MS-98L2

(v1.x) Industrial Computer Board

Copyright Notice

Trademarks

Revision History

Revision	Date
V1.0	2019/03

Technical Support

If a problem arises with your system and no solution can be obtained from the user's manual, please contact your place of purchase or local distributor. Alternatively, please visit the MSI website for technical guide, BIOS updates, driver updates and other information, or contact our technical staff via http://www.msi.com/support/

Safety Instructions

• Always read the safety instructions carefully.

• Keep this User's Manual for future reference.

• Keep this equipment away from humidity.

• Lay this equipment on a reliable flat surface before setting it up.

• The openings on the enclosure are for air convection hence protects the equipment from overheating. DO NOT COVER THE OPENINGS.

• Make sure the voltage of the power source and adjust properly 110/220V before connecting the equipment to the power inlet.

• Place the power cord such a way that people can not step on it. Do not place anything over the power cord.

• Always Unplug the Power Cord before inserting any add-on card or module.

• All cautions and warnings on the equipment should be noted.

• Never pour any liquid into the opening that could damage or cause electrical shock.

• If any of the following situations arises, get the equipment checked by service personnel:

  » The power cord or plug is damaged.

  » Liquid has penetrated into the equipment.

  » The equipment has been exposed to moisture.

  » The equipment does not work well or you can not get it work according to User's Manual.

  » The equipment has dropped and damaged.

  » The equipment has obvious sign of breakage.

• DO NOT LEAVE THIS EQUIPMENT IN AN ENVIRONMENT UNCONDITIONED, STORAGE TEMPERATURE ABOVE 60ºC (140ºF), IT MAY DAMAGE THE EQUIPMENT.

Chemical Substances Information

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

http://www.msi.com/html/popup/csr/evmtprtt_pcm.html

Battery Information

European Union:

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

Taiwan:

For better environmental protection, waste batteries should be collected separately for recycling or special disposal.

廢電池請回收

California, USA:

The button cell battery may contain perchlorate material and requires special handling when recycled or disposed of in California.

For further information please visit:

http://www.dtsc.ca.gov/hazardouswaste/perchlorate/

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer.

WEEE Statement

Under the European Union ("EU") Directive on Waste Electrical and Electronic Equipment, Directive 2002/96/EC, which takes effect on August 13, 2005, products of "electrical and electronic equipment" cannot be discarded as municipal waste anymore and manufacturers of covered electronic equipment will be obligated to take back such products at the end of their useful life.

CE Conformity

Hereby, Micro-Star International CO., LTD declares that this device is in compliance with the essential safety requirements and other relevant provisions set out in the European Directive.

FCC-B Radio Frequency Interference Statement

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

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

Notice 1

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

Notice 2

Shielded interface cables and AC power cord, if any, must be used in order to comply with the emission limits.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference, and
2. this device must accept any interference received, including interference that may cause undesired operation.

CONTENTS

1 Overview

Thank you for choosing the MS-98L2, an excellent industrial computer board.

Based on the innovative Intel® C246 / Q370 chipset for optimal system efficiency, the MS-98L2 accommodates the Intel® Desktop Coffee Lake-S processor and supports up to 4 DDR4 2666MHz U-DIMM slots to provide the maximum of 64 GB memory capacity.

Designed to withstand harsh industrial conditions, the MS-98L2 is engineered to provide reliable performance for a wide variety of industrial applications.

Motherboard Specifications

Processor

- 8th Gen Intel® Desktop Coffee Lake-S Core™ /Pentium® /Celeron® Series Processor, Max 95W

Chipset

- SKU1: Intel® C246
- SKU2 & SKU3: Intel® Q370

Memory

- Dual channel DDR4, up to 2666MHz
- 4 x U-DIMM slots, up to 64GB
- SKU1: ECC, Non ECC supported
- SKU2 & SKU3: Non ECC supported

Network

- SKU1 & SKU2: 4 x LAN ports
  » 1 x Intel® I219-LM GbE LAN PHY
  » 3 x Intel® I210-AT GbE LAN (Co-lay I211-AT)
- SKU3: 2 x LAN ports
  » 1 x Intel® I219-LM GbE LAN PHY
  » 1 x Intel® I210-AT GbE LAN (Co-lay I211-AT)

Storage

- 4 x SATA 6Gb/s ports
- 1 x M.2 M Key slot
  » Supports up to PCIe 3.0 x4 and SATA 6Gb/s
  » PCIe x4 signal switchable with PCIe x4 slot2 (Either PCIe x4 (PCIE2) signal or M.2 M Key (SATA & PCIe) signal is supported when both slots are occupied.
  » Supports 2242/ 2260 /22800 modules
- Supports SATA RAID 0, 1, 5, 10

Expansion Slot

- 1 x PCIe 3.0 x16 slot
- 3 x PCIe x4 slots
  » PCIE2 slot signal switchable with M.2 M Key slot
  » Only PCIE2 & PCIE4 support NVMe
- 1 x full-size Mini-PCIe slot
  » Supports PCIe x1, USB2.0
  » Supports Wi-Fi/Bluetooth modules

Internal I/O

- 1 x 8-pin power connector
- 1 x 24-pin power connector
- 3 x 4-pin System fan connectors
- 1 x 4-pin CPU fan connector
- 2 x USB 2.0 box headers (4 ports)
- 1 x USB 2.0 Vertical Type-A port
- 5 x RS-232 COM port connectors (COM2~COM6)
    - » SKU1 & SKU2: COM2 supports RS-232/422/485 with 0V/5V/12V Auto-flow Control, COM3~6 RS-232, 0V/5V/12V
    - » SKU3: COM2~6 RS-232, 0V/5V/12V
    - » RS-485 support TR 1000 Meter
- 6 x COM port power jumpers
- 1 x Parallel port header
- 2 x GPIO headers
- 1 x Front panel header
- 1 x S/PDIF box header
- 1 x TPM header
- 1 x Front audio box header
- 1 x Keyboard/Mouse box header
- 1 x Chassis intrusion header
- 1 x Clear CMOS jumper
- 1 x AT/ATX select jumper
- 1 x PCIe option jumper
- 1 x ME jumper
- 1 x SMBus box header
- 1 x I^{2}C box header

Rear I/O

- 1 x COM port (COM1)
    - » Supports RS-232/422/485 with Ring/0V/5V/12V Auto-flow Control
    - » RS-485 support TR 1000 Meter
- 1 x VGA port
- 1 x DisplayPort port
- 1 x HDMI port
- 4 or 2 x RJ45 LAN ports (SKU1 & SKU2: 4 x LAN ports, SKU3: 2 x LAN ports)
- 4 x USB 3.1 Gen2 Type-A ports
- 4 x USB 3.1 Gen1 Type-A ports
- 3 x Audio jacks (Line-In, Line-Out, Mic-In)

Graphics

- Integrated Intel® HD Graphics
  - » 1 x VGA (Max resolution 1920 x 1200 @ 60Hz)
  - » 1 x DisplayPort (Max resolution 4096 x 2304 @ 60Hz)
  - » 1 x HDMI (Max resolution 4096 x 2160 @ 24Hz)

Audio

- Realtek® ALC887/888S HD Audio Codec
  - » 1 x Front audio header
  - » 1 x S/PDIF connector
  - » 3 x Audio jacks (Line-In, Line-Out, Mic-In)

Environment

- Operating Temperature: -10 ~ 60°C
- Storage Temperature: -20 ~ 80°C
- Humidity: 10 ~ 90%, non-condensing
- RoHS: Compliant

Form Factor

- Micro-ATX: 244mmx244mm

Certification

- CE, FCC Class B, BSMI, RCM, VCCI

SKU Comparison

Features	SKU1	SKU2	SKU3
PCH	C246	Q370	
LAN3	I210-AT		N/A
LAN4	I210-AT		N/A
COM	2 x RS-232/422/485 4 x RS-232		1 x RS-232/422/485 5 x RS-232
Memory	ECC	non-ECC	

Motherboard Layout

COM1 Jumper | Power Connector | System Fan Connector | CPU Fan Connector | U-DIMM Slots | System Fan Connector

Rear I/O

I²C Box Header
SMBus Box Header
Power Connector
SPI Connector
TPM box header
USB 2.0 Connector

Clear CMOS Jumper

PCIe Slot
M.2 M KEY slot
Chassis Intrusion Header
AT/ATX Jumper
ME Jumper

SATA Ports
Front Panel Box Header
Mini-PCIe Slot
System Fan Connector

S/PDIF Connector | GPIO Box Headers | COM2 Box Header | LPT Connector

Front Audio Box Header | USB 2.0 Box Headers | COM 2~6 Jumpers | COM3~6 Connector

SKU1 & SKU2 Rear I/O

COM Port

DisplayPort

RJ45 GbE LAN Ports

Line-In

Line-Out

Mic-In

VGA Port

HDMI Port

USB 3.1 Gen 2 Ports

USB 3.1 Gen 1 Ports

SKU3 Rear I/O

COM Port

DisplayPort

RJ45 GbE LAN Ports

Line-In

Line-Out

Mic-In

VGA Port

HDMI Port

USB 3.1 Gen 2 Ports

USB 3.1 Gen 1 Ports

2 Hardware Setup

This chapter provides you with the information about hardware setup procedures. While doing the installation, be careful in holding the components and follow the installation procedures. For some components, if you install in the wrong orientation, the components will not work properly.

Use a grounded wrist strap before handling computer components. Static electricity may damage the components.

Components Reference Guide

CPU (Central Processing Unit)

When installing the CPU, make sure that you install the cooler to prevent over-heating. If you do not have the CPU cooler, consult your dealer before turning on the computer.

Important

Overheating

Overheating will seriously damage the CPU and system. Always make sure the cooling fan can work properly to protect the CPU from overheating. Make sure that you apply an even layer of thermal paste (or thermal tape) between the CPU and the heat-sink to enhance heat dissipation.

Replacing the CPU

While replacing the CPU, always turn off the power supply or unplug the power supply's power cord from the grounded outlet first to ensure the safety of CPU.

Introduction to LGA 115x CPU

The surface of LGA 115x CPU. Remember to apply some thermal paste on it for better heat dispersion.

Alignment Key   Alignment Key

Yellow triangle is the
Pin 1 indicator
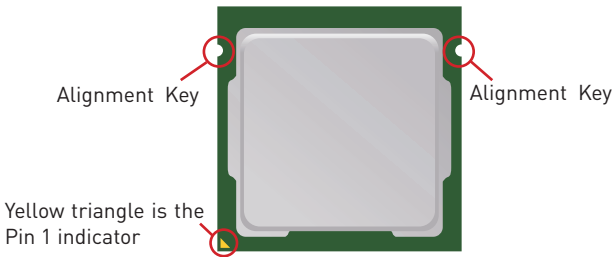
CPU Installation

When you are installing the CPU, **make sure the CPU has a cooler attached on the top to prevent overheating**. Meanwhile, do not forget to apply some thermal paste on CPU before installing the heat sink/cooler fan for better heat dispersion.

1. Open the load lever and remove the plastic cap.

2. Lift the load lever up to fully open position.
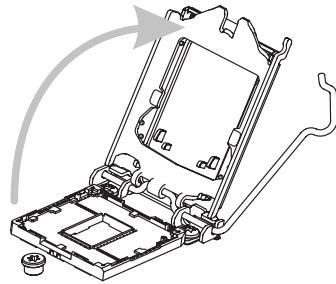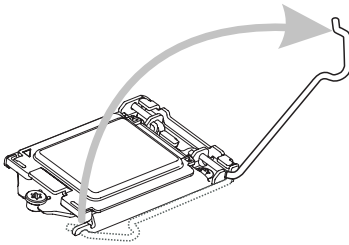
3. After confirming the CPU direction for correct mating, put down the CPU in the socket housing frame. Be sure to grasp on the edge of the CPU base. Note that the alignment keys are matched.

4. Engage the load lever while pressing down lightly onto the load plate.

Alignment Key
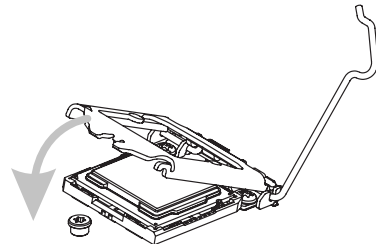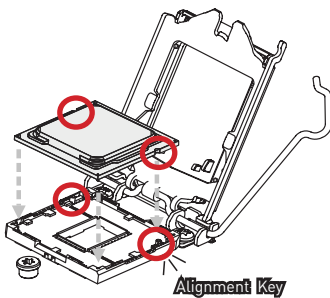
Important

Visually inspect if the CPU is seated well into the socket. If not, take out the CPU with pure vertical motion and reinstall.

5. Secure the load lever with the hook under the retention tab.
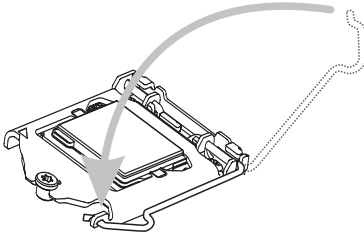
6. Make sure the four hooks are in proper position before you install the cooler. Align the holes on the motherboard with the cooler. Push down the cooler until its four clips get wedged into the holes of the motherboard.
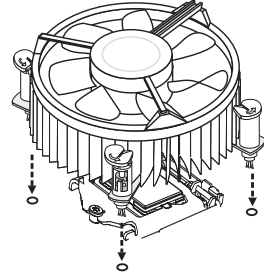
7. Press the four hooks down to fasten the cooler. Turn over the motherboard to confirm that the clip-ends are correctly inserted.
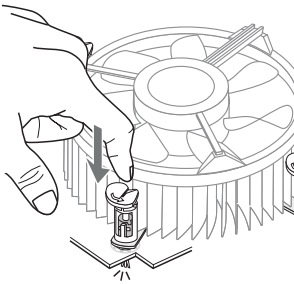
8. Finally, attach the CPU Fan cable to the CPU fan connector on the motherboard.
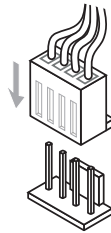
Important

- *Confirm if your CPU cooler is firmly installed before turning on your system.*

- *Do not touch the CPU socket pins to avoid damage.*

- *Whenever CPU is not installed, always protect your CPU socket pins with the plastic cap covered.*

- *Please refer to the documentation in the CPU cooler package for more details about the CPU cooler installation.*

- *Read the CPU status in BIOS.*

Memory

Dual-Channel Mode

In Dual-Channel mode, make sure that you install memory modules of the **same type and density** in different channel slots.

Recommended Memory Population

Number of U-DIMMs installed	1	2	3	4
DIMM1 (ch A)	V	V	V	V
DIMM2 (ch A)			V	V
DIMM3 (ch B)		V	V	V
DIMM4 (ch B)				V

Important

- *"V" indicates a populated DIMM slot.*
- *Paired memory installation for Max performance.*
- *Populate the same DIMM type in each channel, specifically: 1. Use the same DIMM size; 2. Use the same number of ranks per DIMM.*

Installing Memory Modules

1. Unlock the DIMM slot by flipping open its side clips.
2. Vertically insert the DIMM into the slot. The DIMM has an off-center notch at the bottom that will only allow it to fit one way into the slot. Push the DIMM deeply into the slot. The side clips of the slot will automatically close when the DIMM is properly seated and an audible click should be heard.
3. Manually check if the DIMM has been locked in place by the slot's side clips.

Important

You can barely see the golden finger if the DIMM is properly inserted in the DIMM slot.

Power Supply

System Power Connector: JPWR1

This connector allows you to connect a power supply. To connect to the power supply, make sure the plug of the power supply is inserted in the proper orientation and the pins are aligned. Then push down the power supply firmly into the connector.
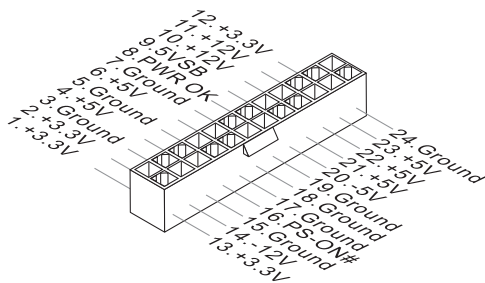
CPU Power Connector: JPWR2

This connector is used to provide power to the CPU.
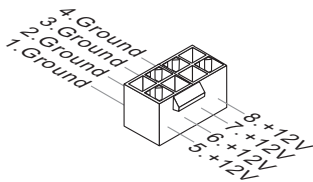
Important

- *Make sure that all power connectors are connected to the power supply to ensure stable operation of the motherboard.*

- *To avoid some issues like system instability, reset and shutdown caused by energy-insufficient power supply, we suggest you should follow Intel Power Supply Design Guide Rev 1.4 list and Intel Document Number 595284 to choose your power supply unit.*

Rear Panel I/O

SKU1 & SKU2 Rear I/O

COM Port

DisplayPort

RJ45 GbE LAN Ports

Line-In

Line-Out

Mic-In

VGA Port   HDMI Port   USB 3.1 Gen 2 Ports   USB 3.1 Gen 1 Ports

SKU3 Rear I/O

COM Port

DisplayPort

RJ45 GbE LAN Ports

Line-In

Line-Out

Mic-In

VGA Port   HDMI Port   USB 3.1 Gen 2 Ports   USB 3.1 Gen 1 Ports
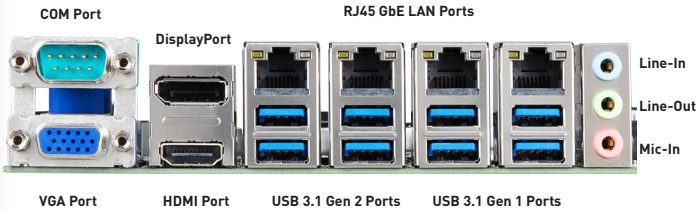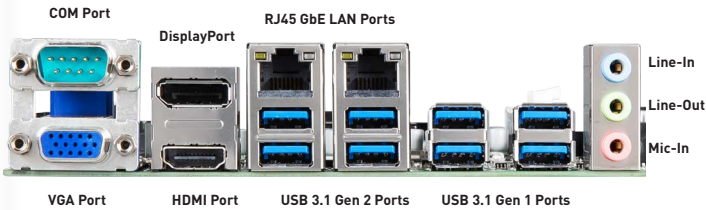
›› VGA Port

The DB15-pin female connector is provided for monitor.

›› DisplayPort

DisplayPort is a digital display interface standard. This connector is used to connect a monitor with DisplayPort inputs.

›› HDMI Port

The High-Definition Multimedia Interface (HDMI) is an all-digital audio/video interface capable of transmitting uncompressed streams. HDMI supports all TV format, including standard, enhanced, or high-definition video, plus multi-channel digital audio on a single cable.

›› RS-232/422/485 Serial Port

The serial port is a 16550A high speed communications port that sends/receives 16 bytes FIFOs. With Auto-Flow Control and RI Function Support, it supports bar-code scanners, barcode printers, bill printers, credit card machine, etc.
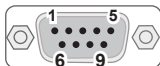
RS-232

PIN	SIGNAL	DESCRIPTION
1	NDCD	Data Carrier Detect
2	NSIN	Signal In
3	NSOUT	Signal Out
4	NDTR	Data Terminal Ready
5	GND	Signal Ground
6	NDSR	Data Set Ready
7	NRTS	Request To Send
8	NCTS	Clear To Send
9	VCC	5V or 12V selected by jumper

RS-422
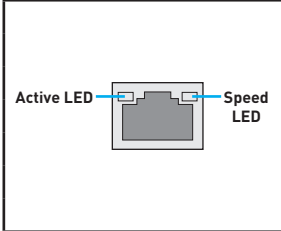
PIN	SIGNAL	DESCRIPTION
1	422 TXD-	Transmit Data, Negative
2	422 TXD+	Transmit Data, Positive
3	422 RXD+	Receive Data, Positive
4	422 RXD-	Receive Data, Negative
5	GND	Signal Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

RS-485

PIN	SIGNAL	DESCRIPTION
1	485 TXD-	Transmit Data, Negative
2	485 TXD+	Transmit Data, Positive
3	NC	No Connection
4	NC	No Connection
5	GND	Signal Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

›› RJ45 GbE LAN Port

The standard single RJ45 LAN jack is provided for connection to the Local Area Network (LAN). You can connect a network cable to it.

	LED	LED Status	Description
Active LED ─ ▭ ⬛ ▭ ─ Speed LED	Active LED	Off	No link
		Yellow	Linked
		Blinking	Data activity
	Speed LED	Off	10 Mbps connection
		Green	100 Mbps connection
		Orange	1 Gbps connection

›› USB3.1 Gen 2, USB3.1 Gen 1 Port

USB 3.1 Gen 2 (SuperSpeed USB 10Gbps) , USB 3.1 Gen 1 (SuperSpeed USB) delivers high-speed data transfer for various devices, such as storage devices, hard drives, video cameras, etc.

›› Line-In Jack

For external CD player, tapeplayer or other audio devices.

›› Line-Out Jack

For speakers or headphones.

›› Mic-In Jack

For microphones.

Connector

Fan Power Connector: CPUFAN1, SYSFAN1~3

The fan power connectors support system cooling fan with +12V. When connecting the wire to the connectors, always note that the red wire is the positive and should be connected to the +12V; the black wire is Ground and should be connected to GND. If the motherboard has a System Hardware Monitor chipset onboard, you must use a specially designed fan with speed sensor to take advantage of the CPU fan control.

1.GND
2.FAN_POWER
3.FAN_SENSE
4.FAN_PWM
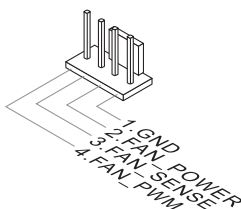
Important

- *Please refer to the recommended CPU fans at processor's official website or consult the vendors for proper CPU cooling fan.*

- *Fan cooler sets with 3- or 4-pin power connector are both available.*

Dual Stacked SATA Connector: SATA1_2, SATA3_4

This connector is a high-speed Serial ATA interface port. Each connector can connect to two SATA devices.
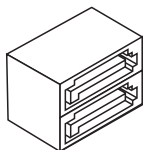
Important

Please do not fold the SATA cable into a 90-degree angle. Otherwise, data loss may occur during transmission.

Chassis Intrusion Header: JCASE1

This connector connects to the chassis intrusion switch cable. If the computer case is opened, the chassis intrusion mechanism will be activated. The system will record this intrusion and a warning message will flash on screen. To clear the warning, you must enter the BIOS utility and clear the record.

2. GND
1. Case open
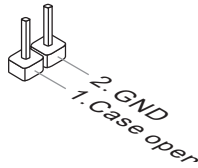
GPI Box Header: JGPIO1

This connector is provided for the General-Purpose Input peripheral module.

10. GPI7
8. GPI6
4. GPI5
2. VCC5

9. GPI3
7. GPI2
5. GPI1
3. GPI0
1. GND
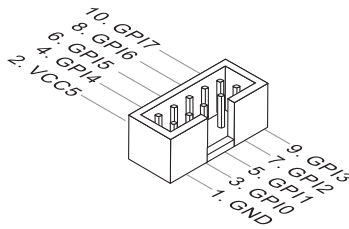
GPO Box Header: JGPIO2

This connector is provided for the General-Purpose Output peripheral module.

10. GPO7
8. GPO6
4. GPO5
2. VCC5

9. GPO3
7. GPO2
5. GPO1
3. GPO0
1. GND
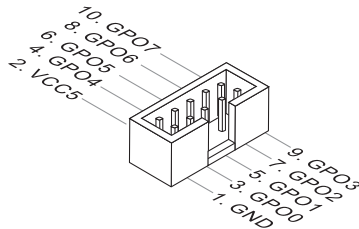
Front Panel Box Header: JFP1

This front panel connector is provided for electrical connection to the front panel switches & LEDs and is compliant with Intel Front Panel I/O Connectivity Design Guide.

PW LED (+)	PW LED (-)	PW SW (+)	PW SW (-)	Key
2	4	6	8	10
1	3	5	7	9
HDD LED (+)	HDD LED (-)	Reser SW (-)	Reset SW(+)	NC
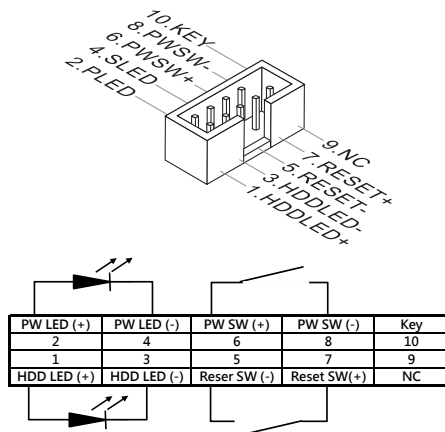
SMBus Box Header: JSMB1

This connector is provided for users to connect System Management Bus (SM-Bus) interface.
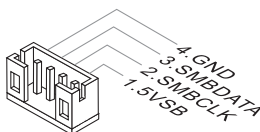
I²C Box Header: JI2C1

This connector is provided for users to connect I²C (Inter-Integrated Circuit) interface.
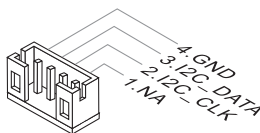
RS232/422/485 COM Port Box Header: JCOM2

This connector is a 16550A high speed communications port that sends/receives 16 bytes FIFOs. You can attach a serial device to it.
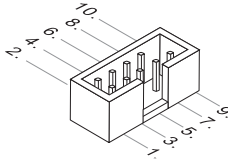
RS232

PIN	SIGNAL	DESCRIPTION
1	DCD	Data Carrier Detect
2	RXD	Receive Data
3	TXD	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	VCC_COM	Voltage select setting by COM jumper

RS422

PIN	SIGNAL	DESCRIPTION
1	422 TXD-	Transmit Data, Negative
2	422 RXD+	Receive Data, Positive
3	422 TXD+	Transmit Data, Positive
4	422 RXD-	Receive Data, Negative
5	GND	Signal Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

RS485

PIN	SIGNAL	DESCRIPTION
1	485 TXD-	Transmit Data, Negative
2	485 TXD+	Transmit Data, Positive
3	NC	No Connection
4	NC	No Connection
5	GND	Signal Ground
6	NC	No Connection
7	NC	No Connection
8	NC	No Connection
9	NC	No Connection

RS232 COM Port Header: JCOM3 (COM3~COM6)

This connector is a 16550A high speed communications port that sends/receives 16 bytes FIFOs. You can attach a serial device to it.
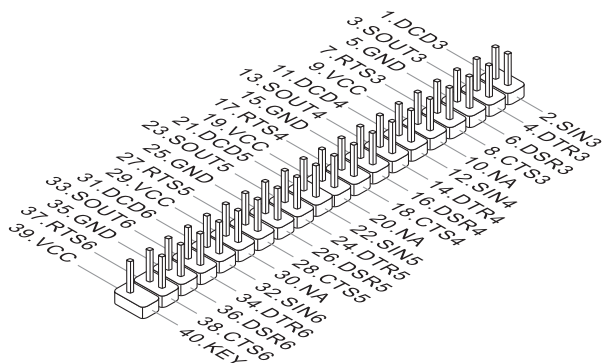
Parallel Port Box Header: JLPT1

The mainboard provides a 26-pin header for connection to an optional parallel port bracket. The parallel port is a standard printer port that supports Enhanced Parallel Port (EPP) and Extended Capabilities Parallel Port (ECP) mode.
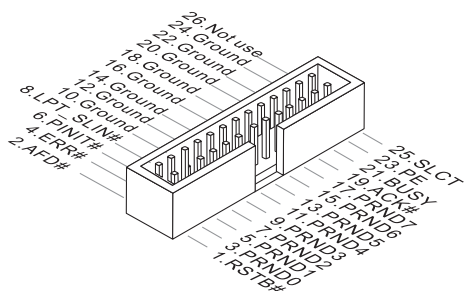
TPM Box Header: JTPM1

This connector works as LPC debug port and supports TPM modules.

14. GND
12. GND
10. NC
8. +5V
6. SERIAL_ IRQ
4. +3.3V
2. +3.3V_ SB

13. LPC_ FRAME#
11. LPC_ AD3
9. LPC_ AD2
7. LPC_ AD1
5. LPC_ AD0
3. LPC_ RESET#
1. LPC_ CLOCK
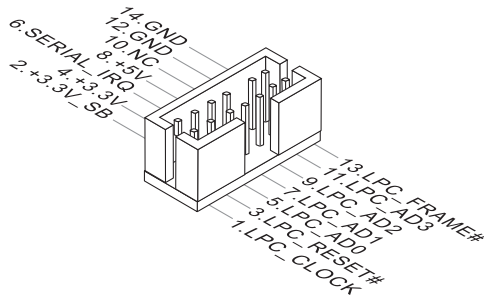
Front Audio Box Header: JAUD1

This connector allows you to connect the front panel audio and is compliant with Intel Front Panel I/O Connectivity Design Guide.

10. Headphone Detection
8. Key
6. MIC Detection
4. NC
2. Ground

9. Headphone L
7. Sense_ Send
5. Headphone R
3. MIC R
1. MIC L
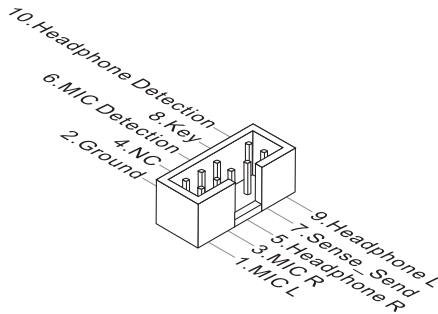
S/PDIF Box Header: JSPDI1

This pinheader is used to connect S/PDIF (Sony & Philips Digital Interconnect Format) interface for digital audio transmission.

1. VCC
2. SPDIF
3. Ground
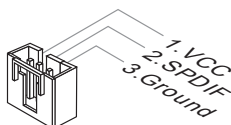
USB 2.0 Box Header: JUSB1, JUSB2,

USB 2.0 Port: USB1

This connector is ideal for connecting USB devices such as keyboard, mouse, or other USB-compatible devices.

10. NC
8. Ground
6. USB1+
4. USB1-
2. VCC

9. No Pin
7. Ground
5. USB0+
3. USB0-
1. VCC
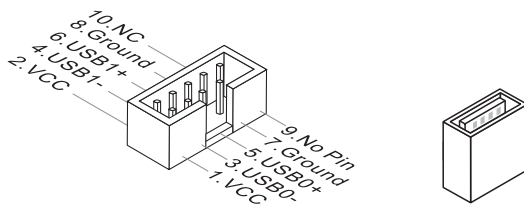
Important

- *Note that the pins of VCC and GND must be connected correctly to avoid possible damage.*
- *Do not pick the motherboard up by grabbing the USB Box Headers to avoid damage.*

PS/2 Keyboard/Mouse Connector: JKBMS1

This connector is provided to connect a keyboard and a mouse.

6. MS_CLK
5. VCC5
4. KB_CLK
3. MS_DAT
2. GND
1. KB_DAT
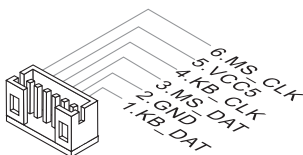
Jumper

Avoid adjusting jumpers when the system is on; it will damage the motherboard.

COM1 Power Jumper: JCOMP1

These jumpers specify the operation voltage of the COM1 port.

RI   +12V   +5V
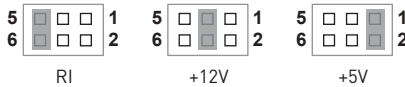
JCOM2~JCOM6 Power Jumper: JCOMP2 ~ JCOMP6

These jumpers specify the operation voltage of the JCOM2~JCOM6 serial ports.

+5V   +12V

Clear CMOS Jumper: JCMOS1

There is a CMOS RAM onboard that has a power supply from an external battery to keep the data of system configuration. With the CMOS RAM, the system can automatically boot OS every time it is turned on. If you want to clear the system configuration, set the jumper to clear data.

Normal   Clear CMOS

You can clear CMOS by shorting 2-3 pin while the system is off. Then return to 1-2 pin position. Avoid clearing the CMOS while the system is on; it will damage the motherboard.

AT/ATX Jumper: JAT1

This jumper allows users to select between AT and ATX power.

ATX   AT

Slot

PCIe (Peripheral Component Interconnect Express) Slot

The PCI Express slot supports PCIe interface expansion cards (signal shared with M.2 Key M, auto switch by switch IC and PCIe x4 as top priority).

PCIe x16 slot

PCIe x4 slot
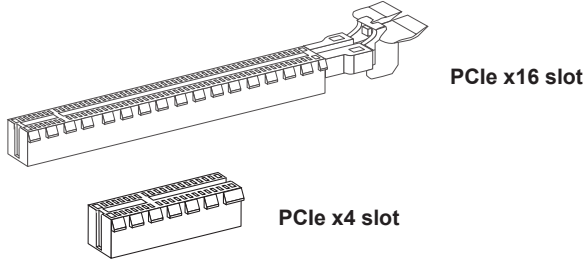
M2_M1: M.2 Slot (Key M, 2242/2260/2280) for SSD

Please install the M.2 solid-state drive (SSD) into the M.2 slot as shown below.
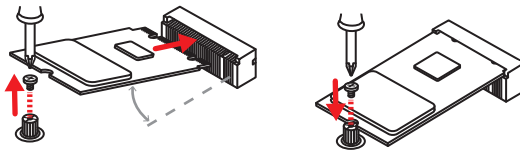
Important

Intel® RST only supports PCIe M.2 SSD with UEFI ROM and does not support Legacy ROM.

MINIPCIE1: Mini-PCIe Slot

The Mini-PCIe slot is provided for Wi-Fi/Bluetooth Mini-PCIe cards.
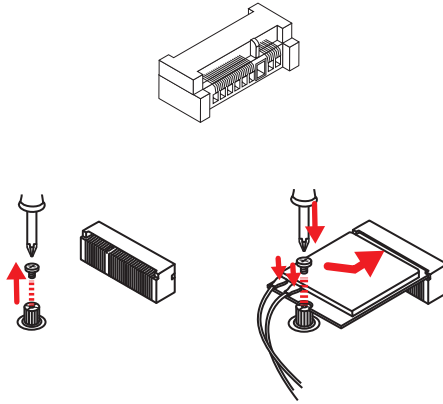
3 BIOS Setup

This chapter provides information on the BIOS Setup program and allows users to configure the system for optimal use.

Users may need to run the Setup program when:

• An error message appears on the screen at system startup and requests users to run SETUP.
• Users want to change the default settings for customized features.

Important

• *Please note that BIOS update assumes technician-level experience.*

• *As the system BIOS is under continuous update for better system performance, the illustrations in this chapter should be held for reference only.*

Entering Setup

Power on the computer and the system will start POST (Power On Self Test) process. When the message below appears on the screen, press <DEL> or <F2> key to enter Setup.

Press <DEL> or <F2> to enter SETUP

If the message disappears before you respond and you still wish to enter Setup, restart the system by turning it OFF and On or pressing the RESET button. You may also restart the system by simultaneously pressing <Ctrl>, <Alt>, and <Delete> keys.

Important

The items under each BIOS category described in this chapter are under continuous update for better system performance. Therefore, the description may be slightly different from the latest BIOS and should be held for reference only.

Control Keys

← →	Select Screen
↑ ↓	Select Item
Enter	Select
+ -	Change Option
F1	General Help
F7	Previous Values
F9	Optimized Defaults
F10	Save & Reset
Esc	Exit

Getting Help

After entering the Setup menu, the first menu you will see is the Main Menu.

Main Menu

The main menu lists the setup functions you can make changes to. You can use the arrow keys (↑↓) to select the item. The on-line description of the highlight-ed setup function is displayed at the bottom of the screen.

Sub-Menu

If you find a right pointer symbol appears to the left of certain fields that means a sub-menu can be launched from this field. A sub-menu contains additional op-tions for a field parameter. You can use arrow keys (↑↓) to highlight the field and press <Enter> to call up the sub-menu. Then you can use the control keys to enter values and move from field to field within a sub-menu. If you want to return to the main menu, just press the <Esc >.

General Help <F1>

The BIOS setup program provides a General Help screen. You can call up this screen from any menu by simply pressing <F1>. The Help screen lists the ap-propriate keys to use and the possible selections for the highlighted item. Press <Esc> to exit the Help screen.

The Menu Bar
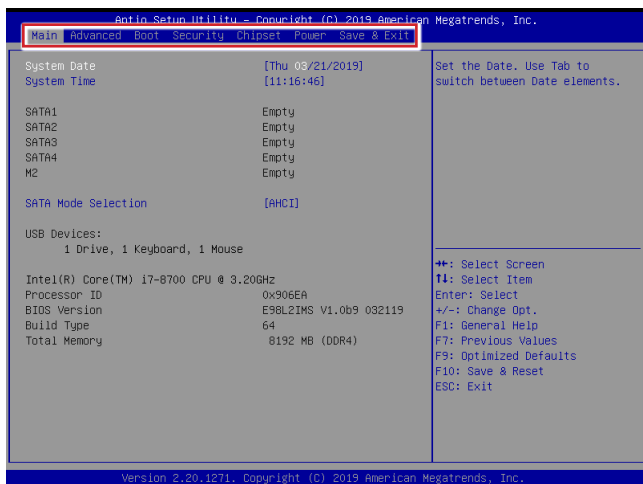
► **Main**
Use this menu for basic system configurations, such as time, date, etc.

► **Advanced**
Use this menu to set up the items of special enhanced features.

► **Boot**
Use this menu to specify the priority of boot devices.

► **Security**
Use this menu to set supervisor and user passwords.

► **Chipset**
This menu controls the advanced features of the onboard chipsets.

► **Power**
Use this menu to specify your settings for power management.

► **Save & Exit**
This menu allows you to load the BIOS default values or factory default settings into the BIOS and exit the BIOS setup utility with or without changes.

Main
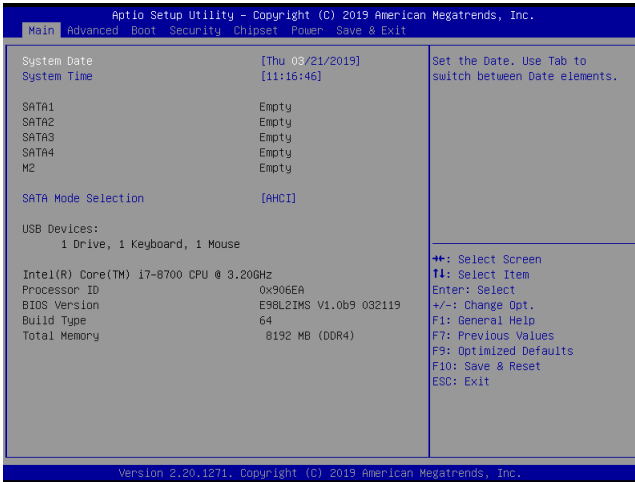
▶ **System Date**

This setting allows you to set the system date. The date format is <Day>, <Month> <Date> <Year>.

▶ **System Time**

This setting allows you to set the system time. The time format is <Hour> <Minute> <Second>.

▶ **SATA Mode Selection**

This setting specifies the SATA controller mode.

Advanced
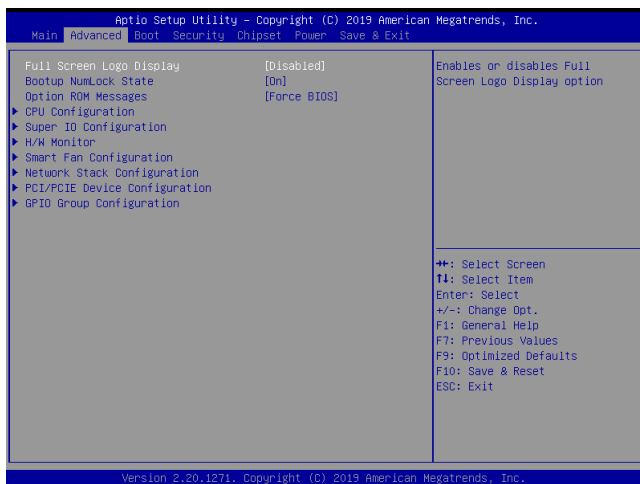
► **Full Screen Logo Display**

This BIOS feature determines if the BIOS should hide the normal POST messages with the motherboard or system manufacturer's full-screen logo.

When it is enabled, the BIOS will display the full-screen logo during the boot-up sequence, hiding normal POST messages.

When it is disabled, the BIOS will display the normal POST messages, instead of the full-screen logo.

Please note that enabling this BIOS feature often adds 2-3 seconds of delay to the booting sequence. This delay ensures that the logo is displayed for a sufficient amount of time. Therefore, it is recommended that you disable this BIOS feature for a faster boot-up time.

► **Bootup NumLock State**

This setting is to set the Num Lock status when the system is powered on. Setting to [On] will turn on the Num Lock key when the system is powered on. Setting to [Off] will allow users to use the arrow keys on the numeric keypad.

► **Option ROM Messages**

This item is used to determine the display mode when an optional ROM is initialized during POST. When set to [Force BIOS], the display mode used by AMI BIOS is used. Select [Keep Current] if you want to use the display mode of optional ROM.

► **CPU Configuration**

```
                 Advanced

  CPU Configuration

  Intel(R) Core(TM) i7-8700 CPU @ 3.20GHz
  Processor ID                    0x906EA
  Processor Speed                 3200 MHz
  L2 Cache                        256 KB x 6
  L3 Cache                        12 MB

  Intel Virtualization Technology  [Enabled]
  Active Processor Cores           [All]
  Hyper-Threading                  [Enabled]
  Intel(R) SpeedStep(tm)           [Enabled]
  C states                         [Enabled]
```
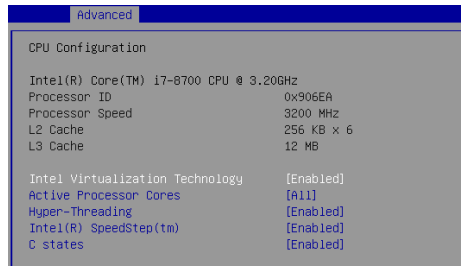
► Intel Virtualization Technology

Virtualization enhanced by Intel Virtualization Technology will allow a platform to run multiple operating systems and applications in independent partitions. With Virtualization, one computer system can function as multiple "Virtual" systems.

► Active Processor Cores

This setting specifies the number of active processor cores.

► Execute Disable Bit

Intel's Execute Disable Bit functionality can prevent certain classes of malicious "buffer overflow" attacks when combined with a supporting operating system. This functionality allows the processor to classify areas in memory by where application code can execute and where it cannot. When a malicious worm attempts to insert code in the buffer, the processor disables code execution, preventing damage or worm propagation.

► Intel(R) SpeedStep(TM)

EIST (Enhanced Intel SpeedStep Technology) allows the system to dynamically adjust processor voltage and core frequency, which can result in decreased average power consumption and decreased average heat production. When disabled, the processor will return the actual maximum CPUID input value of the processor when queried.

► C States

This setting controls the C-States (CPU Power states).

▶ **Super IO Configuration**
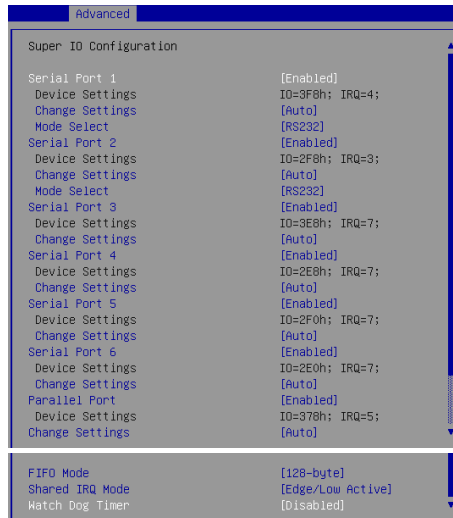
▶ **Serial Port 1/ 2/ 3/ 4/ 5 /6**

This setting enables/disables the specified serial port.

▶ **Change Settings**

This setting is used to change the address & IRQ settings of the specified serial port.

▶ **Mode Select**

Select an operation mode for Serial Port 1.

▶ **Parallel Port**

This setting enables/disables the parallel port.

▶ **Change Settings**

This setting is used to change the address & IRQ settings of the parallel port.

▶ **Device Mode**

Select an operation mode for the parallel port.

▶ **Watch Dog Timer**

You can enable the system watch-dog timer, a hardware timer that generates a reset when the software that it monitors does not respond as expected each time the watch dog polls it.

▶ **FIFO Mode**

This setting controls the FIFO data transfer mode.

▶ **Shared IRQ Mode**

This setting provides the system with the ability to share interrupts among its serial ports.

► **H/W Monitor**

These items display the current status of all monitored hardware devices/ components such as voltages, temperatures and all fans' speeds.

```
                        Advanced

PC Health Status

CPU temperature               : +57 C
System temperature            : +25 C

CPUFAN1                        : 4273 RPM
SYSFAN1                        : N/A
SYSFAN2                        : N/A
SYSFAN3                        : N/A

VCC_CORE                      : +1.016 V
VCC3                          : +3.408 V
VCC5                          : +5.171 V
+12V                          : +11.968 V
VSB3V                         : +3.408 V
VSB5V                         : +4.992 V
VBAT                          : +3.104 V
```

► **Smart Fan Configuration**

```
                    Advanced

Configuration Smart FAN

CPUFAN1                        [Disabled]
SYSFAN1                        [Disabled]
 Type                         [4 Pin]
SYSFAN2                        [Disabled]
 Type                         [4 Pin]
SYSFAN3                        [Disabled]
 Type                         [4 Pin]
```

► **CPUFAN1, SYSFAN1 ~ SYSFAN3**

This setting enables/disables the Smart Fan function. Smart Fan is an excel-lent feature which will adjust the CPU/system fan speed automatically de-pending on the current CPU/system temperature, avoiding the overheating to damage your system.

► **Network Stack Configuration**

This menu provides Network Stack settings for users to enable network boot (PXE) from BIOS.

```
                    Advanced

Network Stack                 [Enabled]
Ipv4 PXE Support              [Disabled]
Ipv4 HTTP Support             [Disabled]
Ipv6 PXE Support              [Disabled]
Ipv6 HTTP Support             [Disabled]
IPSEC Certificate             [Enabled]
PXE boot wait time            0
Media detect count            1
```

► **PCI/PCIE Device Configuration**

```
        Advanced

Legacy USB Support              [Enabled]
Audio Controller                [Enabled]
Launch OnBoard Lan OpRom        [Disabled]
Launch OnBoard Lan OpRom        [Disabled]
Launch OnBoard Lan OpRom        [Disabled]
Launch OnBoard Lan OpRom        [Disabled]
```

► **Legacy USB Support**

Set to [Enabled] if you need to use any USB 1.1/2.0 device in the operating system that does not support or have any USB 1.1/2.0 driver installed, such as DOS and SCO Unix.

► **Audio Controller**

This setting enables/disables the onboard audio controller.

► **Launch OnBoard LAN OpROM**

These settings enable/disable the initialization of the onboard/onchip LAN Boot ROM during bootup. Selecting [Disabled] will speed up the boot process.

► **GPIO Group Configuration**

```
        Advanced

GPIO Group Configuration

GPO0                            [Low]
GPO1                            [Low]
GPO2                            [Low]
GPO3                            [Low]
GPO4                            [Low]
GPO5                            [Low]
GPO6                            [Low]
GPO7                            [Low]
```

► **GPO0 ~ GPO7**

These settings control the operation mode of the specified GPIO.

Boot

```
                Aptio Setup Utility - Copyright (C) 2019 American Megatrends, Inc.
      Main   Advanced   Boot   Security   Chipset   Power   Save & Exit

 CSM Support                         [Disabled]              Enable/Disable CSM Support.

 Boot Option Priorities
 Boot Option #1                      [UEFI:
                                     KingstonDataTraveler
                                     2.0PMAP, Partition 1]

 Boot Option #2                      [UEFI: Built-in EFI
                                     Shell]



                                                            →←: Select Screen
                                                            ↑↓: Select Item
                                                            Enter: Select
                                                            +/-: Change Opt.
                                                            F1: General Help
                                                            F7: Previous Values
                                                            F9: Optimized Defaults
                                                            F10: Save & Reset
                                                            ESC: Exit

                Version 2.20.1271. Copyright (C) 2019 American Megatrends, Inc.
```

► **CSM Support**

This setting enables/disables the support for Compatibility Support Module, a part of the Intel Platform Innovation Framework for EFI providing the capability to support legacy BIOS interfaces.

► **Boot Option Priorities**

This setting allows users to set the sequence of boot devices where BIOS attempts to load the disk operating system.

Security
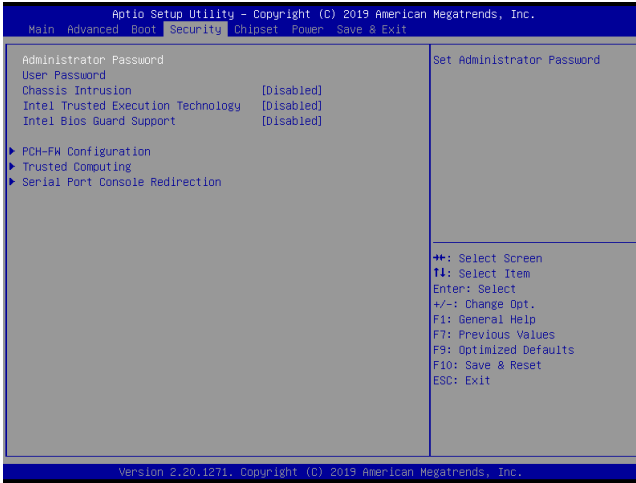
► **Administrator Password**

Administrator Password controls access to the BIOS Setup utility.

► **User Password**

User Password controls access to the system at boot and to the BIOS Setup utility.

► **Chassis Intrusion**

The field enables or disables the feature of recording the chassis intrusion status and issuing a warning message if the chassis is once opened.

► **Intel Trusted Execution Technology**

Intel Trusted Execution Technology provides highly scalable platform security in physical and virtual infrastructures.

► **Intel BIOS Guard Support**

Intel BIOS Guard Support ensures that updates to system BIOS flash are secure.

► **PCH-FW Configuration**

```
                          Security

ME Firmware Version            12.0.30.1408
ME Firmware Mode               Normal Mode
ME Firmware SKU                Corporate SKU
ME Firmware Status 1           0x90000255
ME Firmware Status 2           0x8B10810E

ME State                       [Enabled]
Manageability Features State   [Enabled]
AMT BIOS Features              [Enabled]
► AMT Configuration
ME Unconfig on RTC Clear       [Enabled]
Comms Hub Support              [Disabled]
JHI Support                    [Disabled]
Core Bios Done Message         [Enabled]

► Firmware Update Configuration
► PTT Configuration
► ME Debug Configuration
► Anti-Rollback SVN Configuration
```

► **ME Firmware Version, ME Firmware Mode, ME Firmware SKU, System Integrity Value, ME Firmware Status 1, ME Firmware Status 2**

These settings show the firmware information of the Intel ME (Management Engine).

► **ME State**

This setting specifies the Intel Management Engine state.

► **Manageability Features State**

This setting specifies the Intel ME Manageability Features.

► **AMT BIOS Features**

This setting specifies the AMT BIOS Features.

► **AMT Configuration**

Intel Active Management Technology (AMT) is hardware-based technology for remotely managing and securing PCs out-of-band.

```
                          Security

ASF support                    [Enabled]

USB Provisioning of AMT        [Disabled]
► CIRA Configuration
► ASF Configuration
► Secure Erase Configuration
► OEM Flags Settings
► MEBx Resolution Settings
```
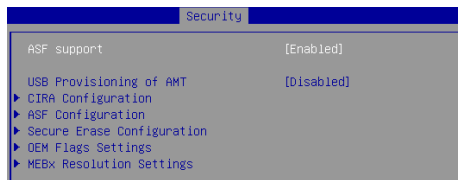
► **ME Unconfig on RTC Clear**

This setting enables/disables ME firmware unconfigure on RTC clear.

► **Comms Hub Support**

This setting enables/disables Communications Hub Support.

► **JHI Support**

This setting enables/disables support for Intel Dynamic Application Loader Host Interface (JHI).

▶ **Core BIOS Done Message**

This setting enables/disables Core BIOS Done Message sent to ME.

▶ **Firmware Update Configuration**

```
                    Security
Me FW Image Re-Flash            [Disabled]
```

▶ **ME FW Image Re-Flash**

This setting enables/disables the ME FW image reflash.

▶ **PTT Configuration**

Intel Platform Trust Technology (PTT) is a platform functionality for credential storage and key management used by Microsoft Windows.

```
                    Security
PTT Capability / State          1 / 0

TPM Device Selection            [dTPM]
```

▶ **ME Debug Configuration**

```
                    Security
HECI Timeouts                   [Enabled]

Force ME DID Init Status        [Disabled]
CPU Replaced Polling Disable    [Disabled]
ME DID Message                  [Enabled]
HECI Retry Disable              [Disabled]
HECI Message check Disable      [Disabled]
MBP HOB Skip                    [Disabled]
HECI2 Interface Communication   [Disabled]
KT Device                       [Enabled]
End Of Post Message             [Send in DXE]
DOI3 Setting for HECI Disable   [Disabled]
MCTP Broadcast Cycle            [Disabled]
```

▶ **Trusted Computing**

```
                    Security
TPM20 Device Found
Firmware Version:               5.63
Vendor:                         IFX

Security Device Support         [Enable]
Active PCR banks                SHA-1,SHA256
Available PCR banks             SHA-1,SHA256

SHA-1 PCR Bank                  [Enabled]
SHA256 PCR Bank                 [Enabled]

Pending operation               [None]
Platform Hierarchy              [Enabled]
Storage Hierarchy               [Enabled]
Endorsement Hierarchy           [Enabled]
TPM2.0 UEFI Spec Version        [TCG_2]
Physical Presence Spec Version  [1.3]
TPM 20 InterfaceType            [TIS]
```

► **Security Device Support**

This setting enables/disables BIOS support for security device. When set to [Disable], the OS will not show security device. TCG EFI protocol and INT1A interface will not be available.

► **SHA-1 PCR Bank, SHA256 PCR Bank**

These settings enable/disable the SHA-1 PCR Bank and SHA256 PCR Bank.

► **Pending Operation**

When **Security Device Support** is set to [Enable], **Pending Operation** will appear. Set this item to [TPM Clear] to clear all data secured by TPM or [None] to discard the selection. It is advised that users should routinely back up their TPM secured data.

► **Platform Hierarchy, Storage Hierarchy, Endorsement Hierarchy**

These settings enable/disable the Platform Hierarchy, Storage Hierarchy and Endorsement Hierarchy.

► **TPM2.0 UEFI Spec Version, Physical Presence Spec Version**

This settings show the TPM2.0 UEFI Spec Version and Physical Presence Spec Version.

► **TPM2.0 Interface Type**

This setting shows the TPM2.0 Interface Type.

► **Serial Port Console Redirection**

COM1

► **Console Redirection**

Console Redirection operates in host systems that do not have a monitor and keyboard attached. This setting enables/disables the operation of console redirection. When set to [Enabled], BIOS redirects and sends all contents that should be displayed on the screen to the serial COM port for display on the terminal screen. Besides, all data received from the serial port is interpreted as keystrokes from a local keyboard.

► **Console Redirection Settings**

```
                        Security
Out-of-Band Mgmt Port          [COM1]
Terminal Type                  [VT-UTF8]
Bits per second                [115200]
Flow Control                   [None]
Data Bits                      8
Parity                         None
Stop Bits                      1
```

► **Terminal Type**

To operate the system's console redirection, you need a terminal supporting ANSI terminal protocol and a RS-232 null modem cable connected between the host system and terminal(s). This setting specifies the type of terminal device for console redirection.

► **Bits per second, Data Bits, Parity, Stop Bits**

This setting specifies the transfer rate (bits per second, data bits, parity, stop bits) of Console Redirection.

► **Flow Control**

Flow control is the process of managing the rate of data transmission between two nodes. It's the process of adjusting the flow of data from one device to another to ensure that the receiving device can handle all of the incoming data. This is particularly important where the sending device is capable of sending data much faster than the receiving device can receive it.

Legacy Console Redirection

► **Legacy Console Redirection Settings**

```
                        Security
Legacy Console Redirection Settings

Redirection COM Port           [COM1]
Resolution                     [80x24]
Redirect After POST            [Always Enable]
```
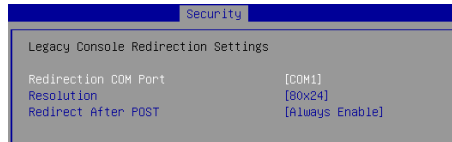
► **Redirection COM Port**

This setting specifies the COM port for redirection.

► **Resolution**

This setting specifies the redirection resolution of legacy OS.

► **Redirect After POST**

This setting determines whether or not to keep terminals' console redirection running after the POST has booted.

Serial Port for Out-of-Band Management/ Windows Emergency Management Services (EMS)

► **Console Redirection**

Console Redirection operates in host systems that do not have a monitor and keyboard attached. This setting enables/disables the operation of console redirection. When set to [Enabled], BIOS redirects and sends all contents that should be displayed on the screen to the serial COM port for display on the terminal screen. Besides, all data received from the serial port is interpreted as keystrokes from a local keyboard.

► **Console Redirection Settings**


```
                        Security
 Out-of-Band Mgmt Port            [COM1]
 Terminal Type                    [VT-UTF8]
 Bits per second                  [115200]
 Flow Control                     [None]
 Data Bits                        8
 Parity                           None
 Stop Bits                        1
```

► **Out-of-Band Mgmt Port**

This setting specifies the Out-of-Band Management Port.

► **Terminal Type**

To operate the system's console redirection, you need a terminal supporting ANSI terminal protocol and a RS-232 null modem cable connected between the host system and terminal(s). This setting specifies the type of terminal device for console redirection.

► **Bits per second, Data Bits, Parity, Stop Bits**

This setting specifies the transfer rate (bits per second, data bits, parity, stop bits) of Console Redirection.

► **Flow Control**

Flow control is the process of managing the rate of data transmission between two nodes. It's the process of adjusting the flow of data from one device to another to ensure that the receiving device can handle all of the incoming data. This is particularly important where the sending device is capable of sending data much faster than the receiving device can receive it.

Chipset


```
                Aptio Setup Utility – Copyright (C) 2019 American Megatrends, Inc.
      Main  Advanced  Boot  Security  Chipset  Power  Save & Exit

 Primary Display                      [Auto]                    Select which of Auto/IGFX/PEG
 DVMT Total Gfx Mem                   [256M]                    Graphics device should be
 Primary IGFX Boot Display            [VBIOS Default]           Primary Display for Switchable
                                                                Gfx.




                                                                →←: Select Screen
                                                                ↑↓: Select Item
                                                                Enter: Select
                                                                +/-: Change Opt.
                                                                F1: General Help
                                                                F7: Previous Values
                                                                F9: Optimized Defaults
                                                                F10: Save & Reset
                                                                ESC: Exit



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```

► **Primary Display**

This setting specifies which is your primary graphics adapter.

► **DVMT Total Gfx Mem**

This setting specifies the memory size for DVMT.

► **Primary IGFX Boot Display**

Use the field to select the type of device you want to use as the display(s) of the system.

Power

```
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       Main  Advanced  Boot  Security  Chipset  Power  Save & Exit

    Restore AC power Loss              [Last State]          Select AC power state when
    Deep Sleep Mode                    [S5]                  power is re-applied after a
                                                             power failure.
    Advanced Resume Events Control
    OnChip GbE/USB                     [Enabled]
    PCIE/Ring PME                      [Disabled]
    RTC                                [Disabled]




                                                             →←: Select Screen
                                                             ↑↓: Select Item
                                                             Enter: Select
                                                             +/-: Change Opt.
                                                             F1: General Help
                                                             F7: Previous Values
                                                             F9: Optimized Defaults
                                                             F10: Save & Reset
                                                             ESC: Exit



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```

► **Restore AC Power Loss**

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

[Power Off]	Leaves the computer in the power off state.
[Power On]	Leaves the computer in the power on state.
[Last State]	Restores the system to the previous status before power failure or interrupt occurred.

► **Deep Sleep Mode**
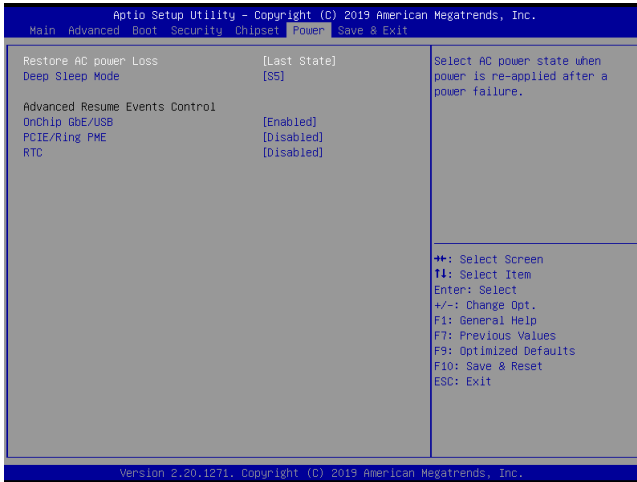
The setting enables/disables the Deep S5 power saving mode. S5 is almost the same as G3 Mechanical Off, except that the PSU still supplies power, at a minimum, to the power button to allow return to S0. A full reboot is required. No previous content is retained. Other components may remain powered so the computer can "wake" on input from the keyboard, clock, modem, LAN, or USB device.

** Advanced Resume Events Control **

► **OnChip GbE/USB**

The item allows the activity of the OnChip GbE/USB device to wake up the system from S3/S4 sleep state.
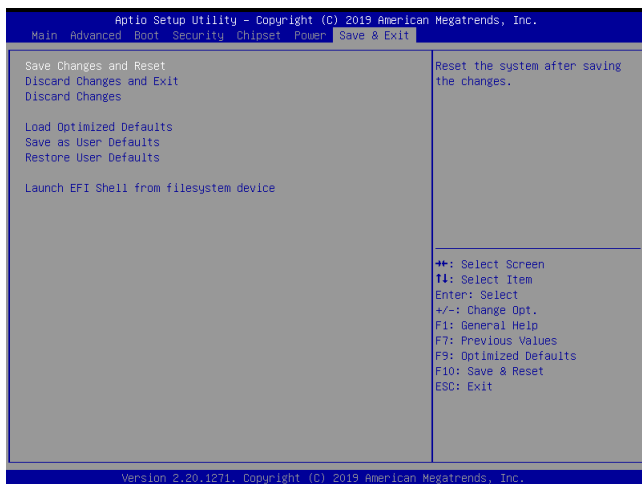
► **PCIE PME/Ring**

This field specifies whether the system will be awakened from power saving modes when activity or input signal of onboard PCIE PME/Ring is detected.

► **RTC**

When [Enabled], your can set the date and time at which the RTC (real-time clock) alarm awakens the system from suspend mode.

Save & Exit

```
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        Main  Advanced  Boot  Security  Chipset  Power  Save & Exit

   Save Changes and Reset                                  Reset the system after saving
   Discard Changes and Exit                                the changes.
   Discard Changes

   Load Optimized Defaults
   Save as User Defaults
   Restore User Defaults

   Launch EFI Shell from filesystem device




                                                           →←: Select Screen
                                                           ↑↓: Select Item
                                                           Enter: Select
                                                           +/-: Change Opt.
                                                           F1: General Help
                                                           F7: Previous Values
                                                           F9: Optimized Defaults
                                                           F10: Save & Reset
                                                           ESC: Exit



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```

► Save Changes and Reset
Save changes to CMOS and reset the system.

► Discard Changes and Exit
Abandon all changes and exit the Setup Utility.

► Discard Changes
Abandon all changes.

► Load Optimized Defaults
Use this menu to load the default values set by the motherboard manufacturer specifically for optimal performance of the motherboard.

► Save as User Defaults
Save changes as the user's default profile.

► Restore User Defaults
Restore the user's default profile.

► Launch EFI Shell from filesystem device
This setting helps to launch the EFI Shell application from one of the available file system devices.

Appendix
GPIO WDT Programming

This appendix provides code examples based on C programming language for customer interest. **Inportb**, **Outportb**, **Inportl** and **Outportl** are basic functions used for access IO ports and defined as following.

Inportb: Read a single 8-bit I/O port.
Outportb: Write a single byte to an 8-bit port.
Inportl: Reads a single 32-bit I/O port.
Outportl: Write a single long to a 32-bit port.

General Purposed IO – GPIO/DIO

The GPIO port configuration addresses are listed in the following table:

Name	IO Port	IO address	Name	IO Port	IO address
N_GPI0	0x12	Bit 0	N_GPO0	0x21	Bit 0
N_GPI1	0x12	Bit 1	N_GPO1	0x21	Bit 1
N_GPI2	0x12	Bit 2	N_GPO2	0x21	Bit 2
N_GPI3	0x42	Bit 3	N_GPO3	0x21	Bit 3
N_GPI4	0x12	Bit 4	N_GPO4	0x21	Bit 4
N_GPI5	0x12	Bit 5	N_GPO5	0x21	Bit 5
N_GPI6	0x12	Bit 6	N_GPO6	0x21	Bit 6
N_GPI7	0x12	Bit 7	N_GPO7	0x21	Bit 7

Note

GPIO should be accessed through controller device 0x6E on SMBus.

Set output value of GPO

1. Read the value from GPO port.
2. Set the value of GPO address.
3. Write the value back to GPO port.

Example: Set **N_GPO0** output "high"

```
val =SMBus_ReadByte (0x6E, 0x21);        // Read value from N_GPO0 port through SMBus.
val = val | (1<<0);                      // Set N_GPO0 address (bit 0) to 1 (output "high").
SMBus_WriteByte (0x6E, 0x21, val);       // Write back to N_GPO0 port through SMBus.
```

Example: Set **N_GPO1** output "low"

```
val = SMBus_ReadByte (0x6E, 0x21);       // Read value from N_GPO1 port through SMBus.
val = val & (~(1<<1));                   // Set N_GPO1 address (bit 1) to 0 (output "low").
SMBus_WriteByte (0x6E, 0x21, val);       // Write back to N_GPO1 port through SMBus.
```

Read input value from GPI：

1. Read the value from GPI port.
2. Get the value of GPI address.

Example: Get **N_GPI2** input value.

```
val = SMBus_ReadByte (0x6E, 0x12);        // Read value from N_GPI2 port through SMBus.
val = val & (1<<2);                       // Read N_GPI2 address (bit 2).
if (val) printf ("Input of N_GPI2 is High");
else printf ("Input of N_GPI2 is Low");
```

Example: Get **N_GPI6** input value.

```
val = SMBus_ReadByte (0x6E, 0x12);        // Read value from N_GPI6 port through SMBus.
val = val & (1<<6);                       // Read N_GPI6 address (bit 6).
if (val) printf ("Input of N_GPI6 is High");
else printf ("Input of N_GPI6 is Low");
```

Watchdog Timer – WDT

The base address (WDT_BASE) of WDT configuration registers is 0xA10.

Set WDT Time Unit

```
val = Inportb (WDT_BASE + 0x05);          // Read current WDT setting
val = val | 0x08;                         // minute mode. val = val & 0xF7 if second mode
Outportb (WDT_BASE + 0x05, val);          // Write back WDT setting
```

Set WDT Time

```
Outportb (WDT_BASE + 0x06, Time);         // Write WDT time, value 1 to 255.
```

Enable WDT

```
val = Inportb (WDT_BASE + 0x0A);          // Read current WDT_PME setting
val = val | 0x01;                         // Enable WDT OUT: WDOUT_EN (bit 0) set to 1.
Outportb (WDT_BASE + 0x0A, val);          // Write back WDT setting.
val = Inportb (WDT_BASE + 0x05);          // Read current WDT setting
val = val | 0x20;                         // Enable WDT by set WD_EN (bit 5) to 1.
Outportb (WDT_BASE + 0x05, val);          // Write back WDT setting.
```

Disable WDT

```
val = Inportb (WDT_BASE + 0x05);          // Read current WDT setting
val = val & 0xDF;                         // Disable WDT by set WD_EN (bit 5) to 0.
Outportb (WDT_BASE + 0x05, val);          // Write back WDT setting.
```

Check WDT Reset Flag

If the system has been reset by WDT function, this flag will set to 1.

```
val = Inportb (WDT_BASE + 0x05);          // Read current WDT setting.
val = val & 0x40;                         // Check WDTMOUT_STS (bit 6).
if (val) printf ("timeout event occurred");
else printf ("timeout event not occurred");
```

Clear WDT Reset Flag

```
val = Inportb (WDT_BASE + 0x05);        // Read current WDT setting
val = val | 0x40;                       // Set 1 to WDTMOUT_STS (bit 6);
Outportb (WDT_BASE + 0x05, val);        // Write back WDT setting
```

SMBus Access

The base address of SMBus must be known before access. The relevant bus and device information are as following.

```
#define IO_SC            0xCF8
#define IO_DA            0xCFC
#define PCIBASEADDRESS   0x80000000
#define PCI_BUS_NUM      0
#define PCI_DEV_NUM      31
#define PCI_FUN_NUM      4
```

Get SMBus Base Address

```
int SMBUS_BASE;
int DATA_ADDR = PCIBASEADDRESS +(PCI_BUS_NUM<<16) +
                                (PCI_DEV_NUM<<11) +
                                (PCI_FUN_NUM<<8);

Outportl (DATA_ADDR + 0x20, IO_SC);
SMBUS_BASE = Inportl (IO_DA) & 0xfffffff0;
```

SMBus_ReadByte (char DEVID, char offset)

Read the value of OFFSET from SMBus device DEVID.

```
Outportb (LOWORD (SMBUS_BASE), 0xFE);
Outportb (LOWORD (SMBUS_BASE) + 0x04, DEVID + 1);   //out Base + 04, (DEVID + 1)
Outportb (LOWORD (SMBUS_BASE) + 0x03, OFFSET);      //out Base + 03, OFFSET
Outportb (LOWORD (SMBUS_BASE) + 0x02, 0x48);        //out Base + 02, 48H
mdelay (20);                                        //delay 20ms to let data ready
while ((Inportl (SMBUS_BASE) & 0x01) != 0);         //wait SMBus ready
SMB_DATA = Inportb (LOWORD (SMBUS_BASE) + 0x05);    //input Base + 05
```

SMBus_WriteByte (char DEVID, char offset, char DATA)

Write DATA to OFFSET on SMBus device DEVID.

```
Outportb (LOWORD (SMBUS_BASE), 0xFE);
Outportb (LOWORD (SMBUS_BASE) + 0x04, DEVID);       //out Base + 04, (DEVID)
Outportb (LOWORD (SMBUS_BASE) + 0x03, OFFSET);      //out Base + 03, OFFSET
Outportb (LOWORD (SMBUS_BASE) + 0x05, DATA);        //out Base + 05, DATA
Outportb (LOWORD (SMBUS_BASE) + 0x02, 0x48);        //out Base + 02, 48H
mdelay (20);                                        //wait 20ms
```