USER'S MANUAL

MMB541

Intel® Socket 1700 Core™ i9/i7/ i5/ i3 /Pentium®/ Celeron® Processors mATX Industrial Motherboard

User's Manual

AXIOMTEK

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CAUTION

Wrong type of batteries may cause explosion. It is recommended that users only replace with the same or equivalent type of batteries as suggested by the manufacturer once properly disposing of any used ones.

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ESD Precautions

Computer boards have integrated circuits sensitive to static electricity. To prevent chipsets from electrostatic discharge damage, please take care of the following jobs with precautions:

- Do not remove boards or integrated circuits from their anti-static packaging until you are ready to install them.
- Before holding the board or integrated circuit, touch an unpainted portion of the system unit chassis for a few seconds. To discharge static electricity from your body.
- Wear a grounding wrist strap, available from most electronic component stores, when handling boards and components.

Trademarks Acknowledgments

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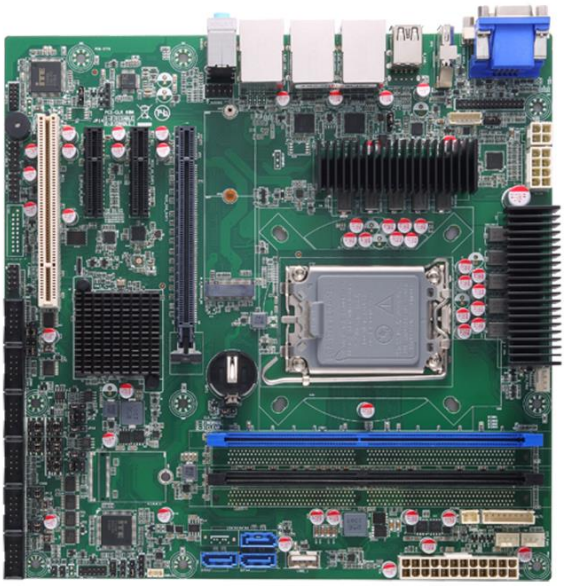
Section 1
Introduction



The MMB541 is an advanced mATX industrial motherboard based on the 14th Generation Intel® Core™ i9 / i7/ i5/ i3/ Pentium®, Celeron® processors (Raptor Lake-S refresh) in an LGA1700 socket and comes with an Intel® H610 chipset. Specially designed for optimal computing and visual performance, the MMB541 motherboard is an ideal solution for major industry applications ranging from traditional automation to AIoT to designing control system and AI workloads applications. With its built-in Intel® UHD Graphics, this industrial grade motherboard delivers superb 3D visual performance and supports triple display through, DVI-D, DP++ and VGA ports to meet professional-grade needs.

In addition, the MMB541 supports Intel® Turbo Boost 3.0 technology, Intel® Hyper-Threading technology, Intel® UHD Graphics, 64GB DDR4-3200 Non-ECC un-buffered Long-DIMM, and PCI-Express 4.0 x16 slot and PCIe x4 slots making it specifically suited for various applications.

1.1 Features

- LGA1700 socket 12/13/14th Generation Intel® Core™ i9 / i7/ i5/ i3/ Pentium®, Celeron® processors (RPL-S Refresh) up to 125W
- 2 x 288-pin DDR4-3200 Non-ECC un-buffered Long-DIMM with maximum memory capacity up to 64GB (max. 32GB per slot)
- 2 x i226-V & 1 x i210-AT
- DVI-D, DP++, and VGA with Triple-view support
- 3 x SATA-6.0Gb/s
- 4 x USB3.2 Gen1x1 (5Gbps), 4 x USB 2.0(Rear I/O) and 1 x USB 2.0 with 180D type A

1.2 Specifications

- **CPU**
- LGA1700 Socket 12/13/14th Generation Intel® Core™ i9 / i7/ i5/ i3/ Pentium®, Celeron® processors (RPL-S Refresh) up to 125W

- **Chipset**
  - Intel® H610

- **BIOS**
  - AMI BIOS

- **System Memory**
  - 2 x 288-pin Non-ECC un-buffered Long-DIMM sockets
  - Maximum 64GB DDR4 memory (max. 32GB per slot)
  - Supports DDR4-3200Mhz

- **Onboard Multi I/O**
  - 1 x SMBus
  - Serial ports:
    - 4 x RS232 (COM1/2/5/6)
    - 1 x RS232/RD422/RS485 (COM3, box header).
    - 1 x RS232/RS485 (COM4, box header)

- **USB Interface**
  - 4 x USB 3.2 Gen1x1 (5Gbps, rear I/O)
  - 4 x USB 2.0 (rear I/O)
  - 4 x USB 2.0 (internal pin header)
  - 1 x USB 2.0 (internal 180D type A)

- **Ethernet**
  - LAN1: 10/100/1000/2500 Mbps with Intel® i226-V; supports Wake-on-LAN, PXE Boot ROM
  - LAN2 & 3: 10/100/1000 Mbps with Intel® i210-AT; supports Wake-on-LAN, PXE Boot ROM

- **Serial ATA**
  - 3 x SATAIII ports

- **Audio**
  - Realtek ALC897 HDA Codec
  - Supports MIC-in/line-in/line-out

- **Display**
  - 1 x DisplayPort: up to 4096x2160@30Hz
  - 1 x DVI :Support DVI-D, max resolution up to 1920x1200@60Hz

- 1 x VGA (DB15/F): max resolution up to 1920x1200@60Hz

- **Expansion Interface**
  - 1 x PCI-E x16 Slot (PCIe x16, GEN4)
  - 2 x PCI-E x4 Slots with open-ended from PCH (PCIe x2, GEN3)
  - 1 x 32-bit PCI Slot (Support CLK 33/66MHz select by jumper, default 33MHz)
  - 1 x M.2 Key-M 2242/2280 Slot (support SATA signal)

- **Power Input**
  - 1 x ATX 8P CPU Power Input Connector
  - 1 x ATX 4P CPU Power Input Connector
  - 1 x ATX 24P Power Input Connector

- **Operating Temperature**
  - 0°C ~ 60°C

- **Humidity**
  - 10% to 95% relative humidity, non-condensing

- **Storage Temperature**
  - -20°C ~ 75°C

- **Form Factor**
  - 244 x 244mm

Note

All specifications and images are subject to change without notice.

1.3 Packing list

- **Bulk packing**
  - 1 x Motherboard
  - 1 x I/O bracket

- **Gift box**
  - 1 x Motherboard
  - 1 x I/O bracket

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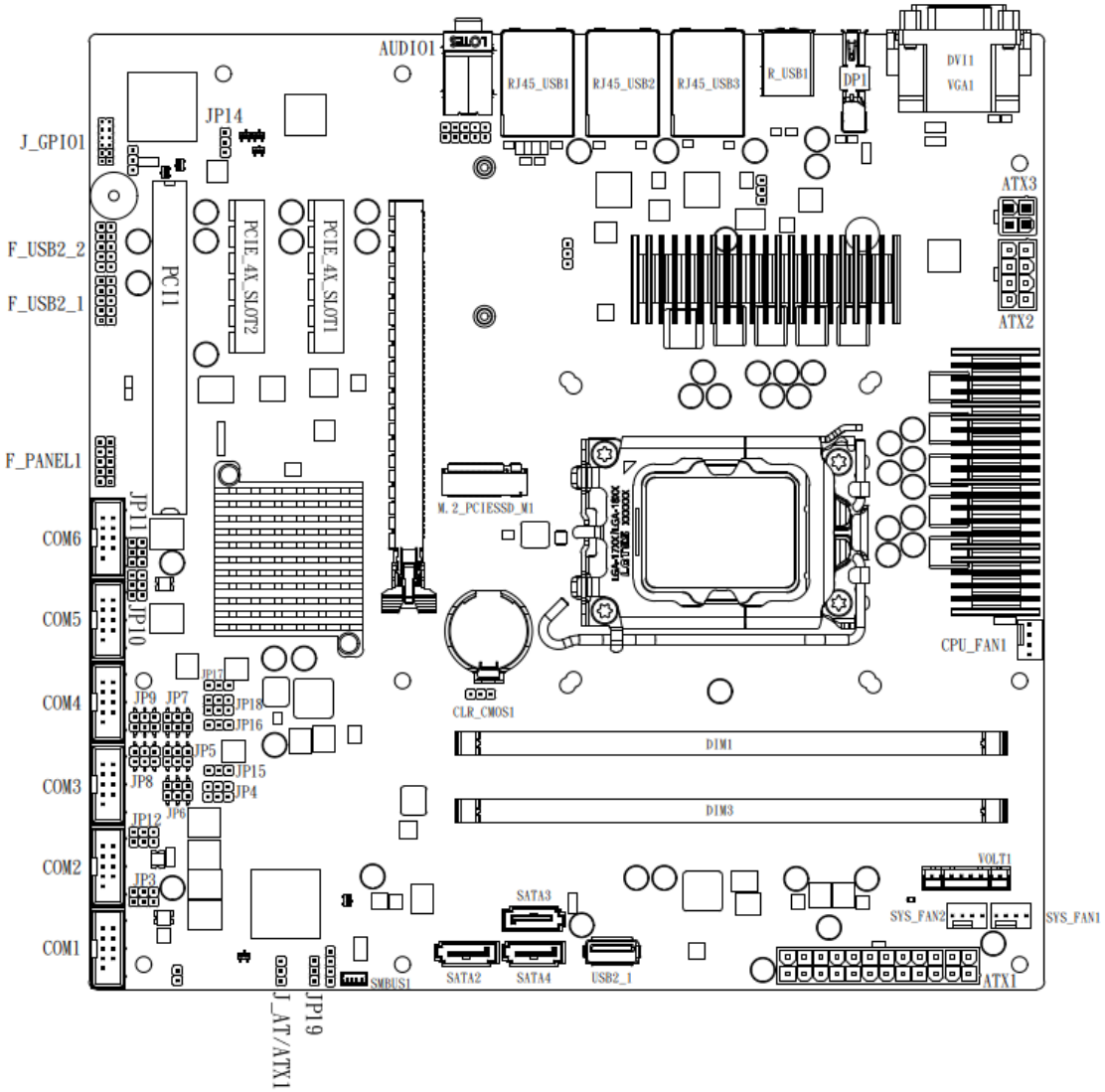
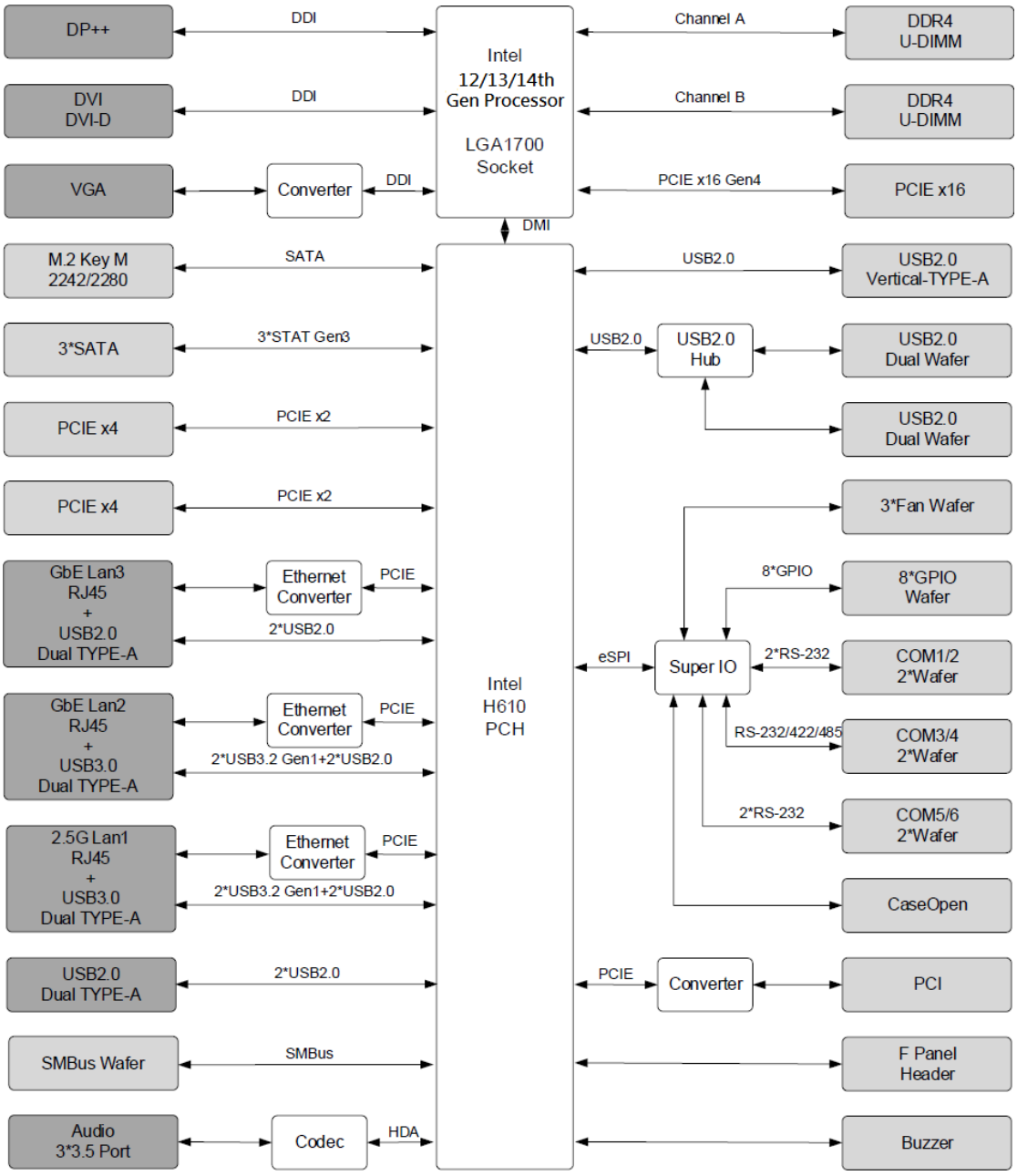
Section 2
Board and Pin Assignments

2.1 Board Layout

Top side

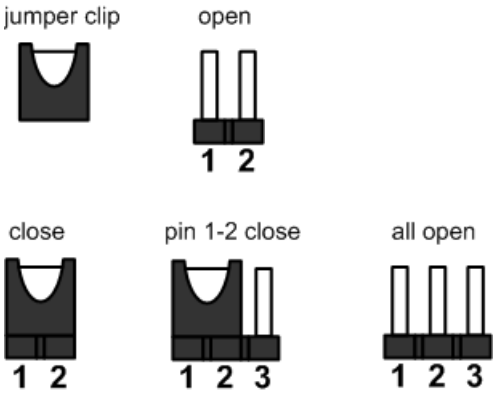


2.2 Block Diagram



2.3 Jumper Settings

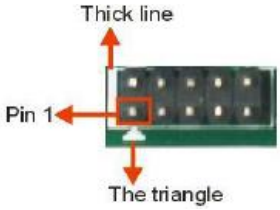
Pin description
A jumper is a small component consisting of a jumper clip and jumper pins. Install a jumper clip on two jumper pins to close the jumper pins. Remove the jumper clip from two jumper pins to open the jumper pins. The following illustration shows how to set up a jumper.



Note

To identify the first pin of a header or jumper, please refer to the following information:

- ***There is a thick line or a triangle near the header or jumper pin 1.***



- ***A square pad, which you can find on the back of the motherboard, is usually used for pin 1.***

Before applying power to the MMB541 series motherboard, make sure all of the jumpers are in factory default position. Below you can find a summary table of all jumpers and onboard default settings.

2.3.1 AT/ATX Mode Select (J_AT/ATX1)

This 3x1-pin p=2.54mm jumper allows you to select AT or ATX power mode.

Function	Setting
ATX mode (Default)	1-2 close
AT mode	2-3 close

2.3.2 Clear CMOS (CLR_CMOS1)

This jumper (3x1 pin p=2.54mm) allows you to clear the Real Time Clock (RTC) RAM in CMOS. You can clear the CMOS memory of date, time, and system setup parameters by erasing the CMOS RTC RAM data. The onboard button cell battery powers the RAM data in CMOS, which includes system setup information such as system passwords.

To erase the RTC RAM:
1. Turn OFF the computer and unplug the power cord.
2. Remove the onboard battery.
3. Move the jumper clip from pins 1-2 (default) to pins 2-3. Keep the clip on pins 2-3 for about 5~10 seconds, then move the clip back to pins 1-2.
4. Re-install the battery.
5. Plug the power cord and turn ON the computer.
6. Hold down the <Del> key during the boot process and enter BIOS setup to re-enter data.

Function	Setting
Normal (Default)	1-2 close
Clear	2-3 close

2.3.3 Watch Dog Reset Enable/Disable Select (JP19)

This 3x1-pin p=2.54mm jumper allows you to enable Watch Dog Reset.

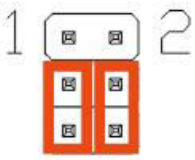
Function	Setting
Disable	1-2
Enable (Default)	2-3

2.3.4 PCI CLK 33/66MHz Select (JP14)

Function	Setting
PCI CLK 33MHz (Default)	1-2
PCI CLK 66MHz	2-3

2.3.5 COM pin1(DCD/5V) pin9(RI/12V) Select (JP3, JP12, JP8, JP9, JP10, JP11)

Function	Setting
COM_PIN1: +5V COM_PIN9: +12V	1-3 2-4
COM_PIN1: DCD (Default) COM_PIN9: RI (Default)	3-5 4-6



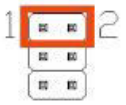
Note

- ***Jumper 1-3/3-5 select the COM_PIN1 signal. Jumper 2-4/4-6 select the COM_PIN9 signal.***
- ***JP3 for COM1, JP12 for COM2, JP8 for COM3, JP9 for COM4, JP10 for COM5, JP11 for COM6.***

2.3.6 COM3 Mode Select (JP4, JP5, JP6)

Use these jumpers (3x2-pin p=2.54mm) to set COM3 port to operate in RS-232, RS-422 or RS-485 communication mode.

Function	Setting
RS232 (Default)	JP4: 1-2 JP5: 3-5、4-6 JP6: 3-5、4-6
RS422	JP4: 3-4 JP5: 1-3、2-4 JP6: 1-3、2-4
RS485	JP4: 5-6 JP5: 1-3、2-4 JP6 (No Effect)



JP4

JP5, JP6

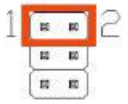
Note

- ***COM3 default is RS232 can be RS485 or RS422 by jumper and BIOS selecting.***

2.3.7 COM4 Mode Select (JP7, JP18)

Use these jumpers (3x2-pin p=2.54mm) to set COM4 port to operate in RS-232 or RS-485 communication mode.

Function	Setting
RS232 (Default)	JP18: 1-2 JP7: 3-5、4-6
RS485	JP18: 5-6 JP7: 1-3、2-4



JP18

JP7

Note

- ***COM4 default is RS232 can be RS485 by jumper and BIOS selecting.***

2.3.8 RS422/RS485 Signal 120Ω Resistive termination Select (JP15, JP16, JP17)

Use these jumpers (3x1-pin p=2.54mm) to set signal

Function	Setting
Disable (Default)	1-2
Enable	2-3

2.4 Connectors

Signals go to other parts of the system through connectors. Loose or improper connection might cause problems. Make sure all connectors are properly and firmly connected. Here is a summary table showing the connectors on the motherboard.

Connector	Description
ATX1	ATX 24P Power Input Connector
ATX2	ATX 8P CPU Power Input Connector
ATX3	ATX 4P CPU Power Input Connector
F_PANEL1	Front Panel Header
CPU_FAN1	CPU FAN Wafer
SYS_FAN1	System FAN Wafer1
SYS_FAN2	System FAN Wafer2
VGA1	VGA DB15/F Connector
DVI1	DVI-D 24+1P/F Connector (Support DVI-D)
DP1	DP Connector
R_USB1	Dual USB2.0 Type-A connector
RJ45_USB3	GbE LAN and USB2.0 Connectors
RJ45_USB2	GbE LAN and USB3.2 Connectors
RJ45_USB1	2.5G LAN and USB3.2 Connectors
AUDIO1	Line-Out + MIC-In + Line-In 3.5mm Jack
M.2_PCIESSD_M1	M.2 Key-M Slot 2242/2280 (SATA SSD only)
SATA 2~4	SATA3.0 7P Upright Connector 2-4
F_USB2_1, F_USB2_2	Front USB2.0 Header
USB2_1	USB2.0 Internal Vertical TYPE-A Connector
J_GPIO1	GPIO Header
COM1~6	COM1/2/3/4/5/6 Box Header
SMBUS1	SMBUS Wafer
VOLT1	Power Monitor Wafer
PCIE_4X_SLOT1~2	PCI-E x4 Slot
PCI1	PCI Slot

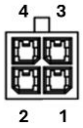
2.4.1 Power Input Connectors (ATX1, ATX2 and ATX3)

Steady and sufficient power can be supplied to all components on the motherboard by connecting the power connector. Please make sure all components and devices are properly installed before connecting the power connector.

An external power supply plug fits into ATX1 and ATX2 and ATX3 in only one orientation. Properly press down power supply plug until it completely and firmly fits into the connector. Loose connection may cause system instability.

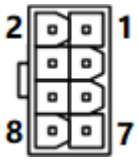
ATX3 CPU power input connector

Pin	ATX3 Signal
1	GND
2	GND
3	+12V
4	+12V



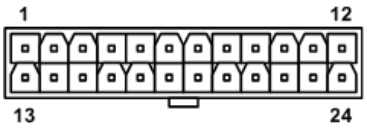
ATX2 CPU power input connector:

Pin	ATX2 Signal	Pin	ATX2 Signal
1	GND	2	+12V
3	GND	4	+12V
5	GND	6	+12V
7	GND	8	+12V



ATX1 24-pin power input connector:

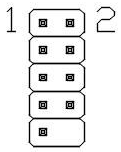
Pin	ATX1 Signal	Pin	ATX1 Signal
1	3.3V	13	3.3V
2	3.3V	14	-12V
3	GND	15	GND
4	+5V	16	PS_ON
5	GND	17	GND
6	+5V	18	GND
7	GND	19	GND
8	PWR OK	20	-5V
9	5VSB	21	+5V
10	+12V	22	+5V
11	+12V	23	+5V
12	3.3V	24	GND



2.4.2 Front Panel Header (F_PANEL1)

This is a front panel header (5x2-pin p=2.54mm).

Pin	Signal	Pin	Signal
1	HD LED+	2	Power LED+
3	HD LED-	4	Power LED-
5	RESET SW-	6	PWR SW+
7	RESET SW+	8	PWR SW-
9	N/C		



2.4.3 Fan Connectors (CPU_FAN1, SYS_FAN1, SYS_FAN2)

This motherboard has three fan connectors. Find fan speed option(s) at BIOS Setup Utility:

The CPU_FAN1 (4x1-pin p=2.54mm) is for the CPU fan connector.

Pin	Signal
1	GND
2	+12V
3	FAN Speed Detection
4	FAN Speed Control

The SYS_FAN1 and SYS_FAN2 (4x1-pin p=2.54mm) are for system fan connectors.

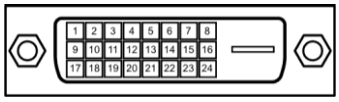
Pin	Signal
1	GND
2	+12V
3	FAN Speed Detection
4	FAN Speed Control

2.4.4 VGA and DVI-D Connector (VGA1, DVI1)

VGA1 DVI1 is a double-deck connector comprising a lower connector for DVI-D port and an upper connector for VGA port.

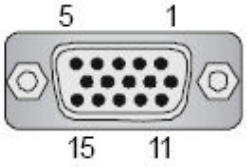
The high rise DVI-D connector provides transmission of fast and high quality video signals between a source device (integrated graphics) and a display device (monitor).

Pin	Signal	Pin	Signal
1	TX2-	2	TX2+
3	Ground	4	NC
5	NC	6	DVI_SPD_CLK
7	DVI_SPD DATA	8	NC
9	TX1-	10	TX1+
11	Ground	12	NC
13	NC	14	VGAVCC
15	Ground	16	HPDETECT
17	TX0-	18	TX0+
19	Ground	20	NC
21	NC	22	Ground
23	TXC+	24	TXC-



The 15-pin D-Sub connector is commonly used for VGA display.

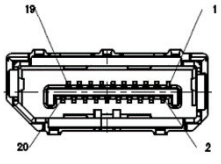
Pin	Signal	Pin	Signal
1	Red	2	Green
3	Blue	4	NC
5	GND	6	GND
7	GND	8	GND
9	VCC	10	GND
11	NC	12	DDC DATA
13	Horizontal Sync	14	Vertical Sync
15	DDC CLK		



2.4.5 DP connector (DP1)

The DP++ is a compact digital interface which is capable of transmitting high-definition video and high-resolution audio over a single cable.

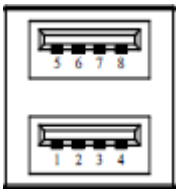
Pin	Signal	Pin	Signal
1	LANE 0	2	GND
3	LANE 0#	4	LANE 1
5	GND	6	LANE 1#
7	LANE 2	8	GND
9	LANE 2#	10	LANE 3
11	GND	12	LANE 3#
13	Detect Pin	14	GND
15	AUX CH	16	GND
17	AUX CH#	18	Hot Plug Detect
19	GND	20	DP_PWR(3.3V)



2.4.6 Dual USB 2.0 Type-A connector (R_USB1)

The R_USB1 is a Universal Serial Bus (compliant with USB 2.0 (480Mbps)) connector on the rear I/O. It is commonly used for installing USB peripherals such as keyboard, mouse, scanner, etc.

Pin	Signal	Pin	Signal
1	+5V	5	+5V
2	USB1 D-	6	USB2 D-
3	USB1 D+	7	USB2 D+
4	GND	8	GND

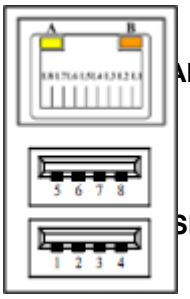


2.4.7 LAN and USB2.0 Connectors (RJ45_USB3)

The motherboard comes with high performance plug and play Ethernet interfaces (RJ-45) which are fully compliant with the IEEE 802.3 standard. Connection can be established by plugging one end of the Ethernet cable into this RJ-45 (RJ45_USB3) connector and the other end to a 1000/100/10 Base-T hub.

The Universal Serial Bus Compliant with USB2.0 connectors on the rear I/O for connecting USB peripherals such as a keyboard, mouse, scanner, etc.

Pin	LAN Signal	Pin	LAN Signal
L1	Tx+ (Data transmission positive)	L2	Tx- (Data transmission negative)
L3	Rx+ (Data reception positive)	L4	RJ-1 (For 1000 Base-T only)
L5	RJ-1 (For 1000 Base-T only)	L6	Rx- (Data reception negative)
L7	RJ-1 (For 1000 Base-T only)	L8	RJ-1 (For 1000 Base-T only)
A	100 LAN LED (Green) / 1000 LAN LED (Orange)	B	Active LED Yellow Blinking



Note

- ***GbE Speed LED turns orange for 1000Mbps or green for 100Mbps. The light is off for 10Mbps.***
- ***Support Wake-on-LAN.***

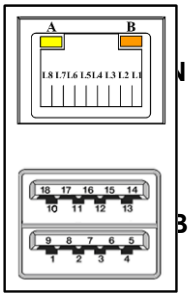
Pin	Signal	Pin	Signal
1	+5V	5	+5V
2	USB1 D-	6	USB2 D-
3	USB1 D+	7	USB2 D+
4	GND	8	GND

2.4.8 LAN and USB 3.2 Connectors (RJ45_USB1, RJ45_USB2 and RJ45_USB3)

The motherboard comes with two high performance plug and play Ethernet interfaces (RJ-45) which are fully compliant with the IEEE 802.3 standard. Connection can be established by plugging one end of the Ethernet cable into this RJ-45 connector and the other end to a (RJ45_USB2 & 3)1000/100/10 (RJ45_USB1)2500/1000/100/10 Base-T hub.

The Universal Serial Bus connectors are compliant with USB 2.0 (RJ45_USB3) and USB 3.2 Gen1(RJ45_USB1 & 2) and ideal for installing USB peripherals such as scanners, cameras and USB devices.

Pin	LAN Signal	Pin	LAN Signal
L1	Tx+ (Data transmission positive)	L2	Tx- (Data transmission negative)
L3	Rx+ (Data reception positive)	L4	RJ-1 (For 1000 Base-T only)
L5	RJ-1 (For 1000 Base-T only)	L6	Rx- (Data reception negative)
L7	RJ-1 (For 1000 Base-T only)	L8	RJ-1 (For 1000 Base-T only)
A	100 LAN LED (Green) / 1000 LAN LED (Orange) / 2500 LAN LED (Orange)	B	Active LED Yellow Blinking



Note

- ***GbE Speed LED turns orange for 1000Mbps or green for 100Mbps. The light is off for 10Mbps.***
- ***2.5GbE Speed LED turns orange for 2500Mbps and 1000Mbps or green for 100Mbps. The light is off for 10Mbps.***
- ***Both RJ45_USB1 and RJ45_USB2 support Wake-on-LAN.***

Pin	USB Signal	Pin	USB Signal
1	USB3_POWER	2	USB1 -
3	USB1 +	4	GND
5	USB3_SSRX1-	6	USB3_SSRX1+
7	GND	8	USB3_SSTX1-
9	USB3_SSTX1+	10	USB3_POWER
11	USB2 -	12	USB2 +
13	GND	14	USB3_SSRX2-
15	USB3_SSRX2+	16	GND
17	USB3_SSTX2-	18	USB3_SSTX2+

2.4.9 Audio Jack (AUDIO1)

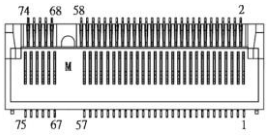
Install an audio driver, and then attach audio devices to AUDIO1

Pin Color	Signal
Blue	Line-in
Green	Line-out
Pink	MIC-in

2.4.10 M.2 Key M 2242/2280 SATA SSD (M.2_PCIESSD_M1)

The M.2 2242/2280 Key M SATA SSD for storage.

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	GND	2	+3.3V	3	GND	4	+3.3V
5	NC	6	NC	7	NC	8	NC
9	GND	10	LED_1#	11	NC	12	+3.3V
13	NC	14	+3.3V	15	GND	16	+3.3V
17	NC	18	+3.3V	19	NC	20	NC
21	GND	22	NC	23	NC	24	NC
25	NC	26	NC	27	GND	28	NC
29	NC	30	NC	31	NC	32	NC
33	GND	34	NC	35	NC	36	NC
37	NC	38	NC	39	GND	40	NC
41	SATA0	42	NC	43	SATA0	44	NC
45	GND	46	NC	47	SATA0	48	NC
49	SATA0	50	PERST#	51	GND	52	CLKREQ#
53	NC	54	PEWAKE#	55	NC	56	NC
57	GND	58	NC	59	CONNECTOR Key M	60	CONNECTOR Key M
61	CONNECTOR Key M	62	CONNECTOR Key M	63	CONNECTOR Key M	64	CONNECTOR Key M
65	CONNECTOR Key M	66	CONNECTOR Key M	67	NC	68	NC
69	OC_PE/GND_SATA	70	+3.3V	71	GND	72	+3.3V
73	GND	74	+3.3V	75	GND		



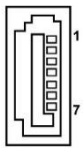
Note

- ***Support M.2 SATA only. Do not support NVMe.***

2.4.11 SATA 3.0 Connectors (SATA2, SATA3, SATA4)

These Serial Advanced Technology Attachment (Serial ATA or SATA) connectors are for SATA 3.0 interface allowing up to 6.0Gb/s data transfer rate. It is a computer bus interface for connecting to devices such as hard disk drive.

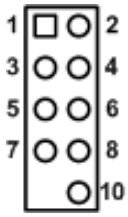
Pin	Signal
1	GND
2	SATA_TX+
3	SATA_TX-
4	GND
5	SATA_RX-
6	SATA_RX+
7	GND



2.4.12 Internal USB Headers (F_USB2_1, F_USB2_2, USB2_1)

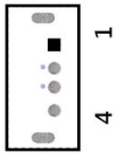
These are 5x2-pin p=2.54mm headers for USB 2.0 interface.

Pin	Signal	Pin	Signal
1	+5V	2	+5V
3	USB -	4	USB -
5	USB +	6	USB +
7	GND	8	GND
		10	GND



The USB2_1 is a Type-A 180D connector for USB2.0 signal.

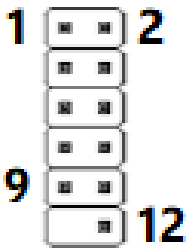
Pin	Signal
1	+5V
2	USB -
3	USB +
4	GND



2.4.13 GPIO Header (J_GPIO1)

This header (6x2-pin p=2.00mm) is for digital I/O interface.

Pin	Signal	Pin	Signal
1	DIO_0	2	DIO_1
3	DIO_2	4	DIO_3
5	GND	6	DIO_4
7	DIO_5	8	DIO_6
9	DIO_7	10	+5V
		12	N/C



Note

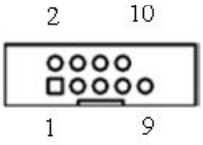
- ***The default value of DIO1 to DIO8 is set as GPI with high level.***

LAN

2.4.14 COM BOX Headers (COM1, COM2, COM3, COM4, COM5, COM6)

The motherboard comes with 5x2-pin p=2.54mm box headers for COM serial port interfaces.

Pin	Signal	Pin	Signal
1	PIN1	2	DSR
3	RXD	4	RTS
5	TXD	6	CTS
7	DTR	8	PIN9
9	GND		



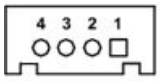
Note

- ***PIN1 of BOX Header can be DCD(default)/5V and Pin8 of BOX Header can be RI(Default)/12V, selectable by "COM pin1(DCD/5V) pin9(RI/12V) Select".***
- ***COM3 can be RS232(default)/RS422/RS485 selecting by JP4, JP5, JP6 Jumper, check "COM3 Mode Select" for detail.***
- ***COM4 can be RS232(default)/RS485 selecting by JP7, JP18 Jumper, check "COM4 Mode Select" for detail.***

2.4.15 SMBus Header (SMBUS1)

The SMBUS1 (4x1-pin p=1.25mm) is for SMBus (System Management Bus) interface.

Pin	Signal	Pin	Signal
1	GND	2	SMB_DATA
3	SMB_CLK	4	*5V



Note

- ***Power on this Pin is 5V by default, 3.3V is available if specified. (resistor selectable)***

2.4.16 Voltage Monitor Header (VOLT1)

The function of VOLT1 (8x1-pin p=2.54mm) is for voltage monitoring. It doesn't supply power.

Pin	Signal	Pin	Signal
1	VCC5_SB	2	GND
3	GND	4	-5V
5	+5V	6	+3.3V
7	-12V	8	+12V

2.4.17 PCI-Express x4 Slots

(PCIE_4X_SLOT1, PCIE_4X_SLOT2)

This motherboard has two PCI-Express x4 slots

Pin	Signal	Pin	Signal
B1	+12V_PS	A1	GND
B2	+12V_PS	A2	+12V_PS
B3	+12V_PS	A3	+12V_PS
B4	GND	A4	GND
B5	SMB_CLK_RESUME	A5	N/C
B6	SMB_DATA_RESUME	A6	N/C
B7	GND	A7	N/C
B8	+3.3V_PS	A8	N/C
B9	N/C	A9	+3.3V_PS
B10	+3.3V_SB	A10	+3.3V_PS
B11	PCH_WAKE_N	A11	PWRGD
B12	N/C	A12	GND
B13	GND	A13	CLKOUT_PCIE_P
B14	PCIE1_TX_DP	A14	CLKOUT_PCIE_N
B15	PCIE1_TX_DN	A15	GND
B16	GND	A16	PCIE1_RX_DP
B17	PCIEX4_SLOT1_PRSNT2_N	A17	PCIE1_RX_DN
B18	GND	A18	GND
B19	PCIE2_TX_DP	A19	N/C
B20	PCIE2_TX_DN	A20	GND
B21	GND	A21	PCIE2_RX_DP
B22	GND	A22	PCIE2_RX_DN
B23	N/C	A23	GND
B24	N/C	A24	GND
B25	GND	A25	N/C
B26	GND	A26	N/C
B27	N/C	A27	GND
B28	N/C	A28	GND
B29	GND	A29	N/C
B30	N/C	A30	N/C
B31	N/C	A31	GND
B32	GND	A32	N/C

Note

- ***PCIE_4X_SLOT1 and PCIE_4X_SLOT2 support the PCIe 2X signal only.***

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Section 3
Hardware Description

3.1 Microprocessors

The MMB541 series supports 14th/13th/12th Gen Intel® Core™ i9 / i7/ i5/ i3/ Pentium®, Celeron® processors, which enable your system to operate under Windows® 10/11 and Linux environments. The system performance depends on the microprocessor. Make sure all correct settings are arranged for your installed microprocessor to prevent the CPU from damages.

Note

Caution: Make sure turnoff the power before you install the processor into the CPU socket.

3.2 BIOS

The MMB541 series uses AMI Plug and Play BIOS.

3.3 System Memory

The MMB541 supports four 288-pin DDR4 DIMM sockets for maximum memory capacity up to 128GB DDR4 SDRAMs. The memory module comes in sizes of 2GB, 4GB, 8GB, 16GB and 32GB.

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Section 4
AMI BIOS Setup Utility

The AMI UEFI BIOS provides users with a built-in setup program to modify basic system configuration. All configured parameters are stored in a flash chip to save the setup information whenever the power is turned off. This chapter provides users with detailed description about how to set up basic system configuration through the AMI BIOS setup utility.

4.1 Starting

To enter the setup screens, follow the steps below:

1. Turn on the computer and press <Del> during the Power On Self Test (POST) to enter BIOS setup, otherwise, POST will continue with its test routines.
2. Once you enter the BIOS, the main BIOS setup menu displays. You can access the other setup screens from the main BIOS setup menu, such as the Advanced and Chipset menus.


Note

If your computer cannot boot after making and saving system changes with BIOS setup, you can restore BIOS optimal defaults by setting press the tact switch "SW1" for 5 seconds (see section 2.3.3).

It is strongly recommended that you should avoid changing the chipset's defaults. Both AMI and your system manufacturer have carefully set up these defaults that provide the best performance and reliability.

4.2 Navigation Keys

The BIOS setup/utility uses a key-based navigation system called hot keys. Most of the BIOS setup utility hot keys can be used at any time during the setup navigation process. These keys include <F1>, <F2>, <Enter>, <ESC>, <Arrow> keys, and so on.

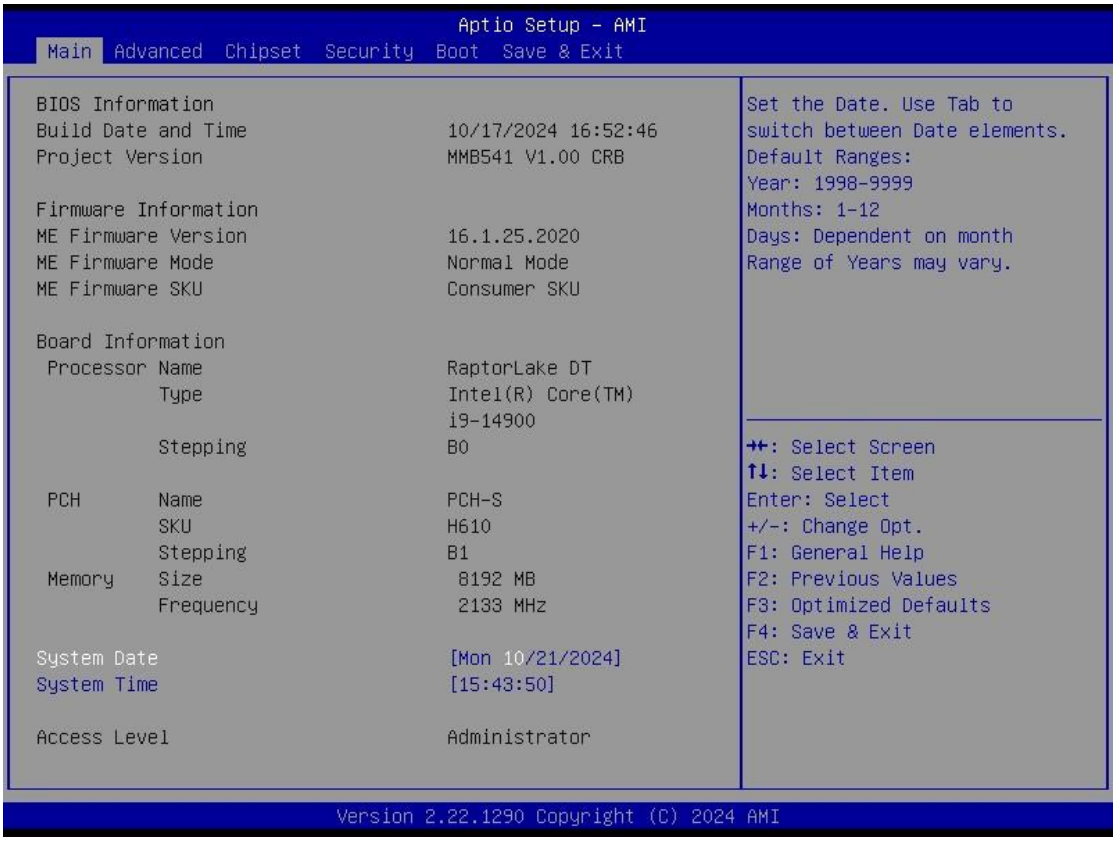

Note

Some of the navigation keys differ from one screen to another.

Hot Keys	Description
←→ **Left/Right**	The Left and Right <Arrow> keys allow you to select a setup screen.
↑↓ **Up/Down**	The Up and Down <Arrow> keys allow you to select a setup screen or sub screen.
Enter	The <Enter> key allows you to display or change the setup option listed for a particular setup item. The <Enter> key can also allow you to display the setup sub screens.
+– Plus/Minus	The Plus and Minus <Arrow> keys allow you to change the field value of a particular setup item.
F1	The <F1> key allows you to display the General Help screen.
F2	The <F2> key allows you to Load Previous Values.
F3	The <F3> key allows you to Load Optimized Defaults.
F4	The <F4> key allows you to save any changes you have made and exit Setup. Press the <F4> key to save your changes.
Esc	The <Esc> key allows you to discard any changes you have made and exit the Setup. Press the <Esc> key to exit the setup without saving your changes.

4.3 Main Menu

When you first enter the setup utility, you will enter the Main setup screen. You can always return to the Main setup screen by selecting the Main tab. System Time/Date can be set up as described below. The Main BIOS setup screen is shown below.



BIOS Information
Display the BIOS information.

System Date/Time
Use this option to change the system time and date. Highlight System Time or System Date using the <Arrow> keys. Enter new values through the keyboard. Press the <Tab> key or the <Arrow> keys to move between fields. The date must be entered in MM/DD/YY format. The time is entered in HH:MM:SS format.

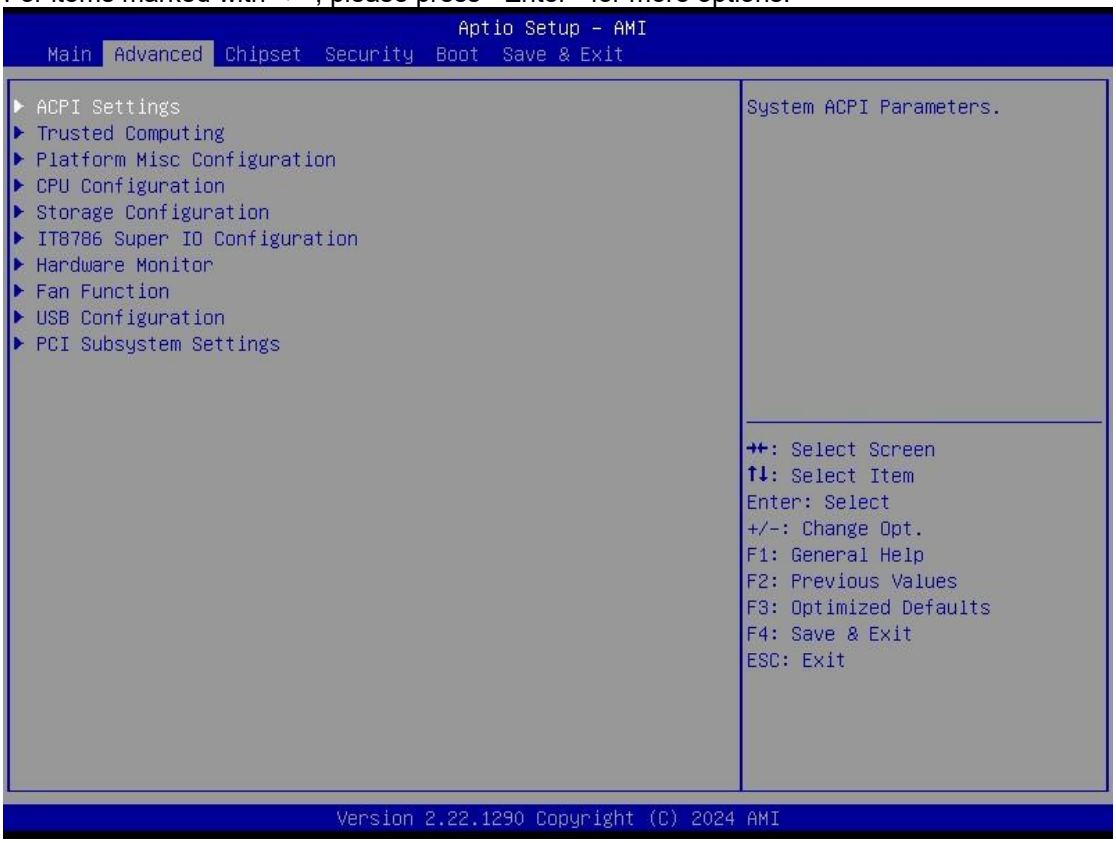
Access Level
Display the access level of current user.

4.4 Advanced Menu

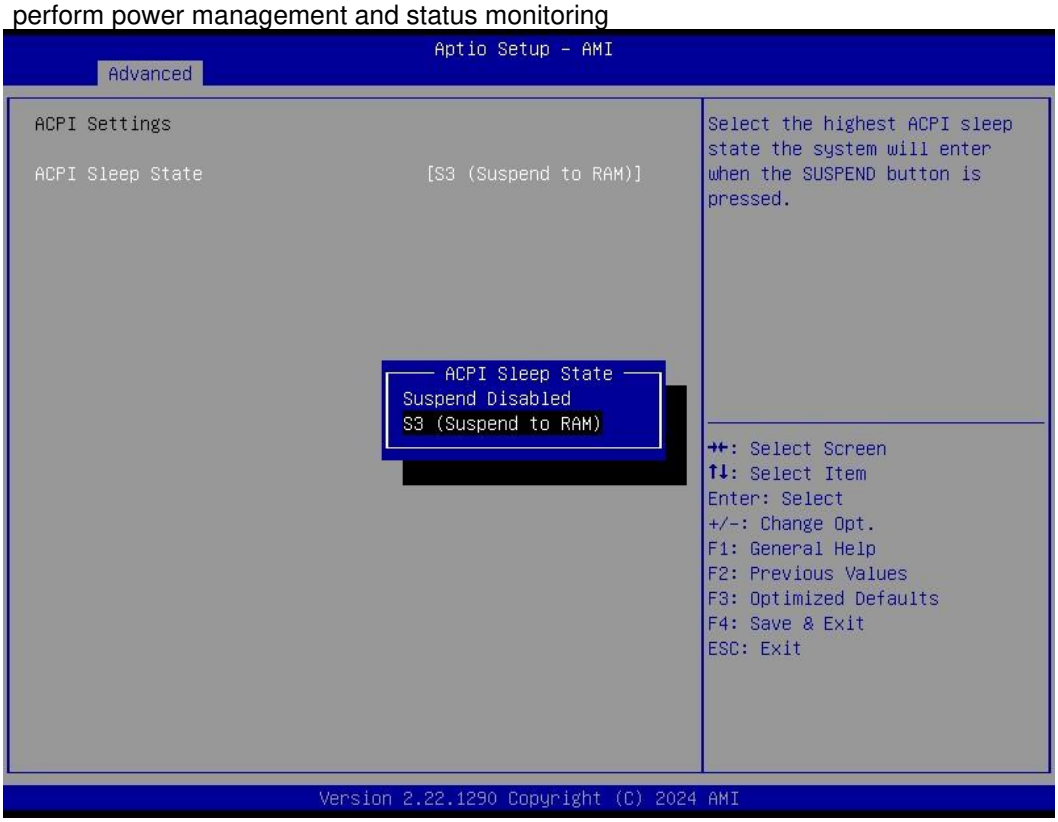
The Advanced menu also allows users to set configuration of the CPU and other system devices. You can select any of the items in the left frame of the screen to go to the sub menus:

- ACPI Settings
- Trusted Computing
- Platform Misc Configuration
- CPU Configuration
- Storage Configuration
- IT8786 Super IO Configuration
- Hardware Monitor
- Fan Function
- USB Configuration
- PCI Subsystem Settings

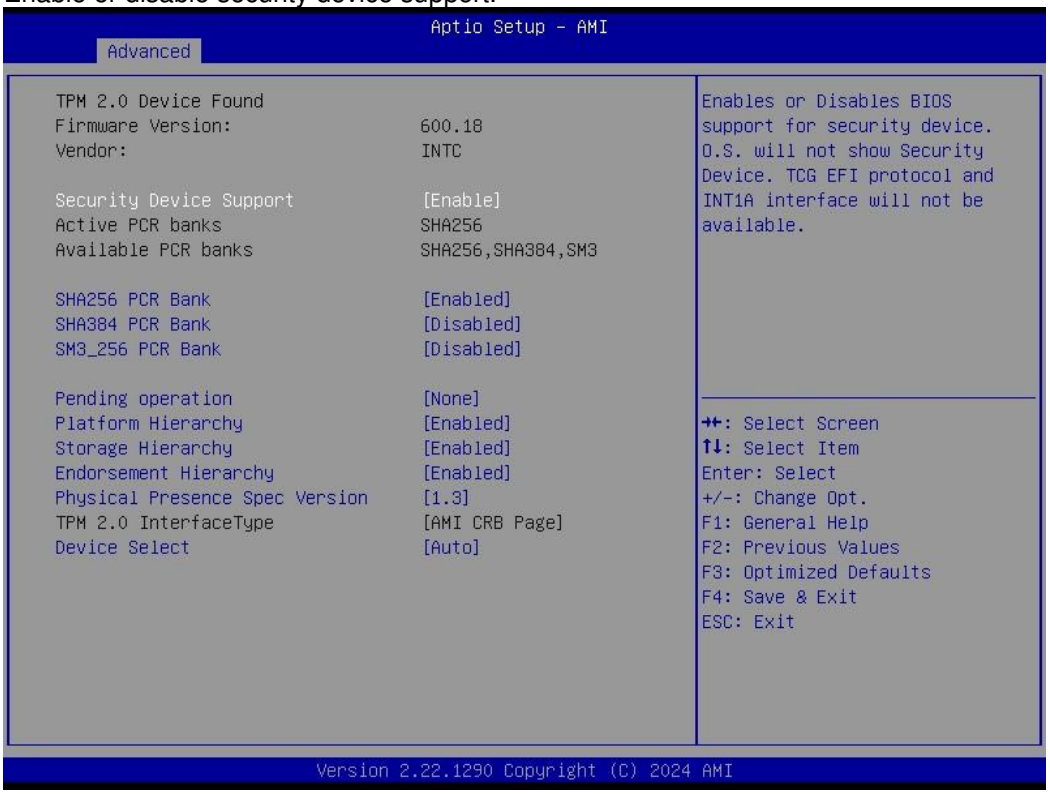
For items marked with "▶", please press <Enter> for more options.



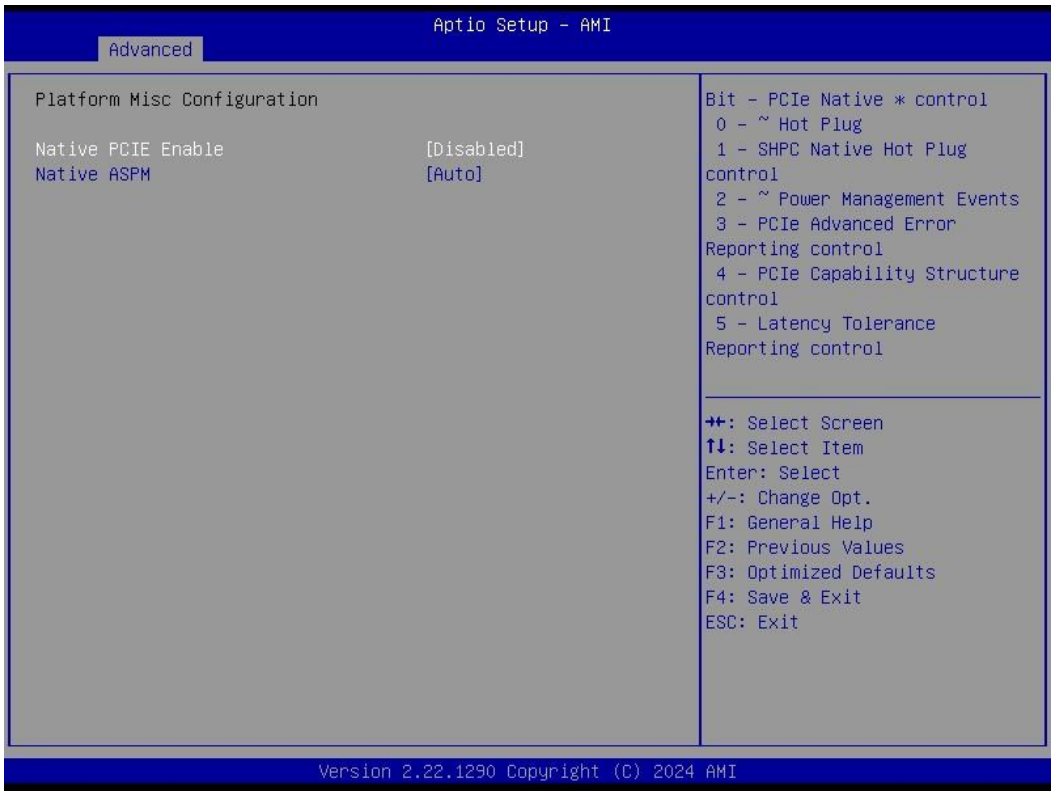
- **ACPI Settings**
  It shows advanced configuration and power interface and hardware components to perform power management and status monitoring



- **Trusted Computing**
  Enable or disable security device support.



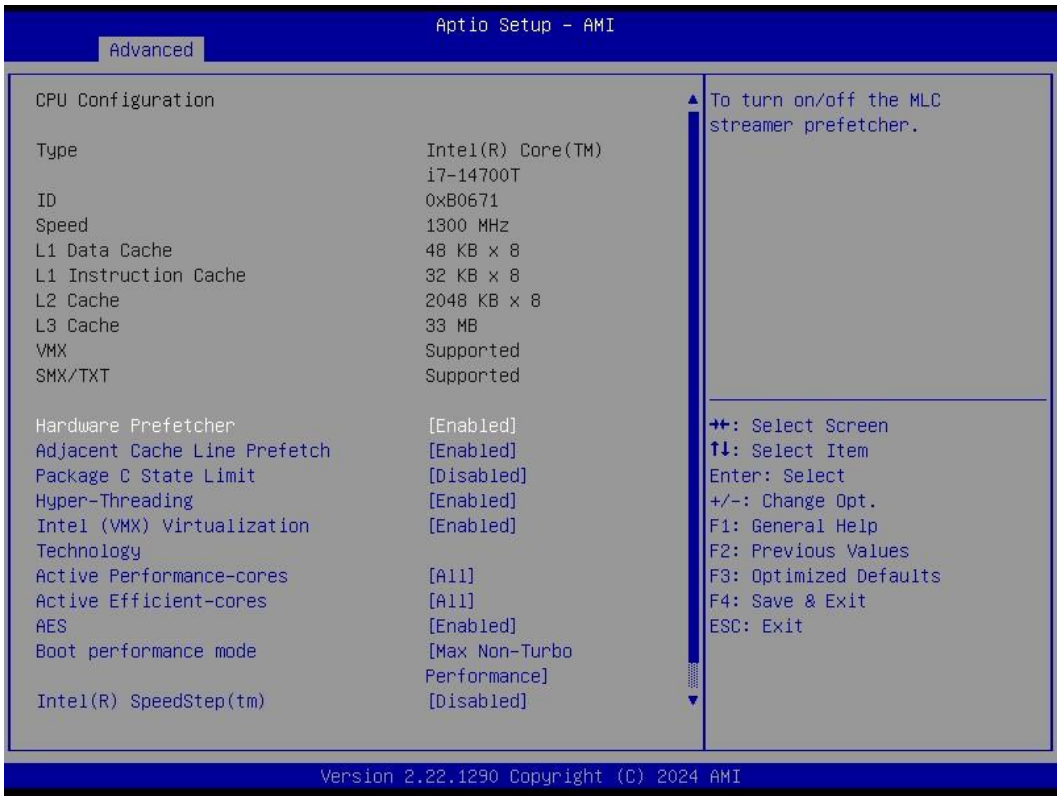
- **Platform Misc Configuration**
  This screen allows you to set Platform Misc Configuration.



Native PCIE Enable
Bit - PCIe Native * control 0 - ~ Hot Plug 1 - SHPC Native Hot Plug control 2 - ~ Power Management Events 3 - PCIe Advanced Error Reporting control 4 - PCIe Capability Structure control 5 - Latency Tolerance Reporting control.

Native ASPM
Enabled - OS Controlled ASPM, Disabled - BIOS Controlled ASPM.

- **CPU Configuration**
  This screen shows CPU information, and you can change the value of the selected option.



Hardware Prefetcher
Turn on/off the MLC streamer prefetcher.

Adjacent Cache Line Prefetch
Turn on/off prefetching of adjacent cache lines.

Package C State Limit
Maximum Package C State Limit Setting. CPU Default: Sets to Factory default value. Auto: Initializes to deepest available Package C State Limit.

Hyper-Threading
Enable or disable Hyper-threading Technology, which allows a single physical processor to multitask as multiple logical processors. When disabled, only one thread per enabled core is enabled.

Intel Virtualization Technology
Enable or disable Intel Virtualization Technology. When enabled, a VMM (Virtual Machine Mode) can utilize the additional hardware capabilities. It allows a platform to run multiple operating systems and applications independently, hence enabling a single computer system to work as several virtual systems.

Active Performance Cores
Number of cores to enable in each processor package.

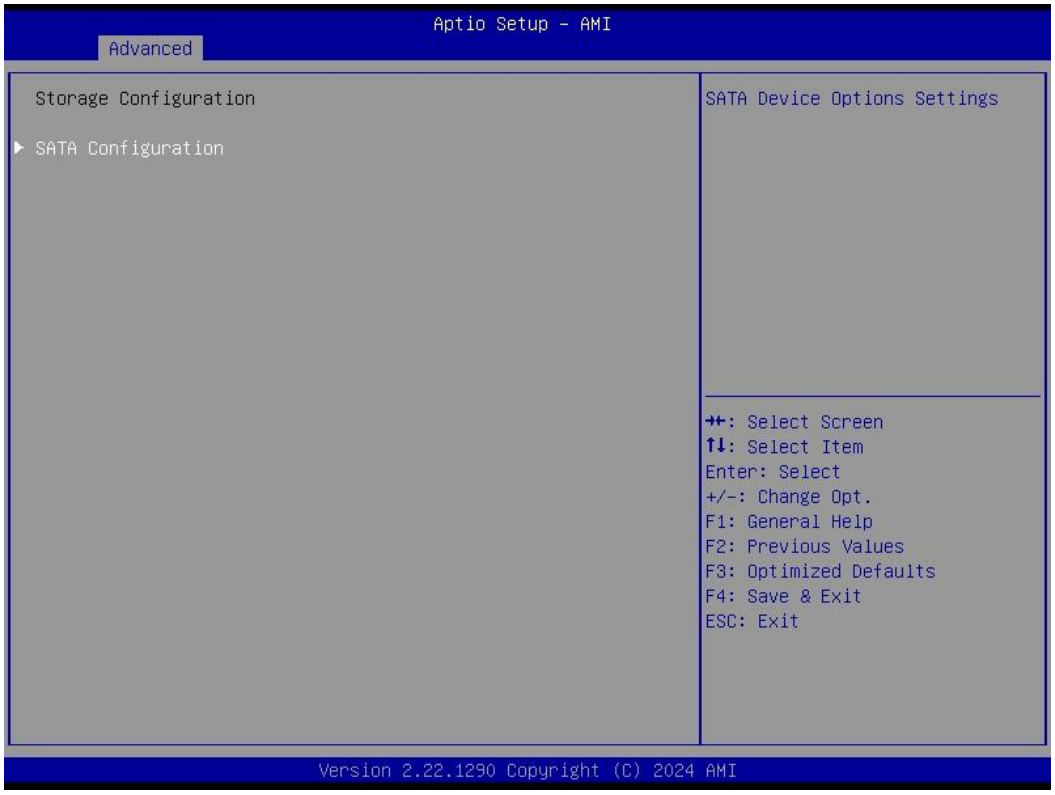
Active Efficient Cores
Number of cores to enable in each processor package.

AES
Enable / Disable AES (Advanced Encryption Standard)

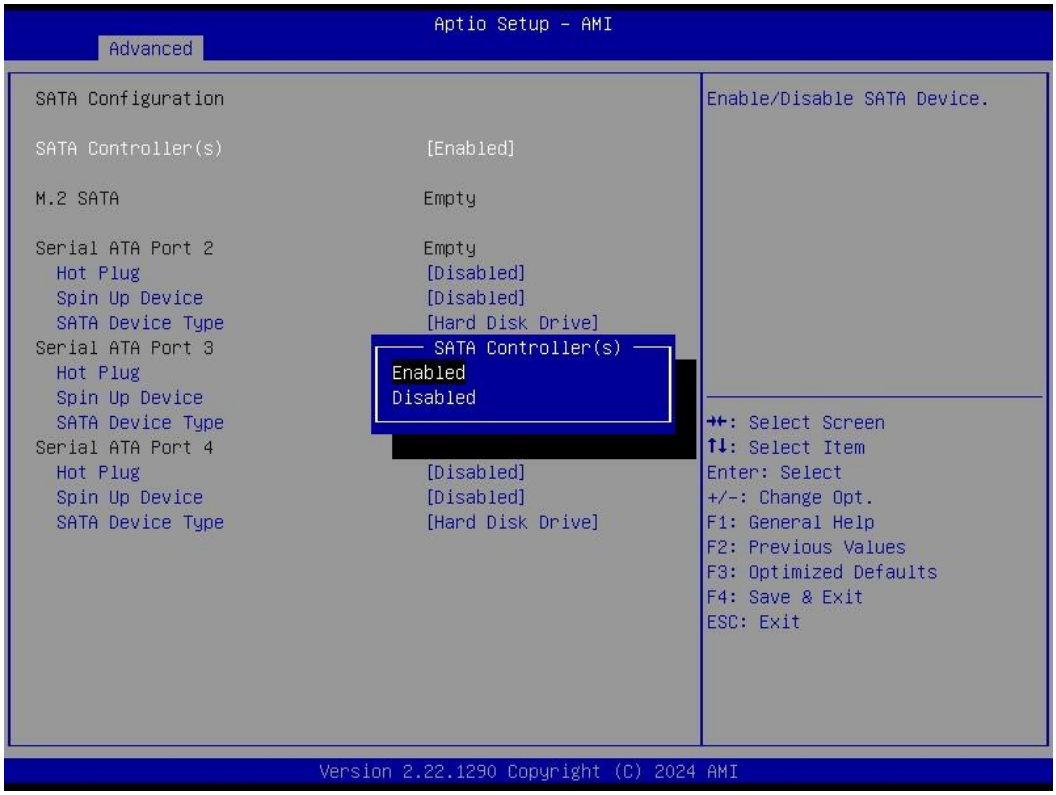
Boot performance mode
Select the performance mode that the BIOS will run after the reset.

Intel (R) SpeedStep(tm)
Allows more than two frequency ranges to be supported.

- **Storage Configuration**
  This screen shows storage information.



- **SATA Configuration**
  During system boot up, the BIOS automatically detects the presence of SATA devices. In the SATA Configuration menu, you can see the hardware currently installed in the SATA ports.



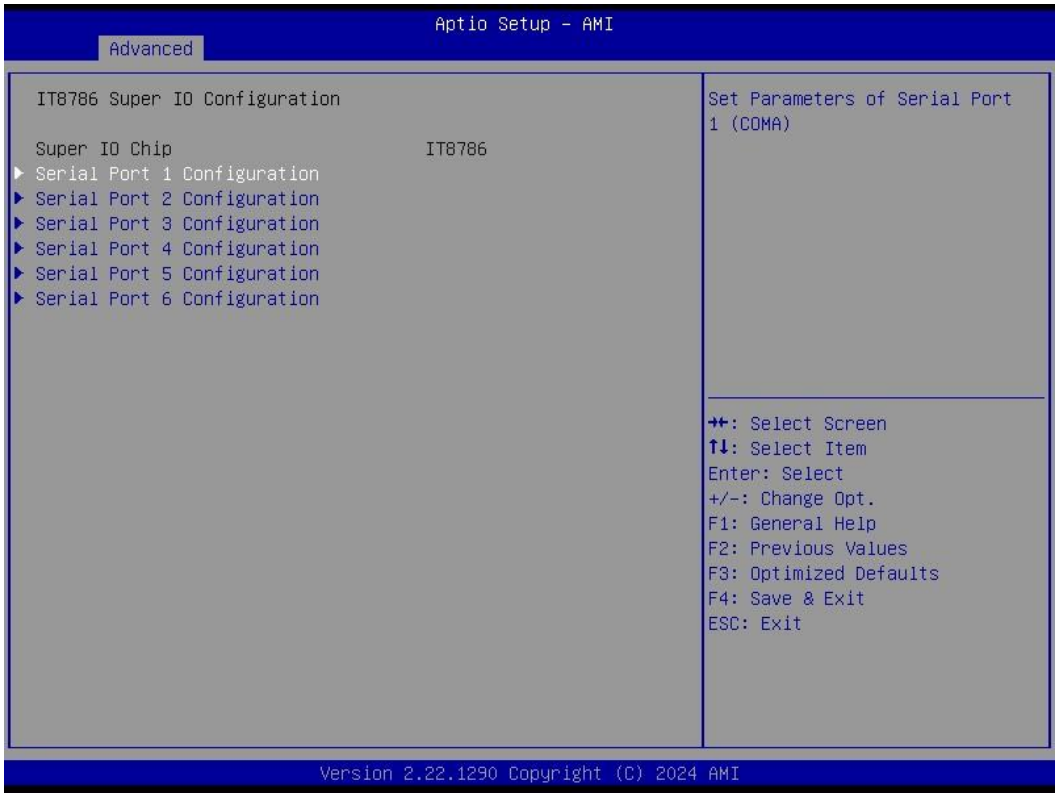
SATA Controller(s)
Enable or disable the SATA Controller feature. The default is Enabled.

Hot Plug
Designates this port as Hot Pluggable.

Spin Up Device
Staggered Spin Up will be performed when any of the drive is enabled for the performance strategy. Otherwise, all drives spin up at boot. Only HDD supports this function.

SATA Device Type
Identify the SATA port is connected to a solid-state drive (SSD) or hard disk drive (HDD).

- **IT8786 Super IO Configuration**
  You can use this screen to select options for the Super IO Configuration, and change the value of the selected option. A description of the selected item appears on the right side of the screen. For items marked with "►", please press <Enter> for more options.



Serial Port 1
This item allows you to use RS232 only .

Serial Port 2
This item allows you to use RS232 only .

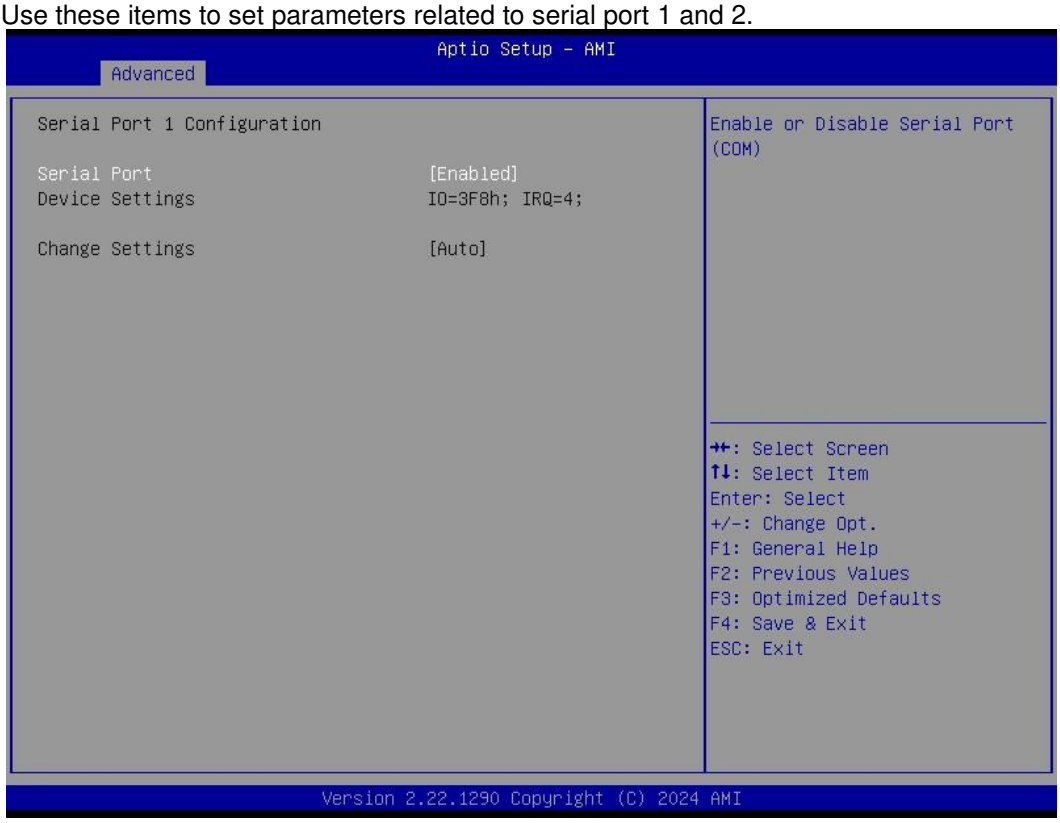
Serial Port 3
This item allows you to use it as RS232/422/485. The default is RS232.

Serial Port 4
This item allows you to use it as RS232/485. The default is RS232.

Serial Port 5
This item allows you to use RS232 only .

Serial Port 6
This item allows you to use RS232 only .

- **Serial Port 1 Configuration**
  Use these items to set parameters related to serial port 1 and 2.

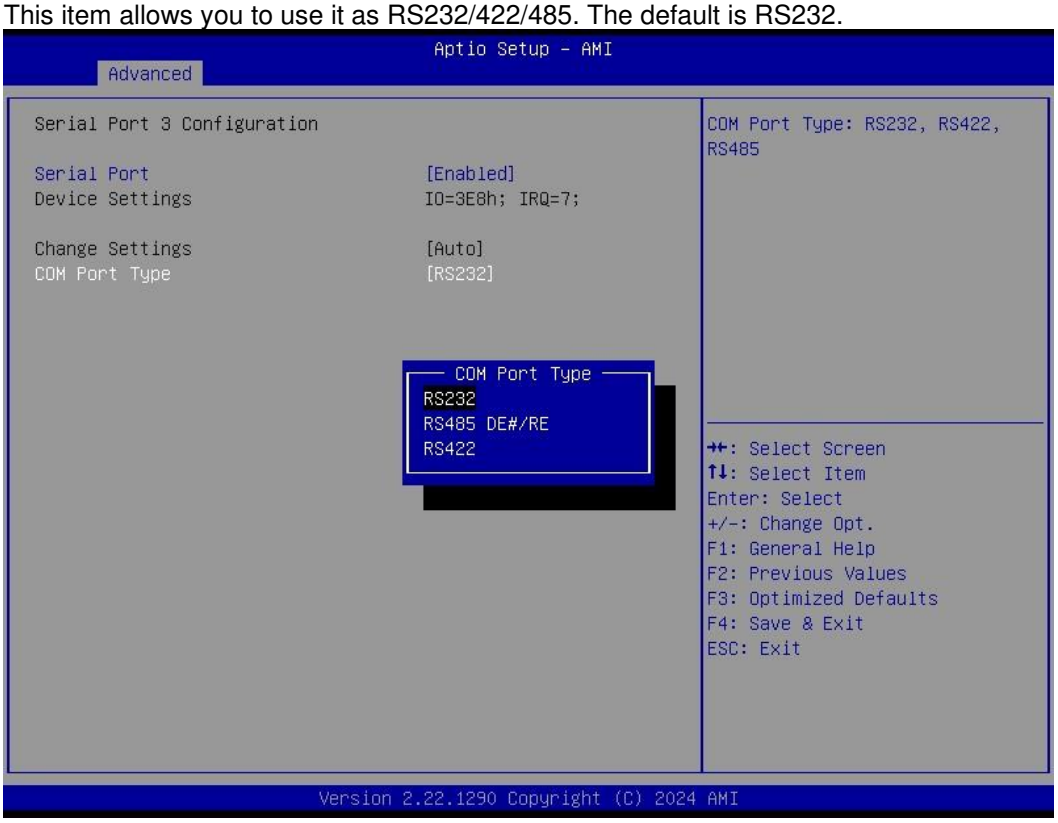


Serial Port 1
This item allows you to use RS232 only .

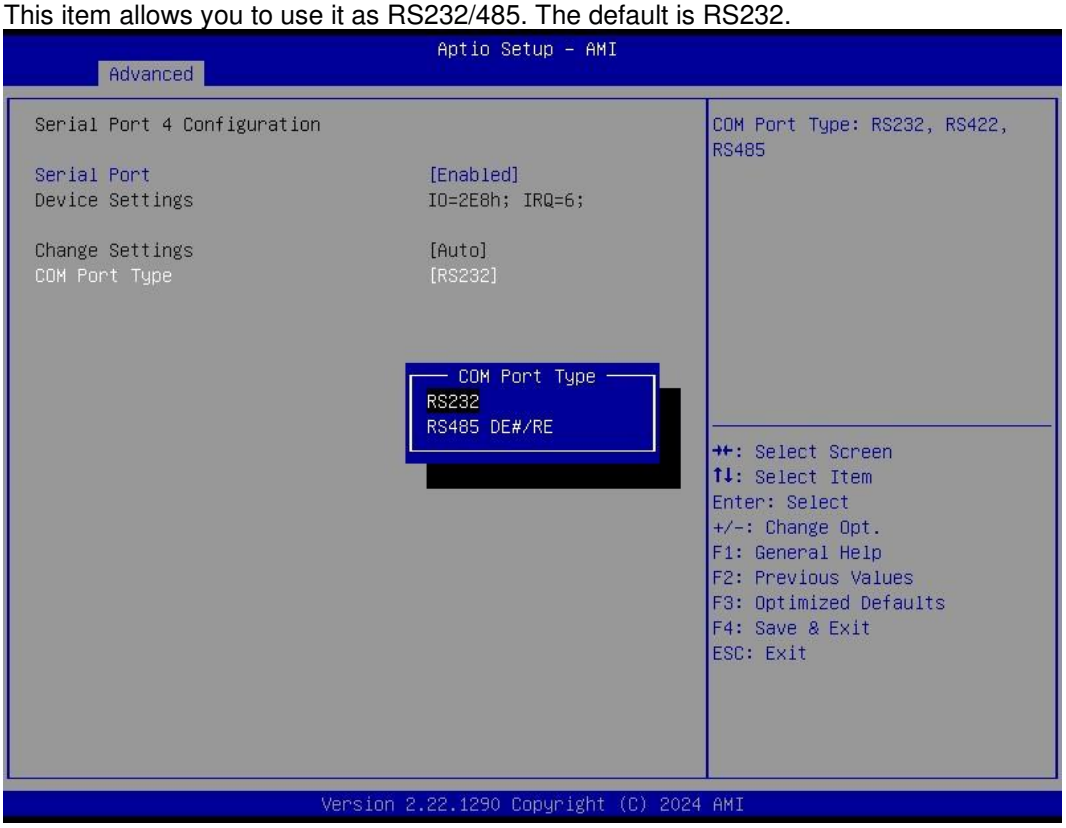
Serial Port 2
This item allows you to use RS232 only .

Serial Port 3

This item allows you to use it as RS232/422/485. The default is RS232.



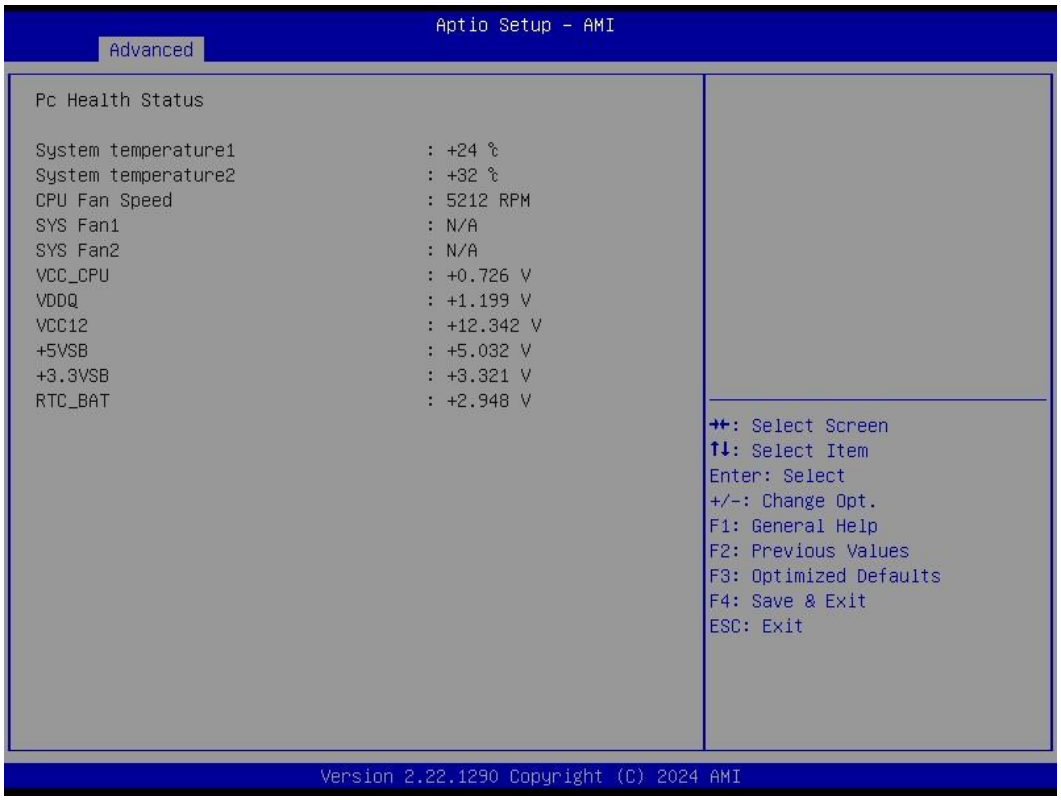
Serial Port 4
This item allows you to use it as RS232/485. The default is RS232.



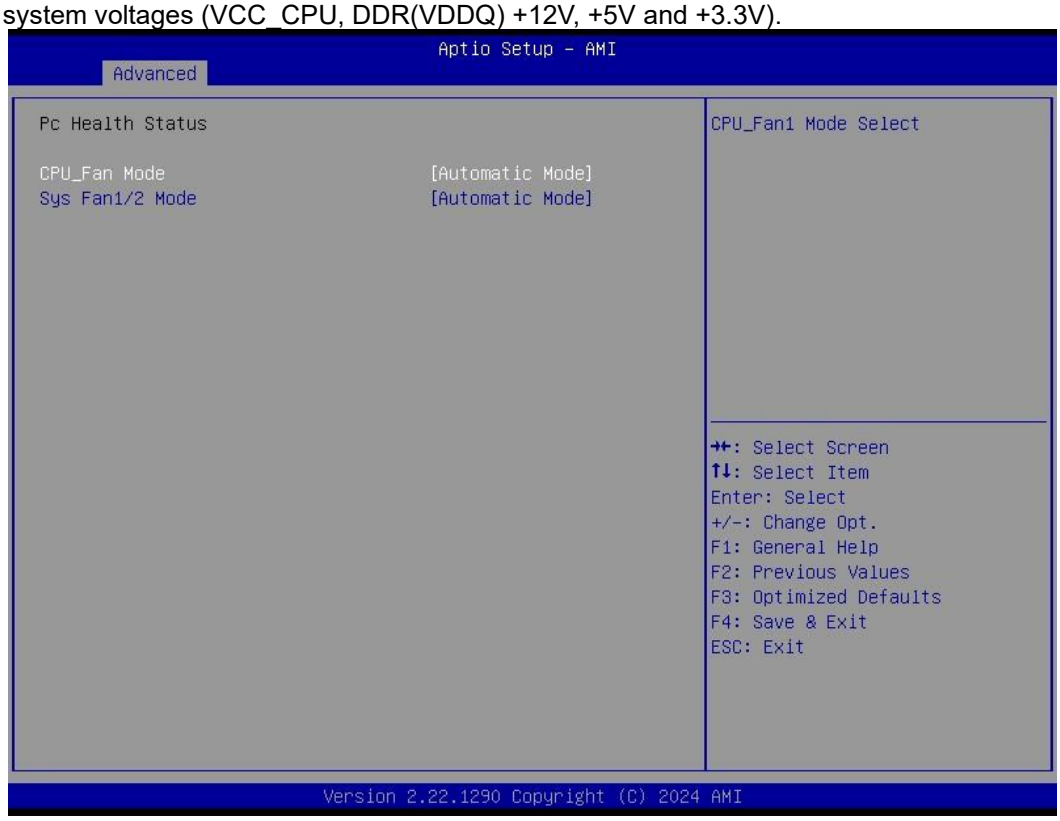
Serial Port 5
This item allows you to use RS232 only.

Serial Port 6
This item allows you to use RS232 only.

- **Hardware Monitor**
  This screen monitors hardware health status.



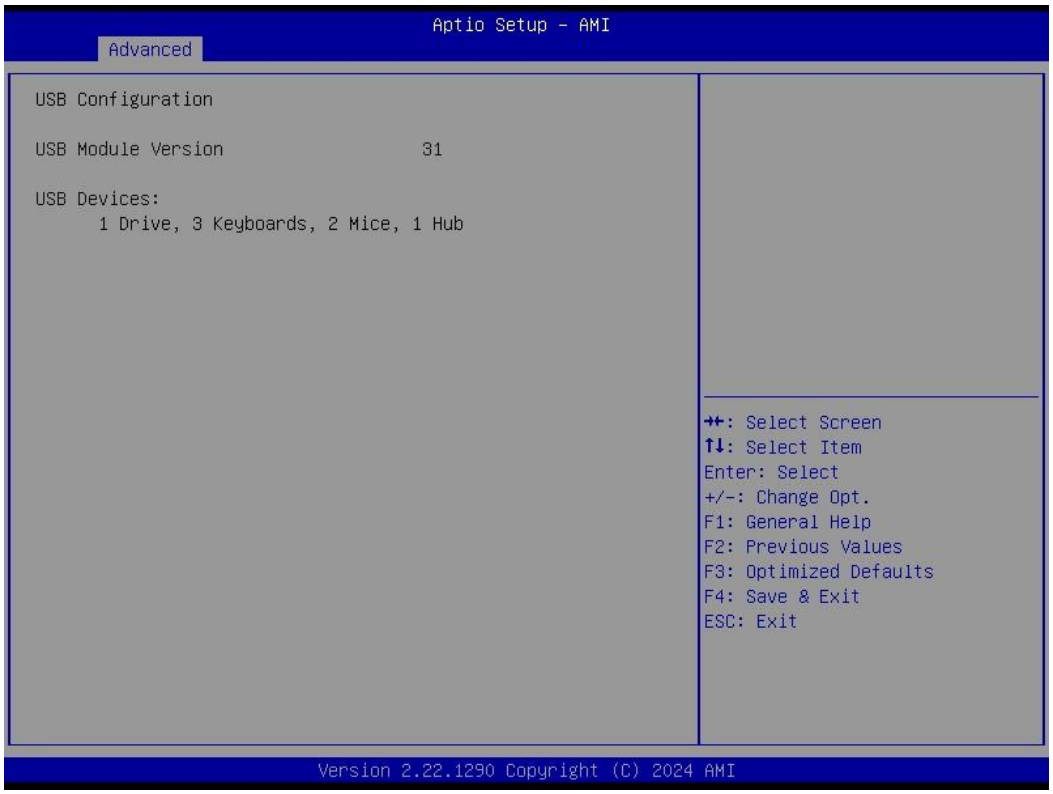
This screen displays the temperature of system and CPU, cooling fans speed in RPM and system voltages (VCC_CPU, DDR(VDDQ) +12V, +5V and +3.3V).



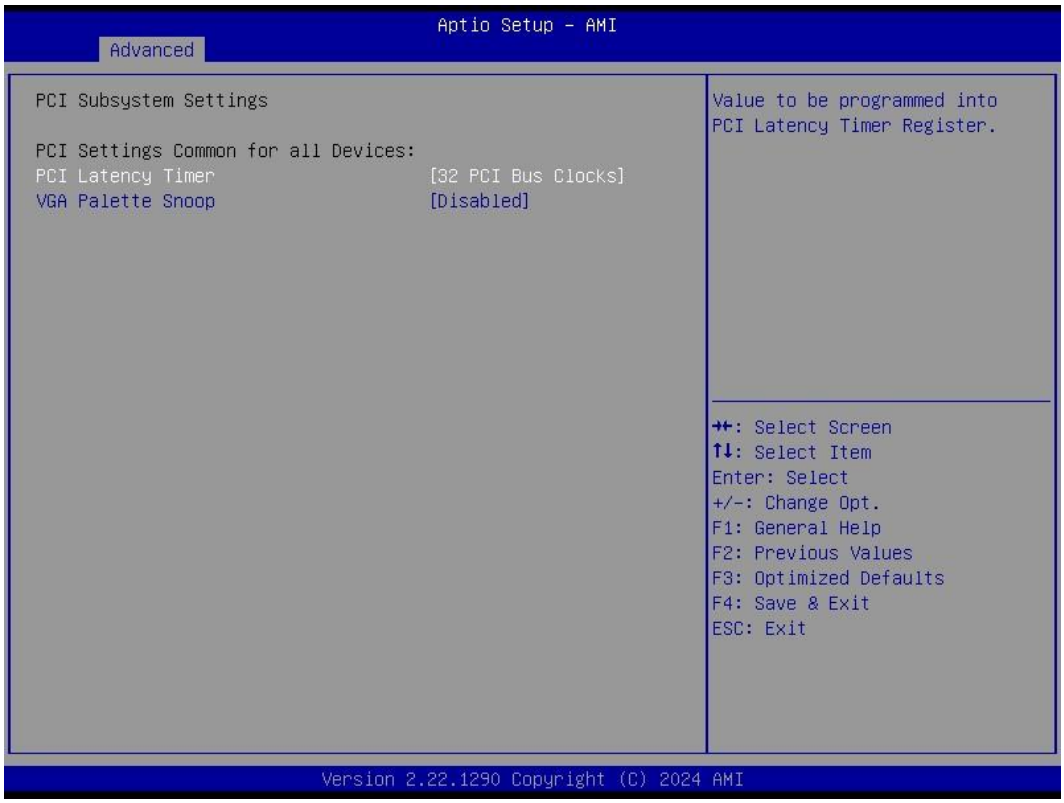
Note ***CPU FAN = CPU FAN Speed; SYS FAN = FAN1/FAN2. (System Smart fan control integrated with fan1/fan2)***

-

- **USB Configuration**
  This screen shows USB configuration.



- **PCI Subsystem Settings**
  This screen allows you to set PCI Subsystem mode.



PCI Latency Timer
Set the value to be programmed into PCI Latency Timer Register.

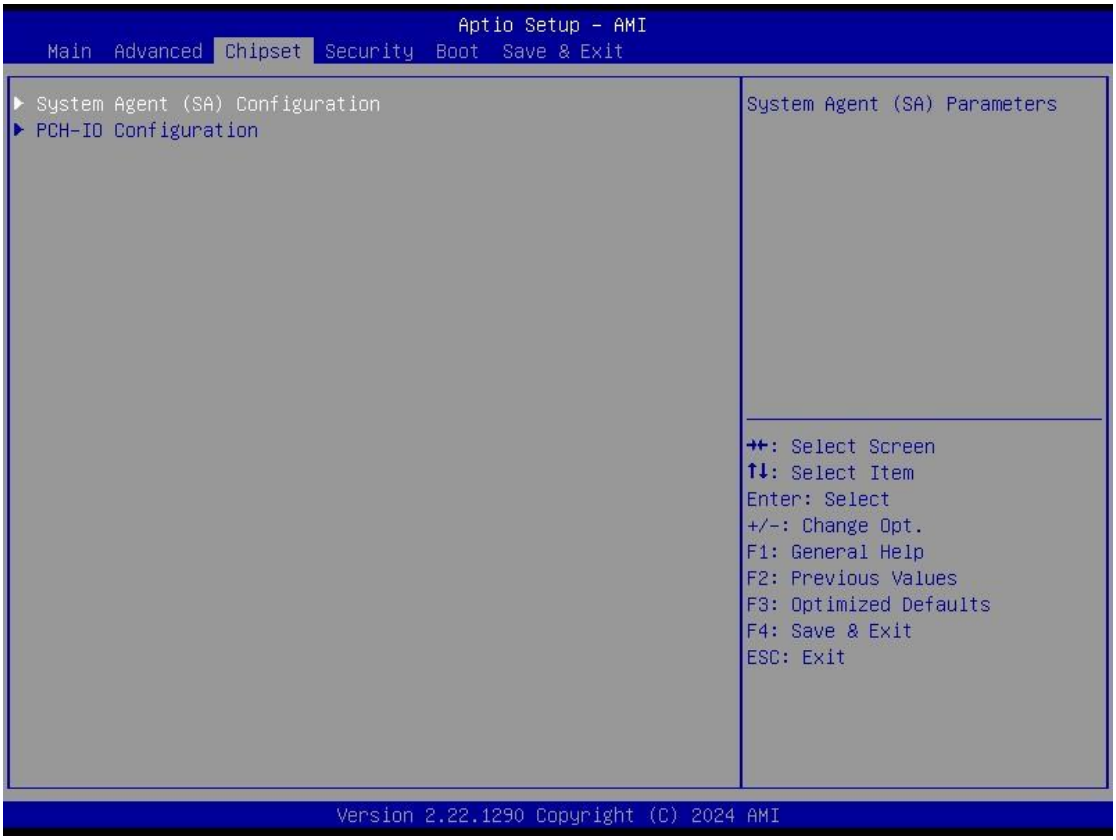
VGA Palette Snoop
Enables or Disables VGA Palette Registers Snooping.

4.5 Chipset Menu

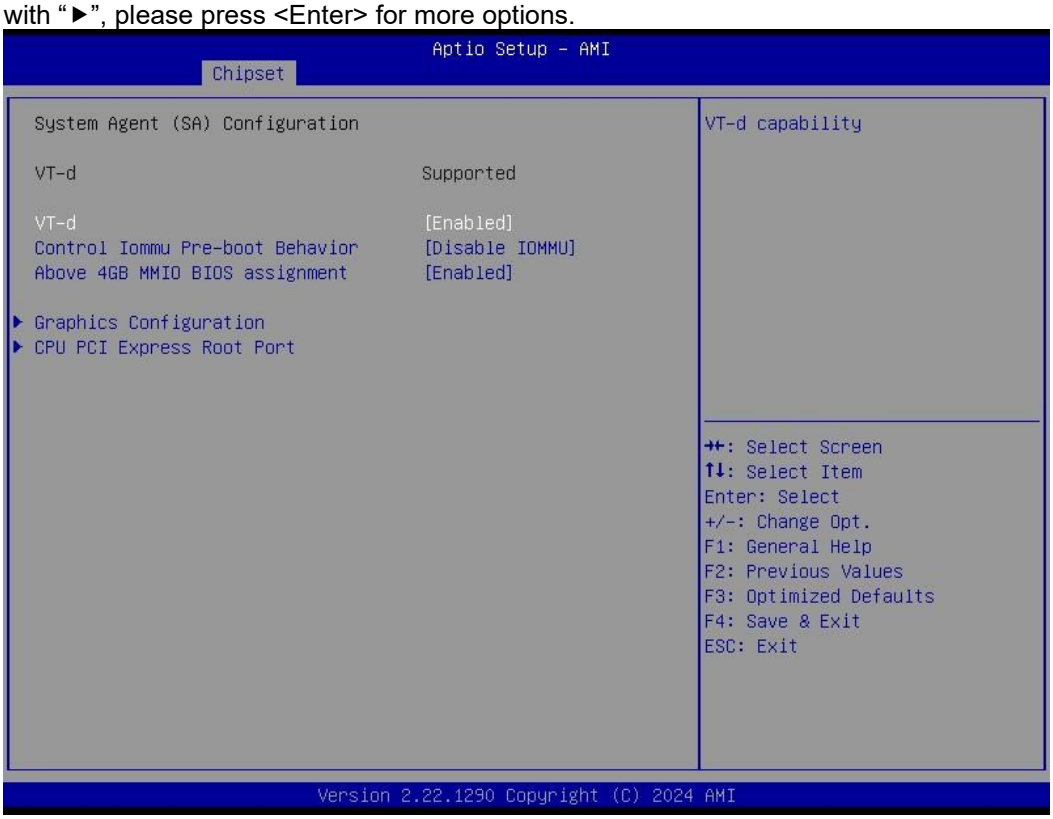
The Chipset menu allows users to change the advanced chipset settings. You can select any of the items in the left frame of the screen to go to the sub menus:

- ► System Agent (SA) Configuration
- ► PCH-IO Configuration

For items marked with "►", please press <Enter> for more options.



- **System Agent (SA) Configuration**
  This screen allows users to configure System Agent (SA) parameters. For items marked with "►", please press <Enter> for more options.



VT-d
Check to enable VT-d function on MCH.

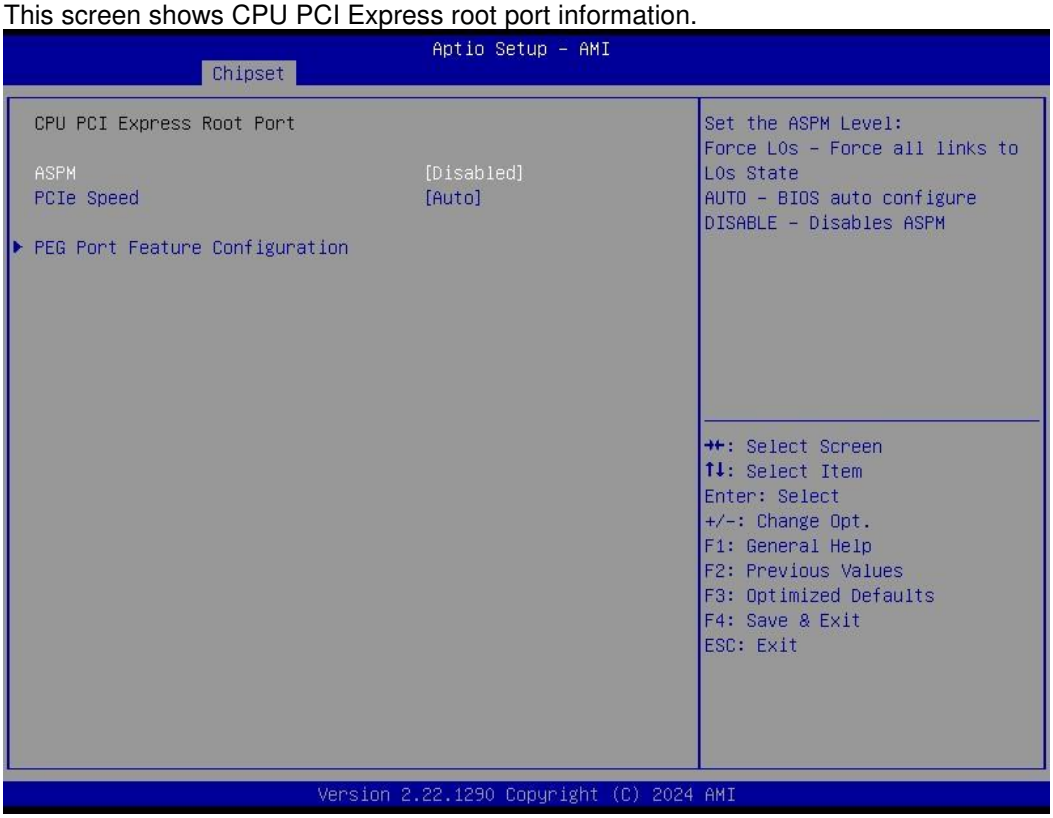
Graphics Configuration
Open the sub menu for parameters related to graphics configuration.

CPU PCI Express Root Port
Set the ASPM Level and PCI Express Speed.

- **Graphics Configuration**
  This screen shows graphics configuration.

Internal Graphics
Keep IGFX enabled based on the setup options.

- **CPU PCI Express Root Port**
  This screen shows CPU PCI Express root port information.

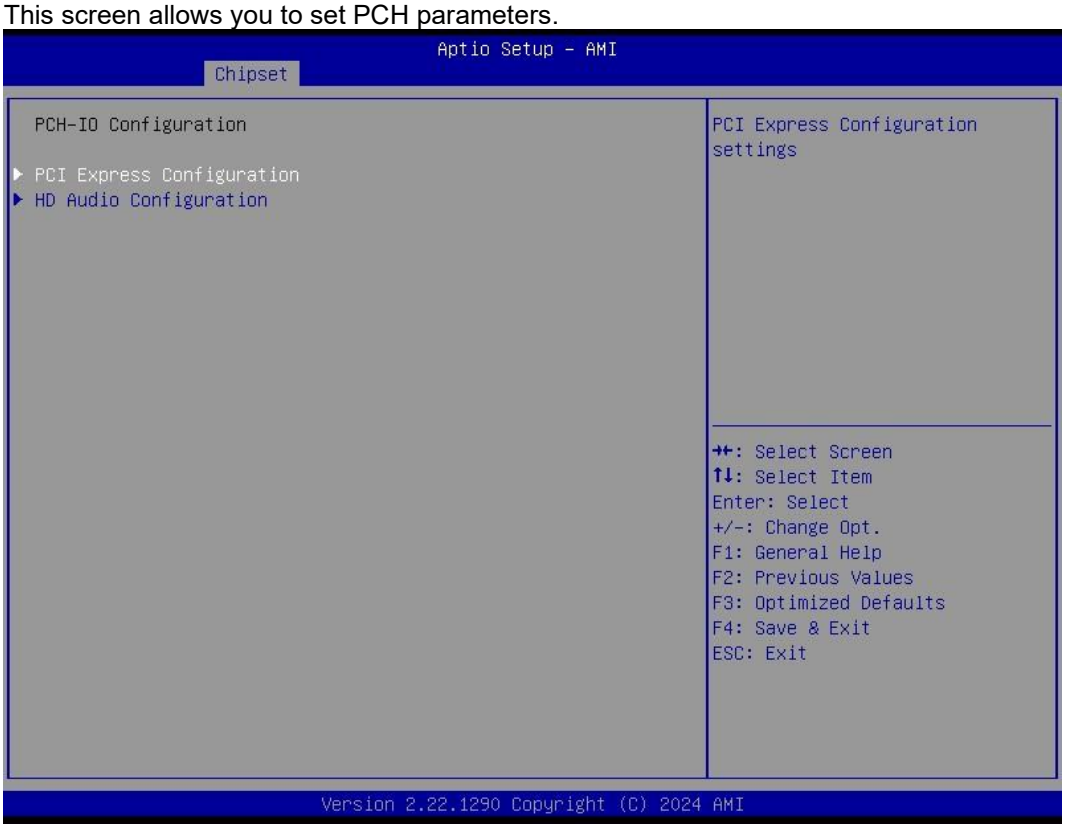


ASPM
Set the ASPM Level:\nForce L0s - Force all links to L0s State\nForce L1 - Force all links to L1 State\nForce L0sL1 - Force all links to L0SL1 State\nDISABLE - Disables ASPM.

PCIe Speed
Configure PCIe Speed.

PEG Port Feature Configuration
Detect Non-Compliance PCI Express Device in PEG

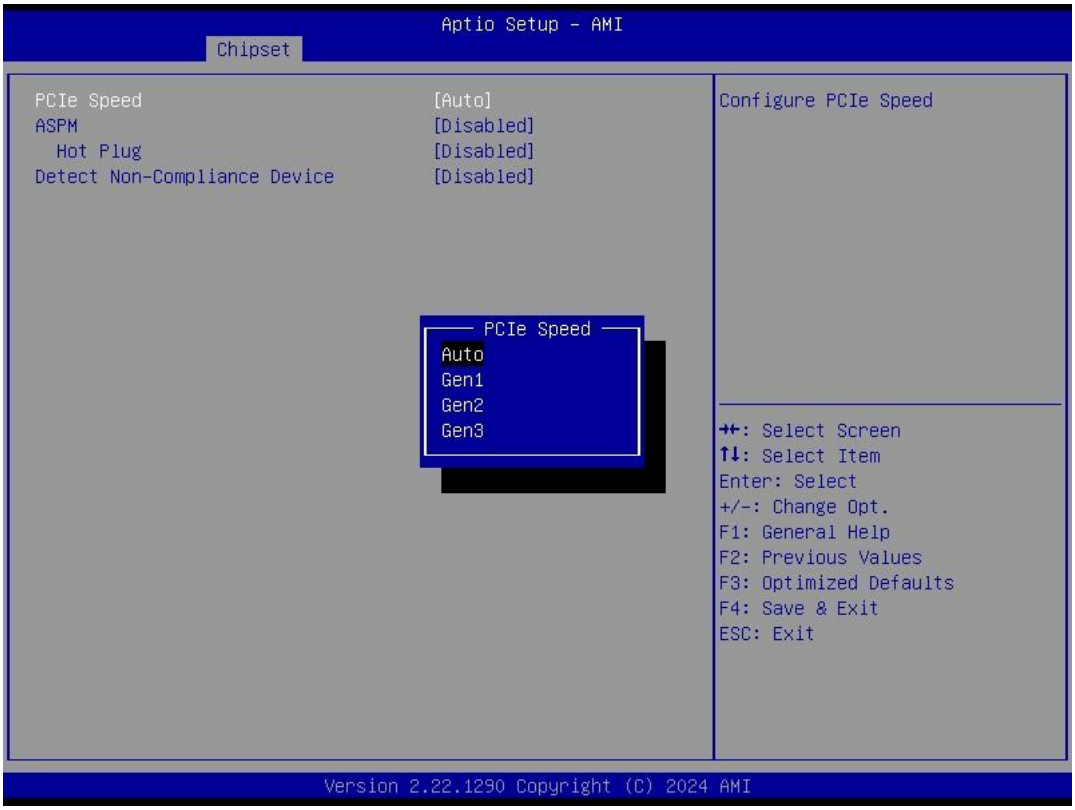
- **PCH-IO Configuration**
  This screen allows you to set PCH parameters.



PCI Express Configuration
Configure PCIe Speed.

PCI Express Root Port 5 = PCIE_4X_SLOT2
PCI Express Root Port 7 = PCIE_4X_SLOT3

HD Audio Configuration
Enable or disable HD Audio.



PCIe Speed
Configure PCIe Speed.

ASPM
Set the ASPM Level:\nForce L1 - Force all links to L1 State\nAUTO - BIOS auto configure\nDISABLE - Disables ASPM.

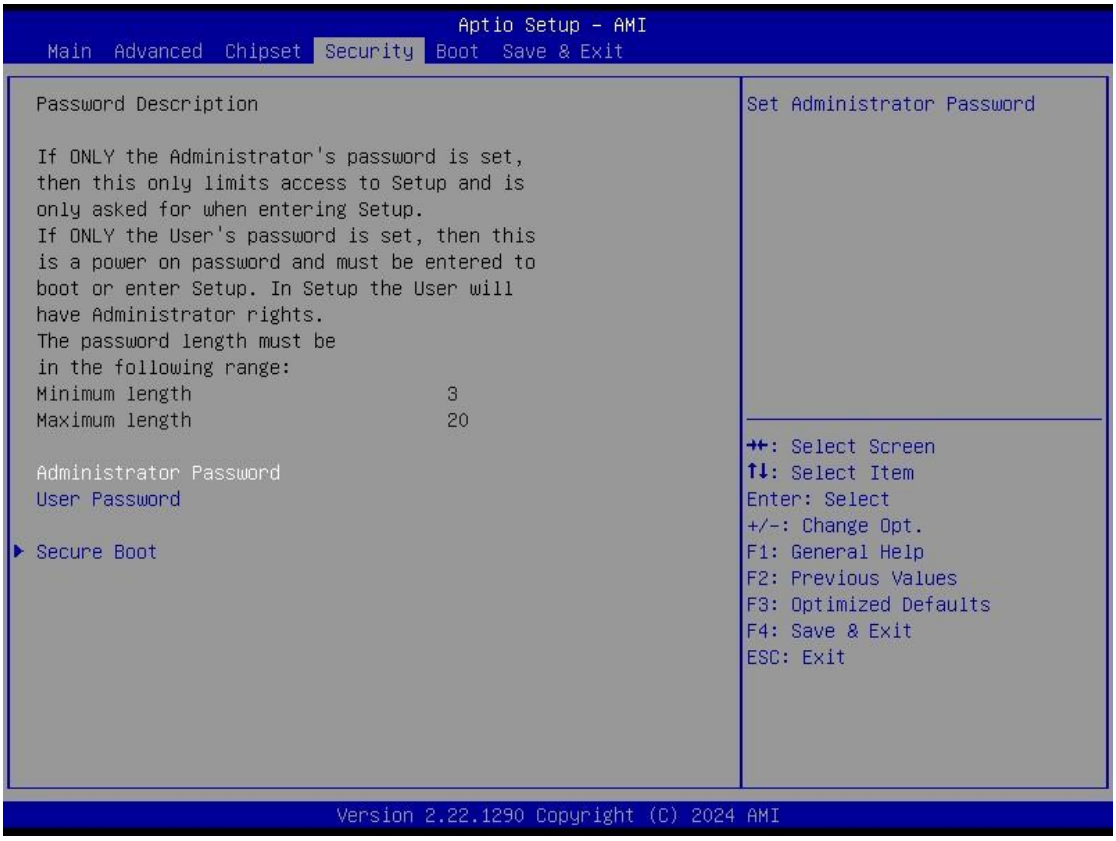
Hot Plug
PCI Express hot plug enable or disable.

Detect Non-Compliance Device
Detect Non-Compliance PCI Express Device. If enabled, it will take more time at POST time.

- **HD Audio Configuration**
  This screen shows HD Audio information

4.6 Security Menu

The Security menu allows users to change the security settings for the system.



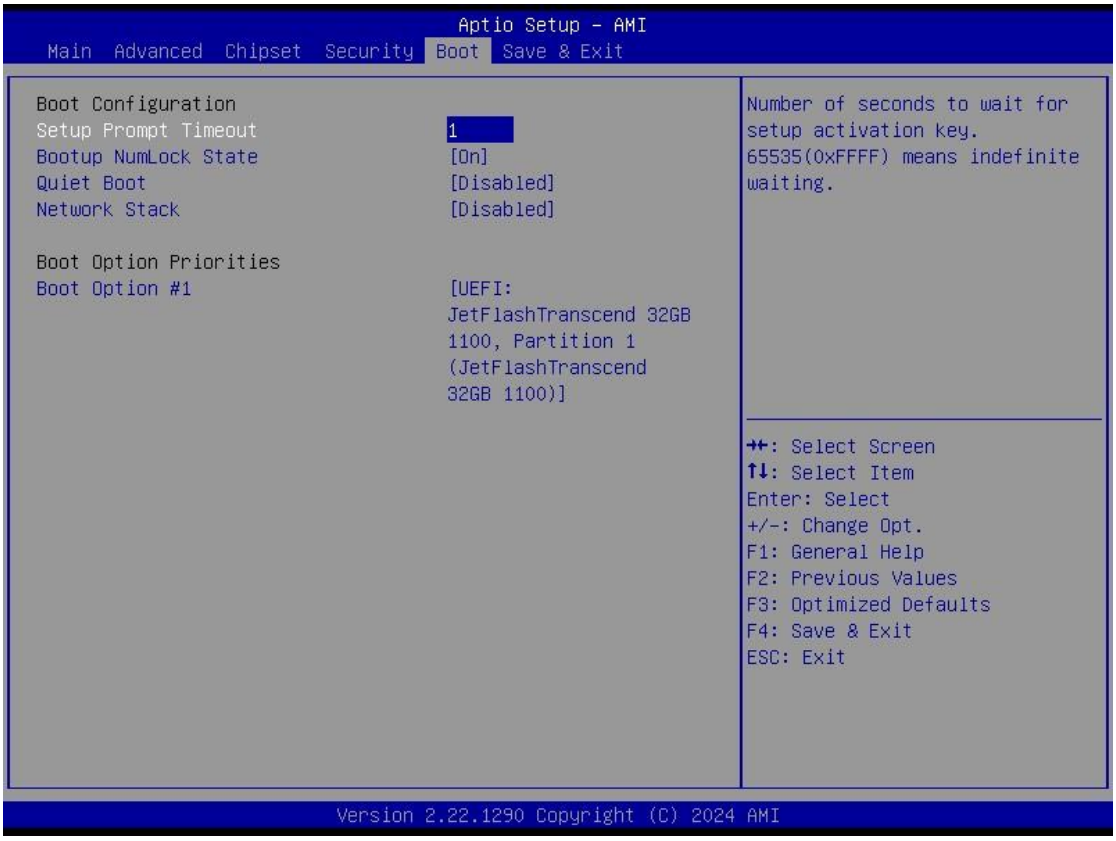
- **Administrator Password**
  This item indicates whether an administrator password has been set (installed or uninstalled).

- **User Password**
  This item indicates whether a user password has been set (installed or uninstalled).

- **Secure Boot**
  This item is available on the UEFI firmware to provide a secure environment.

4.7 Boot Menu

The Boot menu allows users to change boot options of the system.



- **Setup Prompt Timeout**
  Number of seconds to wait for setup activation key. 65535(0xFFFF) means indefinite waiting.

- **Bootup NumLock State**
  Use this item to select the power-on state for the keyboard NumLock.

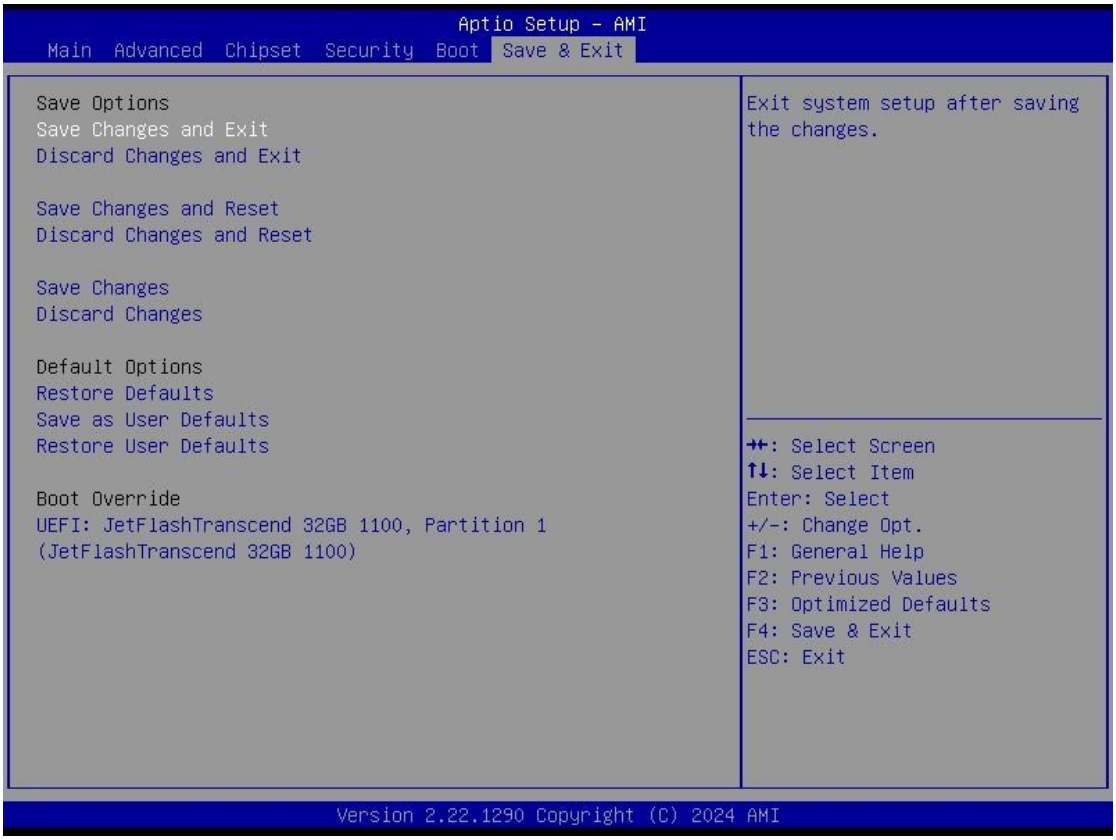
- **Quiet Boot**
  Select to display either POST output messages or a splash screen during boot-up.

- **Network Stack**
  Use this item to run the BIOS of your device through the internet instead of Hard Drives

- **Boot Option Priorities**
  These are settings for boot priority. Specify the boot device priority sequence from the available devices.

4.8 Save & Exit Menu

The Save & Exit menu allows users to load your system configuration with optimal or fail-safe default values.



- **Save Changes and Exit**
  When you have completed the system configuration changes, select this option to leave Setup and return to Main Menu. Select Save Changes and Exit from the Save & Exit menu and press <Enter>. Select Yes to save changes and exit.

- **Discard Changes and Exit**
  Select this option to quit Setup without making any permanent changes to the system configuration and return to Main Menu. Select Discard Changes and Exit from the Save & Exit menu and press <Enter>. Select Yes to discard changes and exit.

- **Save Changes and Reset**
  When you have completed the system configuration changes, select this option to leave Setup and reboot the computer so the new system configuration parameters can take effect. Select Save Changes and Reset from the Save & Exit menu and press <Enter>. Select Yes to save changes and reset.

- **Discard Changes and Reset**
  Select this option to quit Setup without making any permanent changes to the system configuration and reboot the computer. Select Discard Changes and Reset from the Save & Exit menu and press <Enter>. Select Yes to discard changes and reset.

- **Save Changes**
  When you have completed the system configuration changes, select this option to save changes. Select Save Changes from the Save & Exit menu and press <Enter>. Select Yes to save changes.

- **Discard Changes**
  Select this option to quit Setup without making any permanent changes to the system configuration. Select Discard Changes from the Save & Exit menu and press <Enter>. Select Yes to discard changes.

- **Restore Defaults**
  It automatically sets all Setup options to a complete set of default settings when you select this option. Select Restore Defaults from the Save & Exit menu and press <Enter>.

- **Save as User Defaults**
  Select this option to save system configuration changes done so far as User Defaults. Select Save as User Defaults from the Save & Exit menu and press <Enter>.

- **Restore User Defaults**
  It automatically sets all Setup options to a complete set of User Defaults when you select this option. Select Restore User Defaults from the Save & Exit menu and press <Enter>.

- **Boot Override**
  Select a drive to immediately boot that device regardless of the current boot order.

Appendix A
Watchdog Timer

A.1 About Watchdog Timer

Software stability is a major issue in most applications. Some embedded systems are not watched by humans for 24 hours. It is usually too slow to wait for someone to reboot when computer hangs. The systems need to be able to reset automatically when things go wrong. The watchdog timer gives us that solution.

The watchdog timer is a counter that triggers a system reset when it counts down to zero from a preset value. The software starts the counter with an initial value and must reset it periodically. If the counter ever reaches zero which means the software has crashed, the system will reboot.

A.2 How to Use Watchdog Sample Program

```
#include "stdafx.h"

#include <windows.h>
#include <stdio.h>
#include <tchar.h>
#include <stdlib.h>
#ifdef _DEBUG
#define new DEBUG_NEW
#endif
#pragma comment (lib, "User32.lib" )
#define IDT_TIMER WM_USER + 200
#define _CRT_SECURE_NO_WARNINGS 1
#define setbit(value,x) (value |=(1<<x))
#define clrbit(value,x) (value &=~(1<<x))
HINSTANCE hinstLibDLL = NULL;

LONG WDTDATA = 0;


typedef ULONG(*LPFNDLLGETIOSPACE)(ULONG);
LPFNDLLGETIOSPACE lpFnDll_Get_IO;
typedef void(*LPFNDLLSETIOSPACE)(ULONG, ULONG);
LPFNDLLSETIOSPACE lpFnDll_Set_IO;
int _tmain(int argc, _TCHAR* argv[])
{
int unit = 0;
int WDTtimer = 0;
if (hinstLibDLL == NULL)
```

```
{
hinstLibDLL = LoadLibrary(TEXT("diodll.dll"));
if (hinstLibDLL == NULL)
{
//MessageBox("Load diodll dll error", "", MB_OK);
}

}

if (hinstLibDLL)

{
lpFnDll_Get_IO = (LPFNDLLGETIOSPACE)GetProcAddress(GetModuleHandle("diodll.dll"),
"GetIoSpaceByte");
lpFnDll_Set_IO = (LPFNDLLSETIOSPACE)GetProcAddress(GetModuleHandle("diodll.dll"),
"SetIoSpaceByte");
}
printf("Input Watch Dog Timer type, 1:Second ; 2:Minute :");
scanf("%d",&unit);
printf("₩nInput Timer to countdown:");
scanf("%d", &WDTtimer);
printf("Start to countdown...");
//==Enter MB Pnp Mode==
lpFnDll_Set_IO(0x2e, 0x87);
lpFnDll_Set_IO(0x2e, 0x87);
lpFnDll_Set_IO(0x2e, 0x07);
lpFnDll_Set_IO(0x2f, 0x07); //SET LDN 07
//set LDN07 FA 10 to 11
lpFnDll_Set_IO(0x2e, 0xFA);
WDTDATA = lpFnDll_Get_IO(0x2f);
WDTDATA = setbit(WDTDATA, 0);
lpFnDll_Set_IO(0x2f, WDTDATA);
if (unit == 1)
{
lpFnDll_Set_IO(0x2e, 0xF6);
lpFnDll_Set_IO(0x2f, WDTtimer);
//start watchdog counting
lpFnDll_Set_IO(0x2e, 0xF5);
WDTDATA = lpFnDll_Get_IO(0x2f);
WDTDATA = setbit(WDTDATA, 5);
lpFnDll_Set_IO(0x2f, WDTDATA);
}
else if (unit == 2)
{

//set WDT Timer
```

```
lpFnDll_Set_IO(0x2e, 0xF6);

lpFnDll_Set_IO(0x2f, WDTtimer);
//set watchdog time unit to min
lpFnDll_Set_IO(0x2e, 0xF5);
WDTDATA = lpFnDll_Get_IO(0x2f);

WDTDATA = setbit(WDTDATA, 3);
lpFnDll_Set_IO(0x2f, WDTDATA);
//start watchdog counting
lpFnDll_Set_IO(0x2e, 0xF5);
WDTDATA = lpFnDll_Get_IO(0x2f);
WDTDATA = setbit(WDTDATA, 5);
lpFnDll_Set_IO(0x2f, WDTDATA);
}
system("pause");
return 0;

}
```

- Timeout Value Range
  - 1 to 255
  - Minute / Second