower-right corner of the window.
5. The utilities installation will then be in progress, after it has finished it will prompt you to restart.
6. Click **OK** button to finish.
7. Restart your computer.

# BIOS Setup

The default settings offer the optimal performance for system stability in normal conditions. You should **always keep the default settings** to avoid possible system damage or failure booting unless you are familiar with BIOS.

***Important***

• *BIOS items are continuously update for better system performance. Therefore, the description may be slightly different from the latest BIOS and should be for reference only. You could also refer to the **HELP** information panel for BIOS item description.*

• *The pictures in this chapter are for reference only and may vary from the product you purchased.*

## Entering BIOS Setup

Please refer the following methods to enter BIOS setup.

• Press **Delete** key, when the **Press DEL key to enter Setup Menu, F11 to enter Boot Menu** message appears on the screen during the boot process.

• In **MSI Dragon Center** application, click on **GO2BIOS** button and choose **OK**. The system will reboot and enter BIOS setup directly.

### Function key

**F1**: General Help

**F2**: Add/ Remove a favorite item

**F3**: Enter Favorites menu

**F4**: Enter CPU Specifications menu

**F5**: Enter Memory-Z menu

**F6**: Load optimized defaults

**F7**: Switch between Advanced mode and EZ mode

**F8**: Load Overclocking Profile

**F9**: Save Overclocking Profile

**F10**: Save Change and Reset*

**F12**: Take a screenshot and save it to USB flash drive (FAT/ FAT32 format only).

**Ctrl+F**: Enter Search page

* When you press F10, a confirmation window appears and it provides the modification information. Select between Yes or No to confirm your choice.

## Resetting BIOS

You might need to restore the default BIOS setting to solve certain problems. There are several ways to reset BIOS:

- Go to BIOS and press **F6** to load optimized defaults.
- Short the **Clear CMOS** jumper on the motherboard.

***Important***

*Be sure the computer is off before clearing CMOS data. Please refer to the **Clear CMOS** jumper section for resetting BIOS.*

## Updating BIOS

### Updating BIOS with M-FLASH

Before updating:

Please download the latest BIOS file that matches your motherboard model from MSI website. And then save the BIOS file into the USB flash drive.

Updating BIOS:

1. Insert the USB flash drive that contains the update file into the USB port.
2. Please refer the following methods to enter flash mode.
   - Reboot and press **Ctrl + F5** key during POST and click on **Yes** to reboot the system.
   - Reboot and press **Del** key during POST to enter BIOS. Click the **M-FLASH** button and click on **Yes** to reboot the system.
3. Select a BIOS file to perform the BIOS update process.
4. After the flashing process is 100% completed, the system will reboot automatically.

### Updating the BIOS with MSI DRAGON CENTER

Before updating:

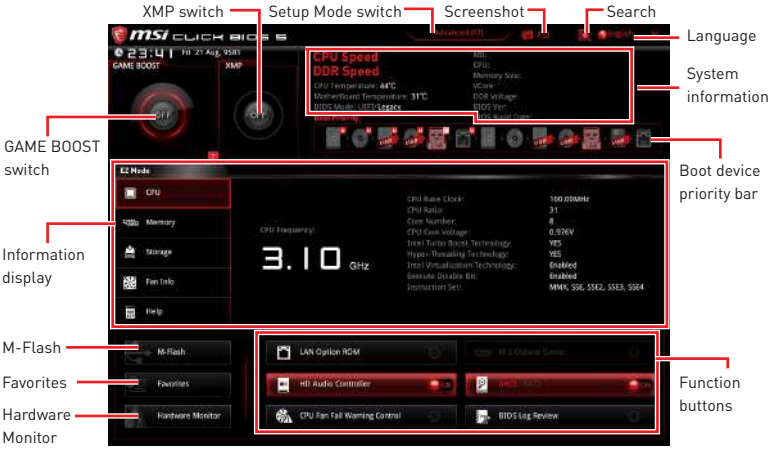
Make sure the LAN driver is already installed and the Internet connection is set properly.

Updating BIOS:

1. Install and launch MSI DRAGON CENTER.
2. Select **BIOS Update**.
3. Click on **Scan** button.
4. Click on **Download** icon to download and install the latest BIOS file.
5. Click **Next** and choose **In Windows mode**. And then click **Next** and **Start** to start updating BIOS.
6. After the flashing process is 100% completed, the system will restart automatically.

## EZ Mode

At EZ mode, it provides the basic system information and allows you to configure the basic setting. To configure the advanced BIOS settings, please enter the Advanced Mode by pressing the **Setup Mode switch** or **F7** function key.




• **GAME BOOST switch** - click on it to toggle the GAME BOOST for OC.

• **XMP switch** - click on the inner circle to enable/ disable the X.M.P. (Extreme Memory Profile). Switch the outer circle to select the X.M.P. profile. This switch will only be available if the X.M.P. supported memory module is installed.

• **Setup Mode switch** - press this tab or the **F7** key to switch between Advanced mode and EZ mode.

• **Screenshot** - click on this tab or the **F12** key to take a screenshot and save it to USB flash drive (FAT/ FAT32 format only).

• **Search** - click on this tab or the **Ctrl+F** keys and the search page will show. It allows you to search BIOS item by key word. Move the mouse over a blank space and right click the mouse to exit search page.

***Important***

*In search page, only the F6, F10 and F12 function keys are available.*

• **Language** - allows you to select the language of BIOS setup.

• **System information** - shows the CPU/ DDR speed, CPU/ MB temperature, MB/ CPU type, memory size, CPU/ DDR voltage, BIOS version and build date.

• **Boot device priority bar** - you can move the device icons to change the boot priority. The boot priority from high to low is left to right.

• **Information display** - click on the **CPU**, **Memory**, **Storage**, **Fan Info** and **Help** buttons on left side to display related information.

• **Function buttons** - enable or disable the **LAN Option ROM, M.2/ Optane Genie, HD audio controller, AHCI/ RAID, CPU Fan Fail Warning Control** and **BIOS Log Review** by clicking on their respective button.

• **M-Flash** - click on this button to perform **M-Flash** function that provides the way to update BIOS with a USB flash drive.

• **Hardware Monitor** - click on this button to display the **Hardware Monitor** menu that allows you to manually control the fan speed by percentage.

• **Favorites menu** - press the **F3** key to enter **Favorites** menu. It allows you to create personal BIOS menu where you can save and access favorite/ frequently-used BIOS setting items.

▪ **Default HomePage** - allows you to select a BIOS menu (e.g. SETTINGS, OC...,etc) as the BIOS home page.

▪ **Favorite1~5 page** - allows you to add the frequently-used/ favorite BIOS setting items in one page.

▪ **To add a BIOS item to a favorite page (Favorite 1~5)**

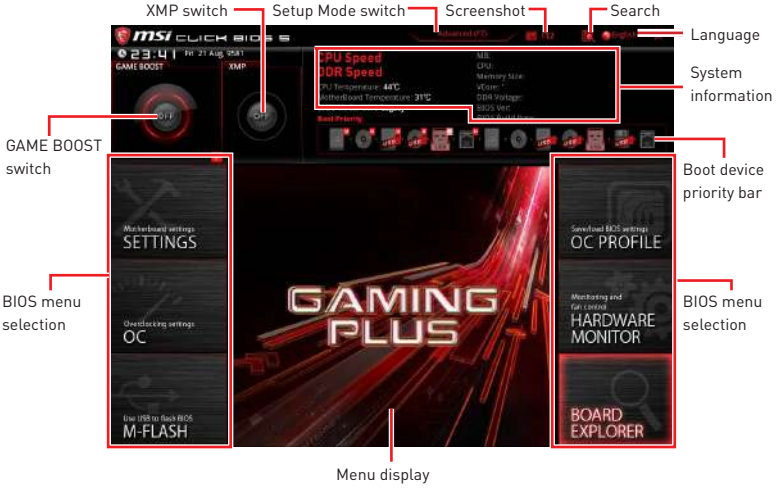
1. Move the mouse over a BIOS item not only on BIOS menu but also on search page.
2. Right-click or press **F2** key.
3. Choose a favorite page and click on **OK.**

▪ **To delete a BIOS item from favorite page**

1. Move the mouse over a BIOS item on favorite page (Favorite 1~5)
2. Right-click or press **F2** key.
3. Choose **Delete** and click on **OK**.

## Advanced Mode

Press **Setup Mode switch** or **F7** function key can switch between EZ Mode and Advanced Mode in BIOS setup.




- **GAME BOOST switch/ XMP switch/ Setup Mode switch/ Screenshot/ Language/ Search/ System information/ Boot device priority bar** - please refer to the descriptions of EZ Mode Overview section.
- **BIOS menu selection** - the following options are available:
  - **SETTINGS** - allows you to specify the parameters for chipset and boot devices.
  - **OC** - allows you to adjust the frequency and voltage. Increasing the frequency may get better performance.
  - **M-FLASH** - provides the way to update BIOS with a USB flash drive.
  - **OC PROFILE** - allows you to manage overclocking profiles.
  - **HARDWARE MONITOR** - allows you to set the speeds of fans and monitor voltages of system.
  - **BOARD EXPLORER** - provides the information of installed devices on this motherboard.
- **Menu display** - provides BIOS setting items and information to be configured.

# SETTINGS




### System Status

**▶ System Date**

Sets the system date. Use tab key to switch between date elements.

The format is <day> <month> <date> <year>.

| | |
|---|---|
| <day> | Day of the week, from Sun to Sat, determined by BIOS. Read-only. |
| <month> | The month from Jan. through Dec. |
| <date> | The date from 1 to 31 can be keyed by numeric function keys. |
| <year> | The year can be adjusted by users. |

**▶ System Time**

Sets the system time. Use tab key to switch between time elements.

The time format is <hour> <minute> <second>.

**▶ SATA PortX/ M2_X**

Shows the information of connected SATA/ M.2 devices.

***Important***

*If the connected SATA device is not displayed, turn off computer and re-check SATA cable and power cable connections of the device and motherboard.*

**▶ System Information**

Shows detailed system information, including CPU type, BIOS version, and Memory (read only).

**▶ DMI Information**

Shows system information, desktop Board Information and chassis Information. (Read only).

## Advanced

**▶ PCI Subsystem Settings**

Sets PCI, PCI express interface protocol and latency timer. Press **Enter** to enter the sub-menu.

▶ **PEG X - Max Link Speed [Auto]**

Sets PCI Express protocol of PCIe x16 slots for matching different installed devices.

[Auto] This item will be configured automatically by BIOS.

[Gen1] Enables PCIe Gen1 support only.

[Gen2] Enables PCIe Gen2 support only.

[Gen3] Enables PCIe Gen3 support only.

▶ **PCI Latency Timer [32]**

Sets latency timer of PCI interface device.

[Options: 32, 64, 96, 128, 160, 192, 224, 248 PCI Bus clocks]

▶ **Above 4G memory/ Crypto Currency mining [Disabled]**

Enables or disables 64-bit capable devices to be decoded in above 4G address space. It is only available if the system supports 64-bit PCI decoding.

[Enabled] Allows you to utilize more than 4x GPUs.

[Disabled] Disables this function.

▶ **ACPI Settings**

Sets ACPI parameters of onboard power LED behaviors. Press **Enter** to enter the sub-menu.

▶ **Power LED [Blinking]**

Sets shining behaviors of the onboard Power LED.

[Dual Color] The power LED turns to another color to indicate the S3 state.

[Blinking] The power LED blinks to indicate the S3 state.

▶ **CPU Over Temperature Alert [Auto]**

Enables or disables the CPU overheating alert when CPU temperature is over 80 degrees centigrade.

▶ **Integrated Peripherals**

Sets integrated peripherals' parameters, such as LAN, HDD, USB and audio. Press **Enter** to enter the sub-menu.

▶ **Onboard LAN Controller [Enabled]**

Enables or disables the onboard LAN controller.

▶ **LAN Option ROM [Disabled]**

Enables or disables the legacy network Boot Option ROM for detailed settings. This item will appear when **Onboard LAN Controller** is enabled.

[Enabled] Enables the onboard LAN Boot ROM.

[Disabled] Disables the onboard LAN Boot ROM.

▶ **Network Stack [Disabled]**

Sets UEFI network stack for optimizing IPv4 / IPv6 function.

[Enabled] Enables UEFI network stack.

[Disabled] Disables UEFI network stack.

▶ **Ipv4 PXE Support [Enabled]**

When **Enabled**, the system UEFI network stack will support Ipv4 protocol. This item will appear when **Network Stack** is enabled.

[Enabled] Enables the Ipv4 PXE boot support.

[Disabled] Disables the Ipv4 PXE boot support.

▶ **Ipv6 PXE Support [Enabled]**

When **Enabled**, the system UEFI network stack will support Ipv6 protocol. This item will appear when **Network Stack** is enabled.

[Enabled] Enables the Ipv6 PXE boot support.

[Disabled] Disables the Ipv6 PXE boot support.

▶ **SATA Mode [AHCI Mode]**

Sets the operation mode of the onboard SATA controller.

[AHCI Mode] Specify the AHCI mode for SATA storage devices. AHCI (Advanced Host Controller Interface) offers some advanced features to enhance the speed and performance of SATA storage device, such as Native Command Queuing (NCQ) and hot-plugging.

[RAID/ Optane Mode] Enables RAID function for SATA storage devices or enables Optane function for NVMe or PCIe storage devices.

▶ **M2_X-RST Pcie Storage Remapping [Disabled]**

Enables or disables Intel Rapid Storage for M.2 PCIe storage device.

▶ **M.2/Optane Genie [Disabled]**

Enables or disables M.2 storage/ Optane memory. M.2 Genie provides a convenient way for setting up M.2 device. When set to Enabled, it will support Intel Optane memory when it is installed and support RAID function when 2 or more M.2 devices are installed.

▶ **SATAx Hot Plug [Disabled]**

Allows user to enable or disable the SATA hot plug support.

[Enabled] Enables hot plug support for the SATA ports.

[Disabled] Disables hot plug support for the SATA ports.

▶ **HD Audio Controller [Enabled]**

Enables or disables the onboard High Definition Audio controller.

▶ **Integrated Graphics Configuration**

Adjusts integrated graphics settings for optimum system. Press **Enter** to enter the sub-menu.

▶ **Initiate Graphic Adapter [PEG]**

Selects a graphics device as the primary boot device.

[IGD] Integrated Graphics Display.

[PEG] PCI-Express Graphics Device.

▶ **Integrated Graphics Share Memory [64M]**

Selects a fixed amount of system memory allocated to the onboard graphics. This item will appear when IGD Multi-Monitor is enabled.

▶ **IGD Multi-Monitor [Disabled]**

Enables or disables the multi-screen output from integrated graphics and external graphics card. This item appears when Initiate Graphic Adapter set to PEG.

[Enabled] Enables multi-screen function for both integrated and external graphics cards.

[Disabled] Disables this function.

▶ **USB Configuration**

Sets the onboard USB controller and device function. Press **Enter** to enter the sub-menu.

▶ **USB Controller [Enabled]**

Enables or disables all USB controller.

▶ **XHCI Hand-off [Diasbled]**

Enables or disables XHCI hand-off support for the operating system without XHCI hand-off feature.

▶ **Legacy USB Support [Enabled]**

Sets Legacy USB function support.

[Auto] The system will automatically detect if any USB device is connected and enable the legacy USB support.

[Enabled] Enable the USB support under legacy mode.

[Disabled] The USB devices will be unavailable under legacy mode.

▶ **Super IO Configuration**

Sets system Super I/O chip parameters including COM ports. Press Enter to enter the sub-menu.

▶ **Serial (COM) Port 0 Configuration**

Sets detailed configuration of serial(COM) port. Press Enter to enter the sub-menu.

▶ **Serial (COM) Port 0 [Enabled]**

Enables or disables serial port.

▶ **Serial (COM) Port 0 Settings [Auto]**

Sets serial port. If set to Auto, BIOS will optimize the IRQ automatically or you can set it manually.

▶ **Power Management Setup**

Sets system Power Management of ErP and AC Power Loss behaviors. Press **Enter** to enter the sub-menu.

▶ **ErP Ready [Disabled]**

Enables or disables the system power consumption according to ErP regulation.

[Enabled] Optimize the system power consumption according to ErP regulation. It will not support S4 & S5 wake up by USB, PCI and PCIe devices.

[Disabled] Disables this function.

▶ **Restore after AC Power Loss [Power Off]**

Sets the system behaviors while encountering the AC power loss.

[Power Off] Leaves the system in power off state after restoring AC power.

[Power On] Boot up the system after restoring AC power.

[Last State] Restores the system to the previous state (power on/ power off) before AC power loss.

▶ **System Power Fault Protection [Disabled]**

Enables or disables the system to boot up when detecting abnormal voltage input.

[Enabled] Protect the system from unexpected power operation and remain the shut down status.

[Disabled] Disables this function.

▶ **USB Standby Power at S3/S4/S5 [Disabled]**

Enables or disables the standby power for all USB ports. This item will be available when **Resume By USB Device** is Disabled.

▶ **Windows OS Configuration**

Sets Windows OS detailed configuration and behaviors. Press **Enter** to enter the sub-menu.

▶ **Windows 10 WHQL Support [Disabled]**

Enables the supports for Windows 10 or disables for other operating systems. Before enabling this item, make sure all installed devices & utilities (hardware & software) should meet the Windows 10 requirements.

[Enabled] The system will switch to UEFI mode to meet the Windows equirement.

[Disabled] Disables this function.

▶ **MSI Fast Boot [Disabled]**

MSI Fast Boot is the fastest way to boot the system. It will disable more devices to speed up system boot time which is faster than the boot time of **Fast Boot**.

[Enabled] Enables the MSI Fast Boot function to speed up booting time. And the following **Fast Boot** field will be disabled and fixed.

[Disabled] Disables MSI Fast Boot.

***Important***

*When MSI Fast Boot is enabled, you can use **MSI FAST BOOT** application to enter BIOS setup if needed. Please refer **Entering BIOS Setup** section for details.*

▶ **Fast Boot [Enabled]**

Enables or disables the fast boot feature for Windows 10. This item will only be available when **MSI Fast Boot** is disabled.

[Enabled] Enables the Fast Boot configuration to accelerate system boot time.

[Disabled] Disables the Fast Boot configuration.

▶ **Internal GOP Configuration**

Manages the onboard Graphics Output Protocol (GOP). Press **Enter** to enter the sub-menu. This sub-menu will appear when **Windows 10 WHQL Support** is enabled.

▶ **Secure Boot**

Sets the Windows secure boot to prevent the unauthorized accessing. Press **Enter** to enter the sub-menu. This sub-menu will appear when **Windows 10 WHQL Support** is enabled.

▶ **Secure Boot Support [Disabled]**

Enables or disables secure boot support.

[Enabled] Enables the secure boot function and allow you to set the secure boot settings.

[Disabled] Disables this function.

▶ **Secure Boot Mode [Standard]**

Selects the secure boot mode. This item is to select how the secure boot keys be loaded. This item appears when **Secure Boot Support** is enabled.

[Standard] The system will automatically load the secure keys from BIOS.

[Custom] Allows user to configure the secure boot settings and manually load the secure keys.

▶ **Key Management**

Manages the secure boot keys. Press <Enter> to enter the sub-menu. This sub-menu will appear when **Secure Boot Mode** sets to **Custom**.

▶ **Wake Up Event Setup**

Sets system wake up behaviors for different sleep modes. Press **Enter** to enter the sub-menu.

▶ **Wake Up Event By [BIOS]**

Selects the wake up event by BIOS or operating system.

[BIOS] Activates the following items, set wake up events of these items.

[OS] The wake up events will be defined by OS.

▶ **Resume By RTC Alarm [Disabled]**

Disables or enables the system wake up by RTC Alarm.

[Enabled] Enables the system to boot up on a scheduled time/ date.

[Disabled] Disables this function.

▶ **Date (of month) Alarm/ Time (hh:mm:ss) Alarm**

Sets RTC alarm date/ Time. If Resume By RTC Alarm is set to [Enabled], the system will automatically resume (boot up) on a specified date/hour/minute/second in these fields (using the **+** and **-** keys to select the date & time settings).

▶ **Resume By PCI-E Device [Disabled]**

Enables or disables the wake up function of installed PCI-E expansion cards, integrated LAN controllers or USB devices which are supported by third party integrated chips.

[Enabled] Enables the system to be awakened from the power saving modes when activity or input signal of PCIe device is detected.

[Disabled] Disables this function.

▶ **Resume By Intel Onboard LAN/ CNVI [Disabled]**

Enables or disables the system wake up by Onboard Intel LAN/ CNVI.

[Enabled] Enables the system to be awakened from the power saving modes when activity or input signal of Intel LAN/ CNVI device is detected.

[Disabled] Disables this function.

▶ **Resume by USB Device [Disabled]**

Enables or disables the system wake up by USB devices.

[Enabled] Enables the system to be awakened from sleep state when activity of USB device is detected.

[Disabled] Disables this function.

▶ **Resume From S3/S4/S5 by PS/2 Mouse [Disabled]**

Enables or disables the system wake up by PS/2 mouse.

[Enabled] Enables the system to be awakened from S3/ S4/ S5 state when activity of PS/2 mouse is detected.

[Disabled] Disables this function.

▶ **Resume From S3/S4/S5 by PS/2 Keyboard [Disabled]**

Enables or disables the system wake up by PS/2 keyboard.

[Any Key] Enables the system to be awakened from S3/ S4/ S5 state when activity of any key on PS/2 keyboard is detected.

[Hot Key] Enables the system to be awakened from S3/ S4/ S5 state when activity of hot key on PS/2 keyboard is detected.

[Disabled] Disables this function.

▶ **Hot Key [Ctrl+Space]**

Selects a combination of keys as a hot key to wake the system. This item appears when you set the Resume From S3/S4/S5 by PS/2 Keyboard to **Hot Key**.

▶ **Secure Erase+**

Enables or disables Secure Erase+ function. **Secure Erase+** is the best way to effectively wipe all data from a SSD. Please note that data of SSD will be erased after enabling **Secure Erase+**.

▶ **Intel ( R ) Ethernet Connection I219-V**

Shows driver information and configuration of the ethernet controller parameter. This item will appear when **Network Stack** is enabled.

## Boot

Sets the sequence of system boot devices.

▶ **Full Screen Logo Display [Enabled]**

Enables or disables to show the full screen logo while system POST.

[Enabled] Shows the logo in full screen.

[Disabled] Shows the POST messages.

▶ **GO2BIOS [Disabled]**

Allows system to enter BIOS setup directly by pressing the Power button for 4 sec pon bootup.

[Enabled] The system boots straight to the BIOS setup by long pressing the power button about 4 seconds when the system is off.

[Disabled] Disables this function.

**▶ Bootup NumLock State [On]**

Select the keyboard NumLock state upon bootup.

**▶ Info Block effect [Unlock]**

Sets the state of Help information block.

[Unlock] Sliding effect.

[Lock] Fix the **Help** information block on the screen.

**▶ POST Beep [Disabled]**

Enables or disables the beep sound during system POST.

**▶ Boot Mode Select [LEGACY+UEFI]**

Sets the system boot mode from legacy or UEFI architecture depending on OS installation requirement. This item will become un-selectable and will be configured automatically by BIOS when **Windows 10 WHQL Support** is enabled.

[UEFI] Enables UEFI BIOS boot mode support only.

[LEGACY+UEFI] Enables both Legacy BIOS boot mode and UEFI BIOS boot mode.

**▶ FIXED BOOT ORDER Priorities**

Sets device priority for system boot.

**▶ Boot Option Priorities**

These items are used to prioritize the installed boot devices.

## Security

**▶ Administrator Password**

Sets administrator password for system security. User has full rights to change the BIOS items with administrator password. After setting the administrator password, the state of this item will show "Installed".

**▶ User Password**

Sets User Password for system security. User has limited rights to change the BIOS items with user password. This item will be available when administrator password is set. After setting the user password, the state of this item will show "Installed".

**▶ Password Check [Setup]**

Selects a condition that will request the password.

[Setup] A password will be requested for entering the BIOS Setup.

[Boot] A password will be requested for booting the system.

**▶ Password Clear [Enabled]**

Enables or disables the clear CMOS behavior to clear a set password.

[Enabled] The password will be erased after clear CMOS.

[Disabled] The password will always be kept.

***Important***

*When selecting the Administrator / User Password items, a password box will appear on the screen. Type the password then press <Enter>. The password typed now will replace any previous set password from CMOS memory. You will be prompted to confirm the password. You may also press <Esc> to abort the selection.*

*To clear a set password, press <Enter> when you are prompted to enter a new password. A message will confirm the password is being disabled. Once the password is disabled, you can enter the setup and OS without authorization.*

▶ **Trusted Computing**

Sets TPM (Trusted Platform Module) function.

▶ **Security Device Support [Disabled]**

Enables or disables the TPM function to build the endorsement key for accessing the system.

▶ **Chassis Intrusion Configuration**

Press <Enter> to enter the sub-menu.

▶ **Chassis Intrusion [Disabled]**

Enables or disables recording messages when the chassis is opened. This function is ready for the chassis equips a chassis intrusion switch.

| | |
|---|---|
| [Enabled] | Once the chassis is opened, the system will record and issue a warning message. |
| [Reset] | Clear the warning message. After clearing the message, please return to **Enabled** or **Disabled**. |
| [Disabled] | Disables this funcion. |

## Save & Exit

▶ **Discard Changes and Exit**

Exit BIOS setup without saving any change.

▶ **Save Changes and Reboot**

Save all changes and reboot the system.

▶ **Save Changes**

Save current changes.

▶ **Discard Changes**

Discard all changes and restore to the previous values.

▶ **Restore Defaults**

Restore or load all default values.

▶ **Boot Override**

The installed bootable devices will appear on this menu, you can select one of them to be the boot device.

## OC




***Important***

- *Overclocking your PC manually is only recommended for advanced users.*
- *Overclocking is not guaranteed, and if done improperly, it could void your warranty or severely damage your hardware.*
- *If you are unfamiliar with overclocking, we advise you to use **GAME BOOST** function for easy overclocking.*

**▶ OC Explore Mode [Normal]**

Enables or disables to show the normal or expert version of OC settings.

| | |
|---|---|
| [Normal] | Provides the regular OC settings in BIOS setup. |
| [Expert] | Provides the advanced OC settings for OC expert to configure in BIOS setup. |

Note: We use * as the symbol for the OC settings of Expert mode.

**▶ CPU Ratio [Auto]**

Sets the CPU ratio that is used to determine CPU clock speed. This item only appears when **CPU Ratio Apply Mode** set to **All Core**.

**▶ Adjusted CPU Frequency**

Shows the adjusted CPU frequency. Read-only.

**▶ CPU Ratio Offset When Running AVX [Auto]**

Sets a offset value to lower the CPU core ratio. It could be helpful for heat dissipation when running AVX instruction set. If set to Auto, BIOS will configure this setting automatically. This item appears when the installed CPU supports this function.

**▶ Ring Ratio [Auto]**

Sets the ring ratio. The valid value range depends on the installed CPU.

**▶ Adjusted Ring Frequency**

Shows the adjusted Ring frequency. Read-only.

**▶ GT Ratio [Auto]**

Sets the integrated graphics ratio. The valid value range depends on the installed CPU.

**▶ Adjusted GT Frequency**

Shows the adjusted integrated graphics frequency. Read-only.

**▶ Misc Setting***

Press Enter, + or - key to open or close the following 3 items related to CPU features.

**▶ EIST [Enabled]***

Enables or disables the Enhanced Intel® SpeedStep Technology.

[Enabled] Enables the EIST to adjust CPU voltage and core frequency dynamically. It can decrease average power consumption and average heat production.

[Disabled] Disables EIST.

**▶ Intel Turbo Boost [Enabled]***

Enables or disables the Intel® Turbo Boost. This item appears when the installed CPU supports this function.

[Enabled] Enables this function to boost CPU performance automatically above rated specifications when system request the highest performance state.

[Disabled] Disables this function.

**▶ Enhanced Turbo [Auto]***

Enables or disables Enhanced Turbo function for all CPU cores to boost CPU performance. This item appears when the installed CPU supports this function.

[Auto] This setting will be configured automatically by BIOS.

[Enabled] All CPU cores would be increased to maximum turbo ratio.

[Disabled] Disables this function.

**▶ CPU Base Clock (MHz) [Default]**

Sets the CPU Base clock. You may overclock the CPU by adjusting this value. Please note that overclocking behavior and stability is not guaranteed. This item appears when a CPU that support this function is installed.

**▶ Extreme Memory Profile (X.M.P.) [Disabled]**

X.M.P. (Extreme Memory Profile) is the overclocking technology by memory module. Please enable XMP or select a profile of memory module for overclocking the memory. This item will be available when the memory modules that support X.M.P. is installed.

**▶ DRAM Frequency [Auto]**

Sets the DRAM frequency. Please note the overclocking behavior is not guaranteed.

**▶ Adjusted DRAM Frequency**

Shows the adjusted DRAM frequency. Read-only.

**▶ Memory Try It ! [Disabled]**

It improve memory compatibility or performance by choosing optimized memory preset.

**▶ Advanced DRAM Configuration**

Press **Enter** to enter the sub-menu. User can set the memory timing for each/ all memory channel. The system may become un-stable or un-bootable after changing memory timing. If it occurs, please clear the CMOS data and restore the default settings. (Refer to the Clear CMOS jumper/ button section to clear the CMOS data, and enter the BIOS to load the default settings.)

**▶ Memory Fast Boot [Auto]***

Enables or disables the initiation and training for memory every booting.

| | |
|---|---|
| [Auto] | The setting will be configured automatically by BIOS. |
| [Enabled] | System will completely keep the archives of first intiation and training for memory. So the memory will not be initialed and trained when booting to accelerate the system booting time. |
| [Disabled] | The memory will be initialed and trained every booting. |

**▶ DigitALL Power**

Press **Enter** to enter the sub-menu. In the sub-menu, you can setup some protecting conditions about voltage/ current/ temputure for CPU.

**▶ CPU Voltages control [Auto]**

These options allows you to set the voltages related to CPU. If set to **Auto**, BIOS will set these voltages automatically or you can set it manually.

**▶ DRAM Voltages control [Auto]**

These options allows you to set the voltages related to memory. If set to **Auto**, BIOS will set these voltages automatically or you can set it manually.

**▶ CPU Memory Changed Detect [Enabled]***

Enables or disables the system to issue a warning message during boot when the CPU or memory has been replaced.

| | |
|---|---|
| [Enabled] | The system will issue a warning message during boot and then you have to load the default settings for new devices. |
| [Disabled] | Disables this function and keeps the current BIOS settings. |

**▶ CPU Specifications**

Press **Enter** to enter the sub-menu. This sub-menu displays the information of installed CPU. You can also access this information menu at any time by pressing [F4]. Read only.

▶ **CPU Technology Support**

Press **Enter** to enter the sub-menu. The sub-menu shows the key features of installed CPU. Read only.

▶ **MEMORY-Z**

Press **Enter** to enter the sub-menu. This sub-menu displays all the settings and timings of installed memory. You can also access this information menu at any time by pressing [F5].

▶ **DIMMA1/A2/B1/B2 Memory SPD**

Press **Enter** to enter the sub-menu. The sub-menu displays the information of installed memory. Read only.

▶ **CPU Features**

Press **Enter** to enter the sub-menu.

▶ **Hyper-Threading [Enabled]**

Intel Hyper-Threading technology treats the multi cores inside the processor as multi logical processors that can execute instructions simultaneously. In this way, the system performance is highly improved. This item appears when the installed CPU supports this technology.

[Enable] Enables Intel Hyper-Threading technology.

[Disabled] Disables this item if the system does not support HT function.

▶ **Active Processor Cores Control [All]**

Allows you to select the number of active CPU cores.

▶ **Limit CPUID Maximum [Disabled]**

Enables or disables the extended CPUID value.

[Enabled] BIOS limits the maximum CPUID input value to circumvent boot problems with older operating system that do not support the processor with extended CPUID value.

[Disabled] Use the actual maximum CPUID input value.

▶ **Intel Virtualization Tech [Enabled]**

Enables or disables Intel Virtualization technology.

[Enabled] Enables Intel Virtualization technology and allows a platform to run multiple operating systems in independent partitions. The system can function as multiple systems virtually.

[Disabled] Disables this function.

▶ **Intel VT-D Tech [Disabled]**

Enables or disables Intel VT-D (Intel Virtualization for Directed I/O) technology.

**▶ Hardware Prefetcher [Enabled]**

Enables or disables the hardware prefetcher (MLC Streamer prefetcher).

[Enabled] Allows the hardware prefetcher to automatically pre-fetch data and instructions into L2 cache from memory for tuning the CPU performance.

[Disabled] Disables the hardware prefetcher.

**▶ Adjacent Cache Line Prefetch [Enabled]**

Enables or disables the CPU hardware prefetcher (MLC Spatial prefetcher).

[Enabled] Enables adjacent cache line prefetching for reducing the cache latency time and tuning the performance to the specific application.

[Disabled] Enables the requested cache line only.

**▶ CPU AES Instructions [Enabled]**

Enables or disables the CPU AES (Advanced Encryption Standard-New Instructions) support. This item appears when a CPU supports this function.

**▶ Intel Adaptive Thermal Monitor [Enabled]**

Enables or disables the Intel adaptive thermal monitor function to protect the CPU from overheating.

[Enabled] Throttles down the CPU core clock speed when the CPU is over the adaptive temperature.

[Disabled] Disables this function.

**▶ Intel C-State [Auto]**

Enables or disables the Intel C-state. C-state is a processor power management technology defined by ACPI.

[Auto] This setting will be configured automatically by BIOS.

[Enabled] Detects the idle state of system and reduce CPU power consumption accordingly.

[Disabled] Disable this function.

**▶ C1E Support [Disabled]**

Enables or disables the C1E function for power-saving in halt state. This item appears when **Intel C-State** is enabled.

[Enabled] Enables C1E function to reduce the CPU frequency and voltage for power-saving in halt state.

[Disabled] Disables this function.

**▶ Package C State limit [Auto]**

This item allows you to select a CPU C-state level for power-saving when system is idle. The options of C-state depend on the installed CPU. This item appears when **Intel C-State** is enabled.

**▶ CFG Lock [Enabled]**

Lock or un-lock the MSR 0xE2[15], CFG lock bit.

[Enabled] Locks the CFG lock bit.

[Disabled] Un-locks the CFG lock bit.

**▶ EIST [Enabled]**

Enables or disables the Enhanced Intel® SpeedStep Technology. This item will appear when **OC Explore Mode** is set to **Normal**.

[Enabled] Enables the EIST to adjust CPU voltage and core frequency dynamically. It can decrease average power consumption and average heat production.

[Disabled] Disables EIST.

**▶ Intel Turbo Boost [Enabled]**

Enables or disables the Intel® Turbo Boost. This item is for **Normal mode** and appears when a CPU that support Turbo Boost is installed.

[Enabled] Enables this function to boost CPU performance automatically over specification when system request the highest performance state.

[Disabled] Disables this function.

**▶ Long Duration Power Limit (W) [Auto]**

Sets the long duration TDP power limit for CPU in Turbo Boost mode.

**▶ Long Duration Maintained (s) [Auto]**

Sets the maintaining time for Long duration power Limit(W).

**▶ Short Duration Power Limit (W) [Auto]**

Sets the short duration TDP power limit for CPU in Turbo Boost mode.

**▶ CPU Current Limit (A) [Auto]**

Sets maximum current limit of CPU package in Turbo Boost mode. When the current is over the specified value, the CPU will automatically reduce the core frequency for reducing the current.

**▶ FCLK Frequency [Auto]**

Sets FCLK frequency. Lower FCLK frequency may help you to set higher base clock frequency.

**▶ DMI Link Speed [Auto]**

Sets DMI speed.

**▶ SW Guard Extensions (SGX) [Software Control]**

Enables or disables Intel SGX.

**▶ Intel Speed Shift Technology [Auto]**

Enables or disables Intel Speed Shift Technology. It can optimize energy efficiency. This item is only available with the CPU that supports this technology.

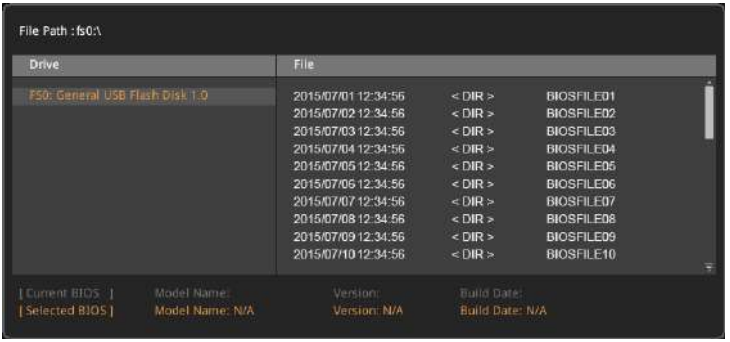
## M-FLASH

M-FLASH provides the way to update BIOS with a USB flash drive. Please down-load the latest BIOS file that matches your motherboard model from MSI website, save the BIOS file into your USB flash drive. And then follow the steps below to update BIOS.

1. Insert the USB flash drive that contains the update file into the computer.
2. Click on **M-FLASH** tab, a demand message will be prompted. Click on **Yes** to reboot and enter the flash mode.




3. The system will enter the flash mode and a file selection menu will appear after rebooting.




4. Select a BIOS file to perform the BIOS update process.
5. After the flashing process is 100% completed, the system will reboot automatically.

## OC PROFILE




**▶ Overclocking Profile 1/ 2/ 3/ 4/ 5/ 6**

Overclocking Profile 1/ 2/ 3/ 4/ 5/ 6 management. Press <Enter> to enter the sub-menu.

**▶ Set Name for Overclocking Profile 1/ 2/ 3/ 4/ 5/ 6**

Name the current overclocking profile.

**▶ Save Overclocking Profile 1/ 2/ 3/ 4/ 5/ 6**

Save the current overclocking profile.

**▶ Load Overclocking Profile 1/ 2/ 3/ 4/ 5/ 6**

Load the current overclocking profile.

**▶ Clear Overclocking Profile 1/ 2/ 3/ 4/ 5/ 6**

Clear the current overclocking profile.

**▶ OC Profile Load from ROM**

Load OC profile from BIOS ROM.

**▶ OC Profile Save to USB**

Save OC profile to the USB flash drive. The USB flash drive should be FAT/ FAT32 format only.

**▶ OC Profile Load from USB**

Load OC profile from the USB flash drive. The USB flash drive should be FAT/ FAT32 format only.

## HARDWARE MONITOR




▶ **Temperature & Speed**

Shows the current CPU temperature, system temperature and fans' speeds.

▶ **Fan Manage**

- **PWM** - allows you to select the PWM mode for fan operation.
- **DC** - allows you to select the DC mode for fan operation.
- **Fan step up/ down time** - allows you to set the period of fan step up/ down.
- **Smart Fan Mode field** - allows you to drag the gradient points to configure the fan target values for **Smart Fan** mode. **Smart Fan** can control the fan speed automatically depending on the CPU temperature to keep it with in a specific range. If the current CPU temperature reaches to the target value, the **Smart Fan** function will be activated.

***Important***

- *The changing will achieve after you save the changes and reboot the system.*
- *Make sure fans are working properly after switching the PWM/ DC mode.*

▶ **Settings Buttons**

- **All Full Speed** - configures all fans to run at full operating speed.
- **All Set Default** - configures all fans to run at default operating speed.
- **All Set Cancel** - discards current changes and restores previous operating fan speeds .

▶ **Temperature/ Voltage display**

Shows CPU/ system temperature and the current voltages of CPU, system and memory.

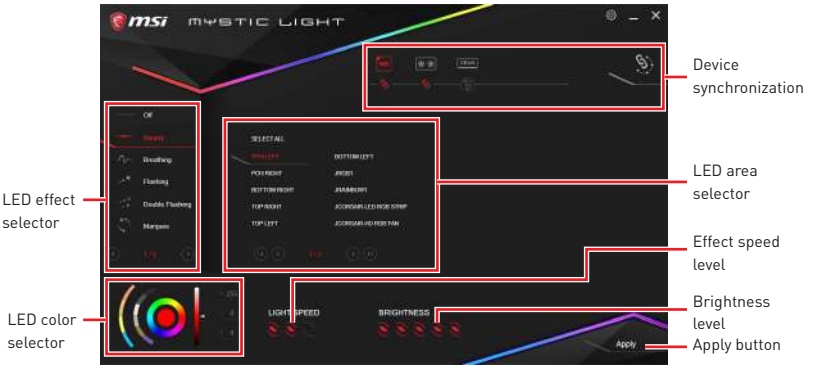
# MYSTIC LIGHT

MYSTIC LIGHT is an application that allows you to control LED light effects of MSI & partner products. For some earlier products, you can go to product download page to download the applicable LED control software.

## Device LED effect control screen

When you start up MYSTIC LIGHT, there will be a list of auto-detected devices on the top of the screen. You can click the device icon to switch control screen between devices from the list and you can synchronize their LED effects.

To change LED effect, select the device and LED area you wish, and then select a LED effect from on the left column.




• **Light effect selector** - allow you to select LED light effects. Please note that for light effect, the option would be more or less depending on the devices you have, it will only list the light effects which are available for all included devices. Each page of effect selector lists six effects, you can use the page navigation on the bottom to find more options.

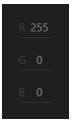
• **LED Color selector** - In this section, you may select the color for single light effects (Stack, Breathing, Flashing etc.).



There are four custom color slots on the outer arc and six unchangeable default colors on the inner arc. You can simply change LED color by clicking a color on the outer or inner arc. To change the custom colors, click one of the color slots on the outer arc to store the color of your choice.



Then use the Hue Circle to choose the color you want. The color you choose will be displayed on the center circle. Drag the brightness slider up to increase brightness or drag down to decrease brightness.




You can specify a color by editing an RGB (red, green, blue) value between 0 and 255.

• **LED area selector -** allows you to select the LED area on the device. The LED effects vary depending on your LED area selection.

• **Effect speed level -** allows you to adjust the LED light effect switching speed. Please note that this function will only be available if your device supports it.




Select more dots to increase the rate of change of the effect and fewer dots to decrease the speed.

• **Brightness level -** allows you to adjust LED light brightness. Please note that this function will only be available if your device supports it.




Select more dots to increase the LED brightness and fewer dots to decrease the LED brightness.

• **Apply Button** - Each time you change the configurations, you need to click the **Apply** button to apply changes.




• **Device synchronization** - In this section, you may synchronize LED light effect to your devices.

▪ **To synchronize devices** - click the chain icon under device icon, when the broken-chain icon changes to the red-chain icon, the device has synchronized the LED effect settings with the other devices.




**Red-chain icon** - indicates the device has been synchronized.

**Broken-chain icon** - indicates the device is not synchronized.

▪ **Individual** - You can also change settings for single device. To do that, click the chain icon and turn the color to gray as below.

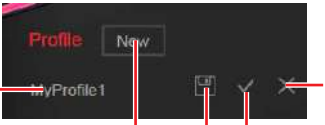



**Device icon** - click it to enter the device LED effect setting screen. When it is turn red, it indicates the device you' re currently setting.

▪ **Synchronize all** - There is a quick button on the upper right that allows you to synchronize all your devices with one click. Click the All Sync button, then the chain icons under all sync devices will be changed in red-chain icons and the Profile control panel will appear on the left.




▪ **Profile control panel** - used to save All Sync profile settings.




**Profile name** - allows you to edit the Profile name.

**Delete button** - delete the Profile setting.

**Create button** - create a new Profile setting.

**Apply button** - apply the Profile setting.

**Save button** - saves sync device settings and lighting effect settings to the current Sync Profile.

# RAID Configuration

Below are the different types of a RAID.

**RAID 0** breaks the data into blocks which are written to separate hard drives. Spreading the hard drive I/O load across independent channels greatly improves I/O performance.

**RAID 1** provides data redundancy by mirroring data between the hard drives and provides enhanced read performance.

**RAID 5** provides data striping at the byte level and also stripe error correction information. This results in excellent performance and good fault tolerance.

**RAID 10** uses four hard drives to create a combination of RAID 0 and 1 by forming a RAID 0 array from two RAID 1 arrays.

### RAID level comparison

| | RAID 0 | RAID 1 | RAID 5 | RAID 10 |
|---|---|---|---|---|
| Minimum # drives | 2 | 2 | 3 | 4 |
| Data protection | None | Excellent | Excellent | Excellent |
| Read performance | Excellent | OK | Good | OK |
| Write performance | Excellent | Good | OK | Good |
| Capacity utilization | 100% | 50% | 67%~(1-1/n) | 50% |

***Important***

*All the information/ volumes/ pictures listed in your system might differ from the illustrations in this appendix.*

## Enabling Intel® Rapid Storage Technology

In Legacy mode, we can change the **AHCI mode** to **RAID mode** and disable the **Fast Boot** then press **Ctrl + I** during the POST to enter the Intel Rapid Storage Technology Legacy mode. However, most newer version of operating systems support UEFI and the Intel Rapid Storage Technology UEFI mode can still run when the Fast Boot is enabled. Therefore we recommend that you use the UEFI BIOS for simple and advanced operations. The following description is based on the UEFI mode.

### To enter the Intel(R) Rapid Storage Technology menu

1. Power on and press **Delete** key to enter BIOS Setup menu.
2. Press **F7** to switch to Advanced mode from EZ mode.
3. Go to **BIOS > SETTINGS > Advanced > Integrated Peripherals > SATA Mode** and change setting to **RAID/ Optane Mode**.
4. Go to **BIOS > SETTINGS > Advanced > Windows OS Configuration > Windows 10 WHQL Support** and change setting to **Enabled.**
5. Skip this step If you are only using SATA storage devices. If you are using NVMe PCIe SSDs, go to **BIOS > SETTINGS > Advanced > Integrated Peripherals > M2_X Pcie Storage Remapping** and change setting to **Enabled**.

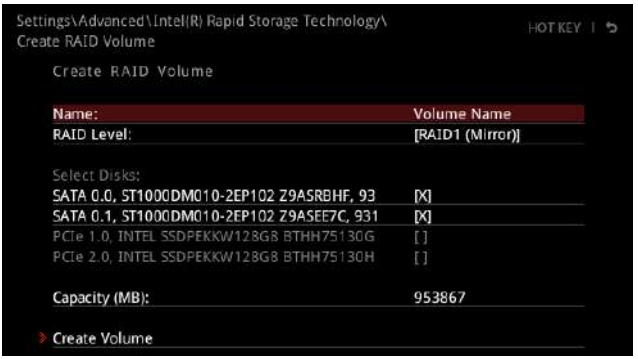
6. Press **F10** to save configuration and exit, and then reboot and press **Delete** key to enter BIOS Setup menu.
7. Go to **BIOS > SETTING > Advanced > Intel(R) Rapid Storage Technology** sub-menu**.**

## Creating RAID Volume

1. As previously mentioned, enable Intel(R) Rapid Storage Technology.




2. Enter **Create RAID Volume** screen. The following screen appears:




3. Specify a **Name** for RAID volume.
4. Select the **RAID Level** best suited to your usage model in RAID Level.
5. In the **Select Disks** field, press **Space** key or press **Enter** key and use the ↑ ↓ **arrow keys** to select the option **X** to select the disks you want to create for the RAID volume.
6. Select the **Strip Size** for the RAID array. The available values range from 4KB to 128 KB in power of 2 increments. The strip size should be chosen based on the planned drive usage. Here are some typical values:
RAID0 -128KB / RAID10 - 64KB / RAID5 - 64KB.
7. Select the capacity of the volume in the **Capacity (MB)** field. The default value is the maximum volume capacity of the selected disks.
8. Go to the **Create Volume** field and press **Enter** to create the RAID volume. Upon completion you are returned to the **Intel(R) Rapid Storage Technology** menu.

## Removing a RAID Volume

Here you can delete the RAID volume, but please be noted that all data on RAID drives will be lost.

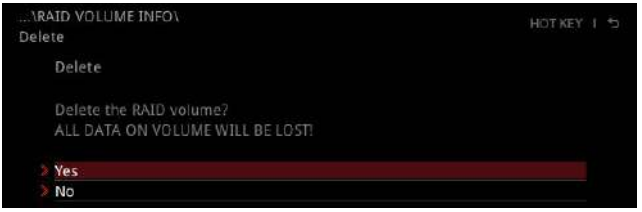
***Important***

*If your system currently boots to RAID and you delete the RAID volume, your system will become unbootable.*

1. Go to **BIOS > SETTING > Advanced > Intel(R) Rapid Storage Technology**.
2. Select the RAID volume from the **Intel(R) Rapid Storage Technology** screen to enter the **RAID VOLUME INFO** screen.




3. Select the **Delete** item and press **Enter** key to delete the selected RAID volume. The following screen appears:



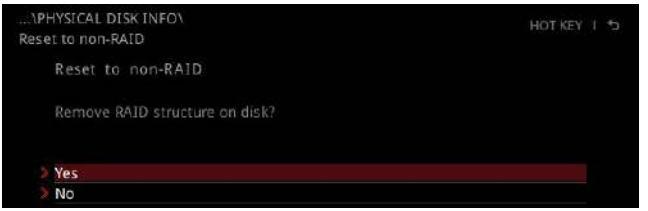

4. Select the **Yes** item and press **Enter** key to accept the volume deletion.

## Resetting Disks to Non-RAID

1. Go to **BIOS > SETTING > Advanced > Intel(R) Rapid Storage Technology**.
2. Select the RAID volume from the **Intel(R) Rapid Storage Technology** screen to enter the **RAID VOLUME INFO** screen.
3. Select the disk and press **Enter** to enter **PHYSICAL DISK INFO** screen.




4. Select **Reset to non-RAID** item and press **Enter** to delete the RAID volume and remove any RAID structures from the drives. The following screen appears:




5. Select the **Yes** item and press **Enter** key to accept the disk reseting.

***Important***

- *You will lose all data on the RAID drives and any internal RAID structures when you perform this operation.*
- *Possible reasons to **Reset Disks to Non-RAID** could include issues such as incompatible RAID configurations or a failed volume or failed disk.*

## Rebuilding RAID Array

A RAID 1, RAID 5 or RAID 10 volume is reported as **Degraded** when one of its hard drive members fails or is temporarily disconnected, and data mirroring is lost. As a result, the system can only utilize the remaining functional hard drive member. To re-establish data mirroring and restore data redundancy, refer to the procedure below that corresponds to the current situation.

1. Power off.
2. Replace the failed hard drive with a new one that is of equal or greater capacity.
3. Reboot the system and go to **BIOS > SETTING > Advanced > Intel(R) Rapid Storage Technology**.




4. Select the **Degraded** RAID volume from the **Intel(R) Rapid Storage Technology** screen to enter the **RAID VOLUME INFO** screen.




5. Select the **Rebuild** item and press **Enter** key to rebuild the new hard drive.

## Installing RAID Driver

### New Operating System Installation

The following details the installation of the drivers while installing Windows 10 x64 bit Editions or newer operating system.

1. During the operating system installation, after selecting the location to install Windows click on **Load driver** button to install a third party RAID driver.
2. When prompted, insert the USB flash drive with **Intel RAID Drivers** and then click **Browse**.

   ▪ To make an **Intel RAID Drivers** USB flash drive. Insert the MSI Driver Disc into the optical drive. Copy all the contents in \\Storage\Intel\16.x\f6flpy-x64
3. Navigate to the directory containing the saved Intel RAID drivers, then click **OK**.
4. Select the **(iaStorAC.inf)** driver, click **Next**.
5. You have successfully installed the RAID driver, and Windows setup should continue.
6. Leave the disk/ USB drive in the computer until the system reboots itself. Windows setup will need to copy the files after the RAID volume is formatted, and Windows setup starts copying files.

## Installing Intel® Rapid Storage Technology Software

1. As previously mentioned, enable Intel(R) Rapid Storage Technology in BIOS.
2. Insert the MSI Driver Disc into the optical drive.
3. Click the **Select to choose what happens with this disc** pop-up notification, then select **Run DVDSetup.exe** to open the installer. If you turn off the AutoPlay feature from the Windows Control Panel, you can still manually execute the **DVDSetup.exe** from the root path of the MSI Driver Disc.
4. Under the **Drivers/Software** tab, check the **Intel RAID Drivers** check-box.
5. Click the **Install** button.
6. When prompt you to restart, click **OK** button to finish.
7. Restart your computer and enter the Windows operating system.
8. Double-click the **Intel® Rapid Storage Technology** icon to open the Intel® Rapid Storage Technology software.

# Intel® Optane™ Memory Configuration

Intel® Optane™ memory can accelerate the Windows 10 64bit operating system. This section describes how to install and remove the Intel® Optane™ memory.

## System Requirements

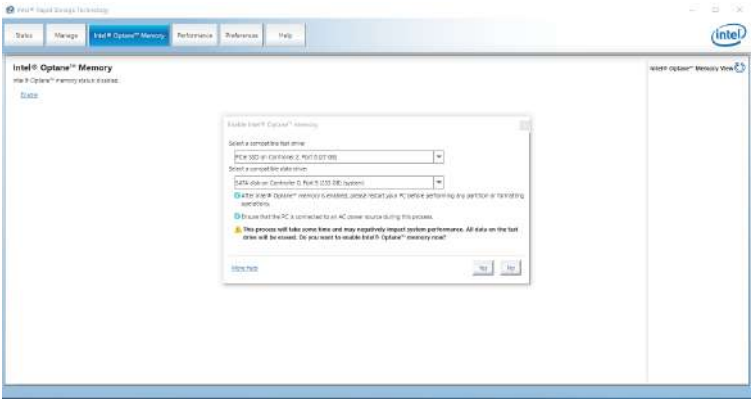
- Intel® Optane™ memory ready MSI® motherboards
- Supported 8th Gen, or later, Intel® Core™ - i Processor
- System BIOS that supports the Intel® Rapid Storage Technology (Intel® RST) 16 or later driver
- Operating system: Windows 10 64 bit (UEFI mode).
- Intel® Optane™ Memory Module

## Installing the Intel® Optane™ memory

Install the Intel® Rapid Storage Technology 16.

1. Update BIOS (refer to the **Updating BIOS** section).
2. Install the Intel® Optane™ memory module.
   - Power off the system.
   - Refer to the **Specifications** for location to install your Intel® Optane™ memory module.
   - Install the Intel® Optane™ memory module into the M.2 slot.
3. Enable M.2/Optane Genie
   - Power on and press **Delete** key to enter BIOS Setup menu.
   - Enable M.2/Optane Genie by clicking the **M.2/Optane Genie** item.
   - Click **Ok** in the dialog.
   - Press **F10** to save configuration and exit.
4. Install the Intel® Rapid Storage Technology
   - Reboot to operating system.
   - Insert the MSI Driver Disc into the optical drive.
   - Click the **Select to choose what happens with this disc** pop-up notification, then select **Run DVDSetup.exe** to open the installer. If you turn off the AutoPlay feature from the Windows Control Panel, you can still manually execute the **DVDSetup.exe** from the root path of the MSI Driver Disc.
   - Under the **Drivers/Software** tab, check the **Intel RAID Drivers** check-box.
   - Click the **Install** button.
   - When prompt you to restart, click **OK** button to finish.
   - Reboot System.

5. Enable Intel® Optane™ Memory.
   - Run the Intel® Rapid Storage Technology software.
   - Click **Intel® Optane™ Memory** tab and click **Enable**.
   - Click **Yes** in the dialog.




6. Reboot System.

***WARNING***

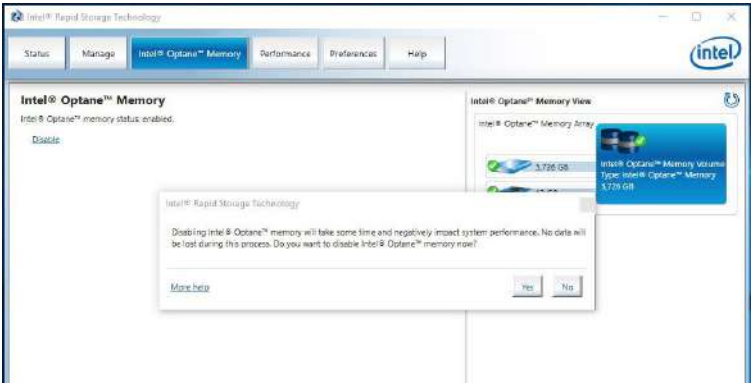
*Once you enable Intel® Optane™ memory, in order to prevent seriously damage your operating system, please follow the cautions listed below.*

- ***DO NOT set the SATA mode back to AHCI in BIOS.***
- ***DO NOT revert back to older version of the BIOS.***
- ***DO NOT remove the Intel® Optane™ memory module.***
- ***DO NOT replace the CPU that is not supported by Intel® Optane™ Memory.***

## Removing the Intel® Optane™ memory

If you no longer want to use Intel® Optane™ memory, you have to disable the Intel® Optane™ memory before removing the Intel® Optane™ memory module to avoid operating system damage. Please follow the steps below to remove the Intel® Optane™ memory.

1. Disable Intel® Optane™ Memory.
   - Disable Intel® Optane™ Memory via the Intel® Optane™ memory application (Intel® Rapid Storage Technology).
   - Click **Yes** in the dialog.




   - Reboot System.
2. Disable M.2/Optane Genie
   - Press **Delete** key to enter BIOS Setup menu during POST.
   - Disable M.2/Optane Genie by clicking **M.2/Optane Genie** item.
   - Click **Ok** in the dialog.
   - Press **F10** to save configuration and exit.
3. Remove the Intel® Optane™ memory module.
   - Power off the system.
   - Remove the Intel® Optane™ memory module.

# Troubleshooting

Before sending the motherboard for RMA repair, try to go over troubleshooting guide first to see if your got similar symptoms as mentioned below.

### The power is not on.

• Connect the AC power cord to an electrical outlet securely.

• Check if all ATX power connectors like **ATX_PWR1, CPU_PWR1** are connected from the power supply to the motherboard?

• Some power supply units have a power button on the rear side, make sure the button is turned on.

• Check if the power switch cable is connected to **JFP1** pin header properly.

• Verify the **Clear CMOS** jumper **JBAT1** is set to **Keep DATA**.

• Test with another known working power supply of equal or greater wattage.

### The power is on, but no signal to monitor

• Connect the monitor power cord to a electrical outlet securely.

• Make sure the monitor is turned on.

• Select different inputs on the monitor.

• If 3 long beeps are heard, remove all memory modules and try to install only one memory module in the **DIMMA2** slot first and then restart the computer.

• If 1 long 2 short beeps are heard, remove and reinstall the graphics card and then restart the computer.

• Test with another known working graphics card.

### The computer does not boot after updating the BIOS

• Clear the CMOS.

• Use the secondary BIOS to bootup the system (Only for motherboard with Dual BIOS)

### Lost BIOS password

• Clear the CMOS, but that will cause you to lose all customized settings in the BIOS.

### There is no audio

• Adjust the volume.

• Connect the speakers/headphones to audio ports on the motherboard rear IO panel.

• Remove secondary speakers/ headphones, HDMI cables, USB audio devices.

• Test with another known working speaker or headphone.

### There is no network

• Make sure the network chipset driver has been installed.

• Verify if the network cable is properly connected and make sure the LAN port LEDs are properly illuminated.

• Verify your TCP/IP settings.

• Restart or reset your router.

• Test with another known working LAN cable.

### The USB device is not working

• Make sure your USB drive driver has been installed.

• Verify if USB device is listed in Windows® Device Manager.

• Connect the USB device to other USB port on the motherboard rear IO panel.

# Regulatory Notices

## FCC Compliance Statement

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user' s authority to operate the equipment.

Tested to comply with FCC standards
FOR HOME OR OFFICE USE

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

## CE Conformity

Products bearing the CE marking comply with one or more of the following EU Directives as may be applicable:
RED 2014/53/EU; Low Voltage Directive 2014/35/EU; EMC Directive 2014/30/EU; RoHS Directive 2011/65/EU. Compliance with these directives is assessed using applicable European Harmonized Standards.
The point of contact for regulatory matters is MSI, MSI-NL Eindhoven 5706 5692 ER Son.

## B급 기기 (가정용 방송통신기자재)

이 기기는 가정용(B급) 전자파적합기기로서 주로 가정에서 사용하는 것을 목적으로 하며, 모든 지역에서 사용할 수 있습니다.

## クラスB情報技術装置

この装置は、クラスB情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信機に近接して使用されると、受信障害を引き起こすことがあります。取扱説明書に従って
正しい取り扱いをして下さい

VCCI-B

## C-Tick Compliance

N1996

## Battery Information

European Union:

Batteries, battery packs, and accumulators should not be disposed of as unsorted household waste. Please use the public collection system to return, recycle, or treat them in compliance with the local regulations.

Taiwan:

廢電池請回收
For better environmental protection, waste batteries should be collected separately for recycling or special disposal.

California, USA:

The button cell battery may contain perchlorate material and requires special handling when recycled or disposed of in California.
For further information please visit:
http://www.dtsc.ca.gov/hazardouswaste/perchlorate/

CAUTION: There is a risk of explosion, if battery is incorrectly replaced.
Replace only with the same or equivalent type recommended by the manufacturer.

## Chemical Substances Information

In compliance with chemical substances regulations, such as the EU REACH Regulation (Regulation EC No. 1907/2006 of the European Parliament and the Council), MSI provides the information of chemical substances in products at:
http://www.msi.com/html/popup/csr/evmtprtt_pcm.html

## Environmental Policy

- The product has been designed to enable proper reuse of parts and recycling and should not be thrown away at its end of life.
- Users should contact the local authorized point of collection for recycling and disposing of their end-of-life products.
- Visit the MSI website and locate a nearby distributor for further recycling information.
- Users may also reach us at gpcontdev@msi.com for information regarding proper Disposal, Take-back, Recycling, and Disassembly of MSI products.

## WEEE (Waste Electrical and Electronic Equipment) Statement

ENGLISH
To protect the global environment and as an environmentalist, MSI must remind you that...

Under the European Union ("EU") Directive on Waste Electrical and Electronic Equipment, Directive 2002/96/EC, which takes effect on August 13, 2005, products of "electrical and electronic equipment" cannot be discarded as municipal wastes anymore, and manufacturers of covered electronic equipment will be obligated to take back such products at the end of their useful life. MSI will comply with the product take back requirements at the end of life of MSI-branded products that are sold into the EU. You can return these products to local collection points.

DEUTSCH
Hinweis von MSI zur Erhaltung und Schutz unserer Umwelt
Gemäß der Richtlinie 2002/96/EG über Elektro- und Elektronik-Altgeräte dürfen Elektro- und Elektronik-Altgeräte nicht mehr als kommunale Abfälle entsorgt werden. MSI hat europaweit verschiedene Sammel- und Recyclingunternehmen beauftragt, die in die Europäische Union in Verkehr gebrachten Produkte, am Ende seines Lebenszyklus zurückzunehmen. Bitte entsorgen Sie dieses Produkt zum gegebenen Zeitpunkt ausschliesslich an einer lokalen Altgerätesammelstelle in Ihrer Nähe.

FRANÇAIS
En tant qu'écologiste et afin de protéger l'environnement, MSI tient à rappeler ceci...
Au sujet de la directive européenne (EU) relative aux déchets des équipement électriques et électroniques, directive 2002/96/EC, prenant effet le 13 août 2005, que les produits électriques et électroniques ne peuvent être déposés dans les décharges ou tout simplement mis à la poubelle. Les fabricants de ces équipements seront obligés de récupérer certains produits en fin de vie. MSI prendra en compte cette exigence relative au retour des produits en fin de vie au sein de la communauté européenne. Par conséquent vous pouvez retourner localement ces matériels dans les points de collecte.

РУССКИЙ
Компания MSI предпринимает активные действия по защите окружающей среды, поэтому напоминаем вам, что....
В соответствии с директивой Европейского Союза (ЕС) по предотвращению загрязнения окружающей среды использованным электрическим и электронным оборудованием (директива WEEE 2002/96/EC), вступающей в силу 13 августа 2005 года, изделия, относящиеся к электрическому и электронному оборудованию, не могут рассматриваться как бытовой мусор, поэтому производители вышеперечисленного электронного оборудования обязаны принимать его для переработки по окончании срока службы. MSI обязуется соблюдать требования по приему продукции, проданной под маркой MSI на территории ЕС, в переработку по окончании срока службы. Вы можете вернуть эти изделия в специализированные пункты приема.

ESPAÑOL
MSI como empresa comprometida con la protección del medio ambiente, recomienda:
Bajo la directiva 2002/96/EC de la Unión Europea en materia de desechos y/o equipos electrónicos, con fecha de rigor desde el 13 de agosto de 2005, los productos clasificados como "eléctricos y equipos electrónicos" no pueden ser depositados en los contenedores habituales de su municipio, los fabricantes de equipos electrónicos, están obligados a hacerse cargo de dichos productos al termino de su período de vida. MSI estará comprometido con los términos de recogida de sus productos vendidos en la Unión Europea al final de su periodo de vida. Usted debe depositar estos productos en el punto limpio establecido por el ayuntamiento de su localidad o entregar a una empresa autorizada para la recogida de estos residuos.

NEDERLANDS
Om het milieu te beschermen, wil MSI u eraan herinneren dat....
De richtlijn van de Europese Unie (EU) met betrekking tot Vervuiling van Electrische en Electronische producten (2002/96/EC), die op 13 Augustus 2005 in zal gaan kunnen niet meer beschouwd worden als vervuiling. Fabrikanten van dit soort producten worden verplicht om producten retour te nemen aan het eind van hun levenscyclus. MSI zal overeenkomstig de richtlijn handelen voor de producten die de merknaam MSI dragen en verkocht zijn in de EU. Deze goederen kunnen geretourneerd worden op lokale inzamelingspunten.

SRPSKI
Da bi zaštitili prirodnu sredinu, i kao preduzeće koje vodi računa o okolini i prirodnoj sredini, MSI mora da vas podesti da...
Po Direktivi Evropske unije ("EU") o odbačenoj ekektronskoj i električnoj opremi, Direktiva 2002/96/EC, koja stupa na snagu od 13. Avgusta 2005, proizvodi koji spadaju pod "elektronsku i električnu opremu" ne mogu više biti odbačeni kao običan otpad i proizvođači ove opreme biće prinuđeni da uzmu natrag ove proizvode na kraju njihovog uobičajenog veka trajanja. MSI će poštovati zahtev o preuzimanju ovakvih proizvoda kojima je istekao vek trajanja, koji imaju MSI oznaku i koji su prodati u EU. Ove proizvode možete vratiti na lokalnim mestima za prikupljanje.

POLSKI
Aby chronić nasze środowisko naturalne oraz jako firma dbająca o ekologię, MSI przypomina, że...
Zgodnie z Dyrektywą Unii Europejskiej ("UE") dotyczącą odpadów produktów elektrycznych i elektronicznych (Dyrektywa 2002/96/EC), która wchodzi w życie 13 sierpnia 2005, tzw. "produkty oraz wyposażenie elektryczne i elektroniczne " nie mogą być traktowane jako śmieci komunalne, tak więc producenci tych produktów będą zobowiązani do odbierania ich w momencie gdy produkt jest wycofywany z użycia. MSI wypełni wymagania UE, przyjmując produkty (sprzedawane na terenie Unii Europejskiej) wycofywane z użycia. Produkty MSI będzie można zwracać w wyznaczonych punktach zbiorczych.

TÜRKÇE
Çevreci özelliğiyle bilinen MSI dünyada çevreyi korumak için hatırlatır:
Avrupa Birliği (AB) Kararnamesi Elektrik ve Elektronik Malzeme Atığı, 2002/96/EC Kararnamesi altında 13 Ağustos 2005 tarihinden itibaren geçerli olmak üzere, elektrikli ve elektronik malzemeler diğer atıklar gibi çöpe atılamayacak ve bu elektonik cihazların üreticileri, cihazların kullanım süreleri bittikten sonra ürünleri geri toplamakla yükümlü olacaktır. Avrupa Birliği'ne satılan MSI markalı ürünlerin kullanım

süreleri bittiğinde MSI ürünlerin geri alınması isteği ile işbirliği içerisinde olacaktır. Ürünlerinizi yerel toplama noktalarına bırakabilirsiniz.

ČESKY
Záleží nám na ochraně životního prostředí - společnost MSI upozorňuje...
Podle směrnice Evropské unie ("EU") o likvidaci elektrických a elektronických výrobků 2002/96/EC platné od 13. srpna 2005 je zakázáno likvidovat "elektrické a elektronické výrobky" v běžném komunálním odpadu a výrobci elektronických výrobků, na které se tato směrnice vztahuje, budou povinni odebírat takové výrobky zpět po skončení jejich životnosti. Společnost MSI splní požadavky na odebírání výrobků značky MSI, prodávaných v zemích EU, po skončení jejich životnosti. Tyto výrobky můžete odevzdat v místních sběrnách.

MAGYAR
Annak érdekében, hogy környezetünket megvédjük, illetve környezetvédőként fellépve az MSI emlékezteti Önt, hogy ...
Az Európai Unió („EU") 2005. augusztus 13-án hatályba lépő, az elektromos és elektronikus berendezések hulladékairól szóló 2002/96/EK irányelve szerint az elektromos és elektronikus berendezések többé nem kezelhetőek lakossági hulladékként, és az ilyen elektronikus berendezések gyártói kötelessé válnak az ilyen termékek visszavételére azok hasznos élettartama végén. Az MSI betartja a termékvisszavétellel kapcsolatos követelményeket az MSI márkanév alatt az EU-n belül értékesített termékek esetében, azok élettartamának végén. Az ilyen termékeket a legközelebbi gyűjtőhelyre viheti.

ITALIANO
Per proteggere l'ambiente, MSI, da sempre amica della natura, ti ricorda che....
In base alla Direttiva dell'Unione Europea (EU) sullo Smaltimento dei Materiali Elettrici ed Elettronici, Direttiva 2002/96/EC in vigore dal 13 Agosto 2005, prodotti appartenenti alla categoria dei Materiali Elettrici ed Elettronici non possono più essere eliminati come rifiuti municipali: i produttori di detti materiali saranno obbligati a ritirare ogni prodotto alla fine del suo ciclo di vita. MSI si adeguerà a tale Direttiva ritirando tutti i prodotti marchiati MSI che sono stati venduti all'interno dell'Unione Europea alla fine del loro ciclo di vita. È possibile portare i prodotti nel più vicino punto di raccolta

## 日本JIS C 0950材質宣言

日本工業規格JIS C 0950により、2006年7月1日以降に販売される特定分野の電気および電子機器について、製造者による含有物質の表示が義務付けられます。
http://www.msi.com/html/popup/csr/cemm_jp.html
http://tw.msi.com/html/popup/csr_tw/cemm_jp.html

## India RoHS

This product complies with the "India E-waste (Management and Handling) Rule 2011" and prohibits use of lead, mercury, hexavalent chromium, polybrominated biphenyls or polybrominated diphenyl ethers in concentrations exceeding 0.1 weight % and 0.01 weight % for cadmium, except for the exemptions set in Schedule 2 of the Rule.

## Türkiye EEE yönetmeliği

Türkiye Cumhuriyeti: EEE Yönetmeliğine Uygundur

## Україна обмеження на наявність небезпечних речовин

Обладнання відповідає вимогам Технічного регламенту щодо обмеження використання деяких небезпечних речовин в електричному та електронному обладнані, затвердженого постановою Кабінету Міністрів України від 3 грудня 2008 № 1057.

## Việt Nam RoHS

Kể từ ngày 01/12/2012, tất cả các sản phẩm do công ty MSI sản xuất tuân thủ Thông tư số 30/2011/TT-BCT quy định tạm thời về giới hạn hàm lượng cho phép của một số hóa chất độc hại có trong các sản phẩm điện, điện tử"

## Wireless Radio Use

This device is restricted to indoor use when operating in the 2.4GHz, 5GHz frequency band.

Cet appareil doit être utilisé à l' intérieur.

당해 무선설비는 운용중 전파혼신 가능성이 있음.

この製品は、周波数帯域 2.4GHz, 5GHz で動作しているときは、屋内においてのみ使用可能です。

**NCC無線設備警告聲明**
工作頻率2.4GHz, 5GHz該頻段限於室內使用。
經型式認證合格之低功率射頻電機，非經許可，公司、商號或使用者均不得擅自變更頻率、加大功率或變更原設計之特性及功能。
低功率射頻電機之使用不得影響飛航安全及干擾合法通信；經發現有干擾現象時，應立即停用，並改善至無干擾時方得繼續使用。前項合法通信，指依電信法規定作業之無線電通信。低功率射頻電機須忍受合法通信或工業、科學及醫療用電波輻射性電機設備之干擾。

**Products with radio functionality (EMF)**
This product incorporates a radio transmitting and receiving device. For computers in normal use, a separation distance of 20 cm ensures that radio frequency exposure levels comply with EU requirements. Products designed to be operated at closer proximities, such as tablet computers, comply with applicable EU requirements in typical operating positions. Products can be operated without maintaining a separation distance unless otherwise indicated in instructions specific to the product.

**Restrictions for products with radio functionality**
CAUTION: IEEE 802.11x wireless LAN with 5.15–5.35 GHz frequency band is restricted for indoor use only in all European Union member states, EFTA (Iceland, Norway, Liechtenstein), and most other European countries (e.g., Switzerland, Turkey, Republic of Serbia).
Using this WLAN application outdoors might lead to interference issues with existing radio services.

**Radio frequency bands and maximum power levels**

| | |
|---|---|
| Features | :802.11 a/b/g/n/ac, BT |
| Frequency Range | :2.4GHz, 5GHz |
| Modulation | :FHSS, DSSS, OFDM |
| Power Output | :10, 20, 23 |
| Channel Band Width | :1, 5, 20 ,40 , 80MHz |

## 产品中有害物质的名称及含量

| 部件名称 | 有害物质 | | | | | |
|---|---|---|---|---|---|---|
| | 铅 (Pb) | 汞 (Hg) | 镉 (Cd) | 六价铬 (Cr(VI)) | 多溴联苯 (PBB) | 多溴二苯醚 (PBDE) |
| 印刷电路板组件* | ╳ | ○ | ○ | ○ | ○ | ○ |
| 电池** | ╳ | ○ | ○ | ○ | ○ | ○ |
| 外部信号连接头 | ╳ | ○ | ○ | ○ | ○ | ○ |
| 线材 | ╳ | ○ | ○ | ○ | ○ | ○ |

本表格依据 SJ/T 11364 的规定编制。

○: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。

╳: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求，但所有部件都符合欧盟RoHS要求。

* 印刷电路板组件: 包括印刷电路板及其构成的零部件。

** 电池本体上如有环保使用期限标识，以本体标识为主。

■ 上述有毒有害物质或元素清单会依型号之部件差异而有所增减。

■ 产品部件本体上如有环保使用期限标识，以本体标识为主。

## 限用物質含有情況標示聲明書

| 單元 | 限用物質及其化學符號 | | | | | |
|---|---|---|---|---|---|---|
| | 鉛 (Pb) | 汞 (Hg) | 鎘 (Cd) | 六價鉻 ($Cr^{+6}$) | 多溴聯苯 (PBB) | 多溴二苯醚 (PBDE) |
| 電路板 | ○ | ○ | ○ | ○ | ○ | ○ |
| 電子元件 | — | ○ | ○ | ○ | ○ | ○ |
| 金屬機構件 | — | ○ | ○ | ○ | ○ | ○ |
| 塑膠機構件 | ○ | ○ | ○ | ○ | ○ | ○ |

備考1. “超出0.1 wt %” 及 “超出0.01 wt %” 係指限用物質之百分比含量超出百分比含量基準值。

備考2. “○” 係指該項限用物質之百分比含量未超出百分比含量基準值。

備考3. “—” 係指該項限用物質為排除項目。


## Copyright

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## Technical Support

If a problem arises with your system and no solution can be obtained from the user guide, please contact your place of purchase or local distributor. Alternatively, please try the following help resources for further guidance.

- Visit the MSI website for technical guide, BIOS updates, driver updates, and other information: http://**www.msi.com**
- Register your product at: http://**register.msi.com**

## Revision History

Version 1.0, 2018/08, First release.
Version 1.1, 2018/10, updated release.
Version 1.2, 2020/11, updated release.