User Manual

RL-20 Motherboard

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RL-20 Motherboard

User Manual

(Version 0.5)

Version:		
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Chapter 1 Product Introduction

1.1 Brief Introduction

The RL20 motherboard is an industrial motherboard based on the Intel Alder Lake/Raptor Lake U series processor and supports 4HDMI_OUT plus 1HDMI_IN for multiple displays with MCU timed power on/off.

1.2 Parameters

Alder Lake U Processors:

- Intel® Core™ i7-1255U Processor, 10Cores 12Threads. Max Turbo Frequency: 4.70GHz, 12 MB Intel® Smart Cache. Processor Base Power: 15W, Maximum Turbo Power: 55W. Intel® Iris® Xe Graphics eligible
- Intel® Core™ i5-1235U Processor, 10Cores 12Threads. Max Turbo Frequency: 4.40GHz, 12 MB Intel® Smart Cache. Processor Base Power: 15W, Maximum Turbo Power: 55W. Intel® Iris® Xe Graphics eligible
- Intel® Core™ i3-1215U Processor, 6Cores 8Threads. Max Turbo Frequency: 4.40GHz, 10 MB Intel® Smart Cache. Processor Base Power: 15W, Maximum Turbo Power: 55W. Intel® UHD Graphics for 12th Gen Intel® Processors

Raptor Lake U Processors:

- Intel® Core™ i7-1355U Processor, 10Cores 12Threads. Max Turbo Frequency: 5GHz, 12 MB Intel® Smart Cache. Processor Base Power: 15W, Maximum Turbo Power: 55W. Intel® Iris® Xe Graphics eligible
- Intel® Core™ i5-1335U Processor, 10Cores 12Threads. Max Turbo Frequency: 4.60GHz, 12 MB Intel® Smart Cache. Processor Base Power: 15W, Maximum Turbo Power: 55W. Intel® Iris® Xe Graphics eligible
- Intel® Core™ i3-1315U Processor, 6Cores 8Threads. Max Turbo Frequency: 4.50GHz, 10 MB Intel® Smart Cache. Processor Base Power: 15W, Maximum Turbo Power: 55W. Intel® UHD Graphics for 13th Gen Intel® Processors

Memory: 2x SO-DIMM DDR4-3200 Slots, supports dual-channel, up to 64GB for maximum memory capacity.

GPU: Integrated Graphics based on CPU, the board provides 4xHDMI 2.0 outputs (dummy load supported, "OFF" by default in BIOS), and 1xHDMI input (4K at 30Hz, available on the Core i7-1255U/1355U only.). **Please Note!!!** Processors that support "Intel Iris Xe Graphics eligible" means the graphics controller will be detected as UHD or Xe graphics depending on whether the system has the dual channels memory installed.

Storage: 2 x M.2 Key M slots in total. 1xM.2_N supports 2280 NVMe(PCIe4.0 x4), 1xM.2_N/S supports 2280 NVMe(PCIe 3.0) and is NGFF adaptive.

USB: 2x USB3.2 Gen 2 ports, 1x USB2.0 port.

Type-C: 1xUSB-C(Type-C) interface, supports USB3.2 Gen 2.

Ethernet: 2x Intel Ethernet Controllers onboard (1x Intel i219 Date Rate Per Port: 1.0 Gbps + 1x Intel i226 Data

Rate Per Port: 2.5 Gbps)

Audio: High-Definition Audio Codec, CONEXANT HD CX20632. 1x CTIA 2 in 1 Audio Jack.

Serial I/O: 1x RS232 COM (RJ45 Console)

Expansion: 1xM.2 Key E slot for WiFi & Bluetooth (supports PCIe & CNVi), 1xM.2 Key B slot for 4G/5G Module. 1x SIM Slot.

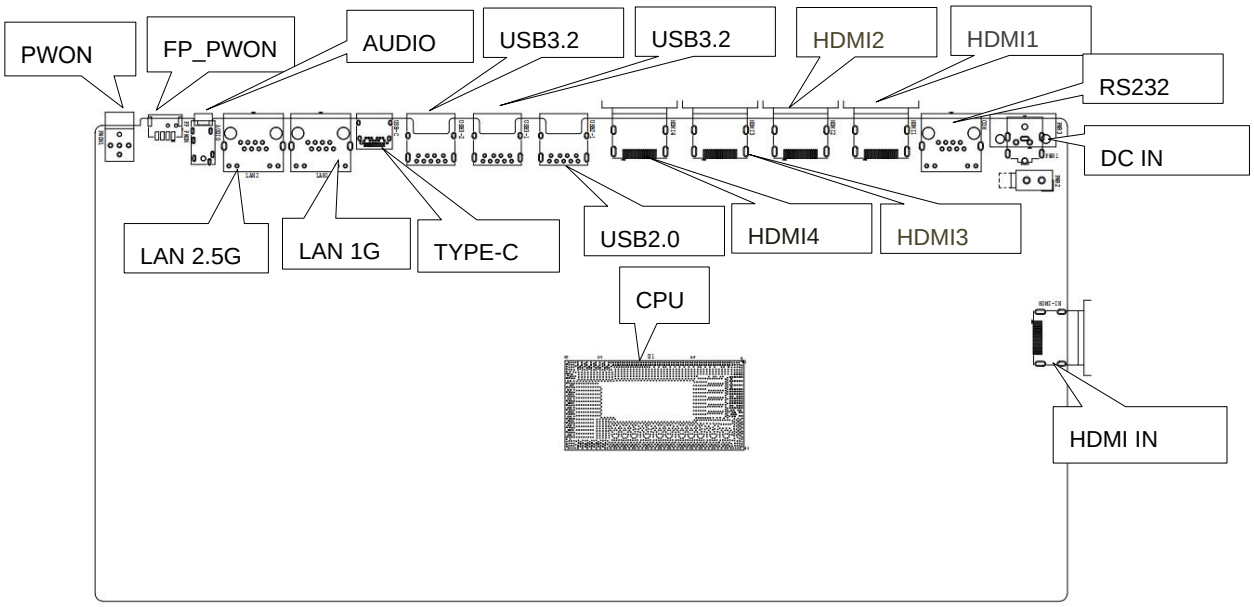
Other I/O: 1x Wired Control, 1x Power Button, 1x CPU FAN Socket, 1x CLR_CMOS Button.

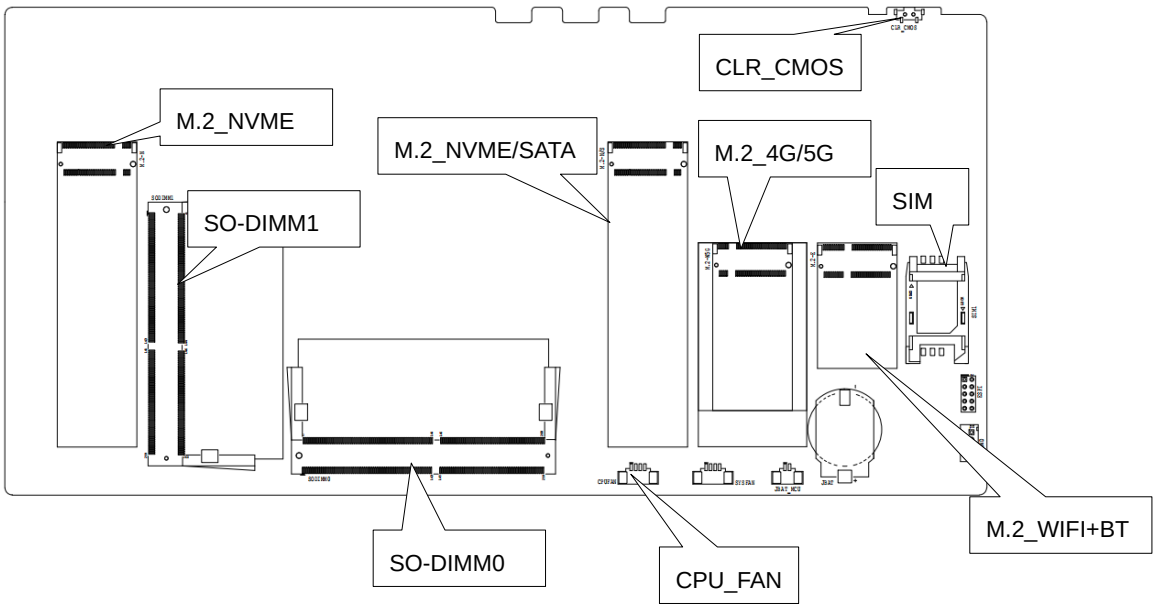
Dimension: 271.5mm x 135mm

Power: 12V/19V DC-in (Attention: the power voltage for the adapter must be 95W or above.)

Operating Temperature: -20℃~60℃

1.3 Connector Diagram





Chapter 2 Hardware

2.1 Installations

Please refer to the following steps for installations:

1. Read the user manual carefully to make sure all the adjustments on the RL-20 are correct.
2. Installing the Memory:
   - Press the ejector tab of the memory slot outwards with your fingertips.
   - Hold the memory module and align the key to the module with that on the memory slot.
   - Gently push the module into the slot until the ejector levers return completely to the closed position, holding the module in place when the module touches the bottom of the slot. To remove the module, press the ejector levers outwards to unseat the module.
3. Installing the expansion cards:
   - Locate the expansion slots and remove the screw, insert the cards into the slot at a 45-degree angle then attach the screw to the expansion cards, gently press down on it then install the screw back.
4. Connect all signal wires, cables, panel control wiring, and power supplies.
5. Start the computer and complete the setup of the BIOS program.

The board's components are integrated circuits and can easily be damaged by Electrostatic Discharge or ESD; therefore, please follow the instructions:

- Hold the board's edge when handing, and do not touch onboard pins, components, or plug sockets.
- When touching integrated circuit components (such as CPU, RAM, etc.), please wear an anti-static wrist strap/glove to avoid electrostatic discharge damage to the board or other sensitive components.
- Before installing the integrated circuits/sensitive components, place the sensitive components in anti-static bags to keep them safe from ESD.
- Please make sure the power switch is OFF before plugging the power plug.

2.2 Jumper Setting

Please configure the jumpers according to your requirements before installing the hardware.

How to identify the first header of jumpers and pins: Observe the mark beside the jumper or pins and find the header marked by “1” or bold line or triangular symbol. Or observe the rear panel and the header with a square solder pad is the first header.

2.3 Memory Slots

The board features two SO-DIMM DDR4-3200 MHz slots and supports dual-channel, up to 64GB for maximum capacity.

Attention: Make sure to hold the memory module and align the key to the module with that on the memory slot. While choosing a memory module, please make sure the module matches the specification.

2.4 Display Interfaces

The board supports Integrated Intel UHD Graphics or Intel Iris Xe Graphics based on the processor model. Processors that support “Intel Iris Xe Graphics eligible” means the graphics controller will be detected as UHD or Xe graphics depending on whether the system has the dual channels memory installed.

The board features 4x HDMI 2.0 outputs (dummy load supported, “OFF” by default in BIOS) and 1x HDMI input (supports 4K at 30Hz, available on the Core i7-1255U/1355U only.).

For processor that supports “Intel Iris Xe Graphics eligible”:

- **Connecting one memory stick**:
  - Graphics Card: Intel® UHD Graphics
  - Split screen setup, HDMI Interfaces Output Signal: HDMI 1.4
- **Connecting two memory sticks**:
  - Graphics Card: Intel® Iris® Xe Graphics
  - Split screen setup, HDMI Interfaces Output Signal: HDMI 2.0

2.5 Storage (Screen printing: M.2_N, M.2_N/S)

The board features 2 x M.2 Key M slots in total. 1xM.2_N supports 2280 NVMe(PCIe4.0 x4), 1xM.2_N/S supports 2280 NVMe(PCIe 3.0) and is NGFF adaptive.

2.6 Expansion Slot (screen printing: M.2_E, M.2_W5G)

Screen printing M.2_E: 1xM.2 key E Slot, type 2230 supports PCIE/CNVi/Wi-Fi/BT.

Screen printing M.2_W5G: 1xM.2 key B Slot, supports 4G/5G.

2.7 USB Interface

The board features 2x USB3.2 Gen2 ports and 1x USB2.0 port.

2.8 USB-C(TYPE-C) Interface

The board features 1x Type-C interface, support USB3.2 Gen2.

2.9 LAN

The board features two RJ45 LAN interfaces with Intel high-speed Gigabit network controllers. The specifications are as follows:

- **Intel i226**: Data rate per port is 2.5 Gbps. ***Note that the MAC address can only be used once and cannot be changed after use.**
- **Intel i219**: Data rate per port is 1.0 Gbps.

Both LAN1 and LAN2 support Magic Packet wake-up. Additionally, LAN1 (Intel i219) supports UEFI PXE network boot. To enable PXE network boot functions, set "IPv4 PXE Support" to "Enabled" in the BIOS.

LED Status Indicators:

LI_LED Status (Green)	Function	ACT_LED Status (Orange)	Function
Always on	Network Connected	Blinking	Data transfer

2.10 Audio (Screen printing: AUDIO)

The board features a CONEXANT CX20632 HD audio codec and supports CTIA 2 IN 1 Audio Jack.

2.11 COM

The board provides 1xRS232 serial port (RJ45 Console).

Console Port Definition (Screen Printing: COM)

Signal	RS232
1	RTS#
2	DTR#
3	SOUT
4	GND
5	GND
6	SIN
7	DSR#
8	CTS#

2.12 Board Power Supply (Screen Printing: PWR1)

The board supports a 12V/19V DC-IN.

PWR1: DC-INPUT, DC Adapter Power Socket.



2.13 CPU Fan

The board provides one auxiliary cooling fan sockets, the CPU cooling fan socket's default power supply is 5V.

CPUFAN: (Screen Printing: CPUFAN)

Pin	Signal
1	GND
2	VCC
3	TAC
4	CTL

2.14 Power Button (Screen Printing: PWON, FP_PWON)

The board is equipped with an on/off Power button, a power indicator (blue light) on the button, and an FP_PWON line switch.

CPUFAN: (Screen Printing: CPUFAN)

Pin	Signal
1	Power on/off signal, low level power on/off
2	GND
3	Light Indicator Negative
4	Light Indicator Positive

2.15 MCU Timer

The MCU timer is integrated into the motherboard, allowing the user to set independent power on/off times for each day of the week.

A microcontroller (MCU) timer is a piece of hardware that tracks time and can count up or down. It's also known as a counter. When a timer reaches a predetermined time, it sends an interrupt to the CPU to alert it.

2.16 CMOS Clearance/Retention (Screen Printing: CLR_CMOS)

CMOS is powered by onboard button batteries. Clearing CMOS will permanently remove the previous system settings and restore the board system to original settings (factory settings).

Step 1: Turn off the computer and disconnect the power supply.

Step 2: Press and hold the CLR_CMOS button for about 10 seconds, then release.

Step 3: Press the <Del> key to enter the BIOS when starting the computer. Load the optimal default values, then save and exit the setup.

⚠ **Please do not clear COMS when the PC is connected to power in case board damages.**

Chapter 3 BIOS Setup

3.1 Entering the BIOS

1. Turn on the computer and press <Delete> entering the BIOS
2. After the computer is turned on, keep pressing F11, select Enter Setup
3. BIOS Hotkeys:

   F9: Restore to Factory setting.

   F10: Save and Exit.

   ESC: Exit

3.2 Main Setup (BIOS info, Date, Time)

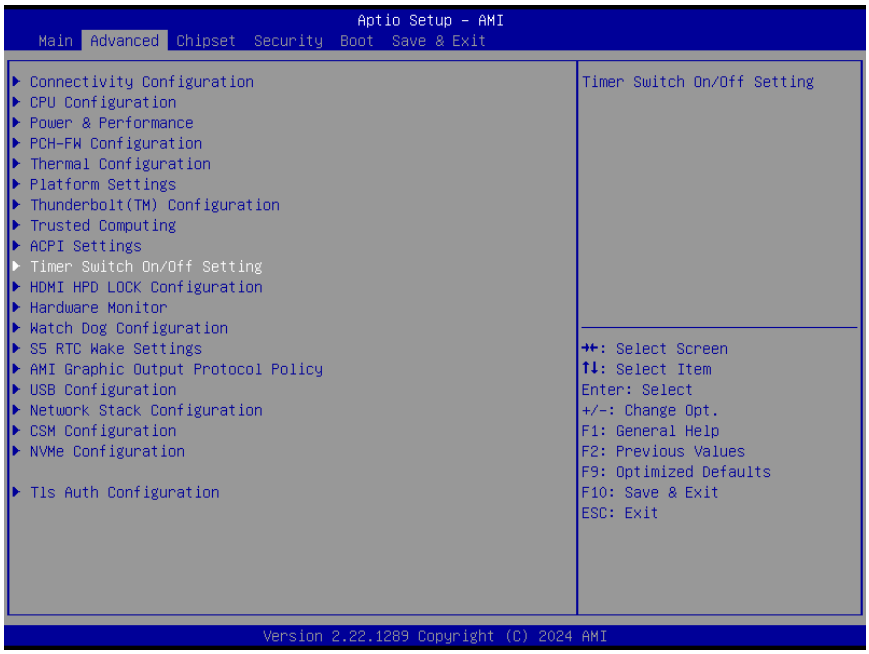
When you enter the BIOS Setup utility the first things you will encounter is the Main Setup screen. Shown below is the Main BIOS Setup screen. You can always return to the Main setup by selecting the Main tab.



System Date: Sets the date. MM/DD/YY format.

System Time: Set the time. HH:MM: SS format.

3.3 Advanced Settings



Select any of the items in the left frame of the screen. The advanced sections allow you to configure, improve and set up system features according to the preference of the CPU Configuration. All Advanced BIOS Setup options are described as follows.

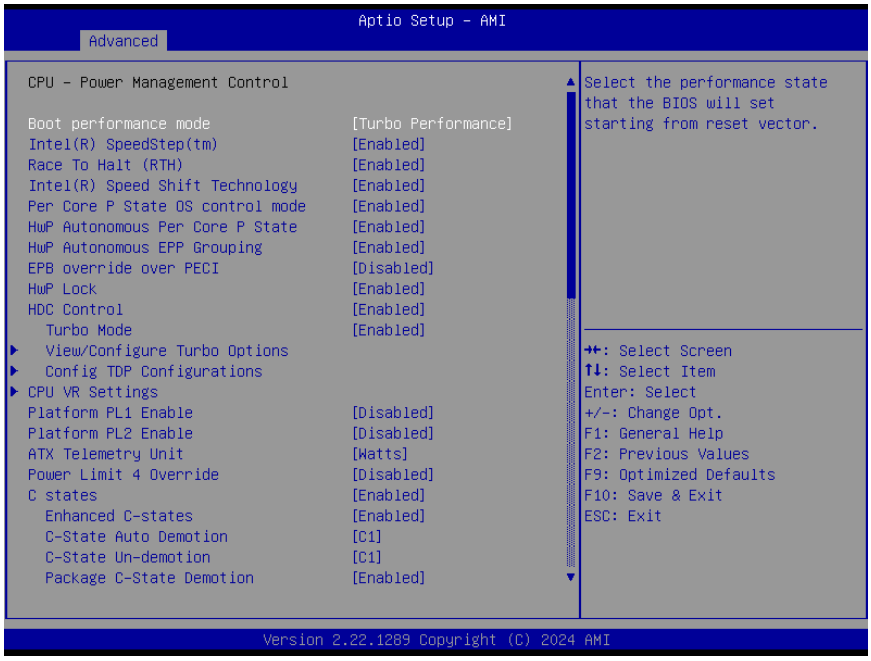
3.3.1 Power & Performance



CPU-Power Management Control

GT-Power Management Control

3.3.1.1 CPU-Power Management Control



Intel® Speedstep®(TM):

Enhanced Intel SpeedStep® Technology enables the operating system to control multiple frequencies and voltage points for optimal performance and power efficiency.

Intel® Speed Shift Technology:

An energy-efficient frequency control method by the hardware rather than relying on OS control. Processor decision is based on the different system constraints for example Workload demand, and thermal limits while taking into consideration the minimum and maximum levels and activity window of performance requested by the operating system. Default enabled.

Turbo Mode

The Turbo mode refers to Nehalem's "Integrated Power Gate" power management technology, which allows running off some cores and adding power to the others so that they run at a higher frequency. The capacity of the entire CPU remains unchanged, and the efficiency of the CPU is optimized. Default enabled.

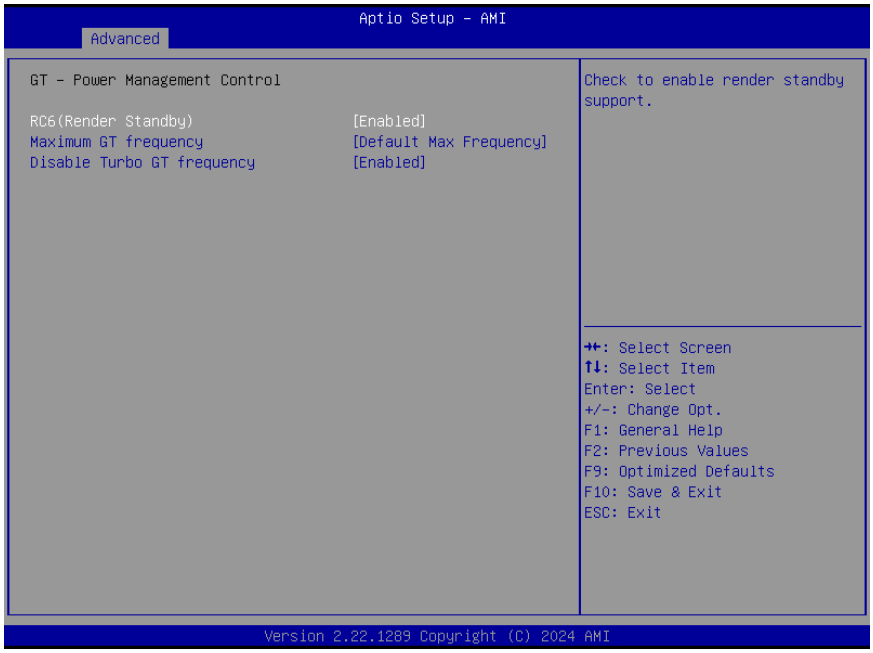
C states

Idle States (C-states) are used to save power when the processor is idle. C0 is the operational state, meaning that the CPU is doing useful work 100% load. C1 is the first idle state, C2 the second, and so on, where more power-saving actions are taken for numerically higher C-states. C1 to C3 cuts off the clock inside the CPU, and C4 to C6 reduces the CPU voltage. Default enabled.

Enhanced C states

C1 to C3 cuts the clock inside the CPU. C4 and C6 mode reduces CPU voltage. Features two way "Enhanced" mode, enable by default.

3.3.1.2 GT-Power Management Control



Maximum GT frequency：

Maximum GT Frequency, default max frequency.

Disable Turbo GT frequency：

Disable Turbo GT Frequency mode, default Enabled.

3.3.2 Thermal Configuration



Enable All Thermal Functions

CPU Thermal Configuration:

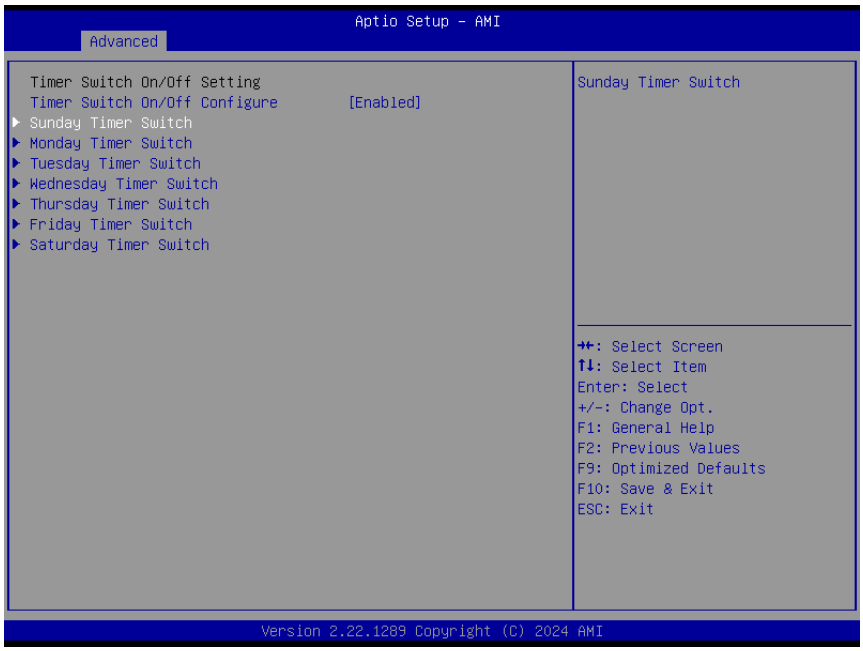
Unlocks the temperature setting, the “Tcc Activation Offset” is the temperature adjustment option. Note that the maximum temperature supported by the CPU can be checked according to Intel's official website. Change the temperature by minus the number of degrees you wish to change. For example, minus 0(100-0) to set the temperature at 100°C, minus 20(100-20) to set the temperature at 80°C.

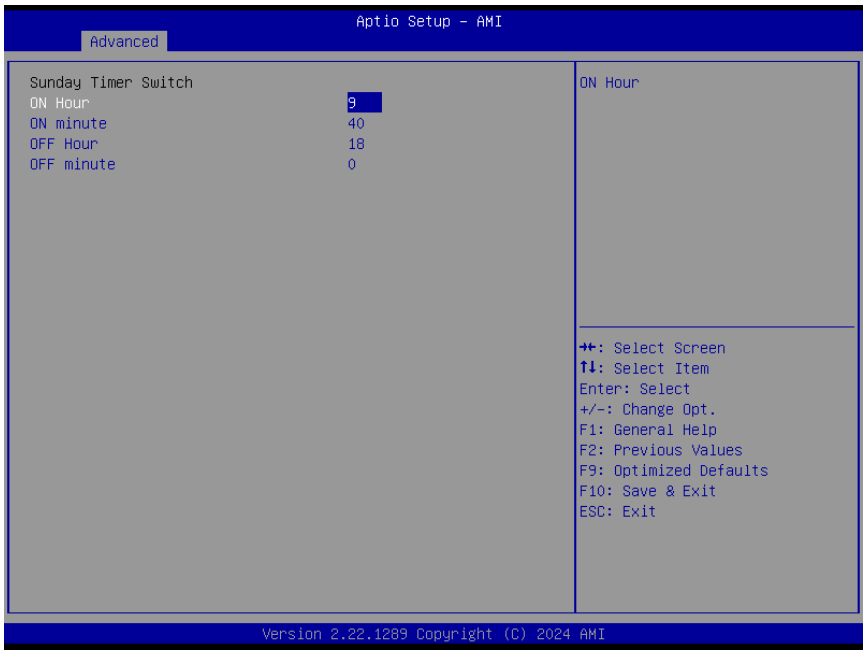
Platform Thermal Configuration

Intel® Dynamic Tuning Technology Configuration

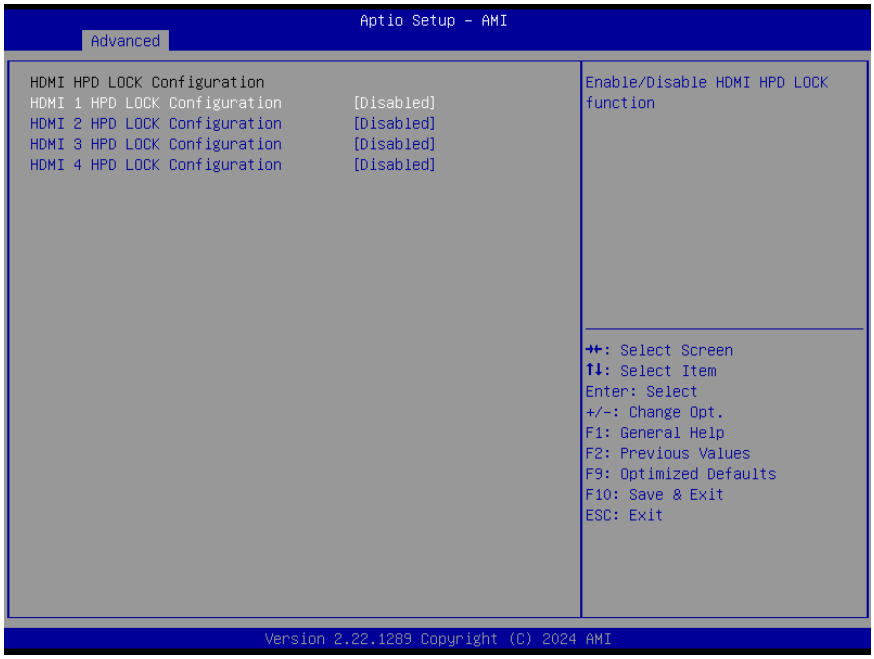
3.3.3 Timer Switch On/Off Setting

The board supports the Timer Switch On/Off Setting on top of the Real Time Clock (RTC) function. Users can set up independent power on/off scheduling for each day of the week.





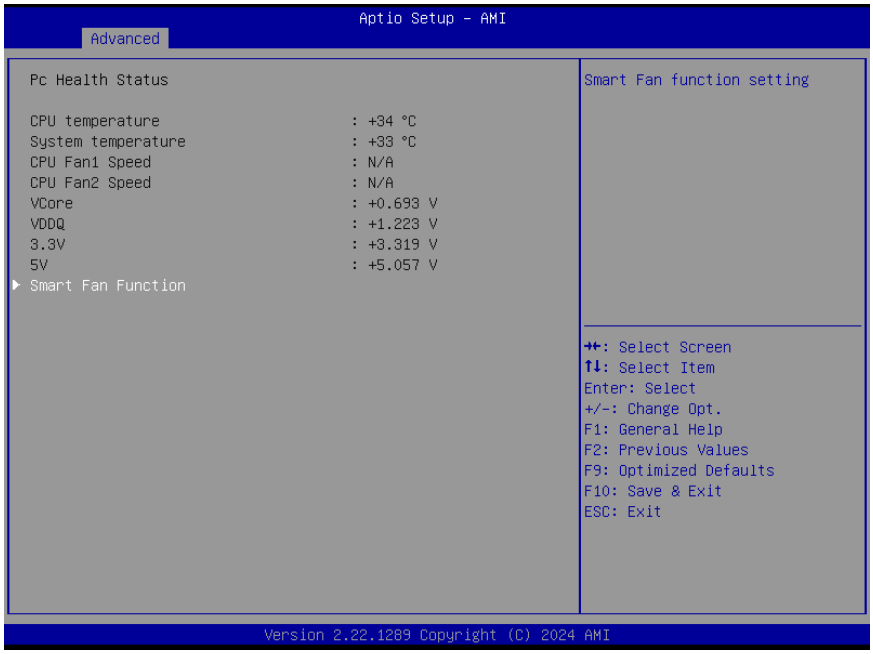
3.3.4 HDMI HPD Configuration



HDMI HPD 1~4 Configuration: HDMI OUT self-locking function 1~4 Configuration

- HDMI 1 HPD Configuration: HDMI 1 HPD enabled or disabled
- HDMI 2 HPD Configuration: HDMI 2 HPD enabled or disabled
- HDMI 3 HPD Configuration: HDMI 3 HPD enabled or disabled
- HDMI 4 HPD Configuration: HDMI 4 HPD enabled or disabled

3.3.5 Hardware Monitor

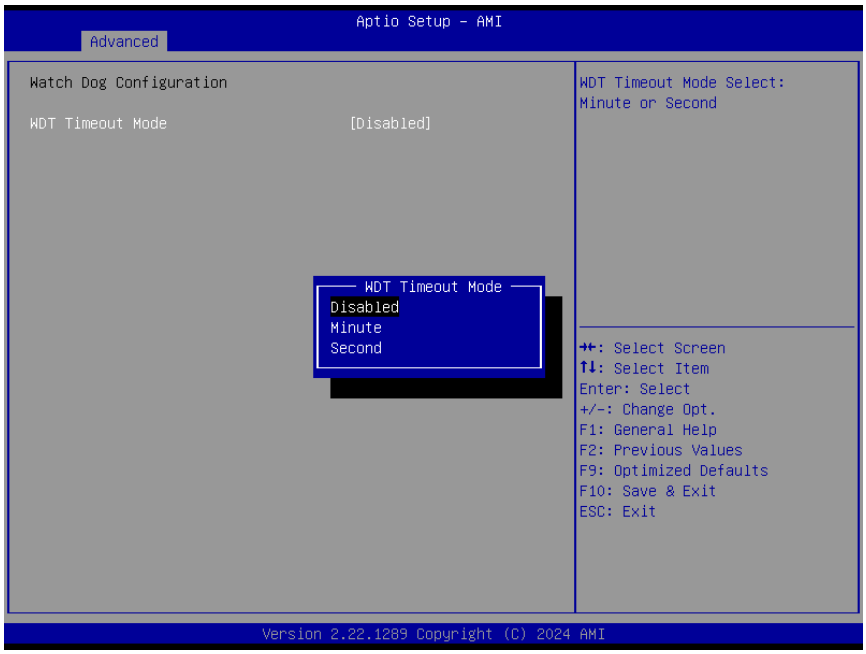


PC Health Status

The PC health status displays CPU temperature, system temperature, fan speed, and other relevant voltage values. The above parameters have a certain range, and the system cannot run beyond these ranges.

- CPU Temperature
- System Temperature
- CPU Fan1 Speed
- CPU Fan2 Speed
- VCore: Core Voltage
- VDDQ: RAM Voltage
- 3.3V: 3.3V
- 5V: 5V
- Smart Fan Function:
  - Automatic Mode
  - Full on Mode
  - Manual Mode

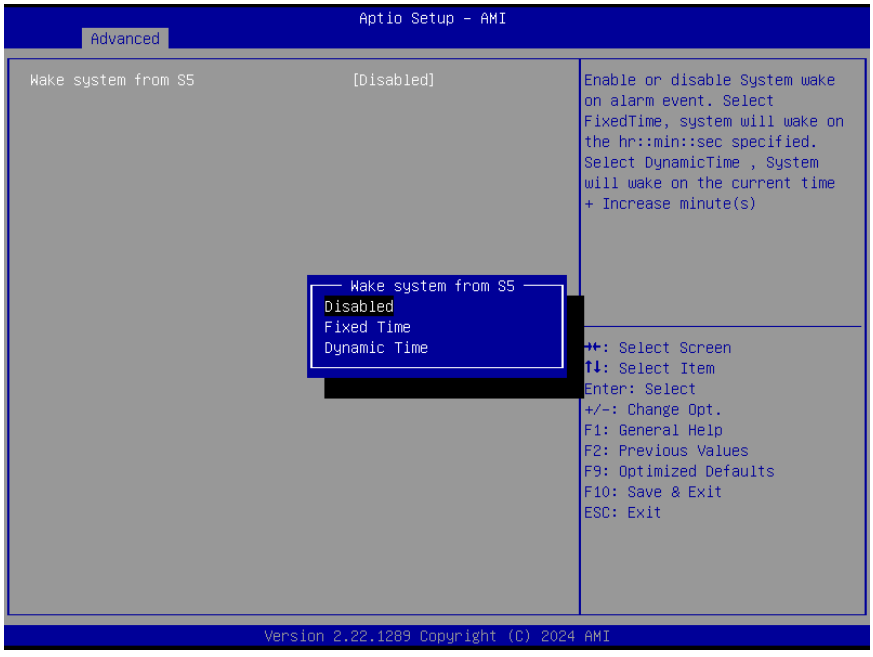
3.3.6 Watch Dog Configuration



Watch Dog Configuration

WDT Timeout Mode select: Minute or Second

3.3.7 S5 RTC Wake Settings

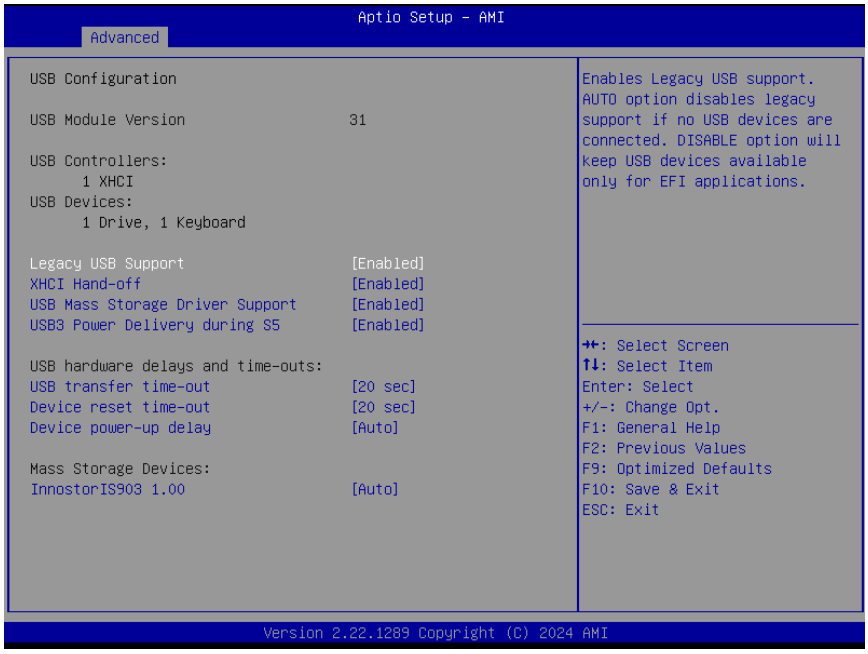


Wake system From S5: timing boot settings, disabled by default.

Fixed Time: Select Fixed Time and the system will wake on the Hr: Min: Sec specified.

Dynamic Time: Select Dynamic Time and the system will wake on a dynamic time.

3.3.8 USB Configuration



Legacy USB Support

Enable Legacy USB support. Disables legacy support if no USB devices are connected. Select enable will keep USB devices available under UEFI's support.

XHCI Hand-off

A workaround for OS without XHCI hand-off support. The XHCI ownership change should be claimed by the USB XCHI driver.

USB Mass Storage Driver Support

Enable(default) or disable USB Mass Storage Driver Support.

USB Transfer Time-out

Time-out value for control, bulk, and interrupt transfers, default time:20 second.

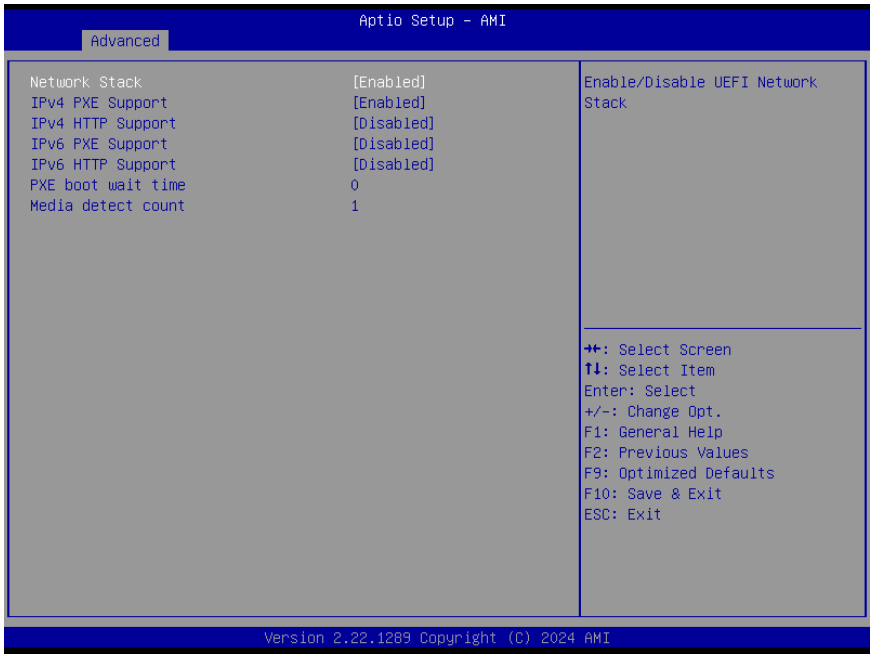
Device Reset Time-out

USB mass storage device start unit command time-out, default time:20 second.

Device Power-up Delay

Maximum time the device will take before it properly reports itself to the host controller.

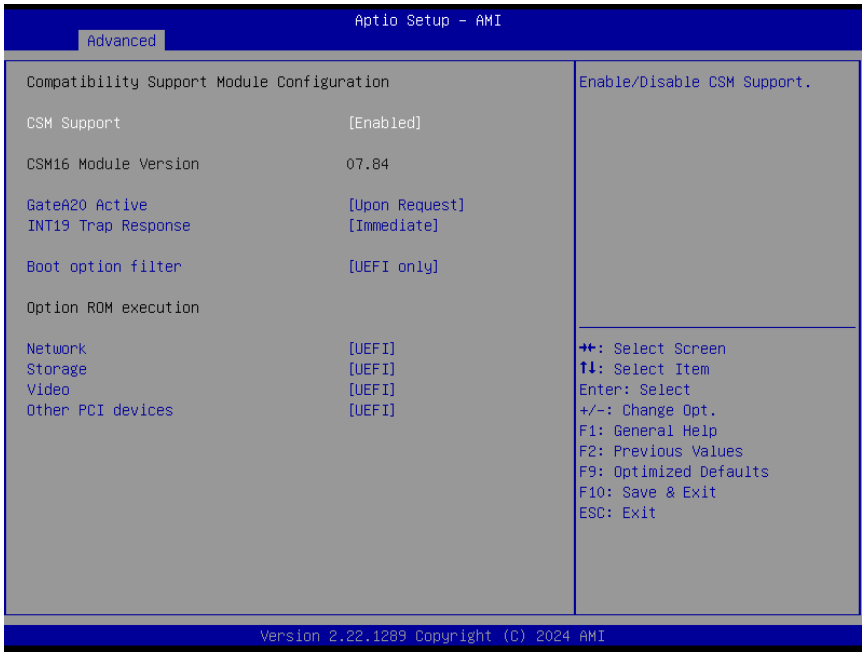
3.3.9 Network Stack Configuration



Network Stack

PXE Network boot setting, disabled by default.

3.3.10 CSM Configuration



Boot Option Filter

Option ROM Execution

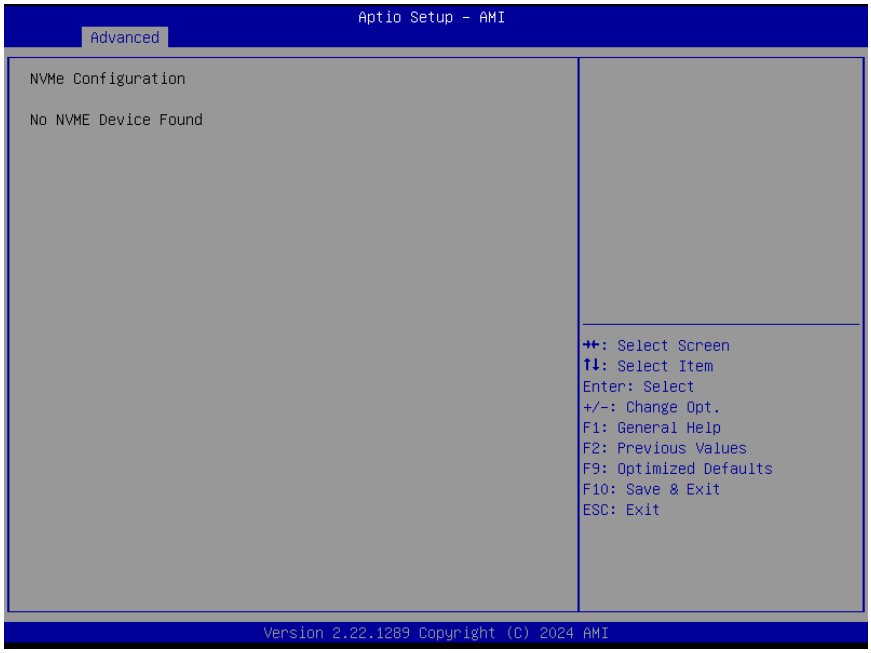
Network

Storage

Video

Other PCI Devices

3.3.11 NVME Configuration



The capacity and model of the SSD will be displayed under the option after the NVMe protocol SSD has been installed.

3.4 Chipset

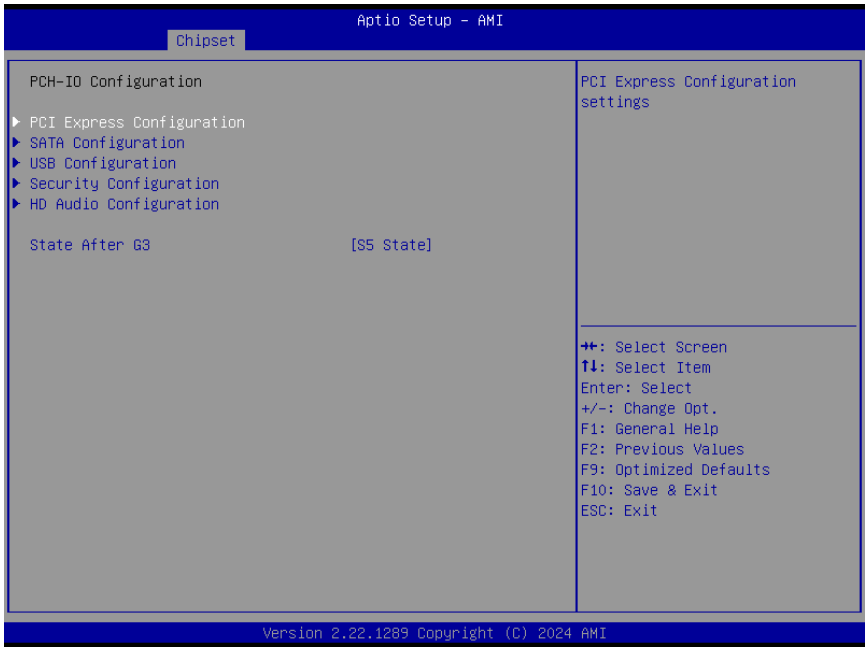
Select the chipset tab from the setup screen to enter the chipset BIOS Setup screen.



System Agent (SA) Configuration: Northbridge configuration options, including video memory, display devices, and other options.

PCH-IO Configuration: Southbridge configuration options, including hard disk, sound card equipment, and other options

3.4.1 PCH-IO Configuration



PCI Express Configuration

SATA Configuration

USB Configuration

Security Configuration

HD Audio Configuration

PCH LAN Controller

State After G3 is set to S0 State (auto-start after power-on)

3.5 Security

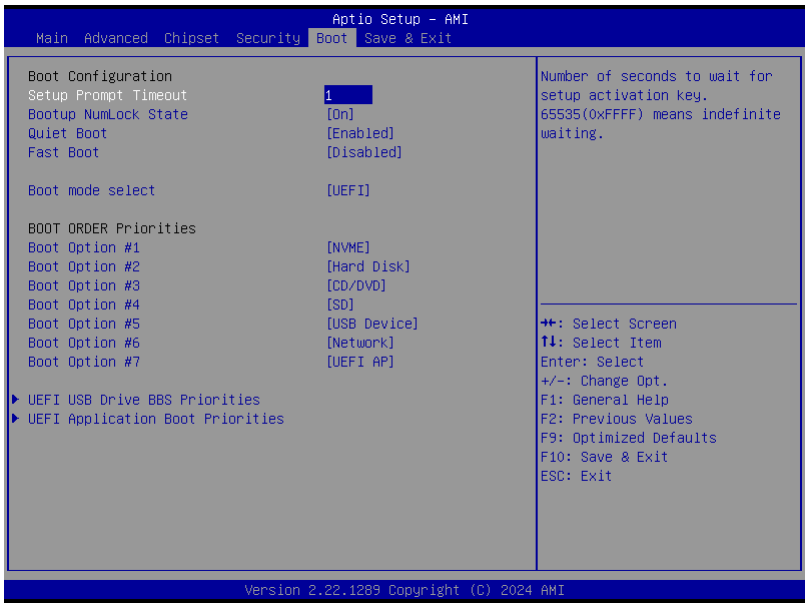


Administrator Password: Set the Administrator Password.

User Password: Set User Password.

Secure Boot: Secure boot

3.6 BOOT



Setup Prompt Timeout:

Number of seconds that the firmware will wait before initiating the original default boot selection. A value of 0 indicates that the default boot selection is to be initiated immediately on boot. A value of 65535(0xFFFF) indicates that firmware will wait for user input before booting. This means the default boot selection is not automatically started by the firmware.

Bootup NumLock State:

Select the keyboard NumLock state

Show Full Logo:

Enabled/Disabled Displays customized boot logo.

Boot Option #1~#7:

Set the system boot order from Number 1 to Number 6.

UEFI Hard Disk Drive BBS Priorities:

UEFI hard drive boot priorities setting.

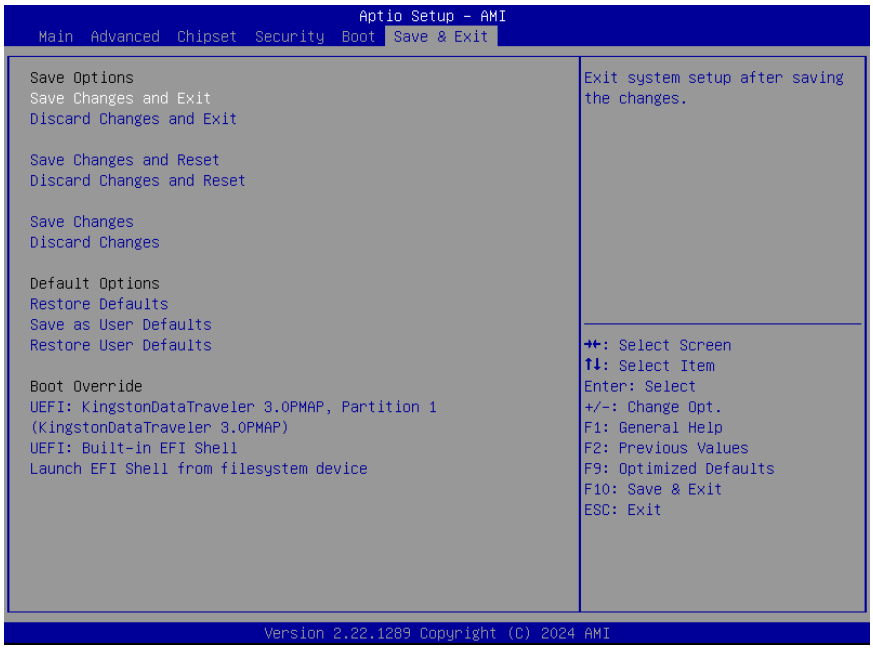
UEFI USB Drive BBS Priorities:

UEFI USB device boot priorities setting.

UEFI Application boot Priorities:

UEFI application boot priority.

3.7 Save & Exit



Save Changes and Exit:

Exit the system setup after saving the changes and continue to start the computer.

Discard Changes and Exit:

Exit the system setup without saving any changes and continue to start the computer.

Save Changes and Reset:

Reset the system after saving the changes.

Discard changes and Reset:

Reset the system without saving any changes.

Save Changes:

Save changes done so far to any of the options.

Discard Changes:

Discard changes done so far to any of the options.

Restore Defaults:

Restore/load default values for all the options.

Save as User Defaults:

Save the changes done so far as the user defaults.

Restore User Defaults:

Restore the user defaults to all the options.

Boot Override:

Boot device selection can override your boot priority. Select the specified boot device such as SATA, USB Flash Disk, EFI Shell, PXE, etc., and boot directly. Or press F11 boot by selecting the specified boot device.