# X99-D8I Motherboard

LGA2011 Socket R3 motherboard for Intel® Xeon E5-2600 V3/V4 series and E5-1600 V3/V4 series Processors

## USER MANUAL

(Version1.0)

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# Chapter 1 Safe operation and User notice

## Operation Safety

- Avoid condition of dusty, humidity and temperature extremes.
- Generally speaking, dramatic changes in temperature may lead to contact malfunction and crackles due to constant thermal expansion and contraction from the welding spots

that connect components and PCB. Computer should go through an adaptive phase before it boots when it is moved from a cold environment to a warmer one to avoid condensation phenomenon. These water drops attached on PCB or the surface of the components can bring about phenomena as minor as computer instability resulted from corrosion and oxidationfrom components and PCB or as major as short circuit that can burn the components. Suggest starting the computer until the temperature goes up.

- The increasing temperature of the capacitor may decrease the life of computer. Using fully- closed case may decrease the life of other device because the higher temperature in the inner of the case.

## Electrical Safety

- When installing or removing the motherboard, please try not to touch the components on the board, and wearing an anti-static bracelet is highly recommended.
- Power off and unplug the power cord from the outlet before installing or removing the motherboard and other hardware devices.
- When connecting other hardware devices or cables to the sockets or headers of the motherboard, please ensure that the connectors and sockets are tightly connected. Before turning on the power supply, please check and make sure that the power supply used meets the requirements of this user manual.

## User Notice

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the products and software described in it may be reproduced, transmitted or translated into any language in any form or by any means without written permission of the manufacturer.

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# Chapter 2 Product introduction

## 2.1 Brief introduction

X99-D8I motherboard is designed on the basis of Intel PCH X99, supports Single LGA2011 Socket R3 for Intel® Xeon E5-2600 V3/V4 series and E5-1600 V3/V4 series Processors, moreover, supports Intel AVX2.0, Intel new generation power management technology, improved both data processing capabilities and energy efficiency ratio, which made it the ideal choice for enterprise-class & home entertainment & office data processing.

## 2.2 Specifications

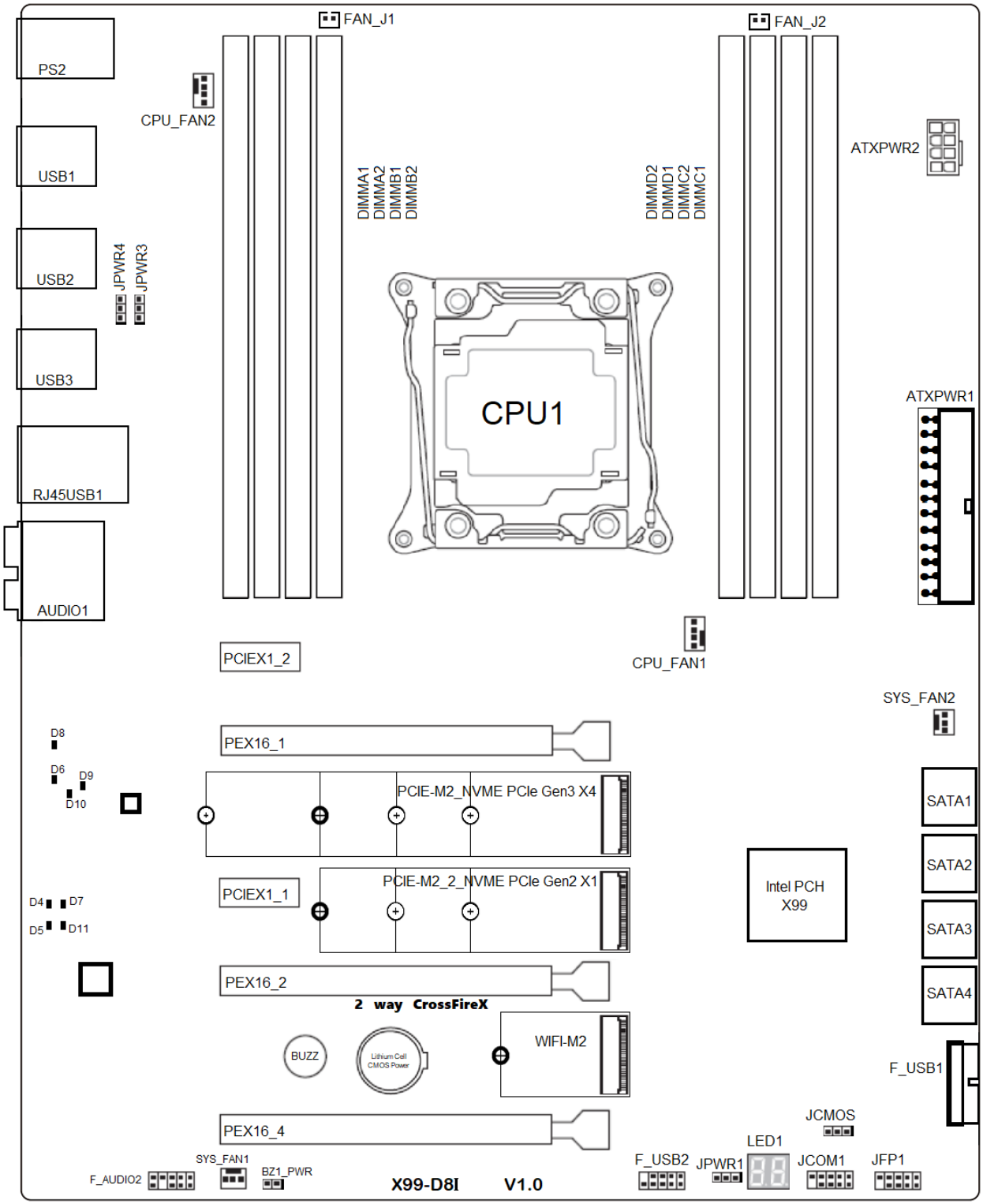
| | | |
|---|---|---|
| CPU | | • LGA2011-v3 socket<br>• Support Xeon E5-2600 V3/V4 series and E5-1600 V3/V4 series Processors |
| Chipset | | • Intel PCH X99/C612 |
| Memory | Slot | • 8 x DDR4 288-pin DIMM slots<br>• Support Quad channel memory |
| | Voltage | • 1.2V |
| | Type | • 8 x DIMM, Max. 128GB, 1600MHz /1866MHz /2133MHz /2400MHz ECC, RDIMM /LRDIMM Memory |

| | | |
|---|---|---|
| Storage | SATA1 & SATA2 connector | • 4 x SATA3.0 ports<br>• Support by Intel AHCI Controller 1<br>• Support Intel RST (for Windows only) with RAID 0, 1, 5 & 10 |
| | SATA3 & SATA4 connector | • 4 x SATA3.0 ports<br>• Support by Intel AHCI Controller 2<br>• Support IDE and AHCI modes only |
| | NVMe | • 1 x M.2 connector, Key M, Type 2242/ 2260/ 2280/ 22110<br>• PCIe3.0 x4 interface |
| | | • 1 x M.2 connector, Key M, Type 2242/ 2260/ 2280<br>• PCIe2.0 x1 interface |
| USB Port | Rear Panel | • 4 x USB3.0 ports<br>• 4 x USB2.0 ports |
| | Onboard Header | • 1 x USB3.0 header (up to 2 ports)<br>• 1 x USB2.0 header (up to 2 ports) |
| Network | | • 1 x Realtek 8111H GbE LAN RJ45 Port |
| Audio | Codec | • Realtek ALC892 High Definition Audio Codec |
| | Rear Panel | • 1 x Line-in (Default)<br>• 1 x Front Line-out<br>• 1 x Mic-in<br>• 1 x Center/Subwoofer out |
| | Front connector | • 1 x Line-Out (Default) |
| PS/2 | | • 1 x PS/2 Keyboard port (Purple) |
| Expansion Slot | | • 2 x PCIe3.0 x16 slots, running at x16 (PEX16_1 & PEX16_2)<br>• 1 x PCIe3.0 x16 slot, running at x4 (PEX16_4)<br>• 2 x PCIe2.0 x1 slots ( PCIEX1_1 & PCIEX1_2) |
| Multi-Graphics Technology | | • Support AMD 2-way CrossFireX™ technology |

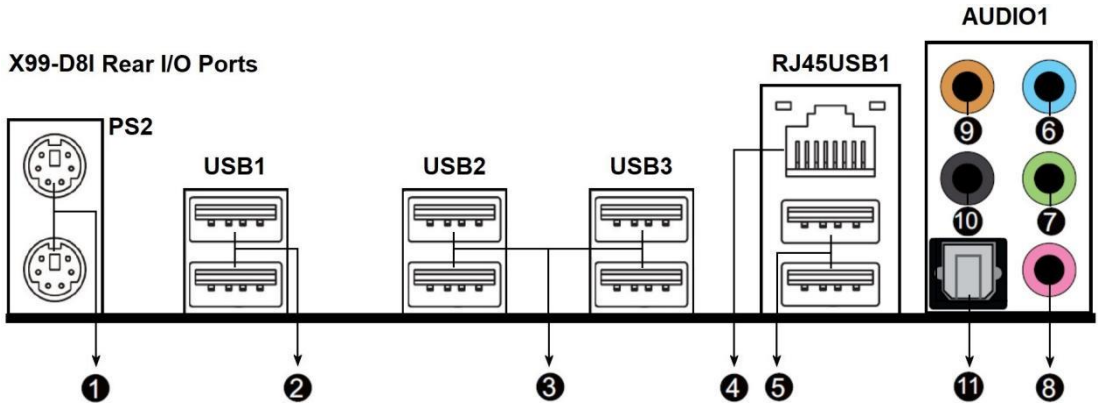
| | |
|---|---|
| Other Onboard I/O Connector | • 1 x 9-pin RS232 serial connector<br>• 1 x 4-pin Smart CPU_FAN1 header<br>• 1 x 4-pin Full Speed CPU_FAN2 header |
| PSU Connector | • Support ATX and SSI PSU<br>• 1 x 24-pin main ATX power connector |
| Operating temperature | • 5°C ~ 40°C |
| Storage temperature | • -40°C ~ 70°C |
| Storage humidity | • 20%~90% (non-condensing) |
| Dimension | • 302mm x 244mm |

## 2.3 X99-D8I Feature

### Diagram of Layout



## Diagram of rear I/O Ports




| RF | Mark | Function | Introduction |
|---|---|---|---|
| 1 | PS2 | PS/2 port | Purple port for PS/2 Keyboard<br>Green port for PS/2 Mouse<br>No hot plug |
| 2 | USB1 | USB2.0 port | 2 x USB2.0 Port based on PCH X99, each port may draw up to 500mA |
| 3 | USB2/USB3 | USB3.0 port | 4 x USB3.0 Ports based on PCH X99, data transfers up to 5.0Gbps |
| 4 | RJ45USB1 | LAN Port | 1 x Gigabit (10/ 100/ 1000 Mb/s) Ethernet RJ45 Port |
| 5 | RJ45USB1 | USB2.0 port | 2 x USB2.0 Port base on PCH X99, each port may draw up to 500mA |
| 6 | AUDIO1 | Line-in (Blue) | 1 x Line-in Jack (default)<br>As Line-in function when set to 2-channel mode<br>To configure 7.1-channel audio, user must retask Line-in jack to be Side-out speaker |

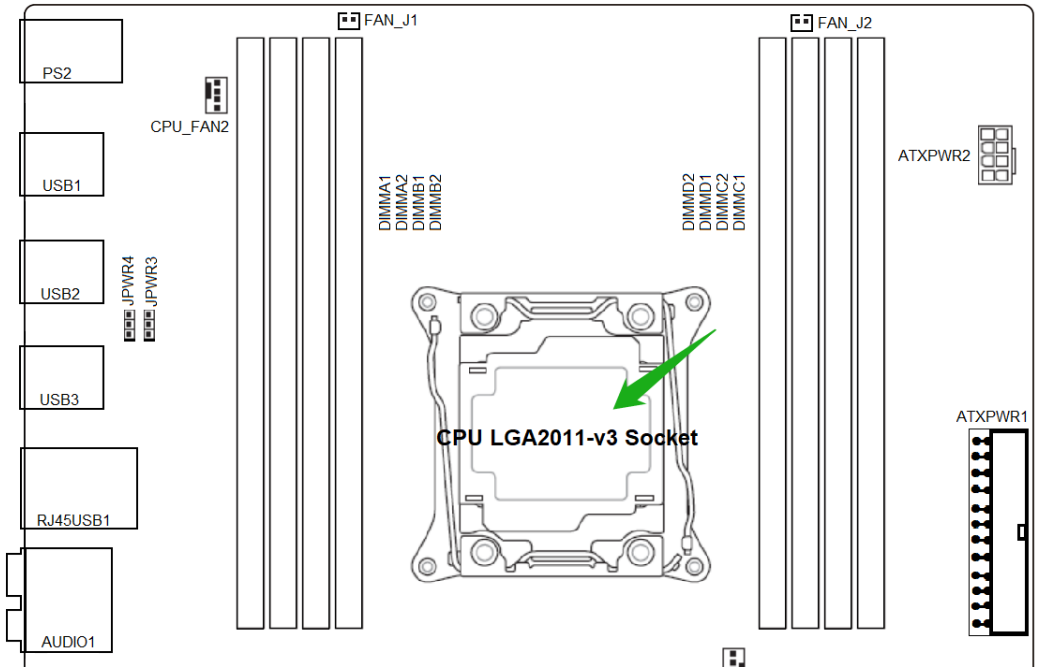
| | | | |
|---|---|---|---|
| | | | through the audio manager panel |
| 7 | | Line-out (Green) | 1 x Line-out Jack<br>As Line-out function when set to 2-channel mode |
| 8 | | MIC-in (Pink) | 1 x Mic-in Jack |
| 9 | | Center/Subwoofer-out (Orange) | 1 x Center/Subwoofer-out Jack<br>As Center/Subwoofer-out function when set to 5.1 /7.1-channel mode |
| 10 | | Rear-out (Black) | 1 x Rear-out Jack<br>As Rear-out function when set to 4/ 5.1 /7.1-channel mode |
| 11 | | Optical S/PDIF Out | 1 x Optical S/PDIF Out<br>Connect a S/PDIF optical cable to get high audio quality |

# Chapter 3 Hardware Functions

## 3.1 CPU

### 3.1.1 Summary

X99-D8I Series Motherboard is designed on the basis of Intel PCH X99, comes with one LGA2011-v3 Socket. Support E5-2600 V3/V4 series and E5-1600 V3/V4 series processors.


FAN_J1
FAN_J2
PS2
CPU_FAN2
USB1
USB2
JPWR4
JPWR3
USB3
RJ45USB1
AUDIO1
DIMMA1
DIMMA2
DIMMB1
DIMMB2
DIMMD2
DIMMD1
DIMMC2
DIMMC1
ATXPWR2
ATXPWR1
CPU LGA2011-v3 Socket

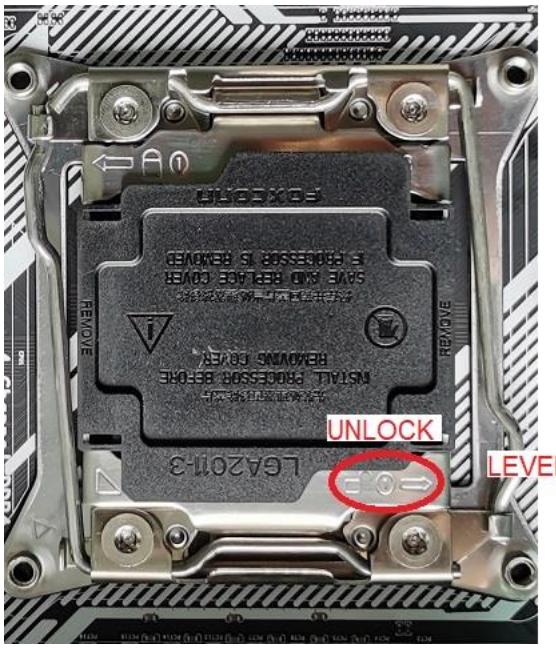
### 3.1.2 CPU installation

This chapter briefly introduced CPU installation.

Make sure that the motherboard supports the CPU.

Be sure to unplug the power cord before installing your CPU to prevent any damage to the motherboard and CPU.

To protect the socket contacts, do not remove the CPU socket protective cover before installing CPU.



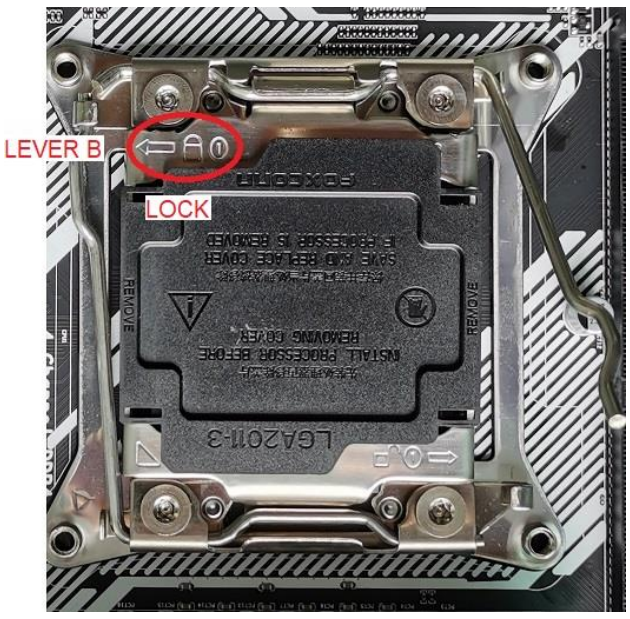

Step 1:

Push the lever closest to the "unlock" marking (below referred as lever A) down and away from the socket to release it.

Step 2:

Push the lever closest to the "lock" marking (below referred as lever B) down and away from the socket.

Then lift the lever.




Step 3:

Gently press lever A to allow the load plate to rise.

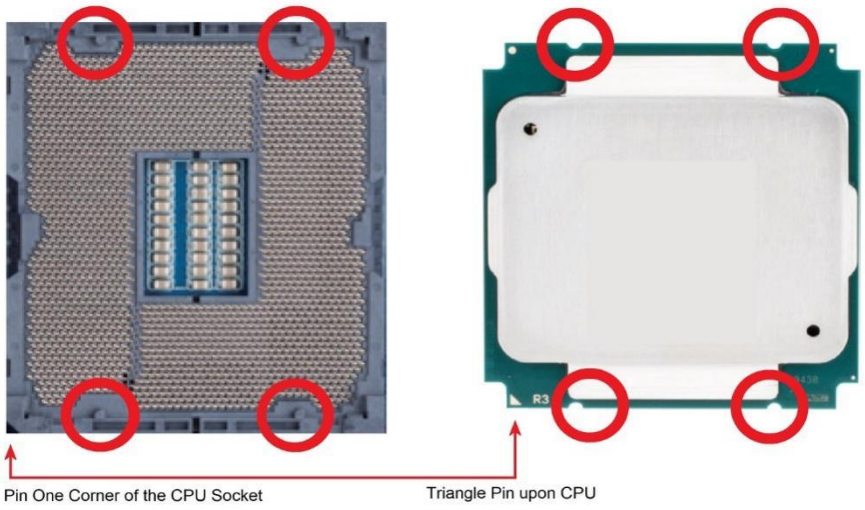
Open the load plate.

(Note: DO NOT touch the socket contacts after the load plate is opened.)

Step 4:

Hold the CPU with your thumb and index fingers.

Align the CPU pin one marking (triangle) with the pin one corner of the CPU socket (or align the CPU notches with the socket alignment keys) and insert the CPU into the socket vertically and carefully.



Step 5:

Once the CPU is properly inserted, carefully close the load plate. Then secure lever B under its retention tab.

The protective plastic cover may pop off from the load plate during the process of engaging the lever.

Move the cover.

(Save the cover properly and always replace it when the CPU is not installed.)


Step 6:

Finally, secure lever A under its retention tab to complete the installation of the CPU.

## 3.2 System Memory

### 3.2.1 Summary

Equipped with 8*DDR4 288-pin @ 1.2V DIMM slots, supports Quad channel technology.

A single slot can support up to 16GB, with 8 slots up to 128GB of total memory capacity.

Note: To ensure the stability of the system operation, highly recommend to install memory module of the same model, capacity, speed, and specifications.

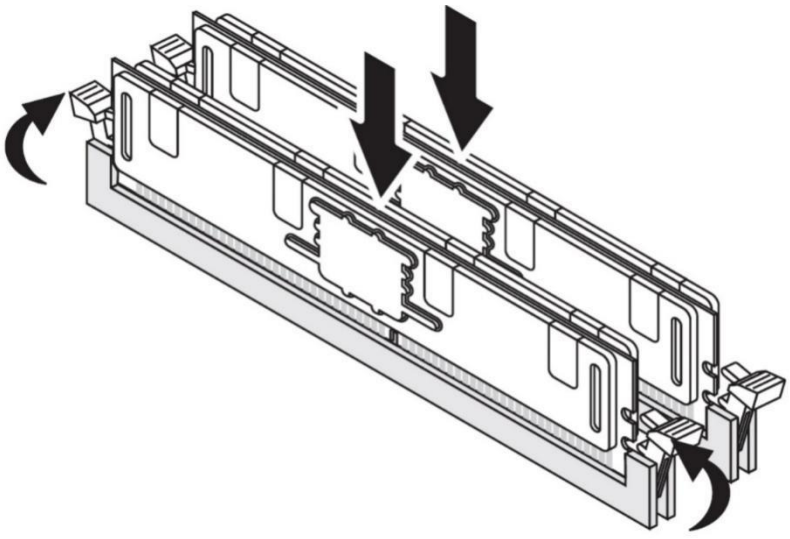
### 3.2.2 Memory Configuration

This motherboard comes with 8 DDR4 DIMM slots and supports Quad channel technology. The corresponding memory configuration is recommended as following.

| # of RAM installed | DIMMA1 | DIMMA2 | DIMMB1 | DIMMB2 | DIMMD2 | DIMMD1 | DIMMC2 | DIMMC1 |
|---|---|---|---|---|---|---|---|---|
| 1 Module | N/A | N/A | √ | N/A | N/A | N/A | N/A | N/A |
| 2 Modules | N/A | N/A | √ | N/A | N/A | √ | N/A | N/A |
| 4 Modules | √ | N/A | √ | N/A | N/A | √ | N/A | √ |
| 6 Modules | √ | N/A | √ | √ | √ | √ | N/A | √ |
| 8 Modules | √ | √ | √ | √ | √ | √ | √ | √ |

### 3.2.3 Installing Memory

Before installing a memory module, make sure to turn off the computer and unplug the power cord from the power outlet to prevent damage to the memory module.



Step1:

Insert the DIMM memory module vertically into the DIMM slot, and push it down.

Step2:

Close the plastic clip at both edges of the DIMM slots to lock the DIMM module.

(Note: For dual-channel operation, DIMMs must be installed in matched pairs.)

Step3:

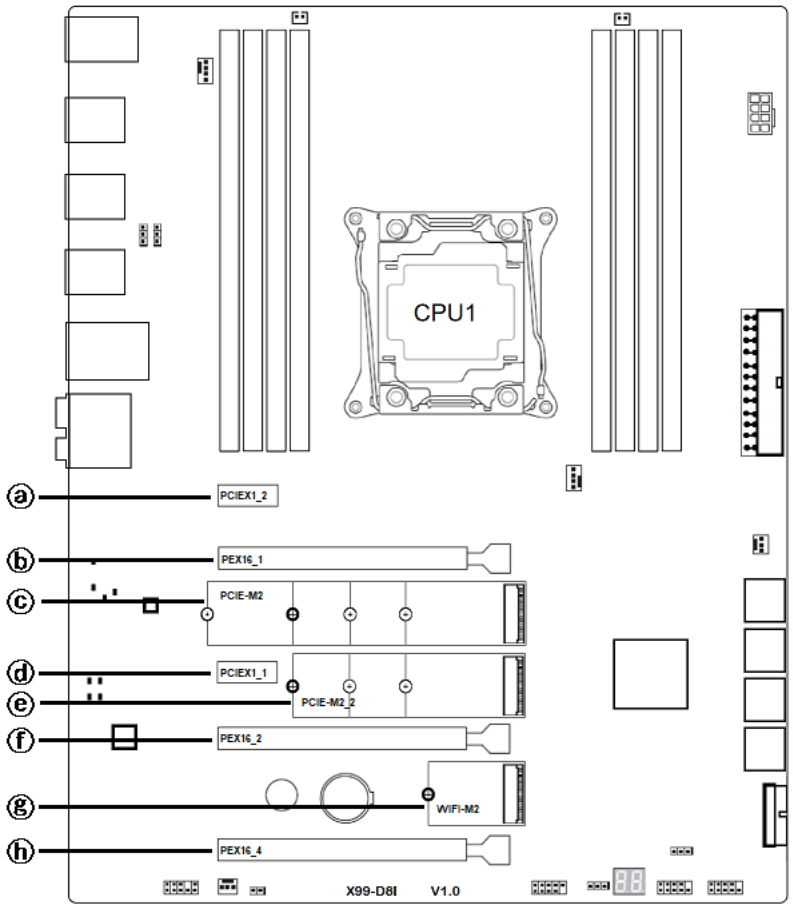
Reverse the installation steps when you wish to remove the DIMM module.

## 3.3 Expansion slots

### 3.3.1 Summary

This motherboard equip five different type PCIe slots and three M.2 connector.

Always turn off the computer and unplug the power cord before adding or removing expansion card.




| RF | Mark | Function | Introduction |
|---|---|---|---|
| a | PCIEX1_2 | PCIe 2.0 x1 slot | • PCIe 2.0 standard, up to 5.0GT/s |

| | | | |
|---|---|---|---|
| b | PEX16_1 | PCIe 3.0 x16 slot | • PCIe 3.0 standard, up to 8.0GT/s<br>• Running at x16 mode<br>• Support 2-way CrossFireX technology |
| c | PCIE-M2 | NVMe_M.2 | • M.2 connector, Key M<br>• Type 2242/ 2260/ 2280/ 22110<br>• PCIe3.0 x4 interface |
| d | PCIEX1_1 | PCIe 2.0 x1 slot | • PCIe 2.0 standard, up to 5.0GT/s |
| e | PCIE-M2_2 | NVMe_M.2 | • M.2 connector<br>• Key M, Type 2242/ 2260/ 2280<br>• PCIe2.0 x1 interface |
| f | PEX16_2 | PCIe 3.0 x16 slot | • PCIe 3.0 standard, up to 8.0GT/s<br>• Running at x16 mode<br>• Support 2-way CrossFireX technology |
| g | WIFI-M2 | WIFI & BT | • M.2 connector<br>• Key E, Type 2230<br>• PCIe2.0 x1 & USB2.0 interface |
| h | PEX16_4 | PCIe 3.0 x16 slot | • PCIe 3.0 standard, up to 8.0GT/s<br>• Running at x4 mode |

### 3.3.2 2-way Graphics technology

This motherboard supports 2-way CrossFireX technology through PEX16_1 and PEX16_2 slots.

1. Ensure that graphics cards supports CrossFireX technology.
2. Ensure that graphics card driver supports CrossFireX technology and enable CrossFireX technology through the Vision Engine Control Center in windows.
3. Insert the CrossFireX bridge connector to the goldfingers on each graphics card.
4. We recommend that you provide sufficient power when running CrossFireX mode.

## 3.4 SATA Ports

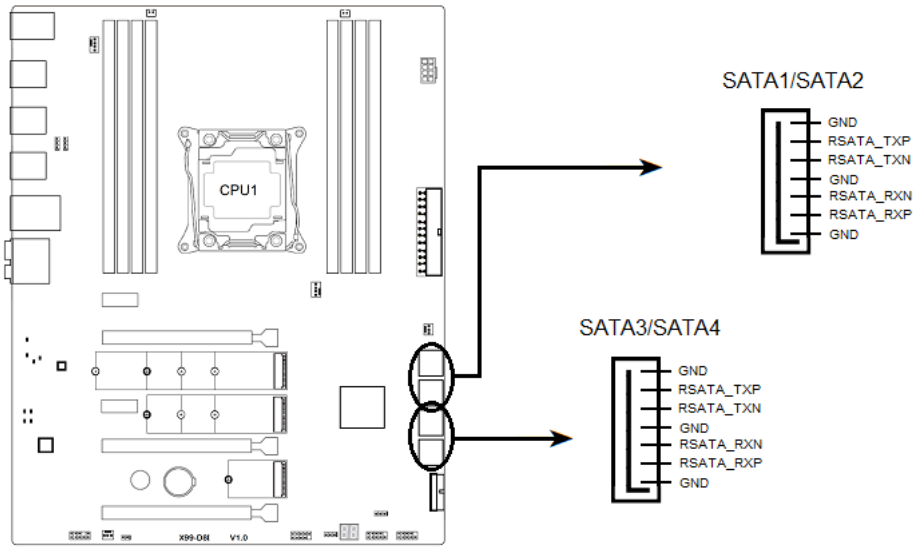
Motherboard support up to 8 (7-pin) SATA ports.

Four ports routed from Intel AHCI controller 1: SATA1 connector & SATA2 connector

Four ports routed from Intel AHCI controller 2 (sSATA port): SATA3 connector & SATA4 connector

Both support up to 6Gb/s transfer rates, and downwards compatible with 3Gb/s and 1.5Gb/s transmission rates.

Only AHCI controller 1 support Intel RST, and Applicable to create RAID 0, RAID 1, RAID 10, or RAID 5 disk arrays (Please Refer to Chapter 5 Section 5.3).

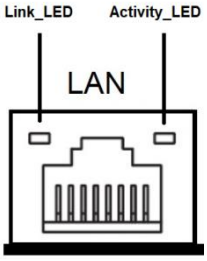


## 3.5 Network Interface

Onboard Realtek 8111H controller provided one Gigabit RJ45 port for Internet connectivity.

This LAN support Magic Packet wake-up and Frame wake-up.

And this LAN support Legacy/UEFI PXE OpROM too.

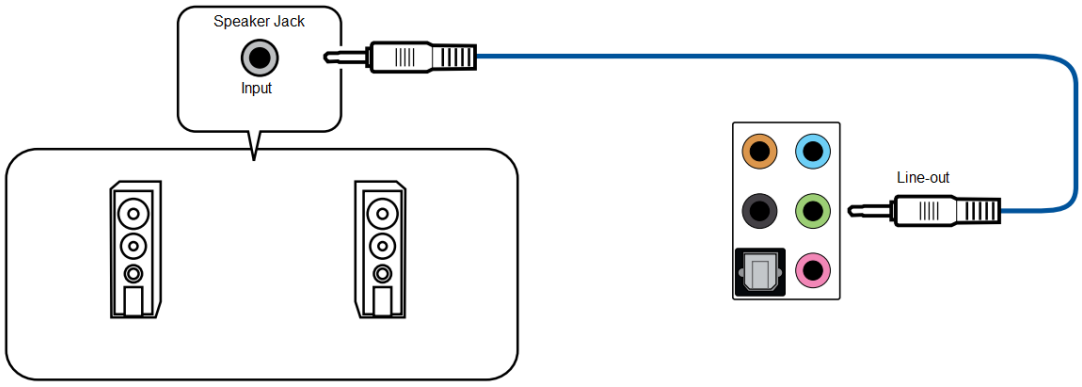



| Link-LED (Amber) | | Activity-LED (Green) | |
|---|---|---|---|
| **Status** | **Definition** | **Status** | **Definition** |
| On | Connection | Blinking | Date transmission |
| Off | No Connection | Off | No Date transmission |

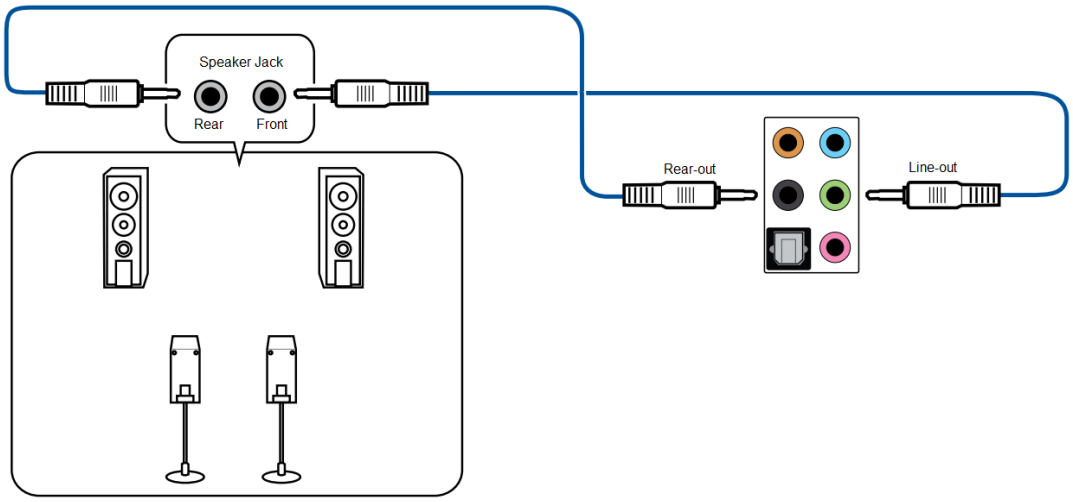
## 3.6 Audio

Depend on Realtek ALC892 High Definition Audio Codec, this motherboard Support 2/ 4/ 5.1/ 7.1-channel Audio output.

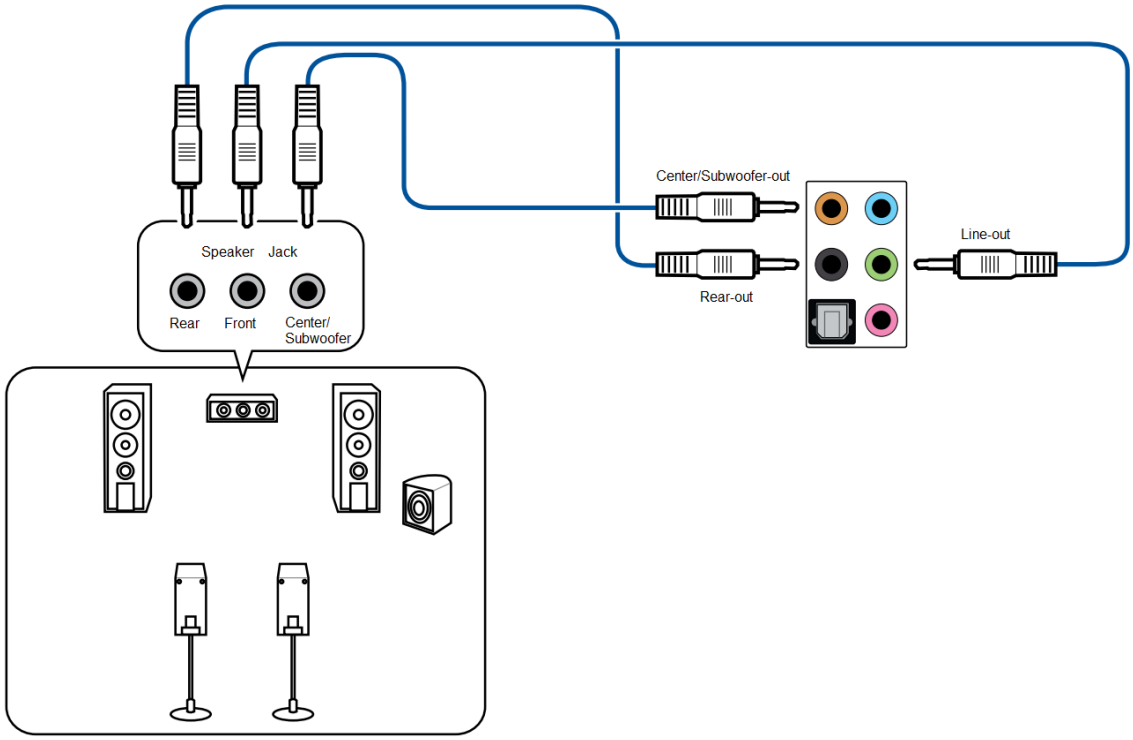
### 3.6.1 Connect to 2 channel Speakers



### 3.6.2 Connect to 4 channel Speakers



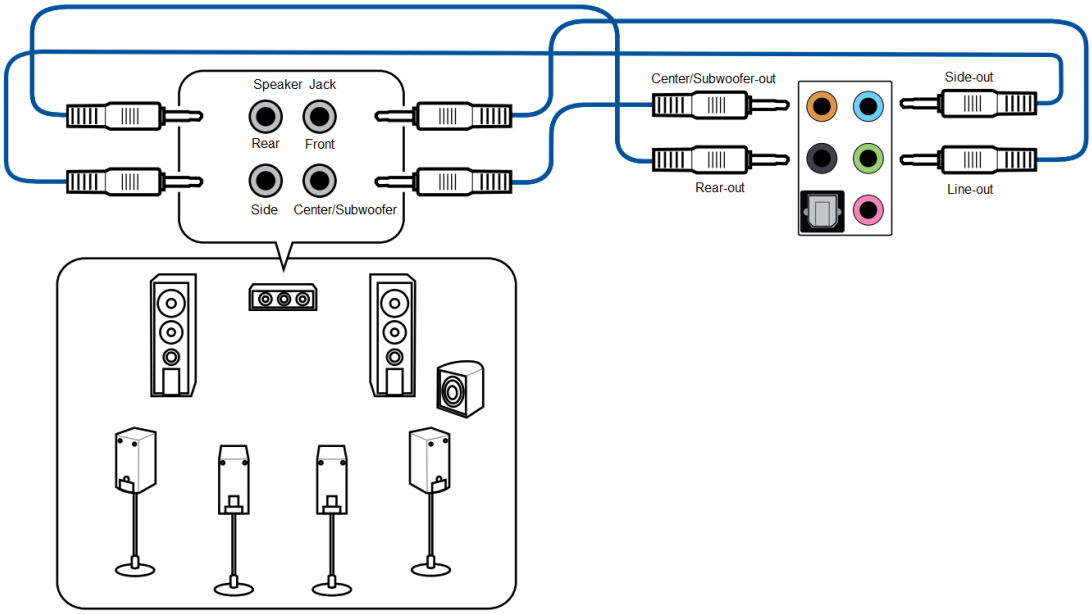

### 3.6.3 Connect to 5.1 channel Speakers




### 3.6.4 Connect to 7.1 channel Speakers

To configure 7.1-channel audio, user must retask Line-in jack to be Side-out speaker through the

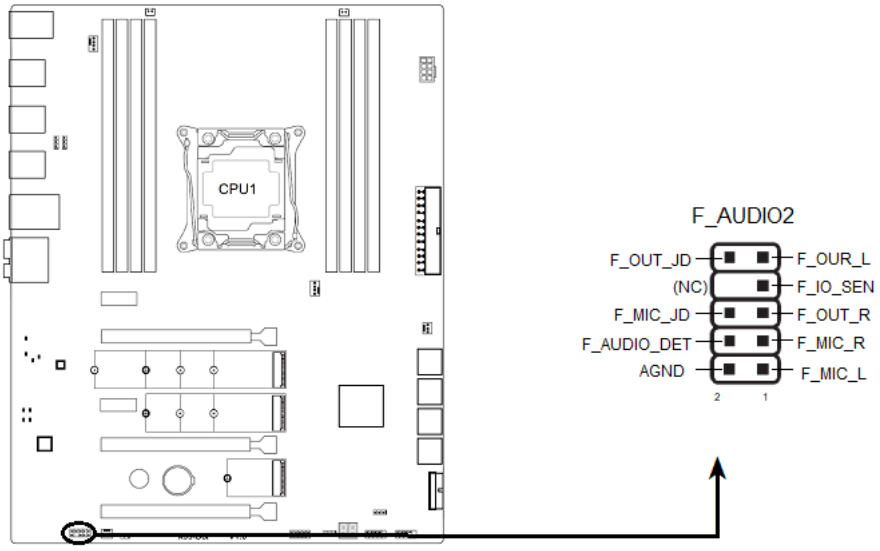
audio manager panel.




### 3.6.5 Front panel audio connector

This connector is for a chassis-mounted front-panel audio I/O module that supports HD Audio standard. And support front panel jack-retasking (MIC) as output mode.

User may connect chassis front audio panel module to this header. Make sure the wire assignments of the module connector match the pin assignments of the motherboard header. Incorrect connection between the module connector and the motherboard header will make the device unable to work or even damage it.




## 3.7 Internal Connector & Header, Jumper configuration

Method for identifying jumpers and pin 1: observe the text marks next to jumpers or pins, which will be represented by number "1" or a bold line or triangle symbol; or check the back pad, and the square pad is pin 1.

Note: Unless specified, the pin spacing for both the pins and jumper is 2.54mm.

### 3.7.1 Onboard USB Connector

This motherboard equipped 4 USB2.0 ports, 4 USB3.0 ports on rear panel and 2 USB2.0 ports, 2 USB3.0 ports inside motherboard.

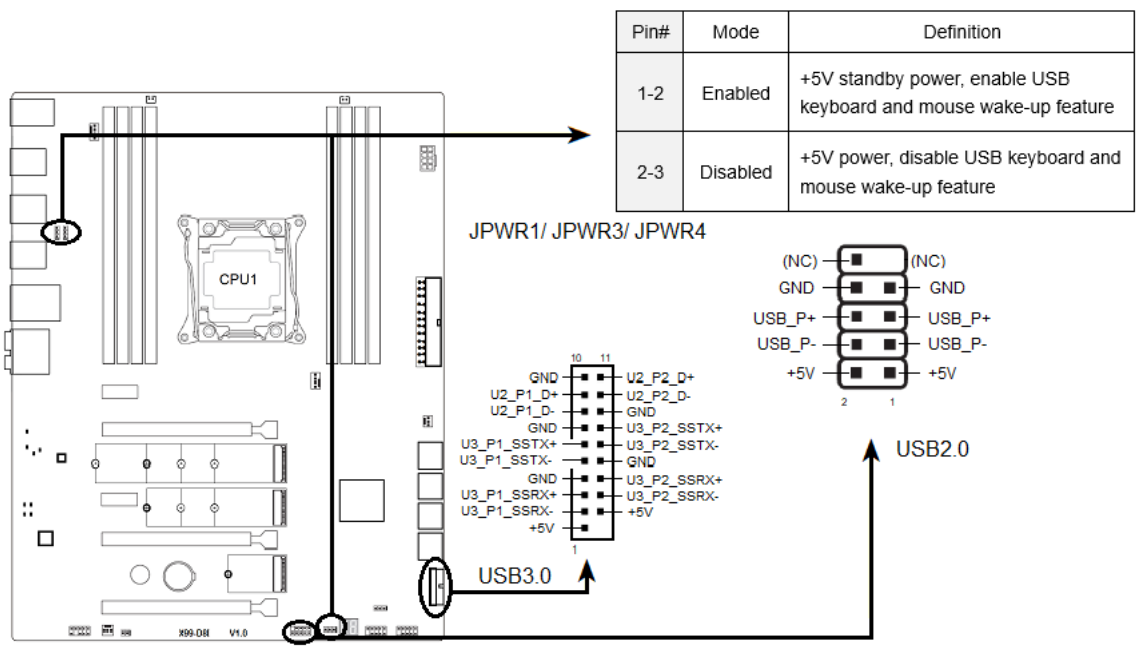
USB2.0 supports up to 480Mbps connection speed and USB3.0 supports up to 5.0Gbps connection speed.

All USB port support wake-up OS S3 and S4 sleep status through jumpers setting.

Jumper JPWR1 enable or disable internal USB ports wake-up feature.

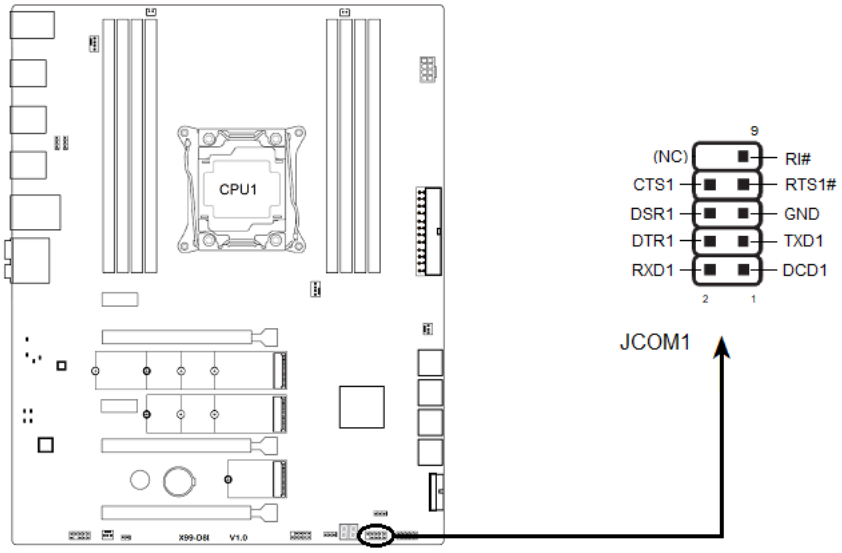
Jumper JPWR3 and JPWR4 enable or disable rear USB ports wake-up feature. The settings of these two jumpers must be the same.

| Pin# | Mode | Definition |
|---|---|---|
| 1-2 | Enabled | +5V standby power, enable USB keyboard and mouse wake-up feature |
| 2-3 | Disabled | +5V power, disable USB keyboard and mouse wake-up feature |



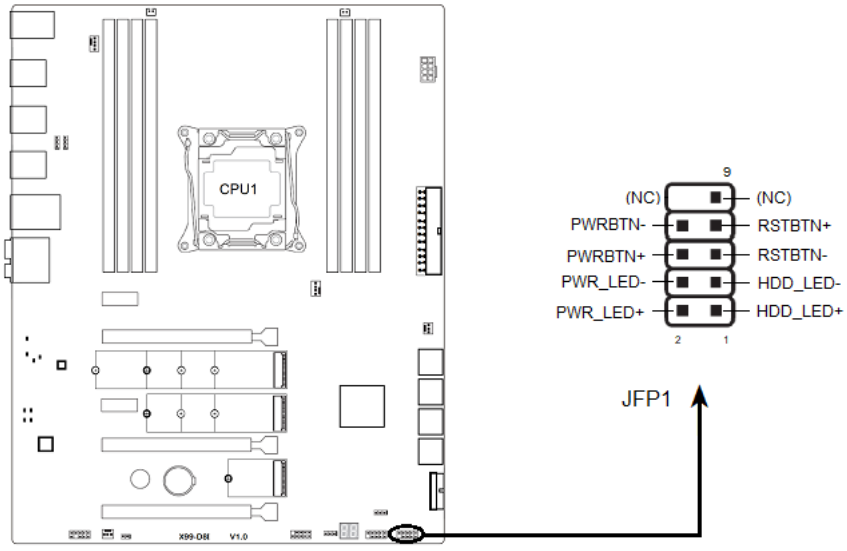

### 3.7.2 COM_RS232 connector

This Serial port support RS323 mode.




### 3.7.3 Front Control Panel connector

Connect the power switch, reset switch and system status indicator on the chassis to this connector. Note the positive and negative pins before connecting the cables.

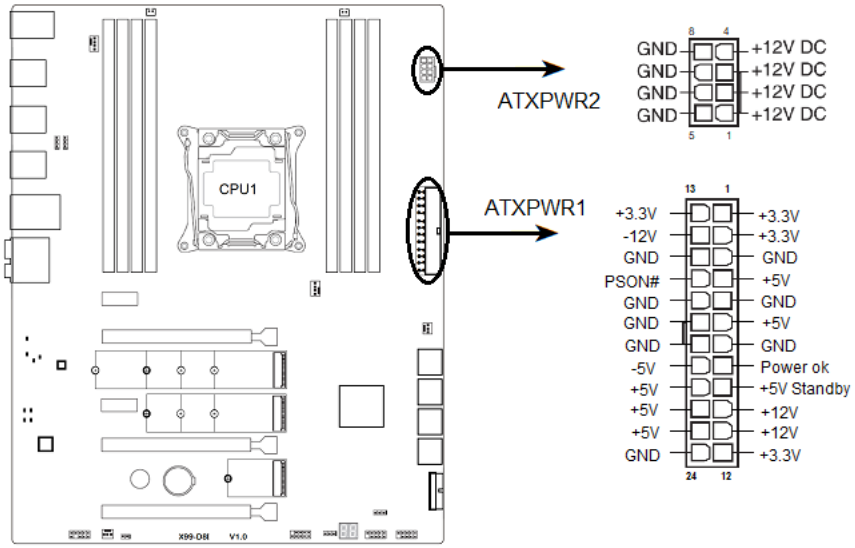



### 3.7.4 ATX PSU Connector

Supports both SSI and ATX power supply units, includes one 24-pin main power supply connector (ATXPWR1) and one 8-pin auxiliary CPU power supply connector (ATXPWR2).

Make sure that both the primary power supply socket and auxiliary power supply connectors are properly connected before power-on.

To ensure system stability and to meet expansion needs, it is highly recommended to use a power supply unit with a rated output voltage of 500W (or more).




### 3.7.5 JCMOS Jumper

This 3-pin jumper JCMOS is to clear the time information and system hardware configuration data stored in CMOS and restore it to factory default settings.

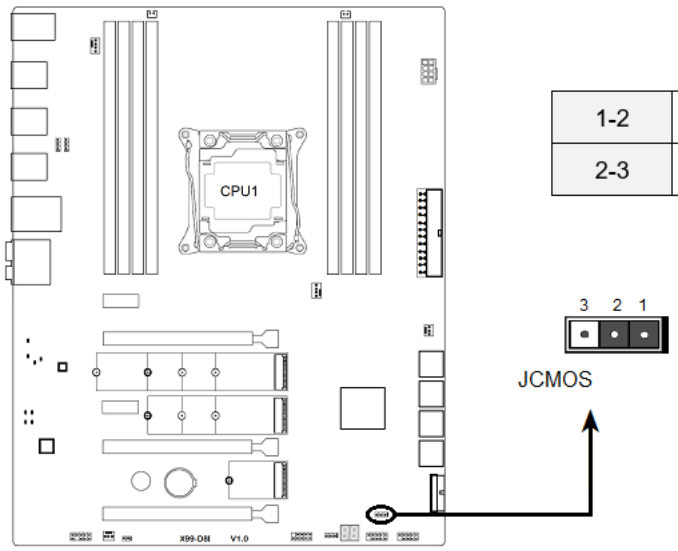
Procedure:

(1) Turn off the computer and disconnect the power supply.

(2) Move the Jumper cap from pins 1-2(default) to pins 2-3 for about 10 seconds, then move the cap back to pins 1-2.

(3) Press the <Del>key to enter the BIOS setting menu when starting the computer, load the optimal default value, save and exit settings.

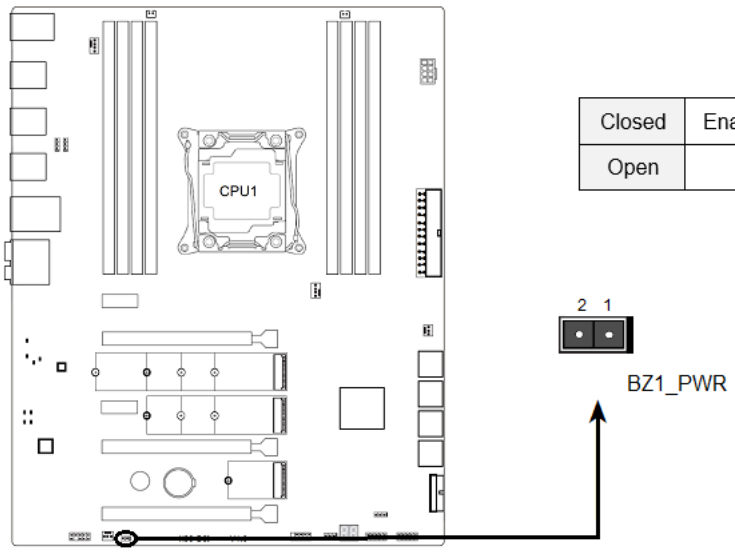
⚠ **Do not clear COMS without unplugging the power cord to prevent any damage to your motherboard.**




| | |
|---|---|
| 1-2 | Normal (default) |
| 2-3 | Clear CMOS |

### 3.7.6 Buzzer Setting Jumper

This jumper allows user to enable or disable onboard buzzer



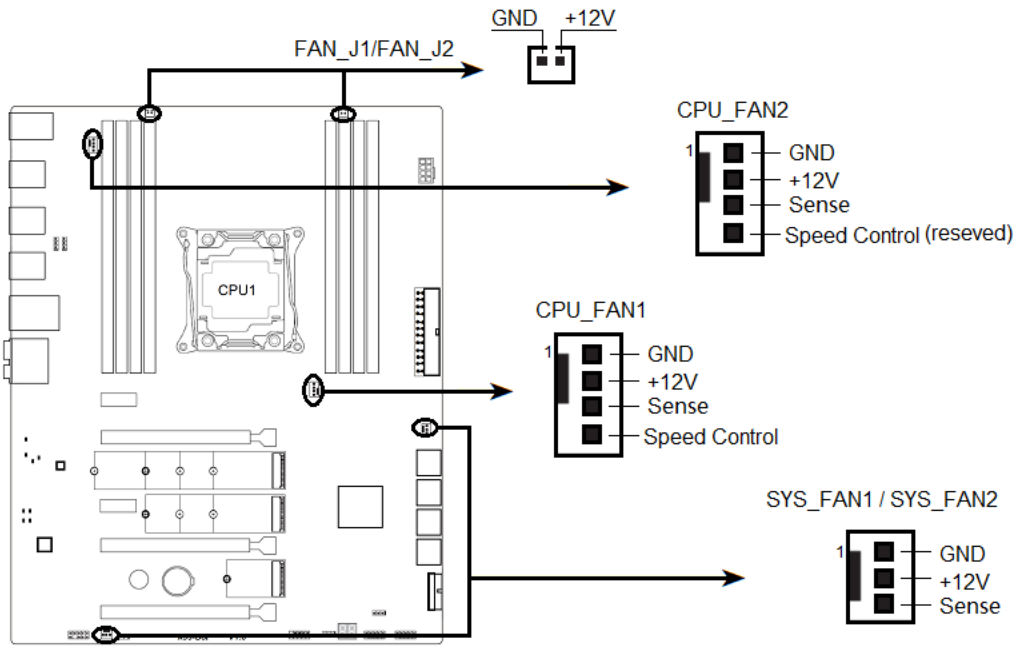

| | |
|---|---|
| Closed | Enable Buzzer (default) |
| Open | Disable Buzzer |

### 3.7.7 CPU FAN & System FAN & Chassis FAN Headers

The motherboard comes with two 4-pin CPU fan headers, two 3-pin system fan headers and 2-pin chassis fan.

When connecting a fan cable, be sure to connect it in the correct orientation (the black connector wire is the ground wire).

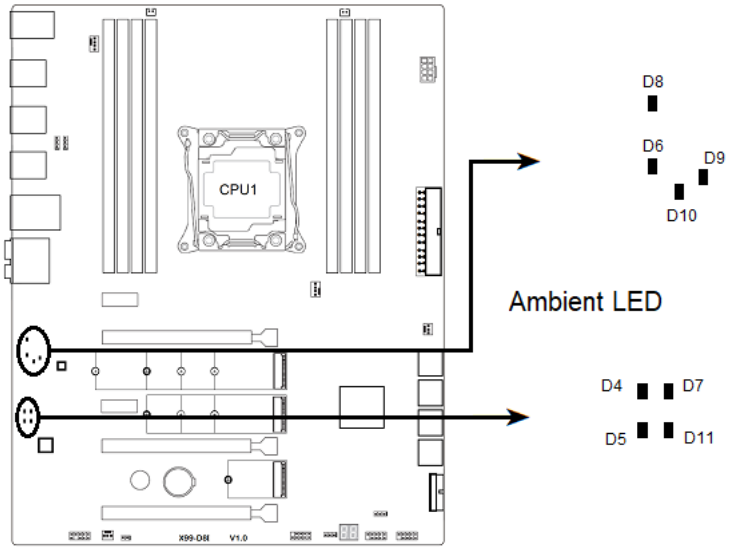
Only the CPU_FAN1 supports CPU fan speed control, and CPU_FAN2 supports full speed mode only.




## 3.8 Ambient LED

The motherboard comes with eight onboard blue ambient LEDs.

User can sets the state through BIOS: Advanced\Miscellaneous Configuration\LED Light (Off/On/Pulsing).

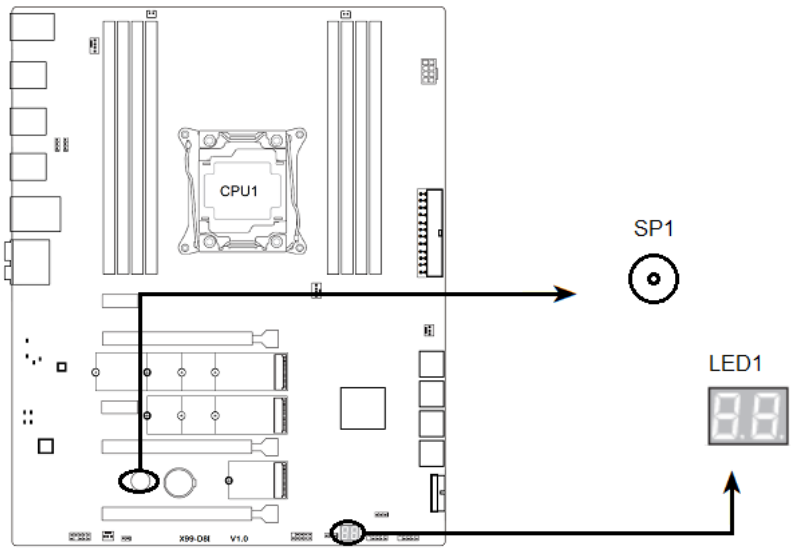



## 3.9 Debug LED & Buzzer

Debug LED (LED1) provides a two-digit display which indicates the progress of the POST. Meanwhile, the motherboard is also equipped with a buzzer, which indicates different abnormal states by combining the frequency and duration of the beeps.

Combined with the function of Debug LED and buzzer (SP1) on the motherboard, it can better help users diagnose the system.

Please refer to the Chapter 5 section 5.1/5.2 for detail.



# Chapter 4 Introducing BIOS

AMI BIOS has been applied to many motherboards, and has been very popular for over a decade. People sometimes refer to AMI BIOS setup menu as BIOS, BIOS setup or CMOS setup.

With AMI BIOS Setup program, user can change BIOS settings and control the special features of the computer. The Setup program adopted a number of menus for making changes and turning

special features on or off. This chapter describes the basic navigation of the BIOS setup screens.

The BIOS options in this manual are for reference only. Different configurations may lead to difference in BIOS screen and BIOS screens in manuals are usually the first BIOS version when the board is released, and may be different from the motherboard your purchased.

| Control Keys | |
|---|---|
| < ↑ >< ↓ >< ← >< → > | Move to select item |
| <Enter> | Select Item |
| <Esc> | Main Menu - Quit and not save changes into CMOS |
| <Page Up/+> | Increase the numeric value or make changes |
| <Page Down/-> | Decrease the numeric value or make changes |
| <F2> | General Help |
| <F2> | Load Previous Values |
| <F9> | Load Optimized Defaults |
| <F10> | Save all CMOS changes and exit |
| <F11> | Show Boot Devices Menu During the Start POST Phase |

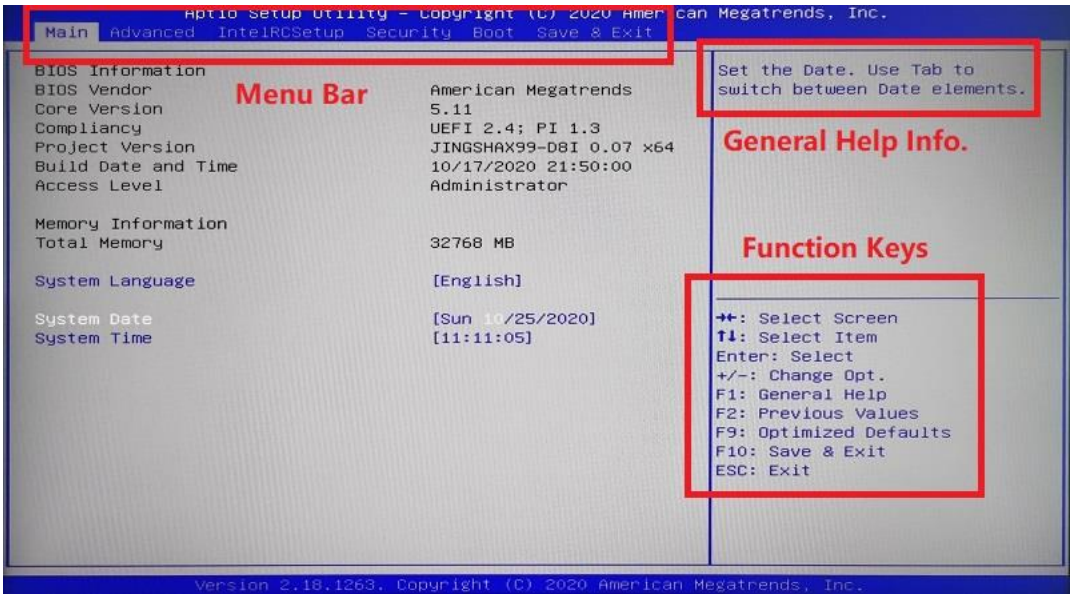
## 4.1 Entering Setup

When the power is turned on, press the <Del> key during the BIOS POST (Power-

On Self-Test) to access the CMOS SETUP screen. If the message disappears and you still wish to enter Setup, restart the system to try again by turning it OFF then ON or pressing the “RESET” button on the system case. You may also restart by simultaneously pressing <Ctrl>, <Alt> and <Delete> keys.

## 4.2 BIOS Menu Screen

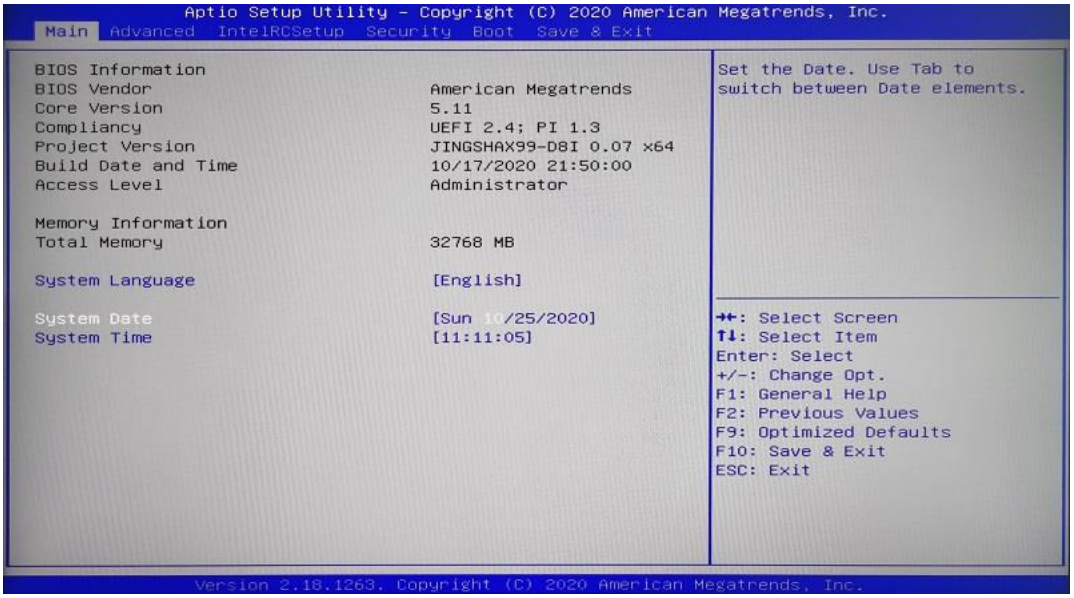
The following diagram show a general BIOS menu screen.




| Menu Bar | |
|---|---|
| Main | System basic configuration |
| Advanced | To change system advanced configuration |
| IntelRCSetup | To change CPU/chipset configuration |
| Security | Password settings |
| Boot | To change boot settings |
| Save & Exit | Save setting, loading and exit options |

## 4.3 Main Menu

Main menu screen includes some basic system information.




### System Date

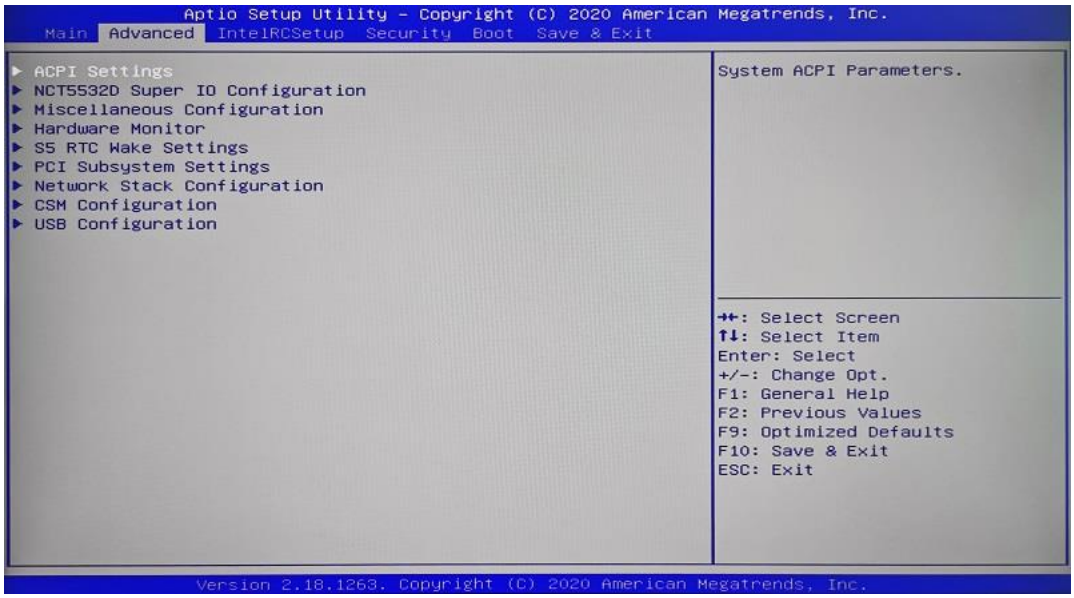
Set the date. Please use [TAB] to switch between data elements.

### System Time

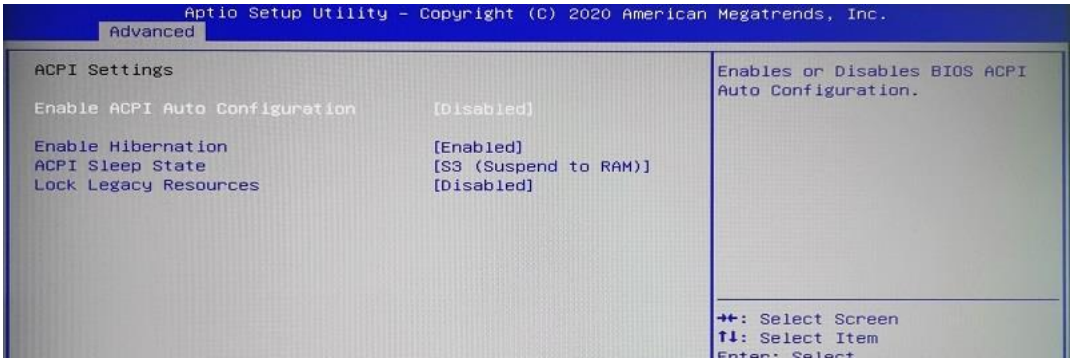
Set the time. Please use [TAB] to switch between time elements.

## 4.4 Advanced Menu

The Advanced menu display submenu options for configuring the function of various hardware components. Select a submenu item, then press Enter to access the related submenu screen.



### 4.4.1 ACPI Settings




**Enable ACPI Auto Configuration**

Allows user to enable or disable the BIOS ACPI Auto Configuration.

Options available: Enabled/Disabled.

Default setting is Disabled.

**Enable Hibernation**

Allows user to enable or disable the ability of the system to hibernate (OS/Sleep State).

Options available: Enabled/Disabled.

Default setting is Enabled.

**ACPI Sleep State**

Allows user to set the ACPI sleep state.

Options available: Suspend Disabled/S3.

Default setting is S3 (Suspend to RAM).

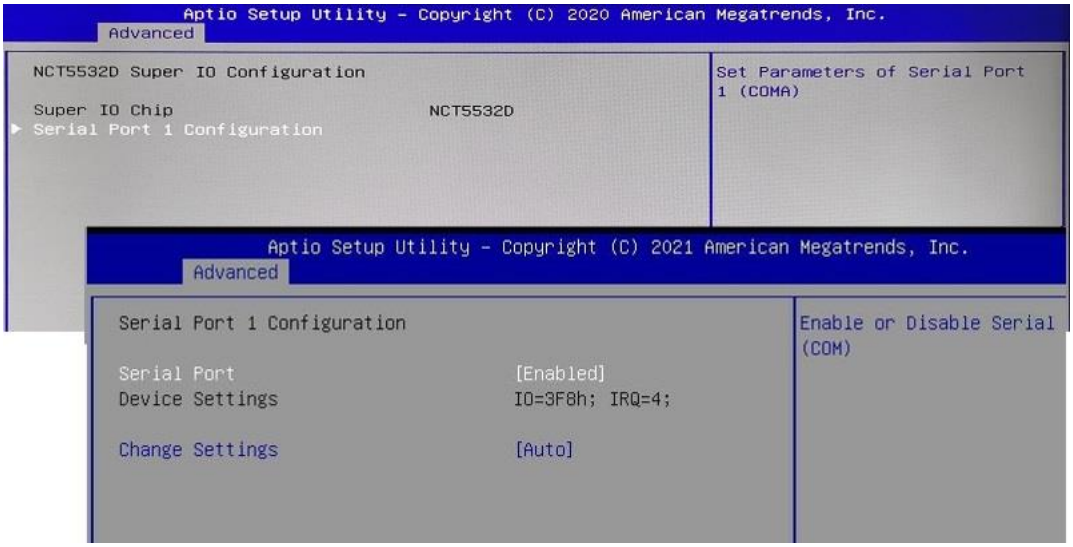
**Lock Legacy Resources**

Allows user to lock legacy device resources.

Options available: Enabled/Disabled.

Default setting is Disabled.

### 4.4.2 NCT5532D Super IO Configuration




#### Serial Port

Allows user to enable or disable Serial Port.

Options available: Enabled/Disabled.

Default setting is Enabled.

#### Change Settings

Allows user to choose the setting for Super IO device.

Default setting is Auto.

Options available:

IO=3F8h; IRQ=3,4,5,7,9,10,11,12; DMA

IO=2F8h; IRQ=3,4,5,7,9,10,11,12; DMA

IO=3E8h; IRQ=3,4,5,7,9,10,11,12; DMA

IO=2E8h; IRQ=3,4,5,7,9,10,11,12; DMA

### 4.4.3 Miscellaneous Configuration


#### LED Light

Allows user to set the motherboard ambient LEDs.

Options available: Off/On/Pulsing.

Default setting is Pulsing.

#### AC Power Loss

Allows user to Specify what state to go to when power is re-applied after a power failure (G3 state).

On: System will boot directly as soon as power applied.

Off: System keeps in power-off state until power button is pressed.

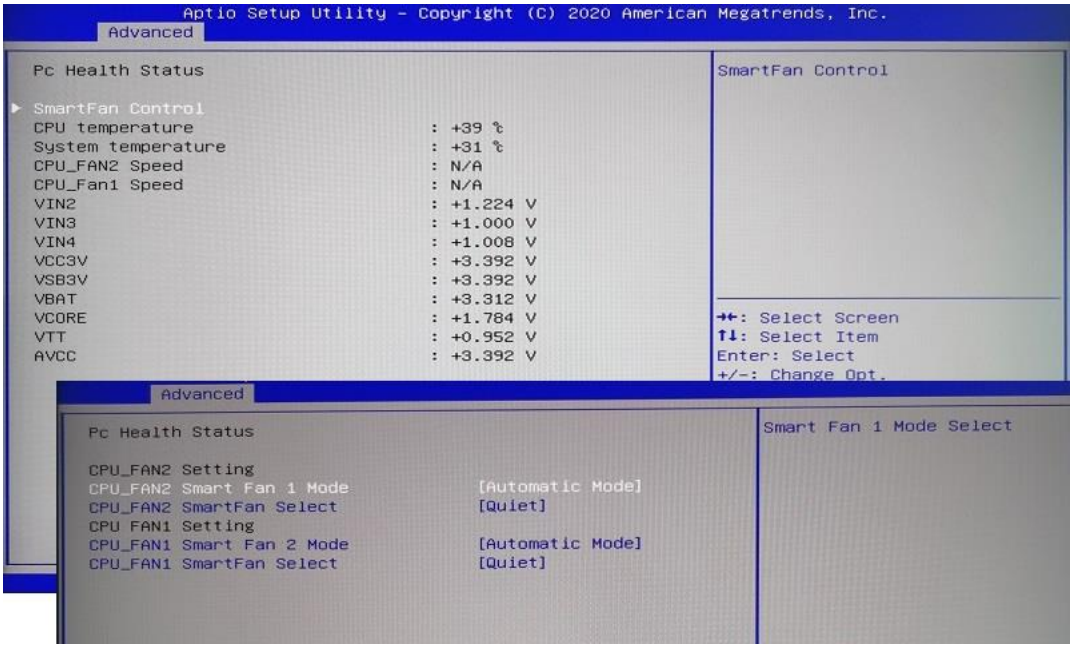
Options available: Off/On.

Default setting is Off.

### 4.4.4 Hardware Monitor

Displays real-time record of the CPU/system temperature, Voltage and fan speed.

Only CPU_FAN1 support smart CPU FAN Speed control by CPU temperature. User can configure the smart FAN feature in Smart Fan Function Sub-menu.




## CPU_FAN1 Smart Fan 2 Mode

Allows user to set CPU_FAN1 speed mode.

Options available: Manual Mode/Automatic Mode.

Default setting is Automatic Mode.

“CPU_FAN1 SmartFan Select” appear When Automatic Mode.

“Manual PWM Setting” appear When Manual Mode.

## CPU_FAN1 SmartFan Select

Allows user to set CPU_FAN1 speed Lever.

Options available: Quiet/Standard/Cool.

Default setting is Quiet.

## Manual PWM Setting

Allows user to set fan PWM Value which determines CPU fan speed.

Options available: 0-100.

Default setting is 50.

### 4.4.5 S5 RTC Wake Settings

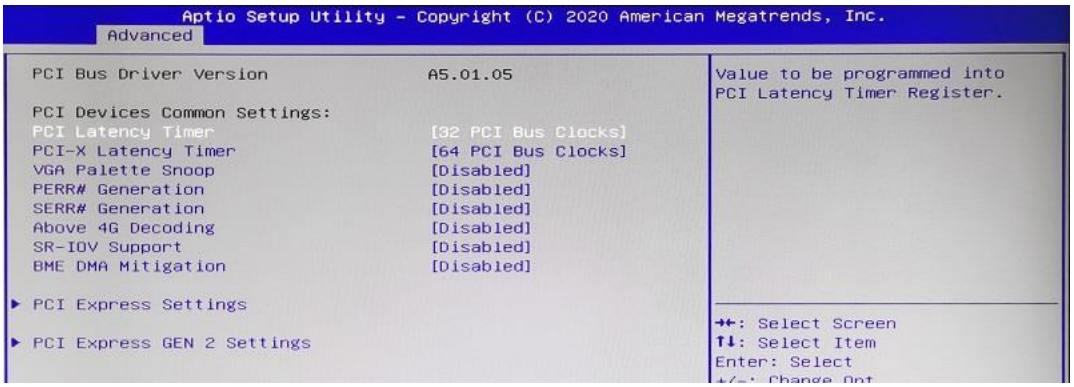

#### Wake system from S5

Allows user to enable or disable system wake on alarm.

Options available: Disabled /Fixed Time/Dynamic Time.

Default setting is Disabled.

### 4.4.6 PCI Subsystem Settings




#### PCI Devices Common Settings

#### PCI Latency Timer

Value to be programmed into PCI Latency Timer Register.

Options available: 32 PCI Bus Clocks/64 PCI Bus Clocks/96 PCI Bus Clocks/128 PCI Bus Clocks/160 PCI Bus Clocks/192 PCI Bus Clocks/224 PCI Bus locks/248 PCI Bus Clocks/.

Default setting is 32 PCI Bus Clocks.

#### VGA Palette Snoop

Enable/Disable VGA Palette Registers Snooping.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Above 4G Decoding

Enable/Disable Above 4G Decoding.

Options available: Enabled/Disabled.

Default setting is Disabled.

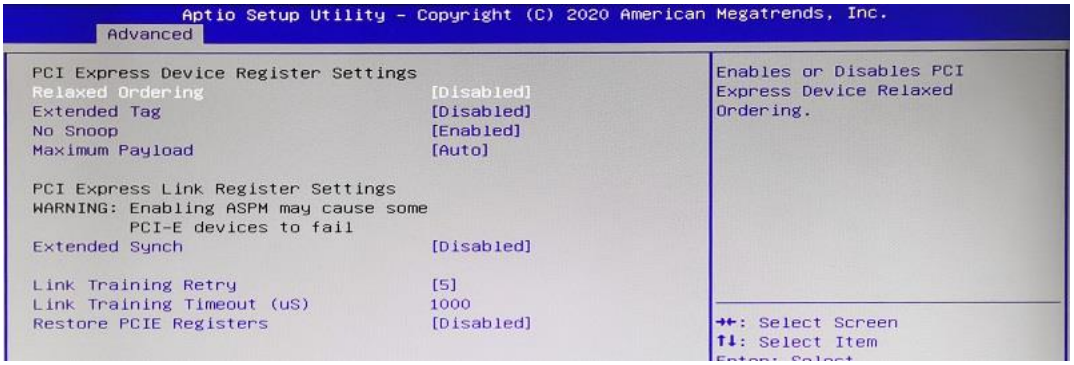
### SR-IOV Support

If system has SR-IOV capable PCIe Devices, this option enables or disables Single Root IO Virtualization Support.

Options available: Enabled/Disabled.

Default setting is Disabled.

## PCI Express Settings




### Relaxed Ordering

Enable/Disable PCI Express Device Relaxed Ordering feature.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Extended Tag

When this feature is enabled, the system will allow device to use 8-bit Tag field as a requester.

Options available: Enabled/Disabled.

Default setting is Disabled.

### No Snoop

Enable/Disable PCI Express Device No Snoop option.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Maximum Payload

Set maximum payload for PCI Express Device or allow system BIOS to select the value.

Options available: Auto/128 Bytes/256 Bytes/512 Bytes/1024 Bytes/2048 Bytes/4096 Bytes.

Default setting is Auto.

### Extended Synch

When this feature is enabled, the system will allow generation of Extended Synchronization patterns.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Link Training Retry

Define the number of Retry Attempts software will take to retrain the link if previous training attempt was unsuccessful. Press <+> / <-> keys to increase or decrease the desired values.

Options available: Disabled/2/3/5.

Default setting is 5.

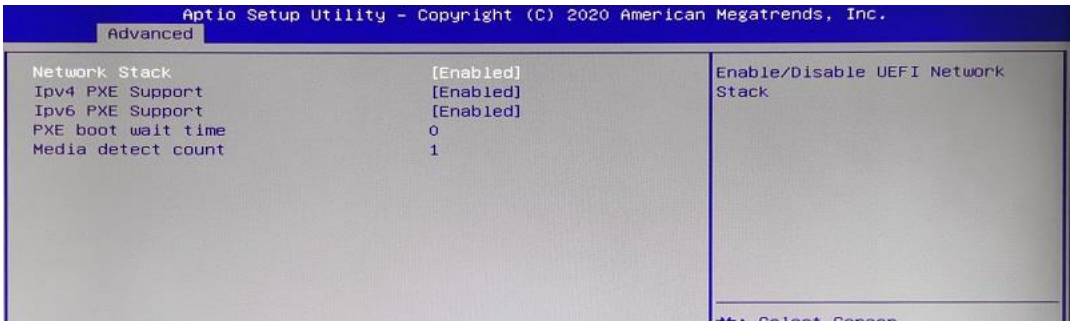
### Link Training Timeout (us)

Define the number of Microseconds software will wait before polling 'Link Training' bit in Link Status register. Press <+> / <-> keys to increase or decrease the desired values. Value rang is from 10 to 10000 us.

## 4.4.7 Network stack Configuration

Setting Advanced/CSM Configuration/Network policy as Enabled is necessary for this

function.




### Network stack

Enable/Disable Legacy/UEFI PXE OpROM.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Ipv4 PXE Support

Enable/Disable Ipv4 PXE feature. Options available: Enabled/Disabled.

Default setting is Enabled.

### Ipv6 PXE Support

Enable/Disable Ipv6 PXE feature. Options available: Enabled/Disabled.

Default setting is Enabled.

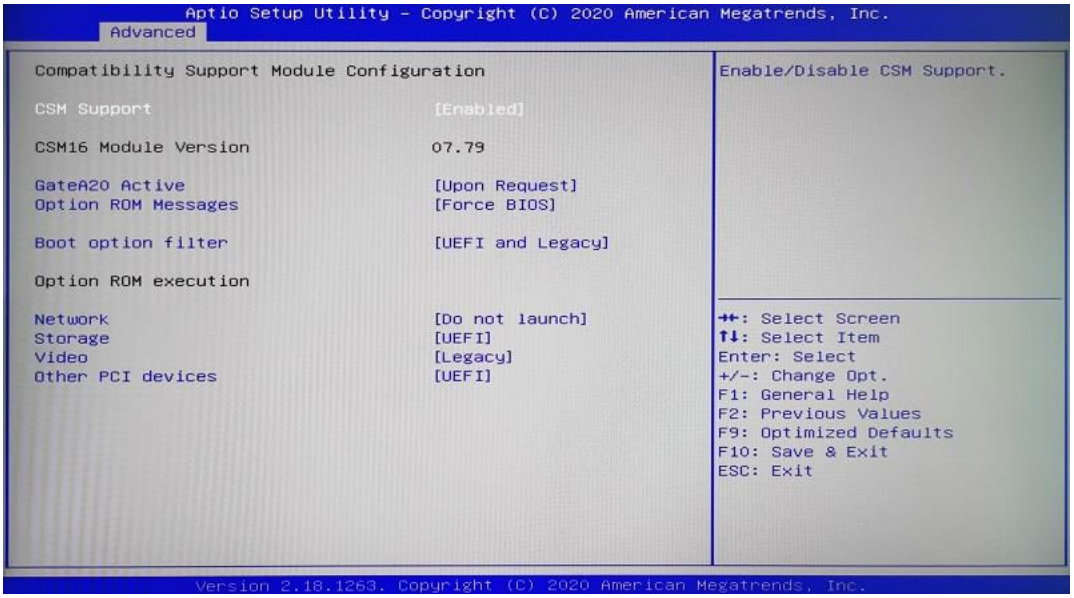
### PXE boot wait time

Press <+> / <-> keys to increase or decrease the desired values.

### Media detect time

Press <+> / <-> keys to increase or decrease the desired values.

### 4.4.8 CSM Configuration




#### CSM Support

Enable/Disable Compatibility Support Module (CSM) support.

Options available: Enabled/Disabled.

Default setting is Enabled.

#### CSM16 Module Version

Display CSM Module version information.

#### Gate20 Active

Upon Request: GA20 can be disabled using BIOS services.

Always: Do not allow disabling GA20; this option is useful when any RT code is executed above 1MB.

Options available: Upon Request/Always.

Default setting is Upon Request.

#### Option ROM Messages

Option ROM Messages.

Options available: Force BIOS/Keep Current.

Default setting is Force BIOS.

### Boot option filter

Determines which devices system will boot to.

Options available: UEFI and Legacy/Legacy only/UEFI only.

Default setting is UEFI and Legacy.

### Network

Controls the execution Legacy/UEFI PXE OpROM.

Options available: Do not launch/Legacy/UEFI.

Default setting is Do not launch.

### Storage

Controls the execution UEFI and Legacy Storage OpROM.

Options available: Do not launch/UEFI only/Legacy.

Default setting is Legacy.

### Video

Controls the execution UEFI and Legacy Video OpROM.

Options available: Do not launch/UEFI only/Legacy.

Default setting is Legacy.

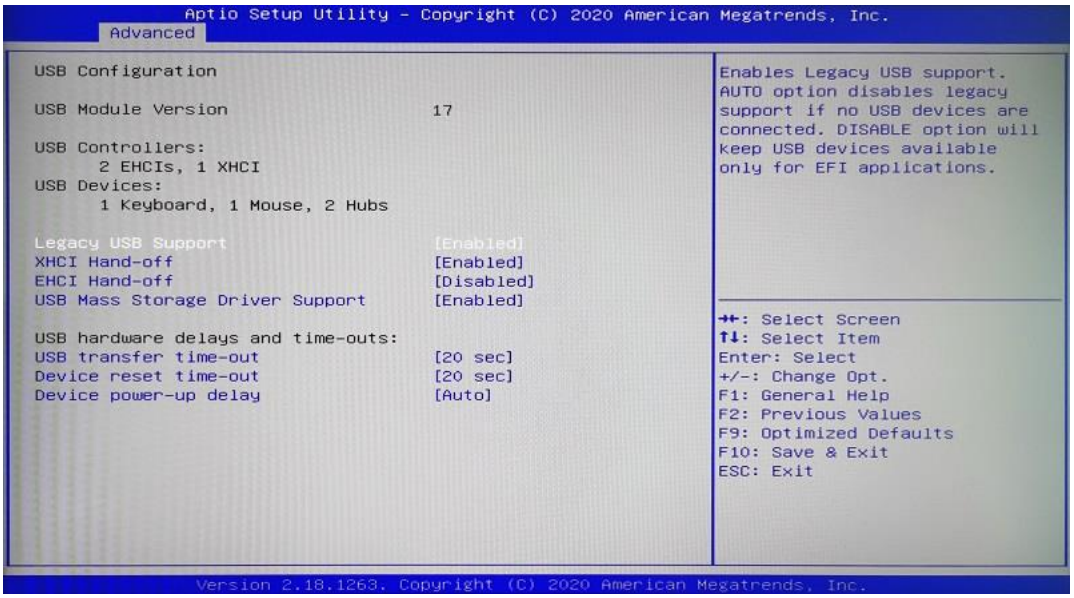
### Other PCI devices

Determines OpROM execution policy for devices other than network, Storage, or Video.

Options available: UEFI/Legacy.

Default setting is UEFI.

### 4.4.9 USB Configuration




#### Legacy USB Support

Allows user to enable or disable the support for USB devices on legacy OS.

When Disabled setting, the USB devices can be used only for the BIOS setup program.

Options available: Enabled/Disabled.

Default setting is Enabled.

#### XHCI Hand-off

This is a workaround for OS without XHCI hand-off support. The XHCI ownership change should be claimed by XHCI driver.

Options available: Enabled/Disabled.

Default setting is Enabled.

### EHCI Hand-off

This is a workaround for OS without EHCI hand-off support. The EHCI ownership change should be claimed by EHCI driver. Options available: Enabled/Disabled.

Default setting is Disabled.

### USB Mass Storage Driver Support

Allows user to enable or disable the USB Mass Storage driver support.

Options available: Enabled/Disabled.

Default setting is Enabled.

### USB transfer time-out

This time-out value for control, bulk, and interrupt transfer.

Options available: 1 sec/5 sec/20 sec.

Default setting is 20 sec.

### Device reset time-out

USB mass storage device start unit command time-out.

Options available: 1 sec/20 sec/30 sec/40 sec.

Default setting is 20 sec.

### Device power-up delay

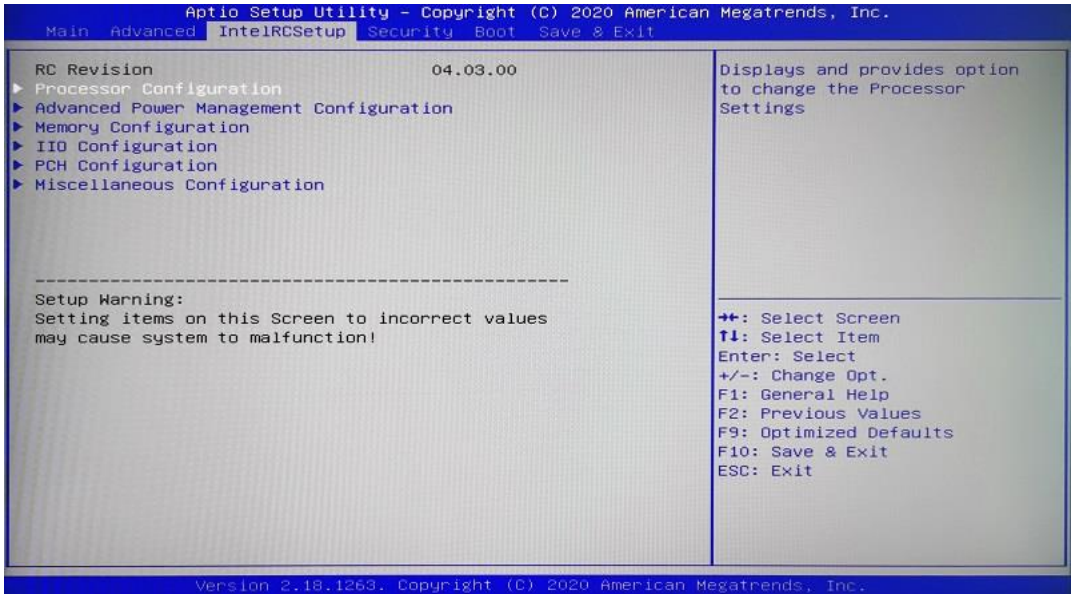
This is the maximum time the device will take before it properly reports itself to the host controller.

Options available: Auto/Manual.

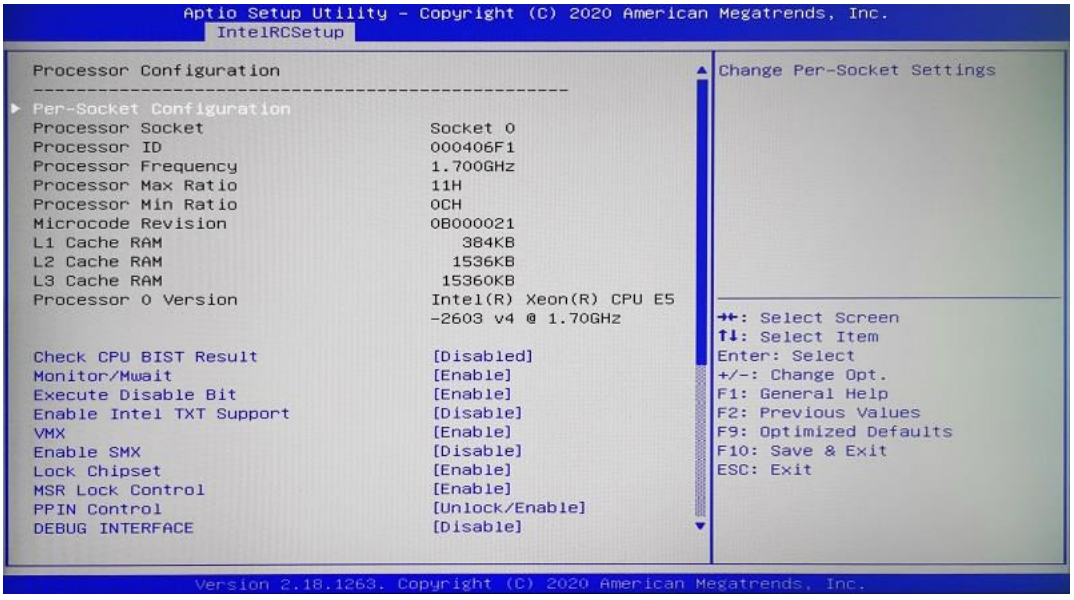
Default setting is Auto.

## 4.5 Intel RCSetup Menu

Intel RCSetup menu displays submenu options for configuring the function of North Bridge and South Bridge. Select a submenu item, then press Enter to access the related submenu screen.




### 4.5.1 Processor Configuration




#### Pre-Socket Configuration

Press [Enter] for configuration of advanced items.

#### Cores Enabled (for CPU socket 0/1)

Number of Cores to enable. 0 means all cores. 14 Cores is available.

Press <+> and <-> keys to adjust desired values.

#### Check CPU BIST Result

Enable/Disable failed BIST core when enable, otherwise, ignore BIST result.

Options available: Enabled/Disabled.

Default setting is Disabled.

### CPU Flex Ratio Override

Enable/Disable CPU Flex Ratio Programming.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Monitor/Mwait

Enable/Disable the Monitor/Mwait instruction.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Hyper-Threading [All]

The Hyper Threading Technology allows a single processor to execute two or more separate threads concurrently. When hyper-threading is enabled, multi-threaded software applications can execute their threads, thereby improving performance.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Execute Disable Bit

When enabled, the processor prevents the execution of code in data-only memory pages. This provides some protection against buffer overflow attacks. When disabled, the processor will not restrict code execution in any memory area. This makes the processor more vulnerable to buffer overflow attacks.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Enable Intel TXT Support

Enable/Disable Intel Trusted Execution Technology support function.

Options available: Enabled/Disabled.

Default setting is Disabled.

### VMX (Vanderpool Technology)

Enable/Disable Vanderpool Technology. This will take effect after rebooting the system.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Enable SMX (Intel Safer Mode Extensions Technology)

Enable/Disable Intel Safer Mode Extensions (SMX) support function.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Hardware Prefetcher

Select whether to enable the speculative prefetch unit of the processor.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Adjacent Cache Line Prefetch

When enabled, cache lines are fetched in pairs. When disabled, only the required cache line is fetched.

Options available: Enabled/Disabled.

Default setting is Enabled.

### DCU Streamer Prefetch

Enable prefetch of next L1 Data line based upon multiple loads in same cache line.

Options available: Enabled/Disabled.

Default setting is Enabled.

### DCU IP Prefetch

Enable prefetch of next L1 Data line based upon sequential load history.

Options available: Enabled/Disabled.

Default setting is Enabled.

### DCU Mode

Configure DCU mode.

Options available: 32KB 8Way Without ECC/16KB 4Way With ECC.

Default setting is 32KB 8Way Without ECC.

### Direct Cache Access (DCA)

Options available: Auto/Enabled/Disabled.

Default setting is Auto.

### DCA Prefetch Delay

Options available: Disabled/8/16/24/32/40/48/56/64/72/80/88/96/104/112. Default setting is 32.

### X2APIC

Options available: Enabled/Disabled.

Default setting is Disabled.

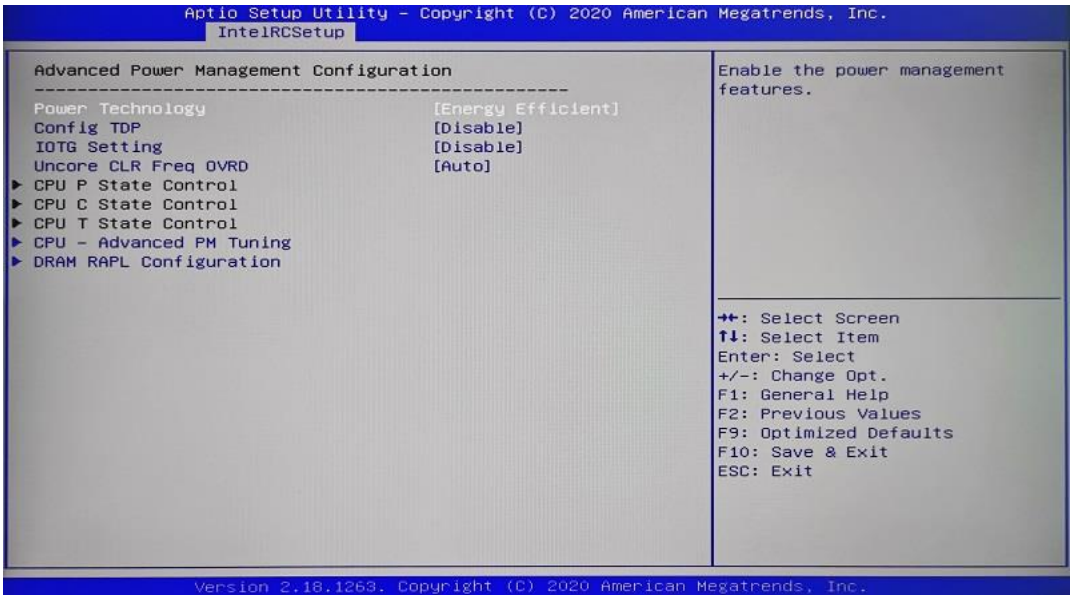
### AES-NI

Enable/Disable AES-NI (Intel Advanced Encryption Standard New Instructions) support function.

Options available: Enabled/Disabled.

Default setting is Enabled.

## 4.5.2 Advanced Power Management Configuration



### Power Technology

Option available: Disable/Energy Efficient/Custom.

Default setting is Energy Efficient.

### Config TDP

Options available: Enabled/Disabled.

Default setting is Enabled.

### Config TDP Level

Options available: Enabled/Disabled.

Default setting is Disabled.

### CPU P State Control

Press [Enter] for configuration of advanced items.

### EIST (P-State)

Conventional Intel SpeedStep Technology switches both voltage and frequency in tandem between high and low levels in response to processor load.

Options available: Enabled/Disabled.

### Turbo Mode

When this item is enabled, processor will automatically ramp up the clock speed of 1-2 of its processing cores to improve its performance. When this item is disabled, the processor will not overclock any of its core.

Options available: Enabled/Disabled.

### P-state coordination

In HW_ALL mode, the processor hardware is responsible for coordinating the P-state among logical processors dependencies. The OS is responsible for keeping the P-state request up to date on all logical processors. In SW_ALL mode, the OS Power Manager is responsible for coordinating the P-state among logical processors with dependencies and must initiate the transition on all of those Logical Processors. In SW_ANY mode, the OS

Power Manager is responsible for coordinating the P-state among logical processors with dependencies and may initiate the transition on any of those Logical Processors.

Options available: HW_ALL/SW_ALL/SW_ANY.

### CPU C State Control

Press [Enter] for configuration of advanced items.

### Package C State Limit

Configure state for the C-State package limit.

Options available: C0 state /C1 state/C2 state/C6 (non Retention) state/C6 (Retention) state.

### CPU C3/C6 Report

Allows user to determine whether to let the CPU enter C3/C6 mode in system halt state. When enabled, the CPU core frequency and voltage will be reduced during system halt state to decrease power consumption. The C3/C6 state is a more enhanced power-saving state than C1.

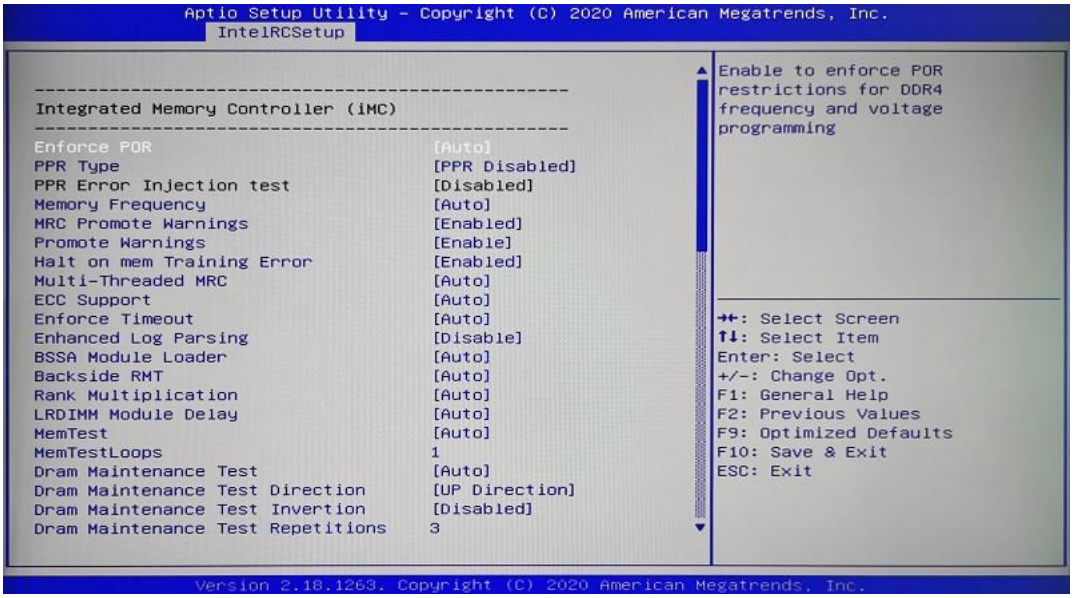
### CPU T State Control

Press [Enter] for configuration of advanced items.

Enable/Disable CPU throttling by OS. Throttling reduces power consumption.

Options available: Enabled/Disabled.

### 4.5.3 Memory Configuration




#### Enforce POR

Enable to enforce POR restrictions for DDR4 frequency and voltage programming.

Options available: Auto/Enforce POR/Disabled/Enforce Stretch Goals.

Default setting is Auto.

#### Memory Frequency

Configure memory frequency.

Options available: Auto/1333/1400/1600/1800/1867/2000/2133.

Default setting is Auto.

#### Rank Margin Tool

Options available: Auto/Disabled/Enabled.

Default setting is Auto.

#### RMT Pattern Length

Display RMT Pattern Length.

#### Memory Topology

Press [Enter] for configuration of advanced items.

#### Memory Thermal

Press [Enter] for configuration of advanced items.

### Set Throttling Mode

Configure Thermal Throttling Mode. Select OLTT or CLTT mode.

Options available: Disabled/CLTT.

Default setting is CLTT.

### MEMHOT Throttling Mode

Options available: Disabled/Output-only/Input-only.

Default setting is Input-only.

### Memory Map

Press [Enter] for configuration of advanced items.

### Socket Interleave Below 4GB

Splits the 0-4GB address space between two sockets, so that both sockets get a chunk of local memory below 4GB.

Options available: Disabled/Enabled.

Default setting is Disabled.

### Channel Interleaving

Options available: Auto/1-way Interleave/2-way Interleave/3-way Interleave/4-way Interleave.

Default setting is Auto.

### Rank Interleaving

Options available: Auto/1-way Interleave/2-way Interleave/4-way Interleave/8-way Interleave.

Default setting is Auto.

### Memory RAS Configuration

Press [Enter] for configuration of advanced items.

### RAS Mode

Enable/Disable RAS modes. Enabling Sparing and Mirroring is not supported. When this item is set to enabled, Sparing will be selected.

Options available: Disable/Mirror/Lockstep Mode.

Default setting is Disabled.

### Lockstep x4 DIMMs

Options available: Auto/Disabled/Enabled.

Default setting is Auto.

### Memory Rank Sparing

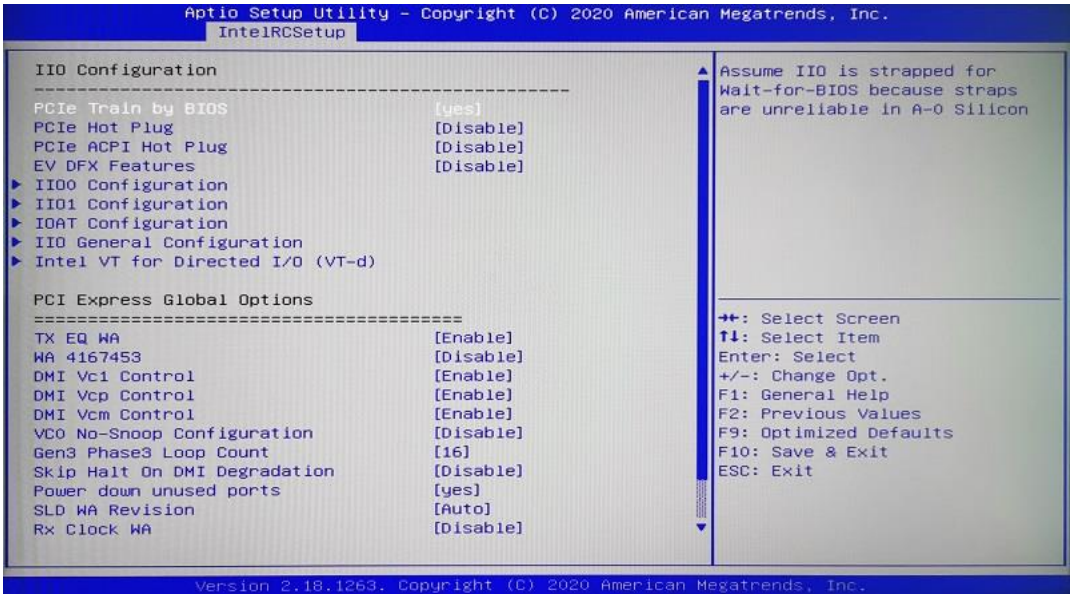
Options available: Disabled/Enabled.

Default setting is Disabled.

### Correctable Error Threshold

Press <+> / <-> keys to increase or decrease the desired values.

## 4.5.4 IIO Configuration




### EV DFX Features

Set this option to allow DFX Lock Bits to remain clear.

Options available: Enabled/Disabled.

Default setting is Disabled.

### IOAT Configuration

Press [Enter] for configuration of advanced items.

### Enable IOAT

Control to enable/disable IOAT (Intel I/O Acceleration Technology) device.

Options available: Enabled/Disabled.

Default setting is Disabled.

### No Snoop

Enable/Disable PCI Express Device No Snoop option.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Intel VT for Directed I/O (VT-d)

Press [Enter] for configuration of advanced items.

### VTd Azalea VCp Optimizations

Enable/Disable Azalea VCp optimizations.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Intel VT for Directed I/O (VT-d)

Enable/Disable Intel VT for Directed I/O (VT-d) support function.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Interrupt Remapping

Enable/Disable interrupt remapping support function.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Coherency Support (Non-Isoch)

Options available: Enabled/Disabled.

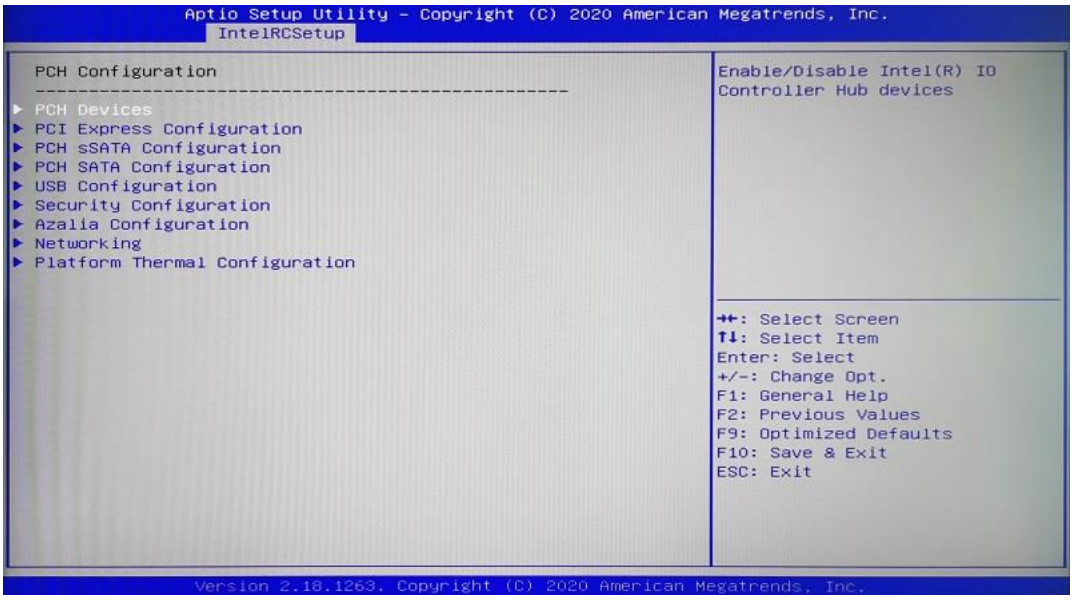
Default setting is Enabled.

### Coherency Support (Isoch)

Options available: Enabled/Disabled.

Default setting is Enabled.

### 4.5.5 PCH Configuration




#### PCH Devices

Press [Enter] for configuration of advanced items.

#### Serial IRQ Mode

Configure Serial IRQ mode.

Continuous mode : the host continually generates SERIRQ frames to check for device interrupts.

Quiet mode: the SERIRQ host waits for a SERIRQ slave to generate a request by driving the device interrupt.

Options available: Continuous / Quiet.

Default setting is Continuous.

#### PCH state after G3

This setting specifies whether your system will reboot after a power failure or interrupt occurs.

Options available: S0/ S5 / Last state.

Default setting is S0.

### PCH sSATA/SATA Configuration

Press [Enter] for configuration of advanced items.

### sSATA/SATA Controller(s)

Enable/Disable sSATA/SATA controller.

Only SATA controller (AHCI controller 1) supports RAID Mode.

Options available: Enabled/Disabled.

Default setting is Enabled.

### Configure sSATA/SATA as

Configure on chip SATA type.

IDE Mode:

When set to IDE, the SATA controller disables its RAID and AHCI functions and runs in the IDE emulation mode. This is not allowed to access RAID setup utility.

ACHI Mode:

When set to AHCI, the SATA controller enables its AHCI functionality. Then the RAID function is disabled and cannot be access the RAID setup utility at boot time.

Options available: IDE/RAID/ACHI/Disabled.

RAID Mode:

Only SATA controller (AHCI controller 1) supports UEFI RAID Mode and Legacy RAID Mode. When set to RAID, the SATA controller enables both its RAID and AHCI functions.

If configure UEFI RAID, user shall sets Advanced\CSM Configuration\Storage Sub-menu as UEFI. Save the changes and reset exit BIOS Setup. After system reboot, enter BIOS again. Then enter the Advanced\Intel Rapid Storage Technology Sub-menu to create RAID Mode.

If configure Legacy RAID, user shall sets Advanced\CSM Configuration\Storage Sub-menu as Legacy. Save the changes and reset exit BIOS Setup. On Motherboard reboot stage, User can press keyboard Ctrl + I to create RAID Mode.

### Azalia Configuration

Press [Enter] for configuration of advanced items.

### Azalia

Allows user to Enable/Disable Onboard HD Audio.

Options available: Auto/Enabled/Disabled.

Default setting is Auto.

### BIOS Security Configuration

Press [Enter] for configuration of advanced items.

### RTC Lock

The optional settings are: [Disabled]; [Enabled].

### BIOS Lock

The optional settings are: [Disabled]; [Enabled].

### Host Flash Lock-Down

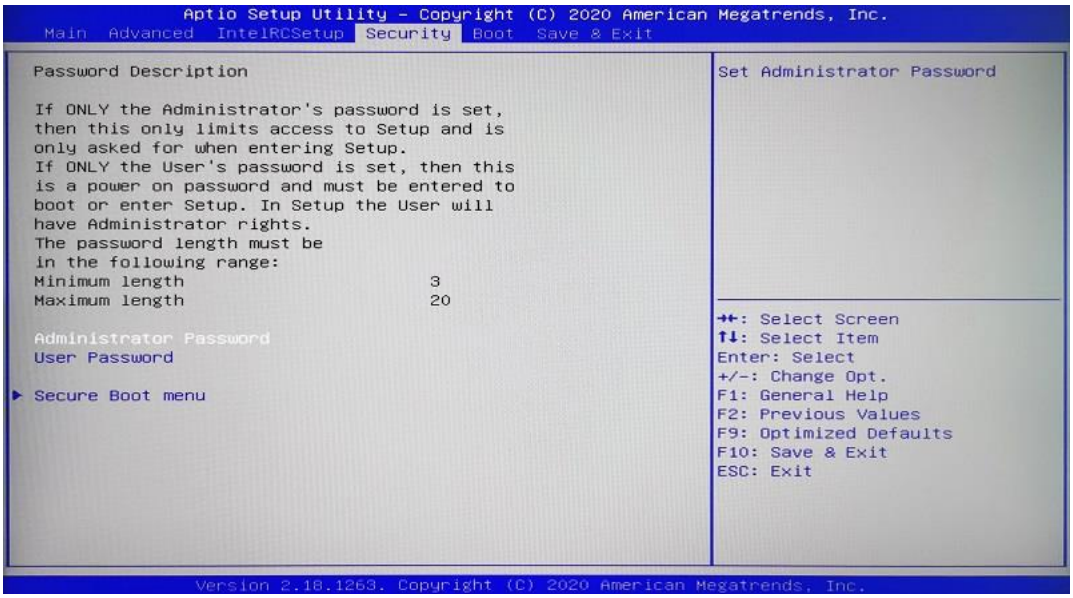
The optional settings are: [Disabled]; [Enabled].

### Gbe Flash Lock-Down

The optional settings are: [Disabled]; [Enabled].

## 4.6 Security Menu

The Security menu allows user to safeguard and protect the system from unauthorized use by setting up access passwords.



### Administrator Password

Configure the Administrator password which is required before entering the BIOS setup utility. The length of the password should be from 3 characters to 20 characters long.

### User Password

Configure the user password which is required to enter the BIOS setup utility and POST continue. The length of the password should be from 3 characters to 20 characters long.

### Secure Boot menu

### Secure Boot Control

This item allows user to set secure boot flow control. Options available: Enabled/Disabled.

Default setting is Enabled.

### Secure Boot Mode

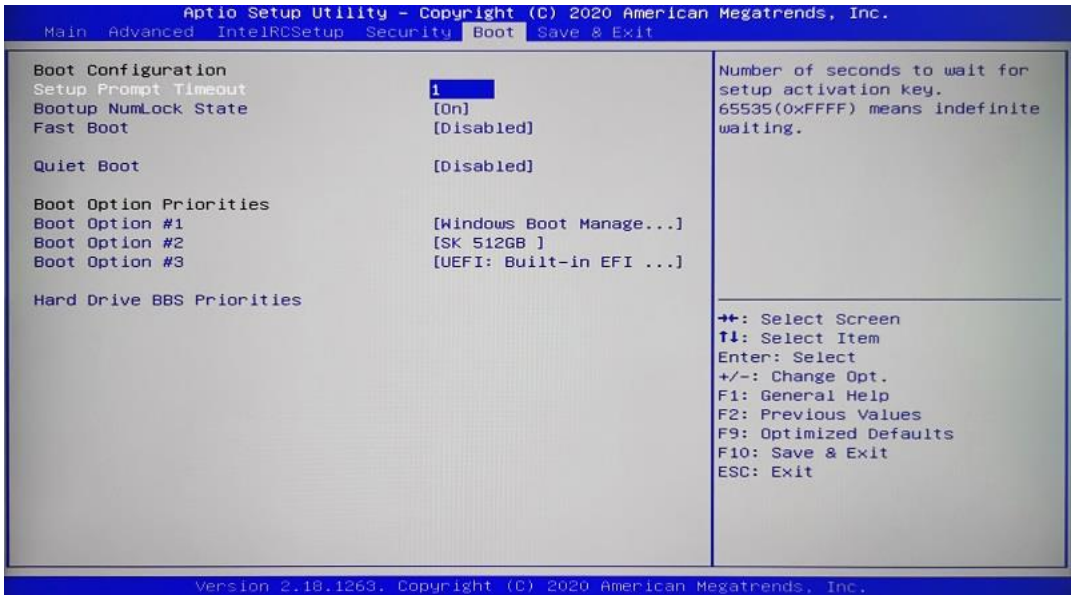
This item allows user to set secure boot mode selector.

Options available: Standard/Custom.

Default setting is Standard.

## 4.7 Boot Menu

The Boot menu allows user to set the drive priority during system boot-up. BIOS setup will display an error message if the legacy drive(s) specified is not bootable.



### Setup Prompt Timeout

Number of seconds to wait for setup activation key. 65535(0xFFFF) means indefinite waiting.

Press the number keys to input the desired value.

### Bootup NumLock State

Enable or Disable Bootup NumLock function. Options available: On/Off.

Default setting is On.

### Fast Boot

Enables or disables Fast Boot to shorten the OS boot process.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Quiet Boot

Enables or disables showing the full logo during POST.

Options available: Enabled/Disabled.

Default setting is Disabled.

### Boot Option #1/#2/#3#4

Press Enter to configure the boot priority.

By default, the server searches for boot devices in the following sequence:

1. UEFI device.

2. Hard drive.

3. Network device.

4. USB device

### Network Device BBS Priorities

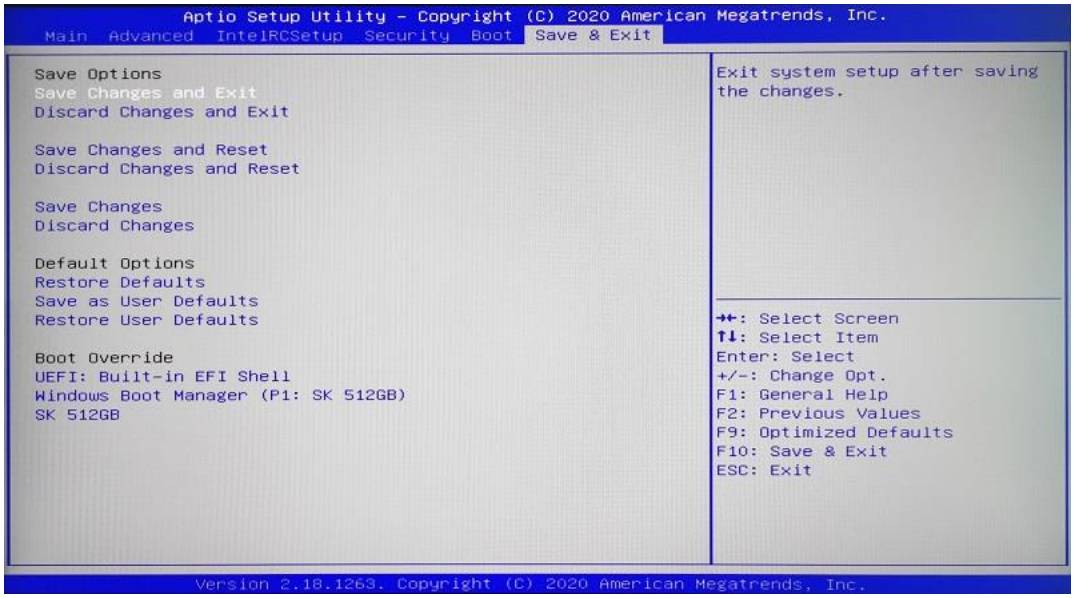
Press Enter to configure the boot priority.

### Hard Drive BBS Priorities

Press Enter to configure the boot priority.

## 4.8 Save & Exit Menu

The Exit menu displays the various options to quit from the BIOS setup. Highlight any of the exit options then press **Enter**.




### Save Changes and Exit

Saves changes made and close the BIOS setup.

Options available: Yes/No.

### Discard Changes and Exit

Discards changes made and exit the BIOS setup.

Options available: Yes/No.

### Save Changes and Reset

Saves changes made and reset the motherboard.

Options available: Yes/No.

### Discard Changes and Reset

Discards changes made and reset the motherboard.

Options available: Yes/No.

# Chapter 5 Appendix

## 5.1 Buzzer Beep Codes

| Buzzer Beep Codes | |
|---|---|
| Codes | Definition |
| 1 beep | Ready to boot |
| 1 long beep + 3 short beeps | Memory error |

## 5.2 Boot DEBUG LED Codes

| Normal Boot DEBUG LED Codes | | |
|---|---|---|
| Phase | Codes | Definition |
| PEI(Pre-EFI initialization) phase | 10 | PEI core entry |
| | 11 | PEI_CAR_CPU_INIT |
| | 15 | PEI_CAR_NB_INIT |
| | 19 | PEI_CAR_SB_INIT |
| | 1D | PEI_MEMORY_SPD_READ |
| | 1E | PEI_MEMORY_PRESENCE_DETECT |
| | 1F | PEI_MEMORY_TIMING |
| | 20 | PEI_MEMORY_CONFIGURING |
| | 21 | PEI_MEMORY_INIT |
| | 31 | PEI_MEMORY_INSTALLED |
| | 32 | PEI_CPU_INIT |

| | | |
|---|---|---|
| | 33 | PEI_CPU_CACHE_INIT |
| | 34 | PEI_CPU_BSP_SELECT |
| | 35 | PEI_CPU_AP_INIT |
| | 36 | PEI_CPU_SMM_INIT |
| | 37 | PEI_MEM_NB_INIT |
| | 3B | PEI_MEM_SB_INIT |
| | 4F | PEI_DXE_IPL_STARTED |
| DXE(Driver Execution Environment) phase | 60 | DXE_CORE_STARTED |
| | 61 | DXE_NVRAM_INIT |
| | 62 | DXE_SBRUN_INIT |
| | 63 | DXE_CPU_INIT |
| | 68 | DXE_NB_HB_INIT |
| | 69 | DXE_NB_INIT |
| | 6A | DXE_NB_SMM_INIT |
| | 70 | DXE_SB_INIT |
| | 71 | DXE_SB_SMM_INIT |
| | 72 | DXE_SB_DEVICES_INIT |
| | 78 | DXE_ACPI_INIT |
| | 79 | DXE_CSM_INIT |
| BDS(Boot Device Selection) phase | 90 | DXE_BDS_STARTED |
| | 91 | DXE_BDS_CONNECT_DRIVERS |
| | 92 | DXE_PCI_BUS_BEGIN |
| | 93 | DXE_PCI_BUS_HPC_INIT |
| | 94 | DXE_PCI_BUS_ENUM |
| | 95 | DXE_PCI_BUS_REQUEST_RESOURCES |
| | 96 | DXE_PCI_BUS_ASSIGN_RESOURCES |
| | 97 | DXE_CON_OUT_CONNECT |
| | 98 | DXE_CON_IN_CONNECT |
| | 99 | DXE_SIO_INIT |
| | 9A | DXE_USB_BEGIN |
| | 9B | DXE_USB_RESET |
| | 9C | DXE_USB_DETECT |
| | 9D | DXE_USB_ENABLE |
| | A1 | DXE_IDEAHCI_BEGIN |
| | A2 | DXE_IDEAHCI_RESET |
| | A3 | DXE_IDEAHCI_DETECT |
| | A4 | DXE_IDEAHCI_ENABLE |
| | A5 | DXE_SCSI_BEGIN |
| | A6 | DXE_SCSI_RESET |
| | A7 | DXE_SCSI_RESET |
| | A8 | DXE_SCSI_ENABLE |
| | A9 | DXE_SETUP_VERIFYING_PASSWORD |
| | AB | DXE_SETUP_START |
| | AC | DXE_SETUP_INPUT_WAIT |
| | AD | DXE_READY_TO_BOOT |
| | AE | DXE_LEGACY_BOOT |
| | AF | DXE_EXIT_BOOT_SERVICES |
| | B0 | RT_SET_VIRTUAL_ADDRESS_MAP_BEGIN |
| | B1 | RT_SET_VIRTUAL_ADDRESS_MAP_END |
| | B2 | DXE_LEGACY_OPROM_INIT |
| | B3 | DXE_RESET_SYSTEM |
| | B4 | DXE_USB_HOTPLUG |

| | | |
|---|---|---|
| | B5 | DXE_PCI_BUS_HOTPLUG |
| | B6 | DXE_NVRAM_CLEANUP |
| | B7 | DXE_CONFIGURATION_RESET |
| Error Codes | | |
| Phase | Codes | Definition |
| PEI(Pre-EFI initialization) phase | 50 | PEI_MEMORY_INVALID_TYPE/SPEED |
| | 51 | PEI_MEMORY_SPD_FAIL |
| | 52 | PEI_MEMORY_INVALID_SIZE/ MISMATCH |
| | 53 | EI_MEMORY_NOT_DETECTED/ NONE_USEFUL |
| | 54 | PEI_MEMORY_ERROR |
| | 55 | PEI_MEMORY_NOT_INSTALLED |
| | 56 | PEI_CPU_INVALID_TYPE/SPEED |
| | 57 | PEI_CPU_MISMATCH |
| | 58 | PEI_CPU_SELF_TEST_FAILED/CACHE_ERROR |
| | 59 | PEI_CPU_MICROCODE_UPDATE_FAILED/ |
| | 5A | PEI_CPU_INTERNAL_ERROR |
| | 5B | PEI_RESET_NOT_AVAILABLE |
| DXE(Driver Execution Environment) phase | D0 | DXE_CPU_ERROR |
| | D1 | DXE_NB_ERROR |
| | D2 | DXE_SB_ERROR |
| | D3 | DXE_ARCH_PROTOCOL_NOT_AVAILABLE |
| | D4 | DXE_PCI_BUS_OUT_OF_RESOURCES |
| | D5 | DXE_LEGACY_OPROM_NO_SPACE |
| | D6 | DXE_NO_CON_OUT |
| | D7 | DXE_NO_CON_IN |
| | D8 | DXE_INVALID_PASSWORD |
| | D9 | DXE_BOOT_OPTION_LOAD_ERROR |
| | DA | DXE_BOOT_OPTION_FAILED |
| | DB | DXE_FLASH_UPDATE_FAILED |
| | DC | DXE_RESET_NOT_AVAILABLE |

## 5.3 RAID Mode

### RAID 0 (Striping)

RAID 0 uses the read/write capabilities of two or more drives working in parallel to maximize the storage performance of a computer system. The following table provides an overview of the advantages, the level of fault-tolerance provided.

| RAID 0(Striping) | |
|---|---|
| Drives Supported | 2 minimum |
| Advantage | High transfer rates |
| Fault-tolerance | None-if one drive fails all data will be lost |

### RAID 1(Mirroring)

RAID 1 volumes contain two drives where the data is copied to both of the drives in real time, to provide data reliability, in the case of a single disk failure. When one disk drive fails, all

data is immediately available on the other drive without any impact to the integrity of the data. The following table provides an overview of the advantages, the level of fault-tolerance provided.

| RAID 1(Mirroring) | |
|---|---|
| Drives Supported | 2 maximum |
| Advantage | Redundancy of data. One drive may fail, but data will continue to be accessible. A rebuild to a new drive is recommended to maintain data redundancy. |
| Fault-tolerance | Excellent-Drive mirroring means that all data on one drive is duplicated on another drive. |

## RAID 5(Striping with Parity)

RAID 5 volumes contain three (minimum) or more drives where the data and parity are striped across all the drives in the volume. Parity is a mathematical method for recreating data that was lost from a single drive, which increases fault-tolerance. If there are N drives in the RAID 5 volume, the capacity for data would be N-1drives, For example, if the RAID 5 volume has 5 drives, the data capacity for this RAID volume consists of 4 drives. The following table provides an overview of the advantage, the level of fault-tolerance provided.

| RAID 5(Striping with Parity) | |
|---|---|
| Drives Supported | 3 minimum |
| Advantage | High Percentage of usable capacity and high read performance as well as fault-tolerance. |
| Fault-tolerance | Excellent-Parity information allows data to be rebuilt after replacing a failed drive with a new drive. |

## RAID 10(Mirroring with Striping)

RAID 10 volumes uses four drives to create a combination of RAID levels 0 and 1. It is a striped set whose members are each a mirrored set. It provides a great balance between performance and excellent fault tolerance as it allows 2 drives to fail while still maintaining access to data but, has a low cost effectiveness. The following table provides an overview of the advantage, the level of fault-tolerance provided.

| RAID 10(Mirroring with Striping) | |
|---|---|
| Drives Supported | 4 |
| Advantage | Combines the read performance of RAID 0 with the fault-tolerance of RAID 1. |
| Fault-tolerance | Excellent-Drive mirroring means that all data on one drive is duplicated on another drive. |