

**ROG STRIX
Z490-H
GAMING**

BIOS Manual



Motherboard

Copyright© 2020 ASUSTeK COMPUTER INC. All Rights Reserved.

No part of this manual, including the products and software described in it, may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language in any form or by any means, except documentation kept by the purchaser for backup purposes, without the express written permission of ASUSTeK COMPUTER INC. ("ASUS").

Product warranty or service will not be extended if: (1) the product is repaired, modified or altered, unless such repair, modification or alteration is authorized in writing by ASUS; or (2) the serial number of the product is defaced or missing.

ASUS PROVIDES THIS MANUAL "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL ASUS, ITS DIRECTORS, OFFICERS, EMPLOYEES OR AGENTS BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES (INCLUDING DAMAGES FOR LOSS OF PROFITS, LOSS OF BUSINESS, LOSS OF USE OR DATA, INTERRUPTION OF BUSINESS AND THE LIKE), EVEN IF ASUS HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES ARISING FROM ANY DEFECT OR ERROR IN THIS MANUAL OR PRODUCT.

SPECIFICATIONS AND INFORMATION CONTAINED IN THIS MANUAL ARE FURNISHED FOR INFORMATIONAL USE ONLY, AND ARE SUBJECT TO CHANGE AT ANY TIME WITHOUT NOTICE, AND SHOULD NOT BE CONSTRUED AS A COMMITMENT BY ASUS. ASUS ASSUMES NO RESPONSIBILITY OR LIABILITY FOR ANY ERRORS OR INACCURACIES THAT MAY APPEAR IN THIS MANUAL, INCLUDING THE PRODUCTS AND SOFTWARE DESCRIBED IN IT.

Products and corporate names appearing in this manual may or may not be registered trademarks or copyrights of their respective companies, and are used only for identification or explanation and to the owners' benefit, without intent to infringe.

Offer to Provide Source Code of Certain Software

This product contains copyrighted software that is licensed under the General Public License ("GPL"), under the Lesser General Public License Version ("LGPL") and/or other Free Open Source Software Licenses. Such software in this product is distributed without any warranty to the extent permitted by the applicable law. Copies of these licenses are included in this product.

Where the applicable license entitles you to the source code of such software and/or other additional data, you may obtain it for a period of three years after our last shipment of the product, either

(1) for free by downloading it from <https://www.asus.com/support/>

or

(2) for the cost of reproduction and shipment, which is dependent on the preferred carrier and the location where you want to have it shipped to, by sending a request to:

ASUSTeK Computer Inc.
Legal Compliance Dept.
1F., No. 15, Lide Rd.,
Beitou Dist., Taipei City 112,
Taiwan

In your request please provide the name, model number and version, as stated in the About Box of the product for which you wish to obtain the corresponding source code and your contact details so that we can coordinate the terms and cost of shipment with you.

The source code will be distributed WITHOUT ANY WARRANTY and licensed under the same license as the corresponding binary/object code.

This offer is valid to anyone in receipt of this information.

ASUSTeK is eager to duly provide complete source code as required under various Free Open Source Software licenses. If however you encounter any problems in obtaining the full corresponding source code we would be much obliged if you give us a notification to the email address gpl@asus.com, stating the product and describing the problem (please DO NOT send large attachments such as source code archives, etc. to this email address).

Contents

1.1	Knowing BIOS	4
1.2	BIOS setup program	5
1.2.1	Advanced Mode	6
1.2.2	EZ Mode.....	9
1.2.3	QFan Control.....	10
1.3	My Favorites	12
1.4	Main menu	14
1.5	Ai Tweaker menu.....	16
1.6	Advanced menu	34
1.6.1	Platform Misc Configuration	35
1.6.2	CPU Configuration	36
1.6.3	System Agent (SA) Configuration	39
1.6.4	PCH Configuration	40
1.6.5	PCH Storage Configuration.....	41
1.6.6	PCH-FW Configuration	42
1.6.7	Thunderbolt(TM) Configuration.....	43
1.6.8	PCI Subsystem Settings	45
1.6.9	USB Configuration	46
1.6.10	Network Stack Configuration.....	47
1.6.11	NVMe Configuration.....	47
1.6.12	Onboard Devices Configuration.....	48
1.6.13	APM Configuration	49
1.6.14	HDD/SSD SMART Information	50
1.7	Monitor menu	51
1.8	Boot menu	56
1.9	Tool menu.....	61
1.9.1	ASUS EZ Flash 3 Utility	61
1.9.2	Secure Erase	62
1.9.3	ASUS User Profile.....	63
1.9.4	ASUS SPD Information	64
1.9.5	ASUS Armoury Crate.....	64
1.10	Exit menu	65
1.11	Updating BIOS.....	66
1.11.1	EZ Update	66
1.11.2	ASUS EZ Flash 3.....	67
1.11.3	ASUS CrashFree BIOS 3.....	68

BIOS Setup

1.1 Knowing BIOS



The new ASUS UEFI BIOS is a Unified Extensible Interface that complies with UEFI architecture, offering a user-friendly interface that goes beyond the traditional keyboard-only BIOS controls to enable a more flexible and convenient mouse input. You can easily navigate the new UEFI BIOS with the same smoothness as your operating system. The term “BIOS” in this user manual refers to “UEFI BIOS” unless otherwise specified.

BIOS (Basic Input and Output System) stores system hardware settings such as storage device configuration, overclocking settings, advanced power management, and boot device configuration that are needed for system startup in the motherboard CMOS. In normal circumstances, the default BIOS settings apply to most conditions to ensure optimal performance. **DO NOT change the default BIOS settings** except in the following circumstances:

- An error message appears on the screen during the system bootup and requests you to run the BIOS Setup.
- You have installed a new system component that requires further BIOS settings or update.



Inappropriate BIOS settings may result to instability or boot failure. **We strongly recommend that you change the BIOS settings only with the help of a trained service personnel.**



- When downloading or updating the BIOS file for your motherboard, rename it as **XXXXX.CAP**. The name of the CAP file varies depending on models. Refer to the user manual that came with your motherboard for the name.
- The screenshots in this manual are for reference only, please refer to the latest BIOS version for settings and options.
- BIOS settings and options may vary due to different BIOS release versions. Please refer to the latest BIOS version for settings and options.

1.2 BIOS setup program

Use the BIOS Setup to update the BIOS or configure its parameters. The BIOS screen include navigation keys and brief onscreen help to guide you in using the BIOS Setup program.

Entering BIOS at startup

To enter BIOS Setup at startup, press <Delete> or <F2> during the Power-On Self Test (POST). If you do not press <Delete> or <F2>, POST continues with its routines.

Entering BIOS Setup after POST

To enter BIOS Setup after POST:

- Press <Ctrl>+<Alt>+<Delete> simultaneously.
- Press the reset button on the system chassis.
- Press the power button to turn the system off then back on. Do this option only if you failed to enter BIOS Setup using the first two options.

After doing either of the three options, press <Delete> key to enter BIOS.



-
- The BIOS setup screens shown in this section are for reference purposes only, and may not exactly match what you see on your screen.
 - Ensure that a USB mouse is connected to your motherboard if you want to use the mouse to control the BIOS setup program.
 - If the system becomes unstable after changing any BIOS setting, load the default settings to ensure system compatibility and stability. Select the **Load Optimized Defaults** item under the **Exit** menu or press hotkey <F5>. See section **Exit menu** for details.
 - If the system fails to boot after changing any BIOS setting, try to clear the CMOS and reset the motherboard to the default value. See your motherboard manual for information on how to erase the RTC RAM.
 - The BIOS setup program does not support Bluetooth devices.
-

BIOS menu screen

The BIOS Setup program can be used under two modes: **EZ Mode** and **Advanced Mode**. You can change modes from **Setup Mode** in **Boot menu** or by pressing the <F7> hotkey.



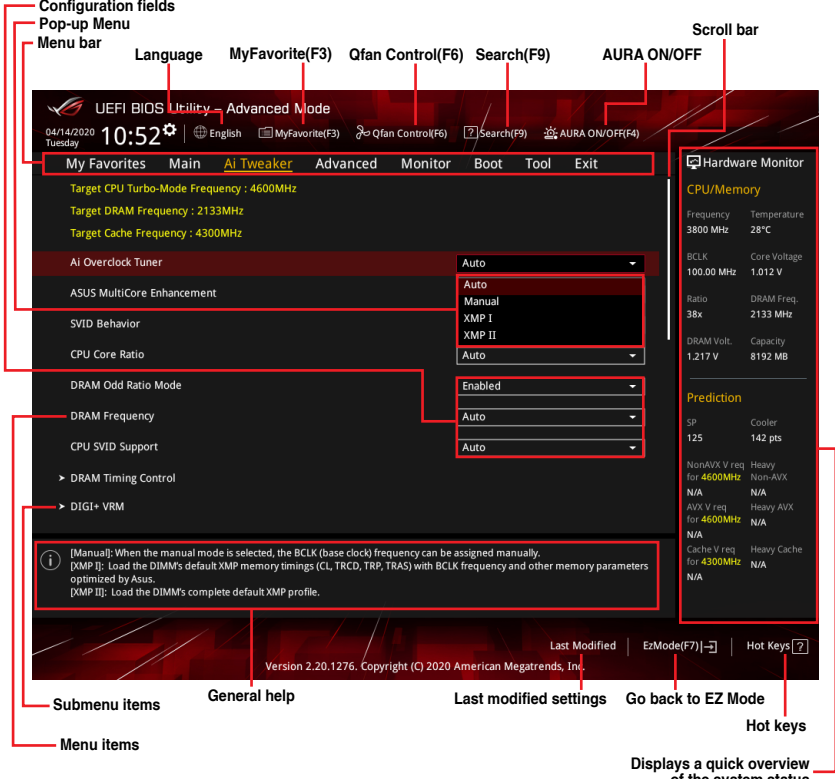
The BIOS settings and options for each motherboard may differ slightly with the options in this manual. Please refer to the BIOS of your motherboard for the settings and options.

1.2.1 Advanced Mode

The Advanced Mode provides advanced options for experienced end-users to configure the BIOS settings. The figure below shows an example of the Advanced Mode. Refer to the following sections for the detailed configurations.



The default screen for entering the BIOS setup program can be changed. Refer to the **Setup Mode** item in section **Boot menu** for details.



Configuration fields

Pop-up Menu

Menu bar

Language MyFavorite(F3) Qfan Control(F6) Search(F9) AURA ON/OFF

Scroll bar

UEFI BIOS Utility - Advanced Mode

04/14/2020 Tuesday 10:52 English MyFavorite(F3) Qfan Control(F6) Search(F9) AURA ON/OFF(F4)

My Favorites Main **AI Tweaker** Advanced Monitor Boot Tool Exit

Target CPU Turbo-Mode Frequency : 4600MHz

Target DRAM Frequency : 2133MHz

Target Cache Frequency : 4300MHz

AI Overclock Tuner Auto

ASUS MultiCore Enhancement Auto

SVID Behavior XMP I XMP II

CPU Core Ratio Auto

DRAM Odd Ratio Mode Enabled

DRAM Frequency Auto

CPU SVID Support Auto

> DRAM Timing Control

> DIGI+ VRM

[Manual]: When the manual mode is selected, the BCLK (base clock) frequency can be assigned manually.
[XMP II]: Load the DIMM's default XMP memory timings (CL, TRCD, TRP, TRAS) with BCLK frequency and other memory parameters optimized by ASUS.
[XMP III]: Load the DIMM's complete default XMP profile.

Hardware Monitor

CPU/Memory

Frequency	Temperature
3800 MHz	28°C
BCLK	Core Voltage
100.00 MHz	1.012 V
Ratio	DRAM Freq.
38x	2133 MHz
DRAM Volt.	Capacity
1.217 V	8192 MB

Prediction

SP	Cooler
125	142 pts
NonAVX V req	Heavy
for 4600MHz	Non-AVX
N/A	N/A
AVX V req	Heavy AVX
for 4600MHz	N/A
N/A	N/A
Cache V req	Heavy Cache
for 4300MHz	N/A
N/A	N/A

Last Modified | EzMode(F7) | Hot Keys

Version 2.20.1276. Copyright (C) 2020 American Megatrends, Inc.

Submenu items

General help

Last modified settings

Go back to EZ Mode

Hot keys

Menu items

Displays a quick overview of the system status

Menu bar

The menu bar on top of the screen has the following main items:

My Favorites	For saving the frequently-used system settings and configuration.
Main	For changing the basic system configuration
Ai Tweaker	For changing the overclocking settings
Advanced	For changing the advanced system settings
Monitor	For displaying the system temperature, power status, and changing the fan settings.
Boot	For changing the system boot configuration
Tool	For configuring options for special functions
Exit	For selecting the exit options and loading default settings

Menu items

The highlighted item on the menu bar displays the specific items for that menu. For example, selecting **Main** shows the Main menu items.

The other items (My Favorites, Ai Tweaker, Advanced, Monitor, Boot, Tool, and Exit) on the menu bar have their respective menu items.

Submenu items

An arrow sign (>) before each item on any menu screen means that the item has a submenu. To display the submenu, select the item and press <Enter>.

Language

This button above the menu bar contains the languages that you can select for your BIOS. Click this button to select the language that you want to display in your BIOS screen.

My Favorite (F3)

This button above the menu bar shows all BIOS items in a Tree Map setup. Select frequently-used BIOS settings and save it to **My Favorites** menu.



Refer to section **My Favorites** for more information.

QFan Control (F6)

This button above the menu bar displays the current settings of your fans. Use this button to manually tweak the fans to your desired settings.



Refer to section **QFan Control** for more information.

Search (F9)

This button allows you to search for BIOS items by entering its name, enter the item name to find the related item listing.

AURA ON/OFF(F4)

This button allows you to turn the RGB LED lighting or functional LED on or off.

[All On]: All LEDs (Aura or Functional) will be enabled.

[Aura Only]: Aura LEDs will be enabled and functional LEDs will be disabled.

[Aura Off]: Aura LEDs will be disabled, however functional LEDs will still be enabled.

[Stealth Mode]: All LEDs (Aura and Functional) will be disabled.

Hot keys

This button above the menu bar contains the navigation keys for the BIOS setup program. Use the navigation keys to select items in the menu and change the settings.

Scroll bar

A scroll bar appears on the right side of a menu screen when there are items that do not fit on the screen. Press the Up/Down arrow keys or <Page Up> / <Page Down> keys to display the other items on the screen.

General help

At the bottom of the menu screen is a brief description of the selected item. Use <F12> key to capture the BIOS screen and save it to the removable storage device.

Configuration fields

These fields show the values for the menu items. If an item is user-configurable, you can change the value of the field opposite the item. You cannot select an item that is not user-configurable.

A configurable field is highlighted when selected. To change the value of a field, select it and press <Enter> to display a list of options.

Last Modified button

This button shows the items that you last modified and saved in BIOS Setup.

1.2.2 EZ Mode

The EZ Mode provides you an overview of the basic system information, and allows you to select the display language, system performance, mode and boot device priority. To access the Advanced Mode, select **Advanced Mode** or press the <F7> hotkey for the advanced BIOS settings.



To switch from Advanced Mode to EZ Mode, click **EZ Mode(F7)** or press the <F7> hotkey.

The screenshot shows the UEFI BIOS Utility - EZ Mode interface. The top bar includes the date and time (04/14/2020 Tuesday 16:31), language (English), search (F9), and AURA ON/OFF (F4). The main area is divided into several sections: Information (System, CPU, Memory), DRAM Status, X.M.P., FAN Profile, CPU Temperature, CPU Core Voltage, Motherboard Temperature, Storage Information, Intel Rapid Storage Technology, CPU FAN graph, AI Overclocking, and Boot Priority. The bottom bar contains Default (F5), Save & Exit (F10), and Advanced Mode (F7) buttons.

Labels and descriptions for the screenshot:

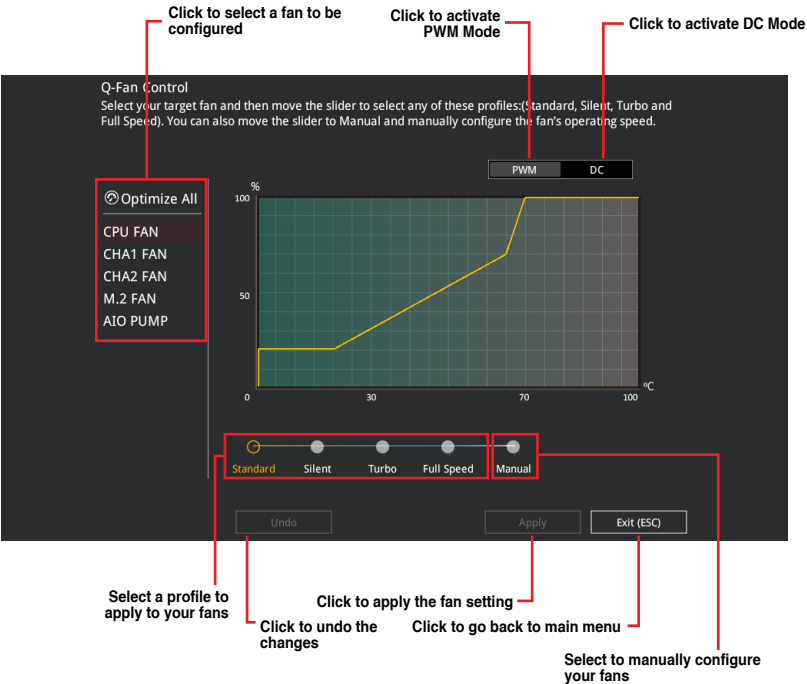
- Displays a quick overview of the system status**: Points to the top bar area.
- Selects the display language of the BIOS setup program**: Points to the Language (English) button.
- Search(F9)**: Points to the Search (F9) button.
- AURA ON/OFF(F4)**: Points to the AURA ON/OFF (F4) button.
- Displays the system properties of the selected mode. Click < or > to switch modes**: Points to the Information section.
- Enables or disables the SATA RAID mode for Intel Rapid Storage Technology**: Points to the Intel Rapid Storage Technology section.
- Displays the CPU Fan's speed. Click the button to manually tune the fans**: Points to the CPU FAN section.
- Loads optimized default settings**: Points to the Default (F5) button.
- Saves the changes and resets the system**: Points to the Save & Exit (F10) button.
- Click to go to Advanced mode**: Points to the Advanced Mode (F7) button.
- Click to display boot devices**: Points to the Boot Priority section.
- Selects the boot device priority**: Points to the Boot Priority section.



The boot device options vary depending on the devices you installed to the system.

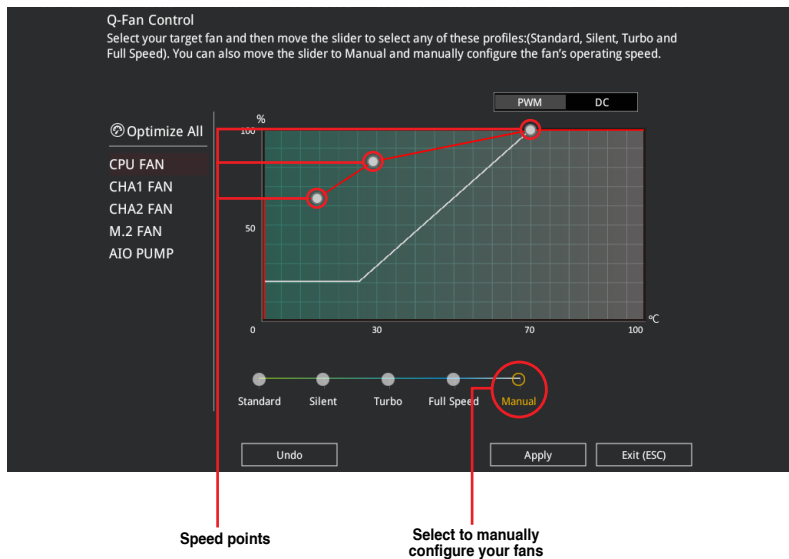
1.2.3 QFan Control

The QFan Control allows you to set a fan profile or manually configure the operating speed of your CPU and chassis fans.



Configuring fans manually

Select **Manual** from the list of profiles to manually configure your fans' operating speed.



To configure your fans:

1. Select the fan that you want to configure and to view its current status.
2. Click and drag the speed points to adjust the fans' operating speed.
3. Click **Apply** to save the changes then click **Exit (ESC)**.

1.3 My Favorites

My Favorites is your personal space where you can easily save and access your favorite BIOS items. You can personalize this screen by adding or removing items.

The screenshot shows the 'My Favorites' tab in the ASUS UEFI BIOS Utility. The interface is dark-themed with red accents. The top bar includes the date and time (04/14/2020, 10:55), language (English), and various function keys. The main menu on the left lists 'My Favorites', 'Main', 'AI Tweaker', 'Advanced', 'Monitor', 'Boot', 'Tool', and 'Exit'. The 'My Favorites' section contains several settings, all set to 'Auto' or 'Enabled': CPU Core Ratio, DRAM Frequency, CPU Core/Cache Voltage, DRAM Voltage, PCH Storage Configuration, Onboard Devices Configuration, CPU C-states, Fast Boot, Next Boot after AC Power Loss, Boot Logo Display, and POST Delay Time. A detailed information box at the bottom left explains the 'Auto' settings. The right sidebar shows 'Hardware Monitor' and 'CPU/Memory' status, including frequency, temperature, core voltage, and DRAM information. A 'Prediction' section at the bottom right shows system performance metrics. The bottom status bar indicates 'Last Modified', 'EZMode(F7)', and 'Hot Keys'.

UEFI BIOS Utility – Advanced Mode

04/14/2020 Tuesday 10:55 English MyFavorite(F3) Qfan Control(F6) Search(F9) AURA ON/OFF(F4)

My Favorites Main AI Tweaker Advanced Monitor Boot Tool Exit

CPU Core Ratio Auto

DRAM Frequency Auto

CPU Core/Cache Voltage Auto

DRAM Voltage Auto

> PCH Storage Configuration

> Onboard Devices Configuration

CPU C-states Auto

> CSM (Compatibility Support Module)

Fast Boot Enabled

Next Boot after AC Power Loss Fast Boot

Boot Logo Display Auto

POST Delay Time 3 sec

Hardware Monitor

CPU/Memory

Frequency 3800 MHz Temperature 28°C

BCLK 100.00 MHz Core Voltage 1.012 V

Ratio 38x DRAM Freq. 2133 MHz

DRAM Volt. 1.200 V Capacity 8192 MB

Prediction

SP 125 Cooler 142 pts

NonAVX V req Heavy for 4600MHz Non-AVX N/A

AVX V req Heavy AVX for 4600MHz N/A

Cache V req Heavy Cache for 4300MHz N/A

Information:

- [Auto]: The system will adjust all core ratios automatically.
- [Sync All Cores]: Configure a core ratio limit to synchronize all cores.
- [By Core Usage]: Configure the ratio limits for active cores depending on how many cores are being utilized.
- [AI Optimized]: Uses dynamic Machine Learning Algorithms to determine optimal settings based on processor and cooler characteristics.

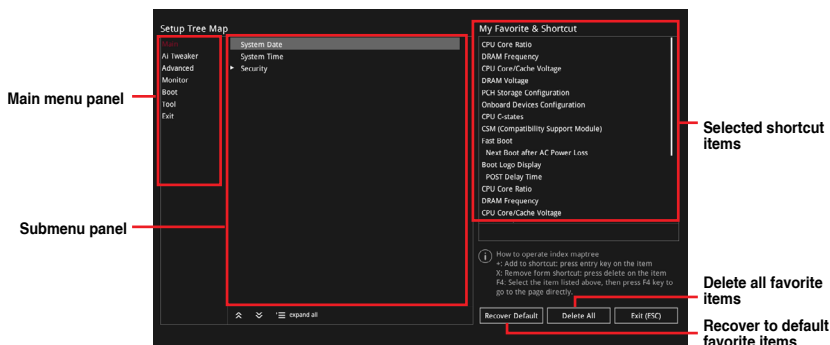
Last Modified | EZMode(F7) | Hot Keys

Version 2.20.1276. Copyright (C) 2020 American Megatrends, Inc.

Adding items to My Favorites

To add BIOS items:

1. Press <F3> on your keyboard or click **MyFavorite(F3)** from the BIOS screen to open Setup Tree Map screen.
2. On the Setup Tree Map screen, select the BIOS items that you want to save in My Favorites screen.



3. Select an item from main menu panel, then click the submenu that you want to save as favorite from the submenu panel and click **+** or press <Enter> on your keyboard.



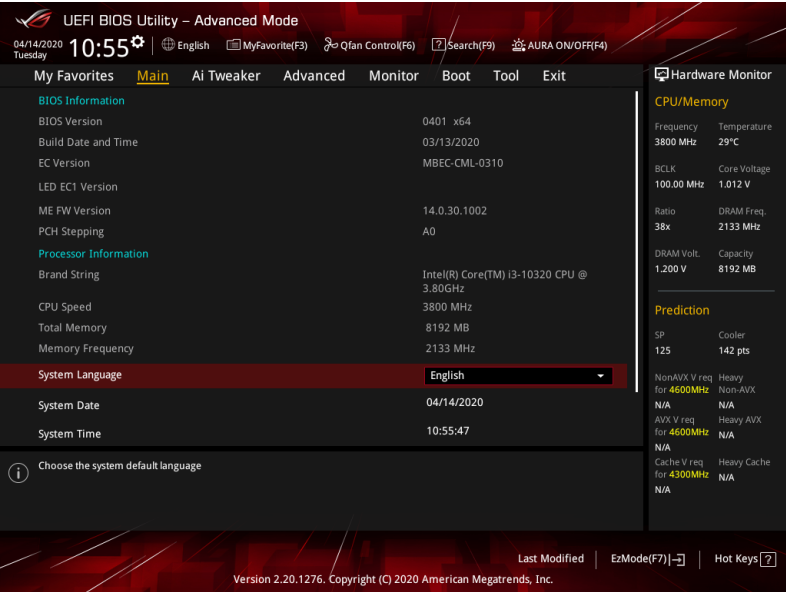
You cannot add the following items to My Favorite items:

- Items with submenu options.
- User-managed items such as language and boot order.
- Configuration items such as Memory SPD Information, system time and date.

4. Click **Exit (ESC)** or press <Esc> key to close Setup Tree Map screen.
5. Go to My Favorites menu to view the saved BIOS items.

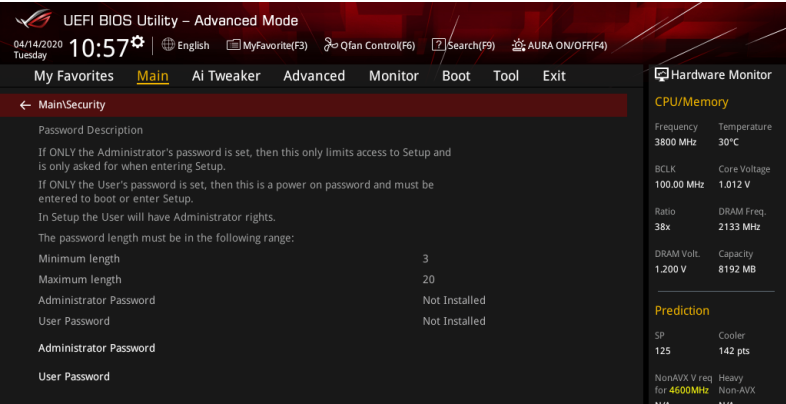
1.4 Main menu

The Main menu screen appears when you enter the Advanced Mode of the BIOS Setup program. The Main menu provides you an overview of the basic system information, and allows you to set the system date, time, language, and security settings.



Security

The Security menu items allow you to change the system security settings.





- If you have forgotten your BIOS password, erase the CMOS Real Time Clock (RTC) RAM to clear the BIOS password. See the motherboard for information on how to erase the RTC RAM via the Clear CMOS header.
- The Administrator or User Password items on top of the screen show the default **[Not Installed]**. After you set a password, these items show **[Installed]**.

Administrator Password

If you have set an administrator password, we recommend that you enter the administrator password for accessing the system. Otherwise, you might be able to see or change only selected fields in the BIOS setup program.

To set an administrator password:

1. Select the **Administrator Password** item and press <Enter>.
2. From the **Create New Password** box, key in a password, then press <Enter>.
3. Re-type to confirm the password then select **OK**.

To change an administrator password:

1. Select the **Administrator Password** item and press <Enter>.
2. From the **Enter Current Password** box, key in the current password, then press <Enter>.
3. From the **Create New Password** box, key in a new password, then press <Enter>.
4. Re-type to confirm the password then select **OK**.

To clear the administrator password, follow the same steps as in changing an administrator password, but leave other fields blank then select **OK** to continue. After you clear the password, the **Administrator Password** item on top of the screen shows **[Not Installed]**.

User Password

If you have set a user password, you must enter the user password for accessing the system. The User Password item on top of the screen shows the default **[Not Installed]**. After you set a password, this item shows **[Installed]**.

To set a user password:

1. Select the **User Password** item and press <Enter>.
2. From the **Create New Password** box, key in a password, then press <Enter>.
3. Re-type to confirm the password then select **OK**.

To change a user password:

1. Select the **User Password** item and press <Enter>.
2. From the **Enter Current Password** box, key in the current password, then press <Enter>.
3. From the **Create New Password** box, key in a new password, then press <Enter>.
4. Re-type to confirm the password then select **OK**.

To clear the user password, follow the same steps as in changing a user password, but leave other fields blank then select **OK** to continue. After you clear the password, the **User Password** item on top of the screen shows **[Not Installed]**.

1.5 Ai Tweaker menu

The Ai Tweaker menu items allow you to configure overclocking-related items.



Be cautious when changing the settings of the Ai Tweaker menu items. Incorrect field values can cause the system to malfunction.



The configuration options for this section vary depending on the CPU and DIMM model you installed on the motherboard.

Scroll down to display other BIOS items.

UEFI BIOS Utility – Advanced Mode

04/14/2020 11:09 Tuesday English MyFavorite(F3) Qfan Control(F6) Search(F9) AURA ON/OFF(F4)

My Favorites Main **Ai Tweaker** Advanced Monitor Boot Tool Exit

Target CPU Turbo-Mode Frequency : 4600MHz
Target DRAM Frequency : 2133MHz
Target Cache Frequency : 4300MHz

Ai Overclock Tuner Auto

ASUS MultiCore Enhancement Auto – Lets BIOS Optimize

SVID Behavior Auto

CPU Core Ratio Auto

DRAM Odd Ratio Mode Enabled

DRAM Frequency Auto

CPU SVID Support Auto

> DRAM Timing Control
> DIGI+ VRM

Hardware Monitor

CPU/Memory

Frequency	Temperature
3800 MHz	29°C
BCLK	Core Voltage
100.00 MHz	1.012 V
Ratio	DRAM Freq.
38x	2133 MHz
DRAM Volt.	Capacity
1.200 V	8192 MB

Prediction

SP	Cooler
125	142 pts
NonAVX V req for 4600MHz	Heavy Non-AVX
N/A	N/A
AVX V req for 4600MHz	Heavy AVX
N/A	N/A
Cache V req for 4300MHz	Heavy Cache
N/A	N/A

[Manual]: When the manual mode is selected, the BCLK (base clock) frequency can be assigned manually.
[XMP I]: Load the DIMM's default XMP memory timings (CL, TRCD, TRP, TRAS) with BCLK frequency and other memory parameters optimized by ASUS.
[XMP II]: Load the DIMM's complete default XMP profile.

Last Modified | EzMode(F7) | Hot Keys

Version 2.20.1276. Copyright (C) 2020 American Megatrends, Inc.

Ai Overclock Tuner

This item allows you to select the CPU overclocking options to achieve the desired CPU internal frequency. Select any of these preset overclocking configuration options:

- [Auto] Loads the optimal settings for the system.
- [Manual] When the manual mode is selected, the BCLK (base clock) frequency can be assigned manually.
- [XMP I] If you install memory modules supporting the eXtreme Memory Profile (XMP) Technology, choose this item to load the DIMM's default XMP memory timings (CL, TRCD, TRP, TRAS) with BCLK frequency and other memory parameters optimized by ASUS.
- [XMP II] If you install memory modules supporting the eXtreme Memory Profile (XMP) Technology, choose this item to load the DIMM's default XMP profile.



The **[X.M.P.]** configuration option appears only when you install memory modules supporting the eXtreme Memory Profile(X.M.P.) Technology.



The following item appears only when **Ai Overclock Tuner** is set to **[XMP I]** or **[XMP II]**.

XMP

This item allows you to select your eXtreme Memory Profile (XMP). Each profile has its own DRAM frequency, timing and voltage.



The following items appear only when **Ai Overclock Tuner** is set to **[XMP I]**, **[XMP II]**, or **[Manual]**.

BCLK Frequency

This item allows you to set the BCLK (base clock) frequency to enhance the system performance. Use the <+> or <-> to adjust the value.



We recommend you to set the value based on the CPU specification, as high BCLK frequencies may damage the CPU permanently.

BCLK Spread Spectrum

This item allows you to enable or disable the BCLK Spread Spectrum. When set to **[Enabled]** the peak value of EMI emissions is reduced. Set to **[Disabled]** for a more accurate Base Clock.

Configuration options: [Auto] [Disabled] [Enabled]

ASUS MultiCore Enhancement

- [Auto - Lets BIOS Optimize] This item allows you to use ASUS optimized core ratio Turbo settings at default processor speeds.
- [Disabled - Enforce All limits] This item allows you to use Intel default Turbo core ratio settings.
- [Enabled - Remove All limits] This item allows you to use optimized power and current thresholds for maintaining maximum performance.

SVID Behavior

This item allows you to program the CPU's SVID behavior based on the CPU's quality. The default option is based on **[Typical Scenario]**, but the more optimistic the mode selected, the lower the temperature of the CPU. **[Intel's Fail Safe]** is the default behavior of the processor oblivious to the actual Motherboard design. **[Trained]** optimizes SVID behavior to match input parameters such as VRM Loadline and Target Frequencies.

Configuration options: [Auto] [Best-Case Scenario] [Typical Scenario] [Worst-Case Scenario] [Intel's Fail Safe] [Trained]

CPU Core Ratio

This item allows you to set the CPU core ratios.

Configuration options: [Auto] [Sync All Cores] [By Core Usage] [AI Optimized]



The **[AI Optimized]** item appears only when you use an unlocked CPU.



The following item appears only when **CPU Core Ratio** is set to **[Sync All Cores]**.

ALL-Core Ratio Limit

Enter **[Auto]** to apply the CPU default Turbo Ratio setting or manually assign a Core ratio limit to synchronize all cores.



The following item appears only when **CPU Core Ratio** is set to **[By Core Usage]**.

1-Core Ratio Limit

Enter **[Auto]** to apply the CPU default Turbo Ratio setting or manually assign a 1-Core Limit value that must be higher than or equal to the 2-Core Ratio Limit.

2-Core Ratio Limit

Enter **[Auto]** to apply the CPU default Turbo Ratio setting or manually assign a 2-core ratio limit that must be higher than or equal to the 3-core ratio limit.



If you assign a value for 2-Core Ratio Limit, do not set the 1-Core Ratio Limit to **[Auto]**.

3-Core Ratio Limit

Enter **[Auto]** to apply the CPU default Turbo Ratio setting or manually assign a 3-core ratio limit that must be higher than or equal to the 4-core ratio limit.



If you assign a value for 3-Core Ratio Limit, do not set the 1-Core Ratio Limit and 2-Core Ratio Limit to **[Auto]**.

4-Core Ratio Limit

Enter **[Auto]** to apply the CPU default Turbo Ratio setting or manually assign a 4-core ratio limit that must be higher than or equal to the 5-core ratio limit.



If you assign a value for 4-Core Ratio Limit, do not set the 1-Core Ratio Limit, 2-Core Ratio Limit, and 3-Core Ratio Limit to **[Auto]**.

DRAM Odd Ratio Mode

This item allows you to enable or disable availability of odd DRAM ratios for improved granularity.

Configuration options: [Enabled] [Disabled]

DRAM Frequency

This item allows you to set the memory operating frequency. The configurable options vary with the BCLK (base clock) frequency setting. Select the auto mode to apply the optimized setting.

Configuration options: [Auto] [DDR4-800MHz] - [DDR4-8533MHz]

CPU SVID Support

Disable this item to stop the CPU from communicating with the external voltage regulator. We recommend setting this item to **[Disabled]** for overclocking.

Configuration options: [Auto] [Disabled] [Enabled]

DRAM Timing Control

The sub-items in this menu allow you to set the DRAM timing control features. Use the <+> and <-> keys to adjust the value. To restore the default setting, type **[Auto]** using the keyboard and press the <Enter> key.



Changing the values in this menu may cause the system to become unstable! If this happens, revert to the default settings.

Primary Timings

DRAM CAS# Latency

Configuration options: [Auto] [1] - [31]

DRAM RAS# to CAS# Delay

Configuration options: [Auto] [1] - [63]

DRAM RAS# ACT Time

Configuration options: [Auto] [1] - [63]

DRAM Command Rate

Configuration options: [Auto] [1N] [2N] [3N] [N:1]



The following item appears only when **DRAM Command Rate** is set to **[N:1]**.

N to 1 ratio

Number of bubbles between wach valid command cycle.

Configurations: [4] - [7]

Secondary Timings

DRAM RAS# to RAS# Delay L

Configuration options: [Auto] [1] - [15]

DRAM RAS# to RAS# Delay S

Configuration options: [Auto] [1] - [15]

DRAM REF Cycle Time

Configuration options: [Auto] [1] - [1023]

DRAM REF Cycle Time 2

Configuration options: [Auto] [1] - [1023]

DRAM REF Cycle Time 4

Configuration options: [Auto] [1] - [1023]

DRAM Refresh Interval

Configuration options: [Auto] [1] - [65535]

DRAM WRITE Recovery Time

Configuration options: [Auto] [1] - [31]

DRAM READ to PRE Time

Configuration options: [Auto] [1] - [15]

DRAM FOUR ACT WIN Time

Configuration options: [Auto] [1] - [63]

DRAM WRITE to READ Delay

Configuration options: [Auto] [1] - [15]

DRAM WRITE to READ Delay L

Configuration options: [Auto] [1] - [15]

DRAM WRITE to READ Delay S

Configuration options: [Auto] [1] - [15]

DRAM CKE Minimum Pulse Width

Configuration options: [Auto] [0] - [15]

DRAM Write Latency

Configuration options: [Auto] [1] - [31]

Skew Control**ODT RTT WR (CHA)**

Configuration options: [Auto] [0 DRAM CLOCK] [80 DRAM CLOCK] [120 DRAM CLOCK] [240 DRAM CLOCK] [255 DRAM CLOCK]

ODT RTT PARK (CHA)

Configuration options: [Auto] [0 DRAM CLOCK] [34 DRAM CLOCK] [40 DRAM CLOCK] [48 DRAM CLOCK] [60 DRAM CLOCK] [80 DRAM CLOCK] [120 DRAM CLOCK] [240 DRAM CLOCK]

ODT RTT NOM (CHA)

Configuration options: [Auto] [0 DRAM CLOCK] [34 DRAM CLOCK] [40 DRAM CLOCK] [48 DRAM CLOCK] [60 DRAM CLOCK] [80 DRAM CLOCK] [120 DRAM CLOCK] [240 DRAM CLOCK]

ODT RTT WR (CHB)

Configuration options: [Auto] [0 DRAM CLOCK] [80 DRAM CLOCK] [120 DRAM CLOCK] [240 DRAM CLOCK] [255 DRAM CLOCK]

ODT RTT PARK (CHB)

Configuration options: [Auto] [0 DRAM CLOCK] [34 DRAM CLOCK] [40 DRAM CLOCK] [48 DRAM CLOCK] [60 DRAM CLOCK] [80 DRAM CLOCK] [120 DRAM CLOCK] [240 DRAM CLOCK]

ODT RTT NOM (CHB)

Configuration options: [Auto] [0 DRAM CLOCK] [34 DRAM CLOCK]
[40 DRAM CLOCK] [48 DRAM CLOCK] [60 DRAM CLOCK] [80 DRAM
CLOCK] [120 DRAM CLOCK] [240 DRAM CLOCK]

ODT_READ_DURATION

Configuration options: [Auto] [0] - [7]

ODT_READ_DELAY

Configuration options: [Auto] [0] - [7]

ODT_WRITE_DURATION

Configuration options: [Auto] [0] - [7]

ODT_WRITE_DELAY

Configuration options: [Auto] [0] - [7]

Data Rising Slope

Configuration options: [Auto] [0] - [15]

Data Rising Slope Offset

Configuration options: [Auto] [0] - [1]

Cmd Rising Slope

Configuration options: [Auto] [0] - [15]

Cmd Rising Slope Offset

Configuration options: [Auto] [0] - [1]

Ctl Rising Slope

Configuration options: [Auto] [0] - [15]

Ctl Rising Slope Offset

Configuration options: [Auto] [0] - [1]

Clk Rising Slope

Configuration options: [Auto] [0] - [15]

Clk Rising Slope Offset

Configuration options: [Auto] [0] - [1]

Data Falling Slope

Configuration options: [Auto] [0] - [15]

Data Falling Slope Offset

Configuration options: [Auto] [0] - [1]

Cmd Falling Slope

Configuration options: [Auto] [0] - [15]

Cmd Falling Slope Offset

Configuration options: [Auto] [0] - [1]

Ctl Falling Slope

Configuration options: [Auto] [0] - [15]

Ctl Falling Slope Offset

Configuration options: [Auto] [0] - [1]

Clk Falling Slope

Configuration options: [Auto] [0] - [15]

Clk Falling Slope Offset

Configuration options: [Auto] [0] - [1]

RTL IOL Control**DRAM RTL INIT Value**

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHA DIMM0 Rank0)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHA DIMM0 Rank1)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHA DIMM1 Rank0)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHA DIMM1 Rank1)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHB DIMM0 Rank0)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHB DIMM0 Rank1)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHB DIMM1 Rank0)

Configuration options: [Auto] [0] - [127]

DRAM RTL (CHB DIMM1 Rank1)

Configuration options: [Auto] [0] - [127]

DRAM IOL (CHA DIMM0 Rank0)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHA DIMM0 Rank1)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHA DIMM1 Rank0)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHA DIMM1 Rank1)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHB DIMM0 Rank0)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHB DIMM0 Rank1)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHB DIMM1 Rank0)

Configuration options: [Auto] [0] - [15]

DRAM IOL (CHB DIMM1 Rank1)

Configuration options: [Auto] [0] - [15]

IO Latency offset

CHA IO_Latency_offset

Configuration options: [Auto] [0] - [127]

CHB IO_Latency_offset

Configuration options: [Auto] [0] - [127]

IO Latency RFR delay

CHA RFR delay

Configuration options: [Auto] [0] - [127]

CHB RFR delay

Configuration options: [Auto] [0] - [127]

Memory Training Algorithms

The items in this menu allows you to enable or disable different Memory Training Algorithms.

Early Command Training

Configuration options: [Enabled] [Disabled]

SenseAmp Offset Training

Configuration options: [Enabled] [Disabled]

Early ReadMPR Timing Centering 2D

Configuration options: [Enabled] [Disabled]

Read MPR Training

Configuration options: [Enabled] [Disabled]

Receive Enable Training

Configuration options: [Enabled] [Disabled]

Jedec Write Leveling

Configuration options: [Enabled] [Disabled]

LPDDR4 Write DQ DQS Retraining

Configuration options: [Enabled] [Disabled]

Early Write Timing Centering 2D

Configuration options: [Enabled] [Disabled]

Early Read Timing Centering 2D

Configuration options: [Auto] [Enabled] [Disabled]

Write Timing Centering 1D

Configuration options: [Enabled] [Disabled]

Write Voltage Centering 1D

Configuration options: [Enabled] [Disabled]

Read Timing Centering 1D

Configuration options: [Enabled] [Disabled]

Dimm ODT Training*

Configuration options: [Auto] [Enabled] [Disabled]

DIMM RON Training*

Configuration options: [Auto] [Enabled] [Disabled]

Write Drive Strength/Equalization 2D*

Configuration options: [Enabled] [Disabled]

Write Slew Rate Training*

Configuration options: [Enabled] [Disabled]

Read ODT Training*

Configuration options: [Enabled] [Disabled]

Read Equalization Training*

Configuration options: [Enabled] [Disabled]

Read Amplifier Training*

Configuration options: [Enabled] [Disabled]

Write Timing Centering 2D

Configuration options: [Enabled] [Disabled]

Read Timing Centering 2D

Configuration options: [Enabled] [Disabled]

Command Voltage Centering

Configuration options: [Enabled] [Disabled]

Write Voltage Centering 2D

Configuration options: [Enabled] [Disabled]

Read Voltage Centering 2D

Configuration options: [Auto] [Enabled] [Disabled]

Late Command Training

Configuration options: [Auto] [Enabled] [Disabled]

Round Trip Latency

Configuration options: [Auto] [Enabled] [Disabled]

Turn Around Timing Training

Configuration options: [Enabled] [Disabled]

Rank Margin Tool

Configuration options: [Auto] [Enabled] [Disabled]

Margin Check Limit

Checks Margin to Limit to see if next boot memory needs to be retrained.

Configuration options: [Disabled] [L1] [L2] [Both]



The following item appears only when **Margin Check Limit** is set to **[L2]** or **[Both]**.

Margin Limit Check L2

L2 check threshold is scale of L1 check.

Configuration options: [1] - [300]

Memory Test

Configuration options: [Enabled] [Disabled]

DIMM SPD Alias Test

Configuration options: [Enabled] [Disabled]

Receive Enable Centering 1D

Configuration options: [Enabled] [Disabled]

Retrain Margin Check

Configuration options: [Enabled] [Disabled]

CMD Drive Strength and Tx Equalization

Configuration options: [Auto] [Enabled] [Disabled]

CMD Slew Rate Training

Configuration options: [Auto] [Enabled] [Disabled]

Write Drive Strength Up/Dn independently

Configuration options: [Enabled] [Disabled]

Third Timings**tRDRD_sg_Training**

Configuration options: [Auto] [0] - [63]

tRDRD_sg_Runtime

Configuration options: [Auto] [0] - [63]

tRDRD_dg

Configuration options: [Auto] [0] - [63]

tRDWR_sg

Configuration options: [Auto] [0] - [63]

tRDWR_dg

Configuration options: [Auto] [0] - [63]

tWRWR_sg

Configuration options: [Auto] [0] - [63]

tWRWR_dg

Configuration options: [Auto] [0] - [63]

tWRRD_sg

Configuration options: [Auto] [0] - [127]

tWRRD_dg

Configuration options: [Auto] [0] - [63]

tRDRD_dr

Configuration options: [Auto] [0] - [63]

tRDRD_dd

Configuration options: [Auto] [0] - [63]

tRDWR_dr

Configuration options: [Auto] [0] - [63]

tRDWR_dd

Configuration options: [Auto] [0] - [63]

tWRWR_dr

Configuration options: [Auto] [0] - [63]

tWRWR_dd

Configuration options: [Auto] [0] - [63]

tWRRD_dr

Configuration options: [Auto] [0] - [63]

tWRRD_dd

Configuration options: [Auto] [0] - [63]

TWRPRE

Configuration options: [Auto] [0] - [127]

TRDPRE

Configuration options: [Auto] [0] - [15]

tREFIX9

Configuration options: [Auto] [0] - [127]

OREF_RI

Configuration options: [Auto] [0] - [255]

Misc.**MRC Fast Boot**

Allows you to enable, disable or automatically set the MRC fast boot.

Configuration options: [Auto] [Enabled] [Disabled]

Delay after Train

This item allows you to enable 10 second delay after training for DRAM to reach a certain temperature during extreme overclocking.

Configuration options: [Disabled] [Enabled]

DRAM CLK Period

This item allows you to set the DRAM clock period.

Configuration options: [Auto] [1] - [58]

Memory Scrambler

Set this item to enable or disable memory scrambler support.

Configuration options: [Enabled] [Disabled]

Channel A DIMM Control

Allows you to enable or disable the Channel A DIMM slots.

Configuration options: [Enable Both DIMMS] [Disable DIMM0] [Disable DIMM1]
[Disable Both DIMMS]

Channel B DIMM Control

Allows you to enable or disable the Channel B DIMM slots.

Configuration options: [Enable Both DIMMS] [Disable DIMM0] [Disable DIMM1]
[Disable Both DIMMS]

MCH Full Check

Enable this item to enhance the stability of your system. Disable this item to enhance the DRAM overclocking capability.

Configuration options: [Auto] [Enabled] [Disabled]

Mem Over Clock Fail Count

Configuration options: [Auto] [1] - [255]

Training Profile

Allows you to select the DIMM training profile.

Configuration options: [Auto] [Standard Profile] [ASUS User Profile]

DLLBwEn

Select values 2 to 4 for best memory overclocking.

Configuration options: [Auto] [0] - [7]

Legacy Mode

This item allows you to enable or disable to workaround issues in Legacy Mode.

Configuration options: [Enabled] [Disabled]

SPD Write Disable

This item allows you to enable or disable setting the SPD Write Disable. For security recommendations, SPD write disable must be set.

Configuration options: [TRUE] [FALSE]

Digi+ VRM

CPU Load-line Calibration

Load-line is defined by Intel® specification and affects CPU power voltage. The CPU working voltage decreases proportionally to CPU loading. Higher load-line calibration could get higher voltage and good overclocking performance, but increases the CPU and VRM thermal conditions.

Configuration options [Auto] [Level 1] - [Level 7]



The actual performance boost may vary depending on your CPU specification.



DO NOT remove the thermal module. The thermal conditions should be monitored.

Current CPU Load-line Calibration

Synch ACDC Loadline with VRM Loadline

Enable this item to allow the VRM Loadline to be adjusted automatically to match the AC/DC Loadline.

Configuration options: [Enabled] [Disabled]

CPU Current Capability

This item allows you to set the shut off current limit for external voltage regulator. A higher setting will allow the voltage regulator to supply more current while a lower setting will cause the voltage regulator to shut off the system when the supplied current is higher than the set value.

Configuration options: [Auto] [100%] - [170%]



Configure higher values when overclocking or under a high loading for extra power support.

CPU VRM Switching Frequency

This item affects the VRM transient response speed and the component thermal production. Select **[Manual]** to configure a higher frequency for a quicker transient response speed.

Configuration options: **[Auto]** **[Manual]**



DO NOT remove the thermal module. The thermal conditions should be monitored.



The following item appears only when **CPU VRM Switching Frequency** is set to **[Manual]**.

Fixed CPU VRM Switching Frequency (KHz)

This item allows you to set a higher frequency for a quicker transient response speed. Use the <+> or <-> to adjust the value. The values range from 250 to 500 with an interval of 50.



The following item appears only when **CPU VRM Switching Frequency** is set to **[Auto]**.

VRM Spread Spectrum

This item allows you to reduce the magnitude of peak noise from the VRM. Enable this item to reduce peak noise. Disable this settings when overclocking.

Configuration options: **[Auto]** **[Disabled]** **[Enabled]**



The following item appears only when **VRM Spread Spectrum** is set to **[Disabled]**.

Active Frequency Mode

Enable this item to enhance the power saving option.

Configuration option: **[Disabled]** **[Enabled]**

CPU Power Duty Control

CPU power duty control adjusts the duty cycle of each VRM phase based upon current and/or temperature.

[T. Probe] Select to set the VRM thermal balance mode.

[Extreme] Select to set the VRM current balance mode.



DO NOT remove the thermal module when setting this item to **[Extreme]**. The thermal conditions should be monitored.

CPU Power Phase Control

This item allows you to set the power phase control of the CPU.

Configuration options: **[Auto]** **[Standard]** **[Extreme]**



DO NOT remove the thermal module when setting this item to **[Extreme]**. The thermal conditions should be monitored.



The following items appear only when using the onboard graphics.

CPU Graphics Load-line Calibration

The load-line is defined by the Intel VRM specification and affects the CPU Graphics power voltage. The CPU Graphics working voltage will decrease proportionally depending on the CPU Graphics loading. Higher levels of the load-line calibration can get a higher voltage and a better overclocking performance but increase the CPU Graphics and VRM thermal production. Select from level 1 to 7 to adjust the CPU Graphics power voltage from 100% to 15%.

Configuration options: [Auto] [Level 1] - [Level 7]



Boosted performance may vary depending on the CPU Graphics specification. DO NOT remove the thermal module.

CPU Graphics Current Capability

The CPU Graphics current capability adjusts the total power range for CPU Graphics overclocking. A higher value provides a wider total power range and extends the overclocking frequency range simultaneously.

Configuration options: [Auto] [100%] - [140%]



Configure higher values when overclocking or under a high CPU Graphics loading for extra support.

CPU Graphics VRM Switching Frequency

The switching frequency will affect the CPU Graphics transient response speed and the component thermal production. Select manual mode to configure a higher frequency to get a quicker transient response speed.

Configuration options: [Auto] [Manual]



The following item appears only when **CPU Graphics VRM Switching Frequency** is set to **[Manual]**.

Fixed CPU Graphics Switching Frequency (KHz)

The switching frequency will affect the CPU Graphics transient response speed and the component thermal production. Use the <+> or <-> to adjust the value. The values range from 250 to 500 with an interval of 50.

CPU Graphics Power Phase Control

The CPU Graphics current capability adjusts the total power range for CPU Graphics overclocking. A higher value provides a wider total power range and extends the overclocking frequency range simultaneously.

Configuration options: [Auto] [Standard] [Extreme]



DO NOT remove the thermal module when setting this item to **[Extreme]**. The thermal conditions should be monitored.

Boot Voltages

CPU Core/Cache Boot Voltage

Configuration options: [Auto] [0.600] - [1.700]

CPU System Agent Boot Voltage

Configuration options: [Auto] [0.7000] - [1.7500]

CPU VCCIO Boot Voltage

Configuration options: [Auto] [0.9000] - [1.8000]

PLL Termination Boot Voltage

Configuration options: [Auto] [0.80000] - [1.60000]

CPU Standby Boot Voltage

Configuration options: [Auto] [0.800] - [1.800]

Internal CPU Power Management

The items in this submenu allow you to set the CPU ratio and features.

Turbo Mode Parameters**CPU Core/Cache Current Limit Max.**

This item allows you to configure a higher current limit to prevent a frequency or power throttling when overclocking. Use the <+> and <-> keys to adjust the value.
Configuration options: [Auto] [0.00] - [255.50]

CPU Graphics Current Limit

This item allows you to configure a higher current limit to prevent a frequency or power throttling when overclocking. Use the <+> and <-> keys to adjust the value.
Configuration options: [Auto] [0.00] - [255.50]

Long Duration Package Power Limit

An Intel parameter known as “power limit” and specified in Watts. The default value is defined by TDP of the processor. Increasing the value will allow the Turbo ratio to be maintained for a longer duration under higher current loads. Use the <+> and <-> keys to adjust the value.

Configuration options: [Auto] [1] - [4095]

Package Power Time Window

An Intel parameter of “power limit 1” and specified in seconds. The applied value indicates how long the Turbo ratio can be active when TDP is exceeded.
Configuration options: [Auto] [1] - [448]

Short Duration Package Power Limit

An Intel parameter known as “power limit 2” and specified in Watts. It is the second Intel power limit which provides protection when package power exceeds power limit 1. The default setting is 1.25 times power limit 1. According to Intel, the platform must support this value for up to 10msec when power consumption exceeds power limit 2. ASUS motherboards are engineered to support this duration for a longer time as required to facilitate overclocking. Use the <+> and <-> keys to adjust the value.
Configuration options: [Auto] [1] - [4095]

IA AC Load Line

This item allows you to set the AC loadline defined in 1/100 mOhms. Use the <+> and <-> keys to adjust the value.
Configuration options: [Auto] [0.01] - [62.49]

IA DC Load Line

This item allows you to set the DC loadline defined in 1/100 mOhms. Use the <+> and <-> keys to adjust the value.

Configuration options: [Auto] [0.01] - [62.49]

TVB Voltage Optimizations

This item controls thermal based voltage optimizations for processors that implement the Intel Thermal Velocity Boost (TVB) feature.

Configuration options: [Auto] [Enabled] [Disabled]

TVB Ratio Clipping

This service controls Core frequency reduction caused by high package temperatures for processors that implement the Intel Thermal Velocity Boost (TVB) feature. It is required to be disabled for supporting overclocking at frequencies higher than the default max turbo frequency. Uses Overclocking Mailbox command 0x18/0x19.

Configuration options: [Auto] [Enabled] [Disabled]

V-Max Stress

If this item is set to **[Enabled]**, Frequency may be clipped if the max voltage on the silicon is too high. Frequency will not be clipped if disabled.

Configuration options: [Auto] [Enabled] [Disabled]

Tweaker's Paradise

Realtime Memory Timing

This item allows you to enable or disable realtime memory timing.

Configuration options: [Enabled] [Disabled]

FCLK Frequency for Early Power On

This item allows you to set the FCLK Frequency for Early Power On.

Configuration options: [Auto] [Normal (800 MHz)] [1GHz] [400 MHz]



1 GHz is not supported for ULT/ULX SKUs.

DRAM VTT Voltage

Configuration options: [Auto] [0.500] - [1.300]

VPPDDR Voltage

Configuration options: [Auto] [1.865] - [3.135]

Internal PLL Voltage

Configuration options: [Auto] [0.900] - [1.845]

GT PLL Voltage

Configuration options: [Auto] [0.900] - [1.845]

Ring PLL Voltage

Configuration options: [Auto] [0.900] - [1.845]

System Agent PLL Voltage

Configuration options: [Auto] [0.900] - [1.845]

Memory Controller PLL Voltage

Configuration options: [Auto] [0.900] - [1.845]

CPU Standby Voltage

Configuration options: [Auto] [0.800] - [1.800]

Min. CPU Cache Ratio

This item allows you to set the minimum possible CPU cache ratio. Use the <+> and <-> keys to adjust the value.

Configuration options: [Auto] [8] - [44]

Max. CPU Cache Ratio

This item allows you to set the maximum possible CPU cache ratio. Use the <+> and <-> keys to adjust the value.

Configuration options: [Auto] [8] - [44]

Max. CPU Graphics Ratio

This item allows you to configure the CPU graphics ratio. The ratio may vary depending on the system loading.

Configuration options: [Auto] [1] - [23]

Extreme Over-voltage

This item can only be enabled when the onboard CPU_OV jumper is switched on. Setting this item to **[Enabled]** allows you to configure higher voltages for overclocking, but the CPU lifetime will not be guaranteed.

Configuration options: [Disabled] [Enabled]

CPU Core/Cache Voltage

Configures the mode of Voltage fed to the cores of the processor.

Configuration options: [Auto] [Manual Mode] [Offset Mode]



The following item appears only when **CPU Core/Cache Voltage** is set to **[Manual Mode]**.

CPU Core Voltage Override

Allows you to configure the CPU Core voltage.

Configuration options: [Auto] [0.600] - [1.700]



The following items appear only when **CPU Core/Cache Voltage** is set to **[Offset Mode]**.

Offset Mode Sign

[+] To offset the voltage by a positive value.

[-] To offset the voltage by a negative value.

CPU Core Voltage Offset

This item allows you to configure the input voltage for the CPU by the external voltage regulator.

Configuration options: [Auto] [-0.635] - [0.635]

DRAM Voltage

Configuration options: [Auto] [1.000] - [2.000]

CPU VCCIO Voltage

Configuration options: [Auto] [0.900] - [1.800]

CPU System Agent Voltage

Configuration options: [Auto] [0.700] - [1.750]

PLL Termination Voltage

Configuration options: [Auto] [0.800] - [1.600]

CPU Graphics Voltage Mode

This item allows you to configure the mode of voltage fed to the CPU Graphics. Manual mode allows user-defined values. Offset mode modifies values by SVID.

Configuration options: [Auto] [Manual Mode] [Offset Mode]



The following item appears only when **CPU Graphics Voltage Mode** is set to **[Manual Mode]**.

CPU Graphics Voltage Override

Allows you to configure the CPU Core voltage.

Configuration options: [Auto] [0.600] - [1.700]



The following items appear only when **CPU Graphics Voltage Mode** is set to **[Offset Mode]**.

Offset Mode Sign

- | | |
|-----|--|
| [+] | To offset the voltage by a positive value. |
| [-] | To offset the voltage by a negative value. |
- CPU Core Voltage Offset

CPU Graphics Voltage Offset

This item allows you to configure the input voltage for the CPU by the external voltage regulator.

Configuration options: [Auto] [-0.635] - [0.635]

PCH Core Voltage

Configuration options: [Auto] [0.900] - [1.800]

DRAM REF Voltage Control

DRAM CTRL REF Voltage on CHA/CHB

Configures the DRAM reference voltage on the control lines. The reference voltage will be the DRAM voltage times the configured value.

Configuration options: [Auto] [0.39500] - [0.63000]

DRAM DATA REF Voltage on CHA DIMM0 Rank0 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHA DIMM0 Rank1 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHA DIMM1 Rank0 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHA DIMM1 Rank1 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHB DIMM0 Rank0 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHB DIMM0 Rank1 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHB DIMM1 Rank0 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

DRAM DATA REF Voltage on CHB DIMM1 Rank1 BL0-7

Configures the DRAM Data REF Voltage.

Configuration options: [Auto] [0] - [63]

1.6 Advanced menu

The Advanced menu items allow you to change the settings for the CPU and other system devices.

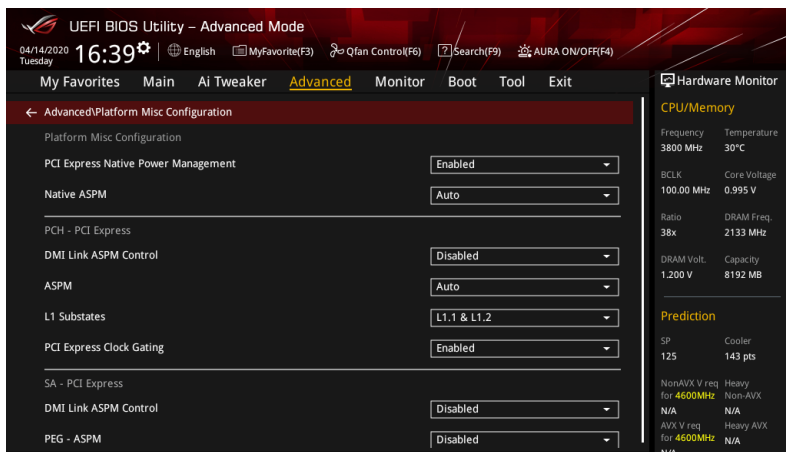


Be cautious when changing the settings of the Advanced menu items. Incorrect field values can cause the system to malfunction.



1.6.1 Platform Misc Configuration

The items in this menu allow you to configure the platform-related features.



PCI Express Native Power Management

This item allows you to enhance the power saving feature of PCI Express and perform ASPM operations in the operating system.

Configuration options: [Disabled] [Enabled]



The following item appears only when **PCI Express Native Power Management** is set to **[Enabled]**.

Native ASPM

Configuration options: [Auto] [Enabled] [Disabled]

PCH - PCI Express

DMI Link ASPM Control

This item allows you to control the Active State Power Management of the DMI Link.

Configuration options: [Disabled] [L0s] [L1] [L0sL1] [Auto]

ASPM

This item allows you to select the ASPM state for energy-saving conditions.

Configuration options: [Disabled] [L0s] [L1] [L0sL1] [Auto]

L1 Substates

This item allows you to select the PCI Express L1 Substates settings.

Configuration options: [Disabled] [L1.1] [L1.1 & L1.2]

PCI Express Clock Gating

This item allows you to enable or disable PCI Express Clock Gating for each root port.

Configuration options: [Disabled] [Enabled]

SA - PCI Express

DMI Link ASPM Control

This item allows you to enable or disable control of the Active State Power Management on SA side of the DMI Link.

Configuration options: [Disabled] [L0s] [L1] [L0sL1]

PEG - ASPM

This item allows you to control the ASPM support for the PEG 0. This has no effect if PEG is not the currently active device.

Configuration options: [Disabled] [Auto] [ASPM L0s] [ASPM L1] [ASPM L0sL1]

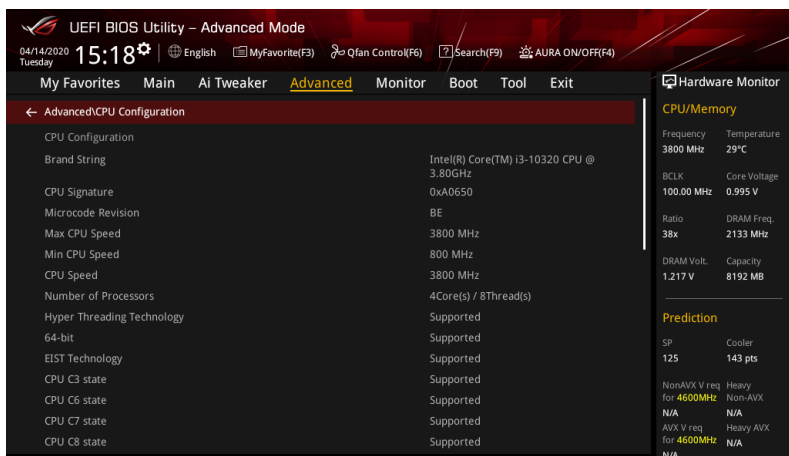
1.6.2 CPU Configuration

The items in this menu show the CPU-related information that the BIOS automatically detects.



The items in this menu may vary based on the CPU installed.

Scroll down to display other BIOS items.



Software Guard Extensions (SGX)

This item allows you to enable or disable Software Guard Extensions (SGX).

Configuration options: [Disabled] [Software Controlled]

Tcc Offset Time Window

This item allows you to set the TCC Offset Time Window for Running Average Temperature Limit (RATL) feature. RATL allows setting an average max thermal temperature.

Temperatures within the time window can get higher than the temperature threshold but only the average is used to cause frequency clipping.

Configuration options: [Auto] [Disabled] [5 ms] - [448 sec]

Hardware Prefetcher

This item allows you to enable or disable the MLC streamer prefetcher.

Configuration options: [Disabled] [Enabled]

Adjacent Cache Line Prefetch

This item allows you to prefetch adjacent cache lines, reducing the DRAM loading time and improving the system performance.

Configuration options: [Disabled] [Enabled]

Intel (VMX) Virtualization Technology

When set to **[Enabled]**, VMX can utilize the additional hardware capabilities provided by Vanderpool Technology.

Configuration options: [Disabled] [Enabled]

Active Processor Cores

This item allows you to select the number of CPU cores to activate in each processor package.

Configuration options: [All] [1] - [3]

Hyper-Threading

This item allows a hyper-threading processor to appear as two logical processors, allowing the operating system to schedule two threads or processes simultaneously.

[Enabled] For two threads per activated core.

[Disabled] For only one thread per activated core.

MonitorMWait

This item allows you to enable or disable MonitorMWait.

Configuration options: [Disabled] [Enabled]

CPU Power Management Configuration

This item allows you to manage and configure the CPU's power.

Boot performance mode

This item allows you to select the CPU performance state during system boot before the operating system takes control. The CPU runs at a selected performance ratio based on CPU configuration.

Configuration options: [Auto] [Max Battery] [Max Non-Turbo Performance]
[Turbo Performance]

Intel(R) SpeedStep(tm)

This item allows more than two frequency to be supported.

Configuration options: [Auto] [Enabled] [Disabled]

Intel(R) Speed Shift Technology

This item allows you to disable or enable Intel(R) Speed Shift Technology support. When enabled, CPPC v2 interface allows hardware controlled P-states.

Configuration options: [Auto] [Enabled] [Disabled]

Turbo Mode

This item allows you to automatically set the CPU cores to run faster than the base operating frequency when it is below the operating power, current and temperature specification limit. (Requires EMTM enabled too)

Configuration options: [Enabled] [Disabled]

CPU C-states

This item allows you to set the power saving of the CPU states.

Configuration options: [Auto] [Disabled] [Enabled]



The following items appear only when **CPU C-states** is set to **[Enabled]**.

Enhanced C-States

When enabled, CPU will switch to minimum speed when all cores enter C-State.

Configuration options: [Enabled] [Disabled]

CPU C3 Report

This item allows you to disable or enable the CPU C3 report to the operating system.

Configuration options: [Enabled] [Disabled]

CPU C6 Report

This item allows you to disable or enable the CPU C6 report to the operating system.

Configuration options: [Enabled] [Disabled]

CPU C7 Report

This item allows you to disable or enable the CPU C7 report to the operating system.

Configuration options: [CPU C7] [CPU C7s] [Disabled]

CPU C8 Report

This item allows you to disable or enable the CPU C8 report to the operating system.

Configuration options: [Enabled] [Disabled]

CPU C9 Report

This item allows you to disable or enable the CPU C9 report to the operating system.

Configuration options: [Enabled] [Disabled]

CPU C10 Report

This item allows you to disable or enable the CPU C10 report to the operating system.

Configuration options: [Enabled] [Disabled]

Package C State Limit

This item allows you to set the C-state limit for the CPU package.

Configuration options: [C0/C1] [C2] [C3] [C6] [C7] [C7s] [C8] [C9] [C10] [CPU Default] [Auto]

Thermal Monitor

This item allows you to enable or disable the Thermal Monitor.

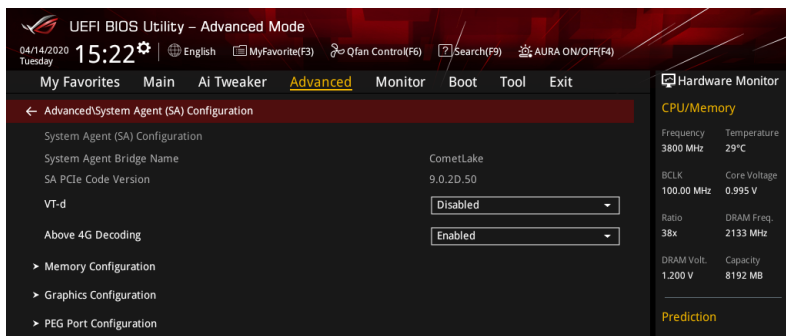
Configuration options: [Disabled] [Enabled]

Dual Tau Boost

This item allows you to enable Dual Tau Boost feature. This is only applicable for CMLS 35W/65W/125W sku.

Configuration options: [Disabled] [Enabled]

1.6.3 System Agent (SA) Configuration



VT-d

Allows you to enable virtualization technology function on memory control hub.

Configuration options: [Enabled] [Disabled]

Above 4G Decoding

This item enables or disables 64-bit capable devices to be decoded in above 4G address space if your system supports 64-bit PCI Decoding.

Configuration options: [Enabled] [Disabled]

Memory Configuration

This item allows you to set memory configuration parameters.

Memory Remap

This item allows you to enable or disable memory remap above 4GB.

Configuration options: [Enabled] [Disabled]

Graphics Configuration

This item allows you to select a primary display from CPU and PCIe graphical devices.

Primary Display

This item allows you to select the primary display from CPU and PCIe devices.

Configuration options: [Auto] [CPU Graphics] [PEG] [PCIe]

DVMT Pre-Allocated

This item allows you to select the DVMT 5.0 Pre-Allocated (Fixed) Graphics Memory size used by the Internal Graphics Device.

Configuration options: [32M] - [1024M]

RC6(Render Standby)

This item allows you to enable render standby support.

Configuration options: [Disabled] [Enabled]

PEG Port Configuration

This item allows you to configure the PEG Port settings.

PCIEx16_1 Link Speed

This item allows you to configure the PCIEx16_1 slot.

Configuration options: [Auto] [Gen1] [Gen2] [Gen3]

PCIEx16_2 Link Speed

This item allows you to configure the PCIEx16_2 slot.

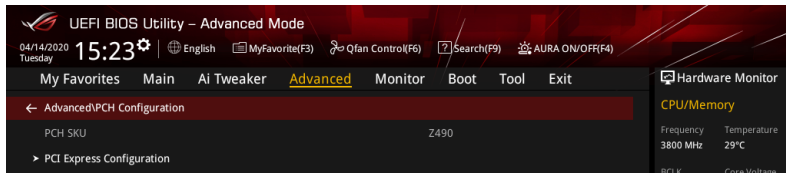
Configuration options: [Auto] [Gen1] [Gen2] [Gen3]

PCIEx16_3 Link Speed

This item allows you to configure the PCIEx16_3 slot.

Configuration options: [Auto] [Gen1] [Gen2] [Gen3]

1.6.4 PCH Configuration



PCI Express Configuration

This item allows you to configure the PCI Express slots.

PCIe Speed

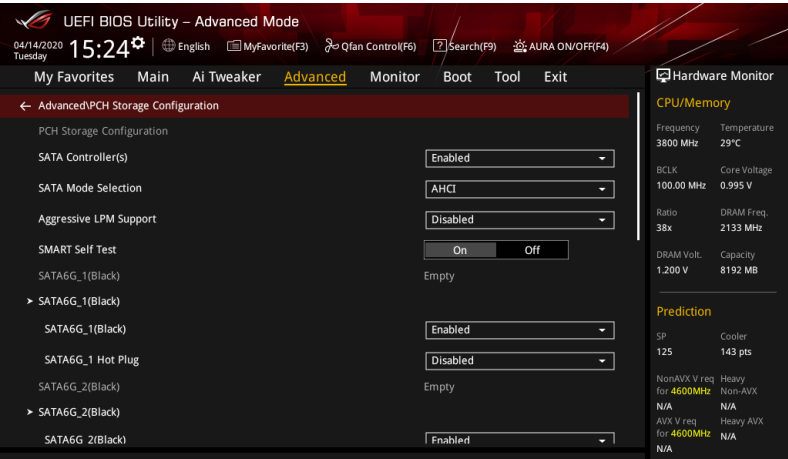
This item allows your system to automatically select the PCI Express port speed.

Configuration options: [Auto] [Gen1] [Gen2] [Gen3]

1.6.5 PCH Storage Configuration

While entering Setup, the BIOS automatically detects the presence of SATA devices. The SATA Port items show **Empty** if no SATA device is installed to the corresponding SATA port.

Scroll down to display the other BIOS items.



SATA Controller(s)

This item allows you to enable or disable the SATA Device.

Configuration options: [Disabled] [Enabled]



The following items appear only when **SATA Controller(s)** is set to **[Enabled]**.

SATA Mode Selection

This item allows you to set the SATA configuration.

[AHCI]

Set to [AHCI] when you want the SATA hard disk drives to use the AHCI (Advanced Host Controller Interface). The AHCI allows the onboard storage driver to enable advanced Serial ATA features that increases storage performance on random workloads by allowing the drive to internally optimize the order of commands.

[Intel RST Premium With Intel Optane System Acceleration (RAID)]

Set to [Intel RST Premium With Intel Optane System Acceleration (RAID)] when you want to create a RAID configuration from the SATA hard disk drives.

Aggressive LPM support

This item is designed for LPM (link power management) support with a better energy saving conditions. When disabled, the hot plug function of SATA ports are disabled.

Configuration options: [Disabled] [Enabled]

SMART Self Test

S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) is a monitoring system that shows a warning message during POST (Power-on Self Test) when an error occurs in the hard disks.

Configuration options: [On] [Off]

SATA6G_1(Black) - SATA6G_6(Black)

SATA6G_1(Black) - SATA6G_6(Black)

This item allows you to enable or disable the selected SATA port.

Configuration options: [Disabled] [Enabled]

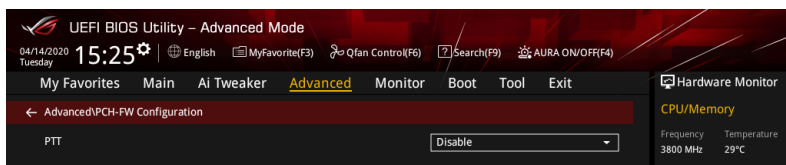
SATA6G_1 - SATA6G_6 Hot Plug

These items appear only when the SATA Mode Selection is set to [AHCI] and allows you to enable or disable SATA Hot Plug Support.

Configuration options: [Disabled] [Enabled]

1.6.6 PCH-FW Configuration

This item allows you to configure the firmware TPM.



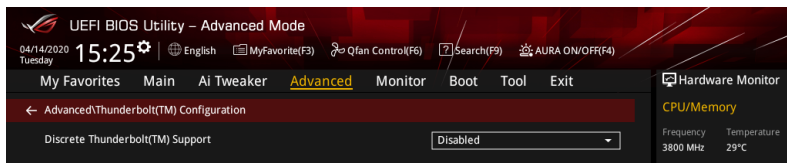
PTT

This item allows you to enable or disable PTT in SkuMgr.

Configuration options: [Disabled] [Enabled]

1.6.7 Thunderbolt(TM) Configuration

The items in this menu allow you to configure Thunderbolt settings.



Discrete Thunderbolt(TM) Support

This item allows you to enable or disable Discrete Thunderbolt(TM) Support.

Configuration options: [Disabled] [Enabled]



The following items appear only when **Discrete Thunderbolt(TM) Support** is set to **[Enabled]**.

Thunderbolt Boot Support

This item allows you to enable boots from Bootable devices which is present behind Thunderbolt.

Configuration options: [Disabled] [Enabled]

Titan Ridge Workabout for OSUP

This item allows you to enable or disable Titan Ridge Workabout for OSUP.

Configuration options: [Disabled] [Enabled]

Tbt Dynamic AC/DC L1

This item allows you to enable or disable Tbt Dynamic AC/DC L1 support.

Configuration options: [Disabled] [Enabled]

Wake From Thunderbolt(TM) Devices

This item allows you to enable or disable system wake from Thunderbolt(TM) devices.

Configuration options: [On] [Off]

Security Level

This item allows you to select the security selection.

Configuration options: [No Security] [User Authorization] [Secure Connect] [Display Port only] [USB Docking Only]

SW SMI on TBT hot-plug

When this item is set to **[Enabled]**, BIOS generates software SMI to assign resource to TBT devices.

Configuration options: [Disabled] [Enabled]

ACPI Notify on TBT Hot-plug

When this item is set to **[Enabled]**, BIOS generates ACPI Notify.

Configuration options: [Disabled] [Enabled]

Discrete Thunderbolt(TM) Configuration

The items in this submenu allow you to configure Discrete Thunderbolt(TM) related configurations.

GPIO3 Force Pwr

Configuration options: [On] [Off]

Wait time in ms after applying Force Pwr

This item allows you to set the wait time (in milli seconds) before accessing the TBT controller, after Force Pwr is asserted. The values range from 1 to 5000.

GPIO filter

GPIO filter is needed to avoid electrical noise on PCH GPIOs during hotplug of 12V USB devices.

Configuration options: [Disabled] [Enabled]

Enable CLK RWQ

This item allows you to enable clock request (CLKREQ#) for all upstream ports.

Configuration options: [Disabled] [Enabled]

Enable ASPM

This item allows you to enable ASPM support for all downstream ports and endpoint devices.

Configuration options: [Disabled] [L0s] [L1] [L0sL1]

Enable LTR

This item allows you to enable Latency Tolerance Reporting support for all Thunderbolt(TM) devices.

Configuration options: [Disabled] [Enabled]

Enable PTM

This item allows you to enable Ptm support for all downstream ports and endpoint devices.

Configuration options: [Disabled] [Enabled]

Enable TBT ASPM

This item allows you to enable TBT ASPM support for all downstream ports and endpoint devices.

Configuration options: [Disabled] [L1.1] [L1.1 & L1.2]

DTBT Controller 0 Configuration

DTBT Contorller 0

Configuration options: [Disabled] [Enabled]

DTbt Root Port Type

This item allows you to select the TBT Root Port Type.

Configuration options: [PCH Root Port] [PEG Root Port]

TBT Host Router

This item allows you to enable host router based on ports available.

Configuration options: [One Port] [Two Port]

Extra Bus Reserved

This item allows you to select the TBT Root Port Type.

[56] One port Host.

[106] Two port Host.

Reserved Memory

This item allows you to set the Reserved Memory for this Root Bridge.

Use the <+> and <-> keys to adjust the value. The values range from 1 to 4096.

Memory alignment

Use the <+> and <-> keys to adjust the value. The values range from 0 to 31.

Reserved PMemory

This item allows you to set the Reserved Prefetchable Memory for this Root Bridge. Use the <+> and <-> keys to adjust the value. The values range from 1 to 4096.

PMemory alignment

Use the <+> and <-> keys to adjust the value. The values range from 0 to 31.

Reserved I/O

Use the <+> and <-> keys to adjust the value. The values range from 0 to 60.

Thunderbolt(TM) OS select

Windows 10 Thunderbolt support

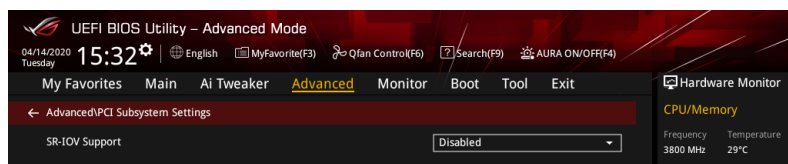
This item allows you to specify Windows 10 Thunderbolt support level.

[Enable + RTD3] OS Native support plus RTD3.

[Enabled] OS Native support only, no RTD3.

[Disabled] No OS native support.

1.6.8 PCI Subsystem Settings



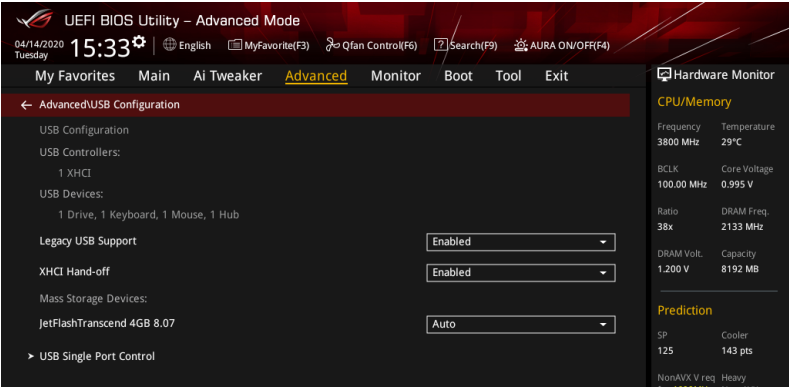
SR-IOV Support

This option enables or disables Single Root IO Virtualization Support if the system has SR-IOV capable PCIe devices.

Configuration options: [Disabled] [Enabled]

1.6.9 USB Configuration

The items in this menu allow you to change the USB-related features.



The **Mass Storage Devices** item shows the auto-detected values. If no USB device is detected, the item shows **None**.

Legacy USB Support

- [Enabled] Your system supports the USB devices in legacy operating systems.
- [Disabled] Your USB devices can be used for BIOS setup only and cannot be recognized in the boot devices list.
- [Auto] Your system automatically detects the presence of USB devices at startup. If any USB devices are detected, the legacy USB support is enabled.

XHCI Hand-off



This item is set to **[Disabled]** by default for the EHCI (enhanced host controller interface) support by XHCI drivers in operating systems.

- [Disabled] Support XHCI by XHCI drivers for operating systems with XHCI support.
- [Enabled] Support XHCI by BIOS for operating systems without XHCI support.

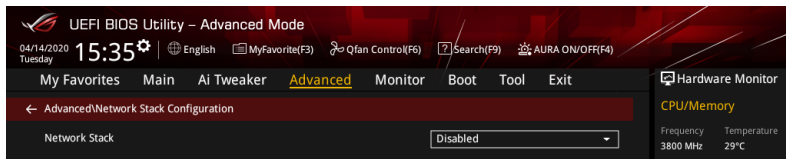
USB Single Port Control

This item allows you to enable or disable the individual USB ports.



Refer to section **Motherboard layout** and **Rear I/O connection** in your motherboard's user manual for the location of the USB ports.

1.6.10 Network Stack Configuration



Network stack

This item allows you to disable or enable the UEFI network stack.

Configuration options: [Disable] [Enable]



The following items appear only when **Network Stack** is set to **[Enabled]**.

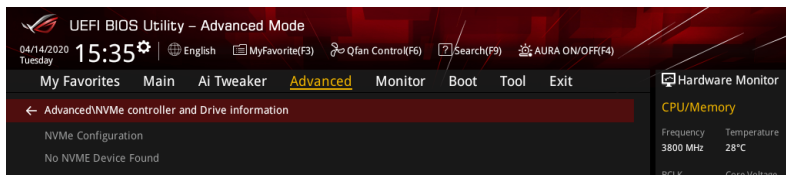
Ipv4/Ipv6 PXE Support

This item allows you to enable or disable the Ipv4/Ipv6 PXE wake event.

Configuration options: [Disabled] [Enabled]

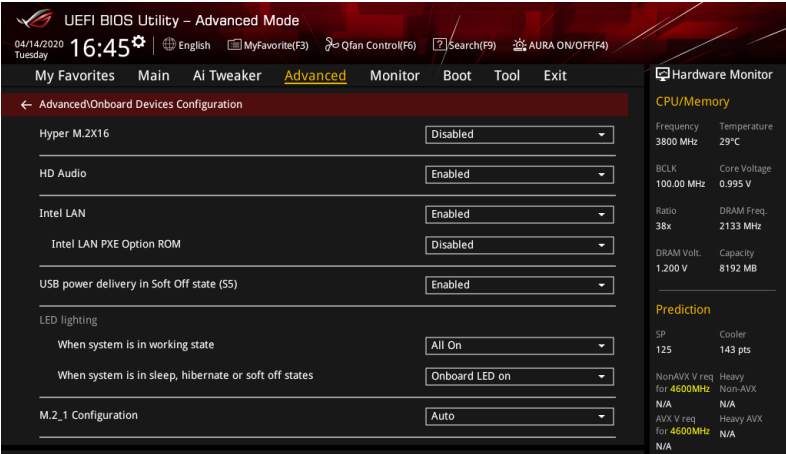
1.6.11 NVMe Configuration

This menu displays the NVMe controller and Drive information of the connected devices.



1.6.12 Onboard Devices Configuration

Scroll down to view the other BIOS items.



Hyper M.2X16

This item allows you to set different configurations for the Hyper M.2X16 card. The configurations may differ between motherboards. Please refer to your motherboard's user manual for more information on the configurations.

HD Audio

This item allows you to use the Azalia High Definition Audio Controller.

Configuration options: [Disabled] [Enabled]

Intel LAN

This item allows you to enable or disable the Intel LAN.

Configuration options: [Disabled] [Enabled]

USB power deliver in Soft Off state (S5)

This item allows you to enable or disable USB power when your PC is in the S5 state.

Configuration options: [Disabled] [Enabled]

LED lighting

When system is in working state

This item allows you to turn the RGB LED lighting on or off when the system is in the working state.

- | | |
|-----------------|--|
| [All On]: | All LEDs (Aura or Functional) will be enabled. |
| [Stealth Mode]: | All LEDs (Aura and Functional) will be disabled. |
| [Aura Only]: | Aura LEDs will be enabled and functional LEDs will be disabled. |
| [Aura Off]: | Aura LEDs will be disabled, however functional LEDs will still be enabled. |

When system is in sleep, hibernate or soft off states

This item allows you to turn the RGB LED lighting on or off when the system is in the sleep, hibernate or soft off states.

[Onboard LED on]: Onboard LEDs will behave normally.

[Onboard LED off]: Onboard LEDs will be disabled.

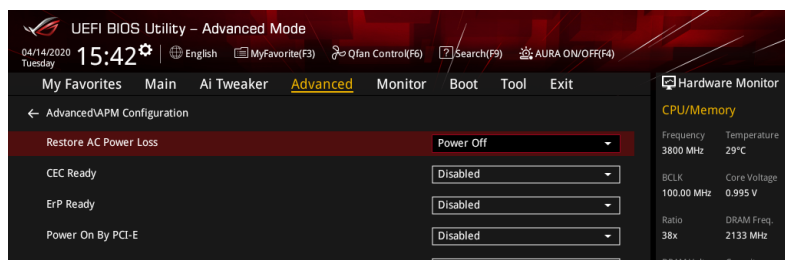
M.2_1 Configuration

[Auto] Auto-detects the M.2 device mode. If a SATA device is detected, SATA6G_2 will be disabled.

[SATA mode] Only supports M.2 SATA devices. Please note that SATA6G_2 port cannot be used in this mode.

[PCI-E mode] Only supports M.2 PCI-E devices.

1.6.13 APM Configuration



Restore AC Power Loss

This item allows your system to go to ON state, OFF state, or both states after an AC power loss. When setting your system to **[Last State]**, it goes to the previous state before the AC power loss.

Configuration options: [Power Off] [Power On] [Last State]

CEC Ready

Enabling this item allows your system to comply with CEC (California Energy Commission) regulations and save more power under S0 state.

Configuration options: [Disabled] [Enabled]

ErP Ready

This item allows you to switch off some power at S4+S5 or S5 to get the system ready for ErP requirement. When set to **[Enabled]**, all other PME options are switched off.

Configuration options: [Disabled] [Enabled (S4+S5)] [Enabled (S5)]

Power On By PCI-E

This item allows you to enable or disable the Wake-on-LAN function of the onboard LAN controller or other installed PCI-E LAN cards.

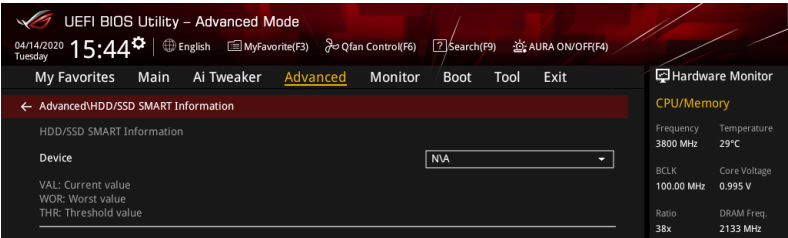
Configuration options: [Disabled] [Enabled]

Power On By RTC

This item allows you to enable or disable the RTC (Real-Time Clock) to generate a wake event and configure the RTC alarm date. When enabled, you can set the days, hours, minutes, or seconds to schedule an RTC alarm date.
Configuration options: [Disabled] [Enabled]

1.6.14 HDD/SSD SMART Information

This menu displays the SMART information of the connected devices.



NVM Express devices do not support SMART information.

1.7 Monitor menu

The Monitor menu displays the system temperature/power status, and allows you to change the fan settings.

Scroll down to display the other BIOS items.



CPU Temperature, CPU Package Temperature, Motherboard Temperature, Chipset Temperature, T_Sensor Temperature [xxx°C/xxx°F]

The onboard hardware monitor automatically detects and displays the CPU, CPU Package, motherboard, chipset, and T-Sensor temperatures. Select **[Ignore]** if you do not wish to display the detected temperatures.

CPU Fan Speed, CPU Optional Fan, Chassis Fan 1-2 Speed, M.2 Fan Speed, AIO pump Speed, VRM Heatsink Fan Speed [xxxx RPM]

The onboard hardware monitor automatically detects and displays the CPU fan, CPU optional fan, chassis fan, M.2 fan, AIO pump fan, and VRM heatsink fan speed in rotations per minute (RPM). If the fan is not connected to the motherboard, the field shows N/A. Select **[Ignore]** if you do not wish to display the detected speed.

CPU Core Voltage, 12V Voltage, 5V Voltage, 3.3V Voltage [x.xxxx V]

The onboard hardware monitor automatically detects the voltage output through the onboard voltage regulators. Select **[Ignore]** if you do not want to detect this item.

Q-Fan Configuration

AI Cooling

ASUS AI Cooling will automatically manage and control all motherboard fans, ensuring the most efficient settings are set depending on the current system load and temperature. When you enable this function, AI Cooling function will try to lower fan speed to decrease fan noise without compromising current performance. You can keep track of fan performance via the ASUS Fan Xpert software with a blue dot in the Fan curve chart.

Configuration options: [Enabled] [Disabled]

Q-Fan Tuning

Click this item to automatically detect the lowest speed and configure the minimum duty cycle for each fan.

CPU Q-Fan Control

This item allows you to set the CPU Q-Fan operating mode.

[Auto]	Detects the type of CPU fan installed and automatically switches the control modes.
[PWM Mode]	Enables the CPU Q-Fan Control feature in PWM mode for 4-pin CPU fan.
[DC Mode]	Enables the CPU Q-Fan Control feature in DC mode for 3-pin CPU fan.
[Disabled]	Disables the Q-Fan Control.



The following items appear only when **CPU Q-Fan Control** is set to **[Auto]**, **[PWM Mode]**, or **[DC Mode]**.

CPU Fan Step Up

This item allows you to set the value of the CPU fan step up.

Configuration options: [0 sec] [2.1 sec] [2.8 sec] [3.6 sec] [4.2 sec] [5.0 sec] [6.3 sec] [8.5 sec] [12 sec] [25 sec]

CPU Fan Step Down

This item allows you to set the value of the CPU fan step down.

Configuration options: [0 sec] [2.1 sec] [2.8 sec] [3.6 sec] [4.2 sec] [5.0 sec] [6.3 sec] [8.5 sec] [12 sec] [25 sec]

CPU Fan Speed Low Limit

This item allows you to set the low limit warning for CPU Fan speed.

Configuration options: [Ignore] [200 RPM] [300 RPM] [400 RPM] [500 RPM] [600 RPM]

CPU Fan Profile

This item allows you to set the appropriate performance level of the CPU fan.

[Standard]	Set to make the CPU fan adjust automatically depending on the CPU temperature.
[Silent]	Set to minimize the fan speed for quiet CPU fan operation.
[Turbo]	Set to achieve maximum CPU fan speed.
[Manual]	Set to assign the detailed fan speed control parameters.



The following items appear only when **CPU Fan Profile** is set to **[Manual]**.

CPU Upper Temperature

Use the <+> or <-> keys to adjust the upper limit of the CPU temperature. The CPU fan will operate at the maximum duty cycle when the temperature source is higher than the limit.

CPU Fan Max. Duty Cycle (%)

Use the <+> or <-> keys to adjust the maximum CPU fan duty cycle. When the temperature source reaches the upper limit, the CPU fan will operate at the maximum duty cycle.

CPU Middle Temperature

Use the <+> or <-> keys to adjust the middle limit of the CPU temperature.

CPU Fan Middle. Duty Cycle (%)

Use the <+> or <-> keys to adjust the CPU fan middle duty cycle.

CPU Lower Temperature

Use the <+> or <-> keys to adjust the lower limit of the CPU temperature. The CPU fan will operate at the minimum duty cycle when the temperature source is lower than the limit.

CPU Fan Min. Duty Cycle(%)

Use the <+> or <-> keys to adjust the minimum CPU fan duty cycle. When the temperature source is under the limit, the CPU fan will operate at the minimum duty cycle.

Chassis Fan(s) Configuration

Chassis Fan 1-2 Q-Fan Control

This item allows you to set the chassis fan operating mode.

[Auto]	Detects the type of chassis fan installed and automatically switches the control modes.
[PWM Mode]	Enables the Chassis Fan Q-Fan Control feature in PWM mode for 4-pin chassis fan.
[DC Mode]	Enables the Chassis Fan Q-Fan Control feature in DC mode for 3-pin chassis fan.
[Disabled]	Disables the Q-Fan control.



The following items appear only when **Chassis Fan 1-3 Q-Fan Control** is set to **[Auto]**, **[PWM Mode]**, or **[DC Mode]**.

Chassis Fan 1-2 Q-Fan Source

The assigned fan will be controlled according to the selected temperature source. Configuration options: [CPU] [MotherBoard] [Chipset] [T_Sensor] [Multiple Sources]



For Multiple Sources, select up to three temperature sources and the fan will automatically change based on the highest temperature.

Chassis Fan 1-2 Step Up

This item allows you to set the value of the chassis fan step up.

Configuration options: [0 sec] [12 sec] [25 sec] [51 sec] [76 sec] [102 sec] [127 sec] [153 sec] [178 sec] [204 sec]

Chassis Fan 1-2 Step Down

This item allows you to set the value of the chassis fan step down.

Configuration options: [0 sec] [12 sec] [25 sec] [51 sec] [76 sec] [102 sec] [127 sec] [153 sec] [178 sec] [204 sec]

Chassis Fan 1-2 Speed Low Limit

This item allows you to disable or set the chassis fan warning speed.

Configuration options: [Ignore] [200 RPM] [300 RPM] [400 RPM] [500 RPM] [600 RPM]

Chassis Fan 1-2 Profile

This item allows you to set the appropriate performance level of the chassis fan.

[Standard] Sets to [Standard] to make the chassis fan automatically adjust depending on the chassis temperature.

[Silent] Sets to [Silent] to minimize the fan speed for quiet chassis fan operation.

[Turbo] Sets to [Turbo] to achieve maximum chassis fan speed.

[Manual] Sets to [Manual] to assign detailed fan speed control parameters.



The following items appear only when **Chassis Fan 1-2 Profile** is set to **[Manual]**.

Chassis Fan 1-2 Upper Temperature

Use the <+> or <-> keys to adjust the upper limit of the Chassis fan 1-2 temperature. The Chassis fan 1-2 will operate at the maximum duty cycle when the temperature source is higher than the limit.

Chassis Fan 1-2 Max. Duty Cycle (%)

Use the <+> or <-> keys to adjust the maximum Chassis fan 1-2 duty cycle. When the temperature source reaches the upper limit, the Chassis fan 1-2 will operate at the maximum duty cycle.

Chassis Fan 1-2 Middle Temperature

Use the <+> or <-> keys to adjust the middle limit of the Chassis fan 1-2 temperature.

Chassis Fan 1-2 Middle. Duty Cycle (%)

Use the <+> or <-> keys to adjust the Chassis fan 1-2 middle duty cycle.

Chassis Fan 1-2 Lower Temperature

Use the <+> or <-> keys to adjust the lower limit of the Chassis fan 1-2 temperature. The Chassis fan 1-2 will operate at the minimum duty cycle when the temperature source is lower than the limit.

Chassis Fan 1-2 Min. Duty Cycle(%)

Use the <+> or <-> keys to adjust the minimum Chassis fan 1-2 duty cycle. When the temperature source is under the limit, the Chassis fan 1-2 will operate at the minimum duty cycle.

AIO PUMP Control

[Disabled]	Disable the AIO PUMP control feature.
[Auto]	Detects the type of AIO PUMP installed and automatically switches the control modes.
[DC mode]	Enable the AIO PUMP control in DC mode for 3-pin chassis fan.
[PWM mode]	Enable the water AIO PUMP control in PWM mode for 4-pin chassis fan.



The following items appear only when **AIO PUMP Control** is set to **[Auto]**, **[DC mode]**, or **[PWM mode]**.

AIO PUMP Q-Fan Source

The assigned fan will be controlled according to the selected temperature source.

Configuration options: [CPU] [MotherBoard] [Chipset] [T_Sensor] [Multiple Sources]



For Multiple Sources, select up to three temperature sources and the fan will automatically change based on the highest temperature.

AIO PUMP Upper Temperature

Use the <+> or <-> keys to adjust the upper limit of the AIO PUMP temperature.

AIO PUMP Max. Duty Cycle (%)

Use the <+> or <-> keys to adjust the maximum AIO PUMP duty cycle. When the CPU temperature reaches the upper limit, the AIO PUMP will operate at the maximum duty cycle.

AIO PUMP Middle Temperature

Use the <+> or <-> keys to adjust the middle limit of the AIO PUMP temperature.

AIO PUMP Middle. Duty Cycle (%)

Use the <+> or <-> keys to adjust the maximum AIO PUMP duty cycle. When the CPU temperature reaches the upper limit, the AIO PUMP will operate at the maximum duty cycle.

AIO PUMP Lower Temperature

Use the <+> or <-> keys to adjust the lower limit of the AIO PUMP temperature. The AIO PUMP will operate at the minimum duty cycle when the temperature is lower than the limit.

AIO PUMP Min. Duty Cycle(%)

Use the <+> or <-> keys to adjust the minimum AIO PUMP duty cycle. When the CPU temperature is under the limit, the AIO PUMP will operate at the minimum duty cycle.

Chassis Intrusion Detection Support

Set this item to **[Enabled]** to enable the chassis intrusion detection function.

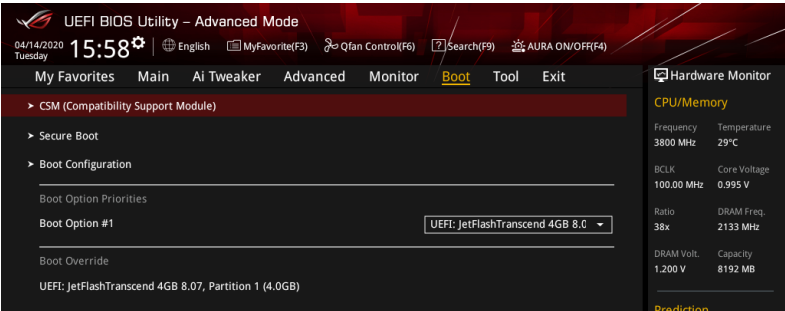
Configuration options: [Enabled] [Disabled]

CPU Temperature LED Switch

This item allows you to turn the CPU Temperature LED on or off.
Configuration options: [Enabled] [Disabled]

1.8 Boot menu

The Boot menu items allow you to change the system boot options.



CSM (Compatibility Support Module)

This item allows you to configure the CSM (Compatibility Support Module) items to fully support the various VGA, bootable devices and add-on devices for better compatibility.

Launch CSM

- [Enabled] For better compatibility, enable the CSM to fully support the non-UEFI driver add-on devices or the Windows® UEFI mode.
- [Disabled] Disable the CSM to fully support the non-UEFI driver add-on devices or the Windows® UEFI mode.



The following items appear only when **Launch CSM** is set to **[Enabled]**.

Boot Device Control

This item allows you to select the type of devices that you want to boot.
Configuration options: [UEFI and Legacy OPROM] [Legacy OPROM only] [UEFI only]

Boot from Network Devices

This item allows you to select the type of network devices that you want to launch.
Configuration options: [Ignore] [Legacy only] [UEFI only]

Boot from Storage Devices

This item allows you to select the type of storage devices that you want to launch.
Configuration options: [Ignore] [Legacy only] [UEFI only]

Boot from PCI-E/PCI Expansion Devices

This item allows you to select the type of PCI-E/PCI expansion devices that you want to launch.

Configuration options: [Ignore] [Legacy only] [UEFI only]

Secure Boot

This item allows you to configure the Windows® Secure Boot settings and manage its keys to protect the system from unauthorized access and malwares during POST.

OS Type

- [Windows UEFI Mode] This item allows you to select your installed operating system. Execute the Microsoft® Secure Boot check. Only select this option when booting on Windows® UEFI mode or other Microsoft® Secure Boot compliant OS.
- [Other OS] Get the optimized function when booting on Windows® non-UEFI mode. Microsoft® Secure Boot only supports Windows® UEFI mode.

Key Management

Install Default Secure Boot keys

This item allows you to immediately load the default Security Boot keys, Platform key (PK), Key-exchange Key (KEK), Signature database (db), and Revoked Signatures (dbx). When the default Secure boot keys are loaded, the PK state will change from Unloaded mode to loaded mode.

Clear Secure Boot keys

This item appears only when you load the default Secure Boot keys. This item allows you to clear all default Secure Boot keys.

Save all Secure Boot variables

This item allows you to save all secure boot keys to a USB storage device.

PK Management

The Platform Key (PK) locks and secures the firmware from any permissible changes. The system verifies the PK before your system enters the OS.

Save To File

This item allows you to save the PK to a USB storage device.

Set New key

This item allows you to load the downloaded PK from a USB storage device.

Delete key

This item allows you to delete the PK from your system. Once the PK is deleted, all the system's Secure Boot keys will not be active.

Configuration options: [Yes] [No]



The PK file must be formatted as a UEFI variable structure with time-based authenticated variable.

KEK Management

The KEK (Key-exchange Key or Key Enrollment Key) manages the Signature database (db) and Revoked Signature database (dbx).



Key-exchange Key (KEK) refers to Microsoft® Secure Boot Key-Enrollment Key (KEK).

Save to file

This item allows you to save the KEK to a USB storage device.

Set New key

This item allows you to load the downloaded KEK from a USB storage device.

Append Key

This item allows you to load the additional KEK from a storage device for an additional db and dbx loaded management.

Delete key

This item allows you to delete the KEK from your system.

Configuration options: [Yes] [No]



The KEK file must be formatted as a UEFI variable structure with time-based authenticated variable.

DB Management

The db (Authorized Signature database) lists the signers or images of UEFI applications, operating system loaders, and UEFI drivers that you can load on the single computer.

Save to file

This item allows you to save the db to a USB storage device.

Set New key

This item allows you to load the downloaded db from a USB storage device.

Append Key

This item allows you to load the additional db from a storage device for an additional db and dbx loaded management.

Delete key

This item allows you to delete the db file from your system.

Configuration options: [Yes] [No]



The db file must be formatted as a UEFI variable structure with time-based authenticated variable.

DBX Management

The dbx (Revoked Signature database) lists the forbidden images of db items that are no longer trusted and cannot be loaded.

Save to file

This item allows you to save the dbx to a USB storage device.

Set New key

This item allows you to load the downloaded dbx from a USB storage device.

Append Key

This item allows you to load the additional dbx from a storage device for an additional db and dbx loaded management.

Delete key

This item allows you to delete the dbx file from your system.
Configuration options: [Yes] [No]



The dbx file must be formatted as a UEFI variable structure with time-based authenticated variable.

Boot Configuration

Fast Boot

[Disabled]

Allows your system to go back to its normal boot speed.

[Enabled]

Allows your system to accelerate the boot speed.



The following item appears only when **Fast Boot** is set to **[Enabled]**.

Next Boot after AC Power Loss

[Normal Boot]

Returns to normal boot on the next boot after an AC power loss.

[Fast Boot]

Accelerates the boot speed on the next boot after an AC power loss.

Boot Logo Display

[Auto]

Auto adjustments for Windows requirements.

[Full Screen]

Maximize the boot logo size.

[Disabled]

Hide the logo during POST.



The following item appears only when **Boot Logo Display** is set to **[Auto]** or **[Full Screen]**.

Post Delay Time

This item allows you to select a desired additional POST waiting time to easily enter the BIOS Setup. You can only execute the POST delay time during normal boot.

Configuration options: [0 sec] – [10 sec]



This feature only works when set under normal boot.

Boot up NumLock State

This item allows you to enable or disable keyboard NumLock during the system boot.
Configuration options: [Disabled] [Enabled]

Wait For 'F1' If Error

This item allows your system to wait for the <F1> key to be pressed when error occurs.

Configuration options: [Disabled] [Enabled]

AMI Native NVMe Driver Support

This item allows you to enable or disable all NVMe device native OpROM.

Configuration options: [Disabled] [Enabled]

Option ROM Messages

[Force BIOS] The Option ROM Messages will be shown during the POST.

[Keep Current] Only the ASUS logo will be shown during the POST.

Interrupt 19 Capture

[Enabled] Execute the trap right away.

[Disabled] Execute the trap during legacy boot.

Setup Mode

[Advanced Mode] This item allows you to go to Advanced Mode of the BIOS after POST.

[EZ Mode] This item allows you to go to EZ Mode of the BIOS after POST.

Boot Sector (MBR/GPT) Recovery Policy

This item allows you to set the Boot Sector Policy.

[Auto Recovery] Follow UEFI Rule.

[Local User Control] You can enter setup page and select Boot Sector (MBR/GPT) Recovery Policy to recovery MBR/GPT on the next boot time.



The following item appears only when **Boot Sector (MBR/GPT) Recovery Policy** is set to **[Local User Control]**.

Next Boot Recovery Action

Choose the (MBR/GPT) recovery action on the next boot.

Configuration options: [Skip] [Recovery]

Boot Option Priorities

These items specify the boot device priority sequence from the available devices. The number of device items that appears on the screen depends on the number of devices installed in the system.



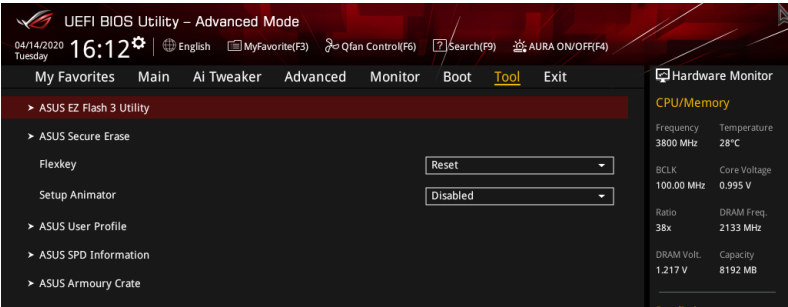
- To access Windows® OS in Safe Mode, press <F8 > after POST (Windows® 8 not supported).
 - To select the boot device during system startup, press <F8> when ASUS Logo appears.
-

Boot Override

This item displays the available devices. The number of device items that appear on the screen depends on the number of devices installed in the system. Click an item to start booting from the selected device.

1.9 Tool menu

The Tool menu items allow you to configure options for special functions. Select an item then press <Enter> to display the submenu.



Flexkey

- [Reset] Reboots the system.
- [Aura On/Off] Enable or Disable Aura LEDs. This setting does not sync with the BIOS/software option.
- [DirectKey] Boot directly into the BIOS.

Setup Animator

This item allows you to enable or disable the Setup animator.
Configuration options: [Disabled] [Enabled]

1.9.1 ASUS EZ Flash 3 Utility

This item allows you to run ASUS EZ Flash 3. When you press <Enter>, a confirmation message appears. Use the left/right arrow key to select between [Yes] or [No], then press <Enter> to confirm your choice.



For more details, refer to section **ASUS EZ Flash 3**.

1.9.2 Secure Erase

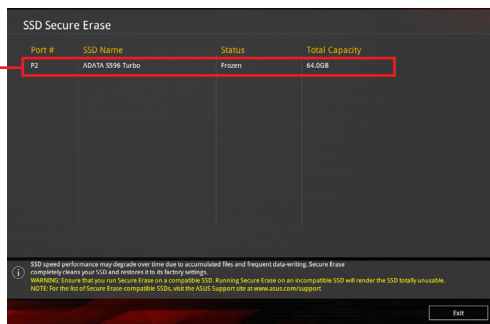
SSD speeds may lower over time as with any storage medium due to data processing. Secure Erase completely and safely cleans your SSD, restoring it to factory performance levels.

To launch Secure Erase, click **Tool > Secure Erase** on the Advanced mode menu.



- The time to erase the contents of your SSD may take a while depending on its size. Do not turn off the system during the process.
- Secure Erase is only supported on Intel SATA port. For more information about Intel SATA ports, refer to section **Motherboard layout** in your user manual.

Displays the available SSDs

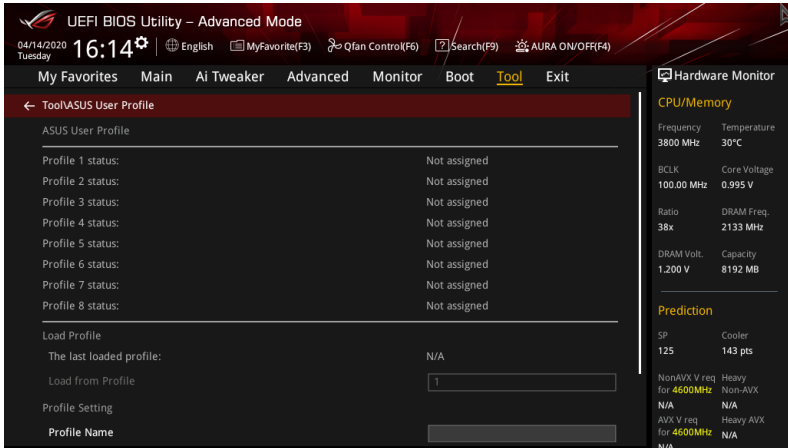


Status definition:

- **Frozen.** The frozen state is the result of a BIOS protective measure. The BIOS guards drives that do not have password protection by freezing them prior to booting. If the drive is frozen, a power off or hard reset of your PC must be performed to proceed with the Secure Erase.
- **Locked.** SSDs might be locked if the Secure Erase process is either incomplete or was stopped. This may be due to a third party software that uses a different password defined by ASUS. You have to unlock the SSD in the software before proceeding with Secure Erase.

1.9.3 ASUS User Profile

This item allows you to store or load multiple BIOS settings.



Load from Profile

This item allows you to load the previous BIOS settings saved in the BIOS Flash. Key in the profile number that saved your BIOS settings, press <Enter>, and then select **Yes**.



- DO NOT shut down or reset the system while updating the BIOS to prevent the system boot failure!
- We recommend that you update the BIOS file only coming from the same memory/CPU configuration and BIOS version.

Profile Name

This item allows you to key in a profile name.

Save to Profile

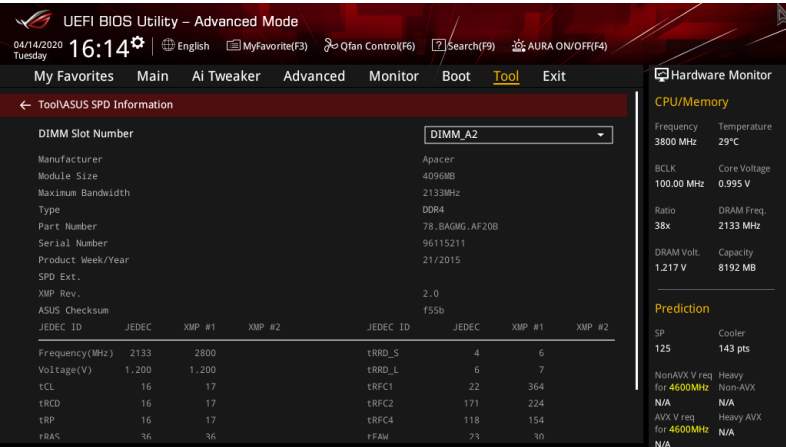
This item allows you to save the current BIOS settings to the BIOS Flash, and create a profile. Key in a profile number from one to eight, press <Enter>, and then select **Yes**.

Load/Save Profile from/to USB Drive

This item allows you to load or save profile from your USB drive, load and save profile to your USB drive.

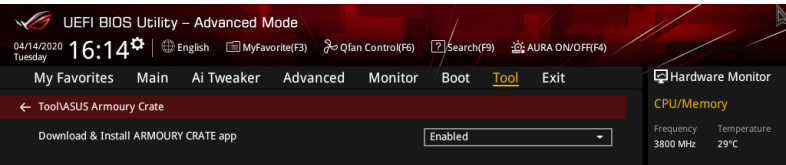
1.9.4 ASUS SPD Information

This item allows you to view the DRAM SPD information.



1.9.5 ASUS Armoury Crate

This item allows you to enable or disable downloading and installing of the Armoury Crate app in the Windows® OS. The Armoury Crate app can help you manage and download the latest ROG drivers and utilities for your motherboard.

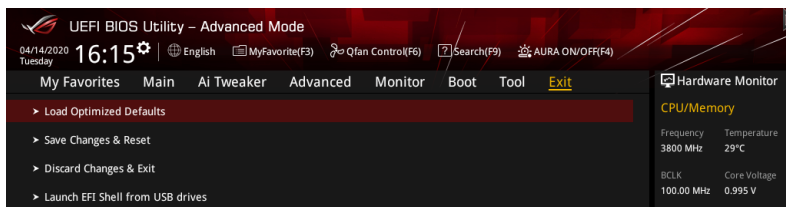


Download & Install ARMOURY CRATE app

Configuration options: [Disabled] [Enabled]

1.10 Exit menu

The Exit menu items allow you to load the optimal default values for the BIOS items, and save or discard your changes to the BIOS items. You can access the EZ Mode from the Exit menu.



Load Optimized Defaults

This option allows you to load the default values for each of the parameters on the Setup menus. When you select this option or if you press <F5>, a confirmation window appears. Select **OK** to load the default values.

Save Changes & Reset

Once you are finished making your selections, choose this option from the Exit menu to ensure the values you selected are saved. When you select this option or if you press <F10>, a confirmation window appears. Select **OK** to save changes and exit.

Discard Changes & Exit

This option allows you to exit the Setup program without saving your changes. When you select this option or if you press <Esc>, a confirmation window appears. Select **Yes** to discard changes and exit.

Launch EFI Shell from USB drives

This option allows you to attempt to launch the EFI Shell application (shellx64.efi) from one of the available filesystem devices.

1.11 Updating BIOS

The ASUS website publishes the latest BIOS versions to provide enhancements on system stability, compatibility, and performance. However, BIOS updating is potentially risky. If there is no problem using the current version of BIOS, DO NOT manually update the BIOS. Inappropriate BIOS updating may result to system's failure to boot. Carefully follow the instructions in this chapter to update your BIOS when necessary.



Visit <http://www.asus.com> to download the latest BIOS file for this motherboard.

The following utilities allow you to manage and update the motherboard BIOS setup program.

1. EZ Update: Updates the BIOS in Windows® environment.
2. ASUS EZ Flash 3: Updates the BIOS using a USB flash drive.
3. ASUS CrashFree BIOS 3: Restores the BIOS using the motherboard support DVD or a USB flash drive when the BIOS file fails or gets corrupted.

1.11.1 EZ Update

The EZ Update is a utility that allows you to update the motherboard BIOS in Windows® environment.



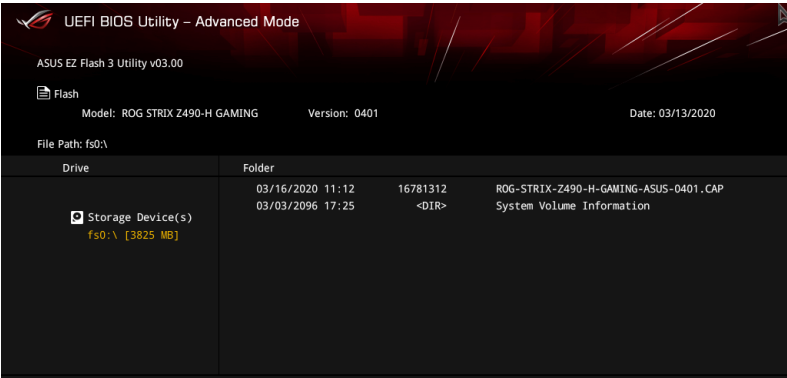
-
- EZ Update requires an Internet connection either through a network or an ISP (Internet Service Provider).
 - This utility is available in the support DVD that comes with the motherboard package.
-

1.11.2 ASUS EZ Flash 3

ASUS EZ Flash 3 allows you to download and update to the latest BIOS using a USB drive.

To update the BIOS:

1. Insert the USB flash drive that contains the latest BIOS file to a USB port.
2. Enter the Advanced Mode of the BIOS setup program. Go to the **Tool** menu to select **ASUS EZ Flash 3 Utility** and press <Enter>.
3. Press <Tab> to switch to the Drive field.
4. Press the Up/Down arrow keys to find the USB flash drive that contains the latest BIOS, and then press <Enter>.
5. Press <Tab> to switch to the Folder Info field.
6. Press the Up/Down arrow keys to find the BIOS file, and then press <Enter> to perform the BIOS update process. Reboot the system when the update process is done.



1.11.3 ASUS CrashFree BIOS 3

The ASUS CrashFree BIOS 3 utility is an auto recovery tool that allows you to restore the BIOS file when it fails or gets corrupted during the updating process. You can restore a corrupted BIOS file using the motherboard support DVD or a USB flash drive that contains the BIOS file.



The BIOS file in the motherboard support DVD may be older than the BIOS file published on the ASUS official website. If you want to use the newer BIOS file, download the file at <https://www.asus.com/support/> and save it to a USB flash drive.

Recovering the BIOS

To recover the BIOS:

1. Turn on the system.
2. Insert the motherboard support DVD to the optical drive, or the USB flash drive containing the BIOS file to the USB port.
3. The utility automatically checks the devices for the BIOS file. When found, the utility reads the BIOS file and enters ASUS EZ Flash 3 automatically.
4. The system requires you to enter BIOS Setup to recover the BIOS setting. To ensure system compatibility and stability, we recommend that you press <F5> to load default BIOS values.



DO NOT shut down or reset the system while updating the BIOS! Doing so can cause system boot failure!
