AMD Ryzen™ Threadripper™ Processor and AMD Ryzen™ Master Overclocking User's Guide

Advanced Micro Devices ⤿

Contents

List of Figures

List of Tables

Revision History

Date	Revision	Description
August 2017	1.10	Aligned with the availability of Ryzen Threadripper processors and AMD Ryzen Master 1.1.0.
March 2017	1.01	Second Release. Aligned with availability of Ryzen 5 processors and AMD Ryzen Master 1.0.1.
March 2017	1.00	Initial release with availability of Ryzen 7 processors and AMD Ryzen Master 1.0.

Chapter 1 Guidance Terms and Conditions

This AMD Ryzen™ Processor, AMD Ryzen™ Threadripper™ Processor and AMD Ryzen™ Master User Guide ("Guidance") and the AMD Ryzen Master application ("AMD Ryzen Master") are provided subject to the following terms and conditions:

- The Guidance in no way modifies, alters or supersedes AMD's officially published specifications for any AMD product (the "Specifications").

- Operation of an AMD product outside of the Specifications or outside of factory settings, including but not limited to the conducting of overclocking (including use of the Guidance), may result in damage to an AMD product and/or lead to other problems, including but not limited to, damage to the AMD product-based computer system components (e.g. the motherboard and components thereon); system instabilities (e.g. data loss and corrupted images); reduction in system performance; shortened product, system component and/or system life; and in extreme cases, total unrecoverable system failure.

- AMD does not provide support or service for issues or damages related to use of an AMD product outside of the Specifications or outside of factory settings and Recipient assumes any and all liability and risk associated with such usage, including by providing motherboards or other components that facilitate or allow usage outside of the Specifications or factory settings.

- THE GUIDANCE IS PROVIDED TO YOU ON AN "AS IS" BASIS WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT, OR THOSE ARISING FROM CUSTOM OR TRADE. AMD DOES NOT WARRANT, GUARANTEE, OR MAKE ANY REPRESENTATIONS AS TO THE CORRECTNESS, ACCURACY OR RELIABILITY OF THE GUIDANCE (INCLUDING THE PERFORMANCE OF THE AMD PRODUCT) AND MAY MODIFY, AMEND, DELETE OR RETRACT THE GUIDANCE AT ANY TIME. TO THE FULLEST EXTENT ALLOWED BY LAW, IN NO EVENT WILL AMD BE LIABLE TO YOU OR ANY OTHER PARTY FOR ANY DIRECT OR INDIRECT DAMAGES, LOST PROFITS, LOST SAVINGS OR OTHER INCIDENTIAL OR CONSEQUENTIAL DAMAGES WHICH MAY ARISE OUT OF OR RELATE TO THE GUIDANCE.

<u>**WARNING:**</u> *AMD processors, including chipsets, CPUs, APUs and GPUs (collectively and individually "AMD processor"), are intended to be operated only within their associated specifications and factory settings. Operating your AMD processor outside of official AMD specifications or outside of factory settings, including but not limited to the conducting of overclocking (including use of this overclocking software, even if such software has been directly or indirectly provided by AMD or an entity otherwise affiliated in any way with AMD), may damage your processor, affect the operation of your processor or the security features therein and/or lead to other problems, including but not limited to damage to your system components (including your motherboard and components thereon (e.g., memory)), system instabilities (e.g., data loss and corrupted images), reduction in system performance, shortened processor, system component and/or system life, and in extreme cases, total system failure. It is recommended that you save any important data before using the tool. AMD does not provide support or service for issues or damages related to use of an AMD processor outside of official AMD specifications or outside of factory settings. You may also not receive support or service from your board or system manufacturer. Please make sure you have saved all important data before using this overclocking software. DAMAGES CAUSED BY USE OF YOUR AMD PROCESSOR OUTSIDE OF OFFICIAL AMD SPECIFICATIONS OR OUTSIDE OF FACTORY SETTINGS ARE NOT COVERED UNDER ANY AMD PRODUCT WARRANTY AND MAY NOT BE COVERED BY YOUR BOARD OR SYSTEM MANUFACTURER'S WARRANTY.*

This information describes methods to change factory settings and operate the processor outside of AMD's published operating specifications. Recipient understands that operation of the product outside of AMD's published specifications will void any AMD warranty and that overclocking of the processor may impact its functionality and longevity

Chapter 2 Supported Products and Operating Systems

This document and the AMD Ryzen Master application currently support the following AMD products:

- AMD "Ryzen Threadripper" Processor family in the TR4 socket infrastructure
- Referred to in this document as "AMD Ryzen processor," "Ryzen processor" or "processor" with any exceptions noted.

Future AMD products will be added when supported.

AMD product overclocking support provided by AMD OverDrive™ utility and the AMD Ryzen Master application are mutually exclusive.

The AMD OverDrive utility remains the sole AMD-provided overclocking tool for the following AMD products:

- Processor products in the AMD AM3 and AM3+ socket infrastructures
- Processor products in the AMD FM2 and FM2+ socket infrastructures

The AMD Ryzen Master application is supported on the following operating systems:

1. Microsoft® Windows® 10 64-bit version

Chapter 3 Introduction to AMD Ryzen™ Processor Overclocking

Systems based on the AMD Ryzen processor may be tuned to deliver added system performance. The AMD Ryzen family of processors offer an exciting amount of performance tuning options, including potential overclocking headroom. Note that each processor and motherboard is different, and may result in lower or no overclocking margin. *Examples of processor configurations, cores and frequencies described herein are examples only and do not necessarily reflect commercially available products or overclocking range.*

AMD Ryzen Master gives users advanced, real-time control of system performance. More details on how to use the AMD Ryzen Master application are included in the "AMD Ryzen Master Application" section of this guide.

The purpose of this document is to provide detailed information on the various performance tuning knobs that are present in systems using the AMD Ryzen processor based on the AMD Zen processor core.

Chapter 4   AMD Ryzen™ Processor Overclocking Summary

AMD TR4 and AM4-based Ryzen processors are unlocked when paired with the enabling AMD chipsets and necessary BIOS software and therefore allow the user to adjust the CPU and system memory clocks and related parameters above or below the stock values. When run on boards enabled for overclocking, AMD Ryzen Master will automatically enable the Overclocking Mode at the user's initiation of a change to a stock parameter. The CPU overclocking parameters will be returned to stock operation through a system power cycle (Windows Shutdown, then re-starting). System memory overclocking parameters and operation are persistent through a power cycle and can only be changed from Ryzen Master or within the BIOS Setup.

The process for finding a stable overclocking configuration with the AMD Ryzen processor is not fundamentally different from the previous generation AMD processors (such as the AMD FX processors). The final operating voltages and frequencies will depend highly on the specific system's processor, memory, motherboard, cooling solution, operating environment, and the user's decisions on what elements to overclock and to what degree.

4.1   AMD Ryzen™ Processor Normal Operation

To describe how the AMD processor operates in Overclocking Mode it is best to understand how the AMD Ryzen processor operates normally. When operating normally, the AMD Ryzen processor has the following characteristics:

1. The frequency of processor core clock is determined by a combination of the software-requested p-state and then adjusted by a combination of numerous power and performance optimizing features to attain any of number of fine grain p-states around that software-requested p-state.

2. Internal control mechanisms measure internal temperatures, power and current consumption, and manage the operating voltage and frequency of various internal cores to maintain specified levels. For example, when the number of active cores is below a pre-determined threshold, the active core temperatures are below maximum, and the consumed total current is below infrastructure limits, then those active cores will be boosted in voltage and frequency to the c-state "boost" frequency until any of those conditions are no longer true.

3. The voltages for some of the various cores are internally generated from external supplies. For example, each of the processor cores uses a supply independently generated from the external supply. As the operating frequency for each processor core is adjusted to attain various fine grain p-states, the operating voltage of the core is adjusted to support that new frequency at optimal power consumption. The voltage adjustments are done using the internal voltage regulator and the SVI2 controlled external supply voltage, if needed.

4. Software requested p-state or halt states adjust the level of power to which those internal control mechanisms manage. For example, when software executes a HALT instruction on a processor core, that core will enter the C1 reduced-power state. If that core does not receive an interrupt to resume execution, it will progress to increasingly-lower power states until finally saving the state of the core and being powered off.

5. The internal memory controller and various other data paths will be initialized to the highest common operating frequency of any of the memory DIMMS present in the system and with memory timing parameters obtained from the DIMM resident SPD ROMs.

A fundamental assumption of the normal operation of the AMD Ryzen processor is that the surrounding system current delivery and cooling capabilities are designed to the specified levels. The complicated operation described above manages the overall AMD Ryzen processor operation to maintain those specified capabilities. But what can be done if the system provides more current and cooling than those required for normal operation?

4.2   AMD Ryzen™ Processor Overclocking Mode

The AMD Ryzen processor supports an operating mode allowing enthusiast users to directly control the operating condition of the processor to precisely tune the performance and power consumption to the extent of their specific and unique system capabilities (current and cooling) and environmental conditions (ambient temperature). This is done by allowing the user to program or run utilities to directly set the precise voltage and frequency at which the CPU operates so that the maximum performance can be achieved. This is called the Overclocking Mode. This mode still uses the processor's control methods for the external power supplies (SVI2) and internal clock generators and divisors thereby simplifying the implementation and eliminating any needs for voltage regulator overrides or external clock generators. This mode allows overclocking-capable motherboards to use the same voltage regulator controllers and the same BIOS to support normal operation and overclocking.

4.3   CPU Overclocking Enablement

When used on an overclocking-enabled motherboard, an AMD Ryzen processor is ready for Overclocking Mode. The processor will run normally with all internal power, voltage, and thermal management features enabled until a point in time when user-directed system software re-programs the specific voltage and frequency values to levels other than stock operating values. The following changes take effect when the values are re-programmed and the processor enters Overclocking Mode:

1. All enabled CPU cores operate at the newly user-programmed voltage and P0 frequency value. Adjustment of the CPU clock is in 25MHz steps.

2. Internal features of the processor which control the CPU operating voltage and frequency to manage the CPU temperature, current consumption, and power consumption to specified maximums are disabled so that no additional stress to system voltage regulators and thermals are induced. This includes c-state boost.

3. CPU low power c-states (CC1, CC6, and PC6) and software visible p-states (P1 and P2) remain operational and may be requested by software so that power savings can be achieved.

    a. The P1 and P2 p-state tables may also be modified to adjust the voltage and frequency of the CPU when running in software-requested, reduced-performance states. These may also be left at stock values.

    b. If the OS-level software power policy is also changed so that the CPU's power-saving p-states are not used, then these power-saving states will never be requested.

    c. If AMD Cool'N'Quiet™ technology is disabled, then low power c-states will also be disabled.

4. Various internal voltage regulators supplying CPU core power are placed into bypass mode, allowing the external VDDCR_CPU to directly supply the CPU cores.

Chapter 5 AMD Ryzen™ Master Application

The new AMD Ryzen Master application supports AMD's new generation of Socket TR4 processors. This new application no longer includes GPU overclocking as was provided in the former AMD OverDrive™ utility. For overclocking AMD's discrete graphics cards, see the Radeon WattMan GPU Overclocking utility within the Radeon Settings software provided with AMD discrete graphics cards. AMD Ryzen Master is compatible with GPU overclocking tools provided by other discrete graphics card manufacturers.

AMD Ryzen Master allows the user to control various clock and voltage settings in real time directly from the supported Windows Operating System. In addition to real-time control there are certain adjustable parameters – normally found only inside the BIOS menu – that require a Windows Restart or Windows Shutdown for applying the new values or behaviors.

The use of the AMD Ryzen Master application requires that the user accepts the End User License Agreement and inherent risks of configuring the AMD processor to performance levels that exceed specifications and stock settings
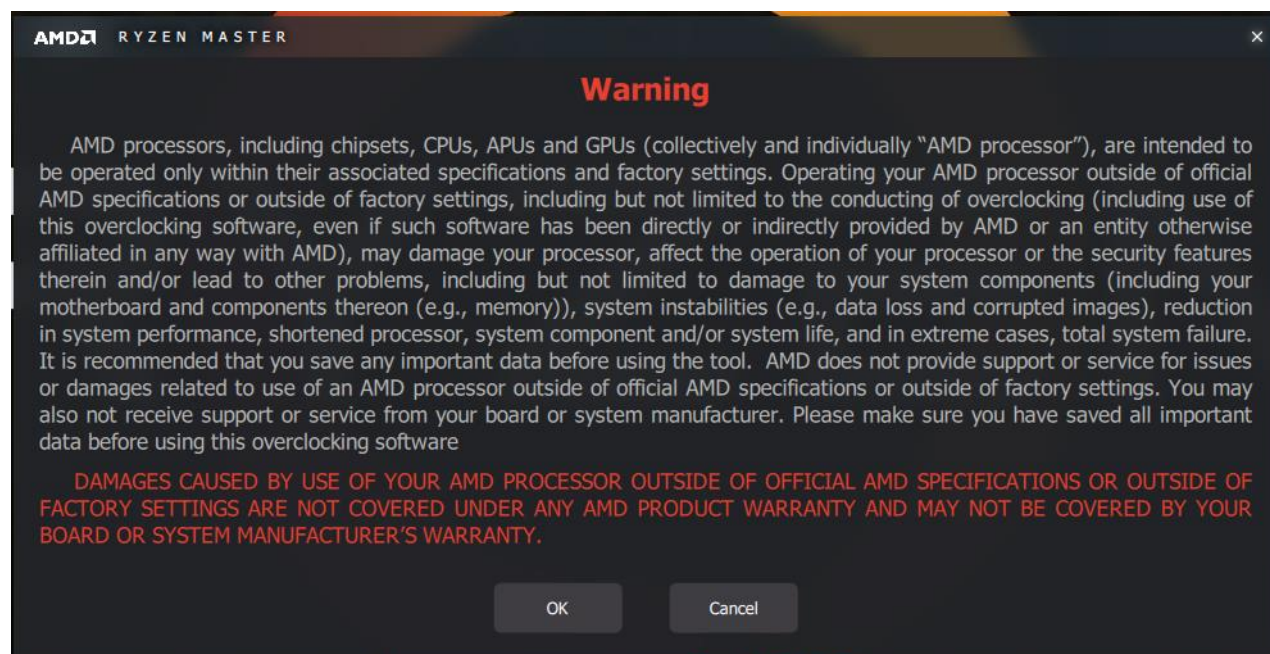
Figure 1. AMD Ryzen™ Master Warning and Warranty Disclaimer Message

5.1   The Ryzen™ Master User Interface Overview
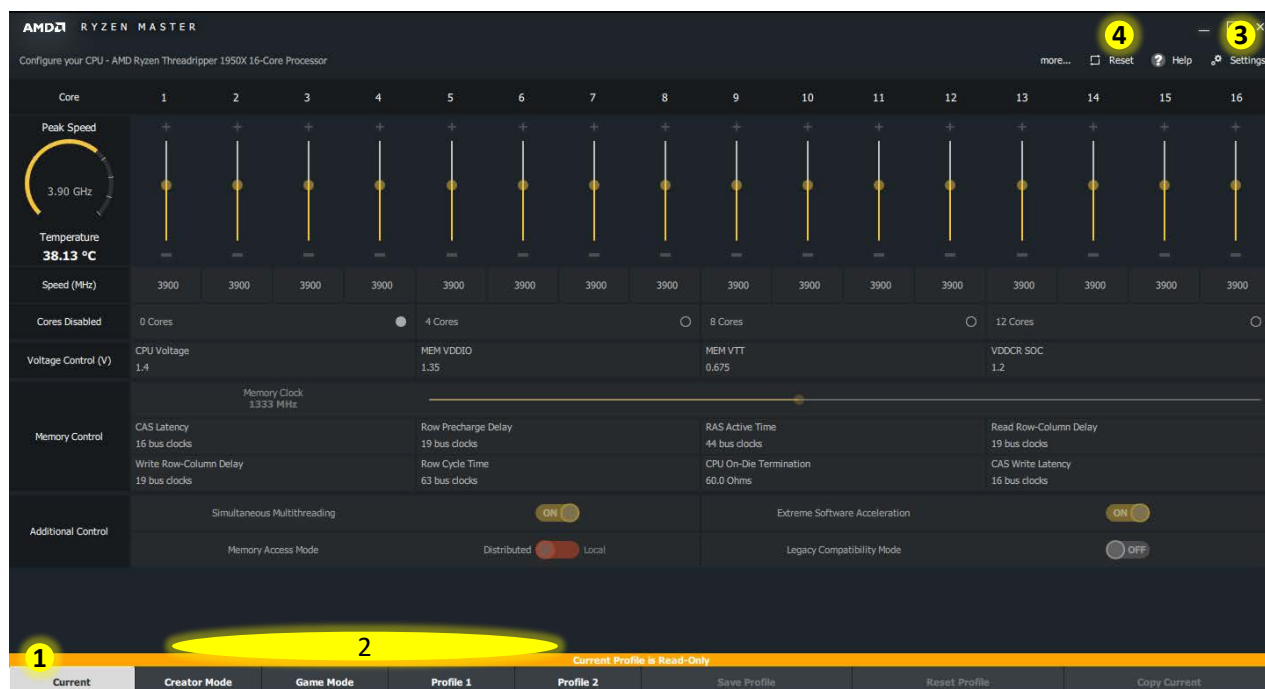
Figure 2. Ryzen™ Master User Interface

The user interacts with Ryzen Master through the Current view tab, the Profiles tabs, and through the Settings page:

1. The Current view is a dashboard of the current configuration and performance state of the system. This view shows the same parameter controls as you will see in the Profiles but uses the controls as status displays; they cannot be edited in the Current view, only in the Profiles.

2. The profiles "Creator Mode," "Game Mode," and Profiles 1 and 2 provide controls to change parameters, subject to support by the specific processor and motherboard, including board BIOS. Each Profile tab can be optionally renamed by the user with up to 20 characters to represent the optimized use of the profile, such as "Video editing," or "4Core gaming."

3. The Settings page accessible from the upper-right menu provides controls for global settings.

4. The Reset control that resets the processor CPU voltages, speed, core enablement and additional controls to stock settings.

After considering the Settings, the user tends to spend most of the time on a Profile, tuning it up, confirming function on the Current view, and running independent applications as stress tests to find the edge of stable performance.

5.2   Settings
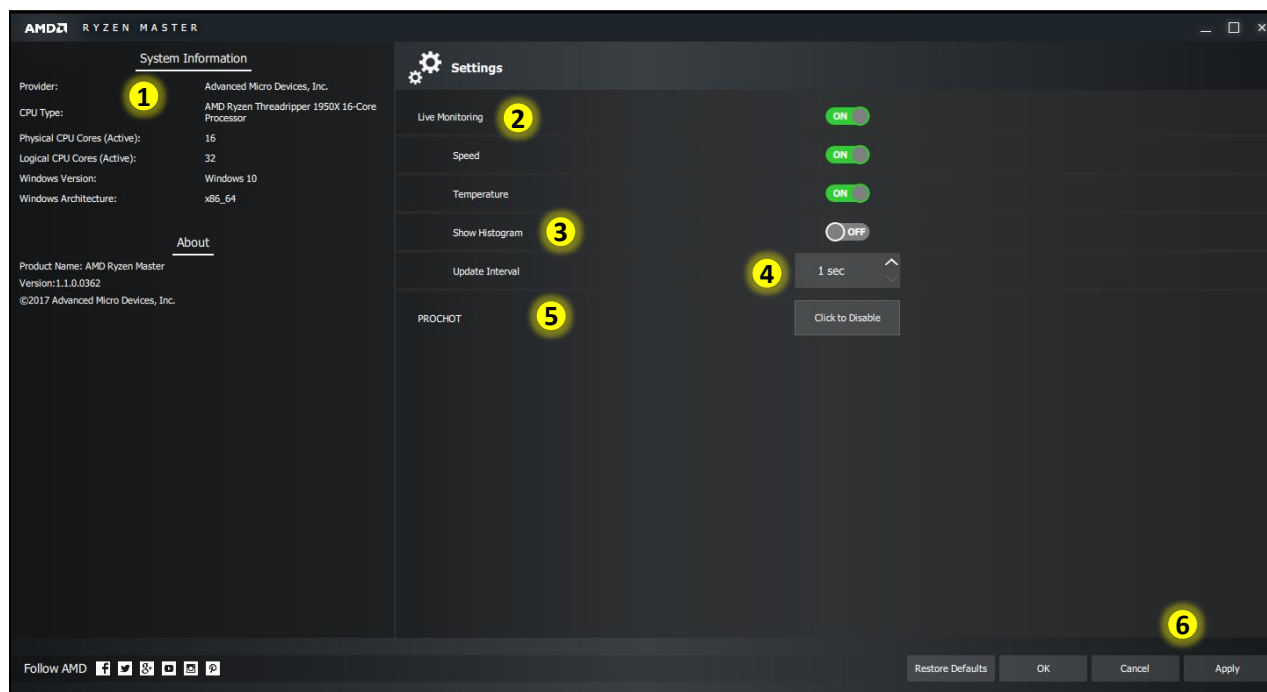
Figure 3. Settings

The Settings page provides system and software information and several global parameters. The
Live Monitoring settings take immediate effect. Changes to the PROCHOT setting must be
applied with the "Apply" button in the lower-right corner, or can be canceled. Using the "OK"
button returns the user to the Current view. The Restore Defaults button returns the settings to
default values.

Settings descriptions

1. Processor and operating system information is provided. The Ryzen Master revision is
   identified.

2. Live Monitoring

   o Ryzen Master samples CPU speed per core and die temperature to display in the Current
     view and Profiles. As an application action, the sampling presents a minor load on the
     CPU. If the user is running benchmarks or other workloads and wishes to eliminate Ryzen
     Master's load on the CPU, Live Monitoring can be turned off by setting the control.

   o The Live Monitoring control is a master control over the Speed, Temperature and Show
     Histogram controls. When Live Monitoring is switched off, Speed, Temperature and
     Show Histogram controls are also switched off.

- Speed
  - o If Live Monitoring is on, the Speed setting can be turned off if the user wishes to suspend CPU speed sampling and display. When Speed sampling is suspended, no speed will be displayed in the Profiles, but Speed will be sampled once and displayed when moving to the Current view.
  - o Speed sampling typical presents much less than 1% load on the CPU in combination with Temperature sampling.
- Temperature
  - o If Live Monitoring is on, the Temperature setting can be turned off if the user wishes to suspend die temperature sampling and display. When Temperature sampling is suspended, no temperature will be displayed in the Profiles, but Temperature will be sampled once and displayed when moving to the Current view.
  - o Temperature sampling typically presents less than 1% load on the CPU in combination with Speed sampling.

3. Show Histogram

  - o Within the Current view, the user can choose to show a real-time, dynamic line graph of the speed of each CPU core and the die temperature. This feature requires that Live Monitoring be on and either or both of Speed and Temperature monitoring enabled.
  - o Under system idle conditions, the graphically-significant histogram feature presents less than 3% load on the CPU, depending on core count. However, under high-thread-count applications or heavy multi-tasking, the CPU load can become significant and degrade the performance of the application(s) of interest. If the user wishes to maximize the application performance under these conditions, the Show Histogram feature can be turned off, suspending the state of the histogram display in the Current view.

4. Update Interval

  - o The Update Interval is the sample rate of the CPU cores' speeds and die temperature. The sample rate defaults to one second and can be increased in one-second increments up to five seconds.

  - *Note: When application performance is critical, such as when running a benchmark application, it is typically easier to use the Windows Task Manager to set the priority of the application to "Above Normal." This allows the Ryzen Master Live Monitoring to remain active but it may be suppressed during the heavier resource-consumption phases of the application.*

5. PROCHOT – NOT FOR TYPICAL USE

  - o The PROCHOT signal within the motherboard design tells the processor that other system elements are overheating or approaching a limit and allows the processor to throttle back and gracefully degrade performance.
  - o When set by the expert user, the Ryzen Master PROCHOT control feature disables the processor's reaction to the motherboard's PROCHOT signal.

o   This feature is intended only for extreme overclocking cases where the expert user wishes the processor to ignore the PROCHOT signal.

o   When PROCHOT is disabled, the processor's self-protection from overheating remains active. When tripped by overheating during an application workload, this self-protection immediately shuts down the system.

o   After disabling PROCHOT, the function can be re-enabled through a Windows Shutdown or power-cycling reboot.

o   Changes to PROCHOT on the Settings page must be Applied to take effect, or Canceled to clear. Selecting OK returns to the last active view, whether the Current view or a profile.

5.3   Profiles

Figure 4. Profiles

Ryzen Master provides two pre-configured profiles, Creator Mode and Game Mode, and two general purpose profiles, Profiles 1 and 2. Each Profile tab offers a unique system configuration the user optimizes to a particular type of application. The Profile interface is arranged in rows of controls that will be described in order of illustrated number in the above figure using general purpose Profile 1 first for description. Creator Mode and Game Mode will be described thereafter.

1.   All of the controls on the Profile can be changed and adjusted but will not take effect until the Apply control is selected or the settings made since the last Apply are Discarded. The Apply action will only have effect if it is different from the Current configuration. If the settings are applied successfully, a green banner will be displayed at the bottom of the view with information. If the Apply is not successful, a red banner will advise why.

a. The CPU speed and CPU voltage controls take immediate effect on Apply.

b. The Core Disable, Voltage Controls (except CPU Voltage), Memory Control, and Additional Controls require a Windows Restart (warm boot) that is executed automatically by Ryzen Master. Upon restart, Ryzen Master will start automatically to register the new settings. Be patient as Ryzen Master self-starts. Do not manually start Ryzen Master or one process instance will block the other.

c. When disabling cores, only a Windows Restart automatically done by Ryzen Master is necessary. When enabling more cores, either within a profile or switching to another profile with a different core-count setting, the user will be told to initiate a Windows Shutdown then manually restart the system, or to cancel the core-enabling request.

It is typically best to change and Apply one control type at a time so you can evaluate the influence of each on performance or more easily understand the error messages of a failed Apply.

2. As changes are made to a profile, it is not necessary to immediately apply them, but if you wish to keep them before moving to a different view, the profile must be saved with the Save Profile command. Or you can reset the profile to the processor's settings when Ryzen Master was first opened with Reset Profile. When using Reset Profile, the overclocking status of the processor is not changed until the reset profile is applied, including changes made after the profile was reset. Use the Copy Current command to clone the Current settings to the active profile. This is particularly useful if you are building a profile that builds upon another profile.

3. The Speed of the cores can be controlled to 25MHz increments through the vertical slider, the + or – ends of the slider, or the CPU clock speed text box (type in value, use mouse scroll, use up/down keyboard keys or click the up/down button). All cores track one another; changes to one apply to all. Speed is immediately changed when Applied and should be reflected in the speedometer view, along with a likely increase in temperature if speed is increased.

Sampled core speed and die temperature are displayed at the left end of the row, assuming the Settings page controls enable Live Monitoring, or individually the Speed or Temperature sampling controls.

Note that the Speed control and the others below it along the left edge of the interface window each have a green (attention) or gray (ignor) button. Toggling the button for a control group determines whether the parameters associated with that group are included in the Apply action. In the default attention (green) position, the group's parameters are included in the Apply action. But when toggled off (gray), the Apply action ignores that control group. This can be handy when you have settings in the profile that will require a Restart or Shutdown when Applied but you want to first tune up a CPU speed and CPU voltage.

Example)

    a.   The memory timing parameters in the profile do not match the Current configuration, either because you've changed them in this profile or another profile has applied to set the current configuration, and

    b.   You want to raise the CPU voltage and core speed.

       With all groups active, you change the core speed and hit Apply. You get the message that Ryzen Master must initiate a Windows Restart. Normally changing the core speed does not require a Restart, but Ryzen Master is also reacting to the differences between the memory control group and the current settings, thus attempting to apply the profile's memory control group, too.

       By deactivating the memory control group, the Apply will immediately apply the core speed change without the Restart necessary for memory changes since Ryzen Master is ignoring the memory control group. Whenever you're ready to include the memory control group in the overclocking action, re-active the group, make your changes and Apply, proceeding with the Restart or Shutdown as advised by Ryzen Master.

It's a good idea to verify the performance increase and stability by running CPU performance benchmark(s) and stability tests (example: Maxon's CINEBENCH R15). Please close all background apps to ensure stable and consistent performance results run-to-run, but expect some variation.

The recommendation is to increase the CPU clock in small steps while monitoring CPU performance, stability and CPU, motherboard, system and GPU temperatures.

Once an unstable CPU clock has been reached and the CPU temperature is not too high it's possible to increase the CPU voltage in small steps to see if the increased CPU voltage allows stable operation at higher frequencies.

4.   The Cores Disabled controls allow the number of active cores to be reduced from the stock processor's total cores. This might be done to attempt to achieve higher core frequencies with fewer cores active. The button controls are used to select which core count to disable, which depends on how many cores the stock processor has. For example, disabling 8 cores from a 16-core processor results in 8 active cores.

Disabling cores requires a Windows Restart that Ryzen Master will automatically initiate, then Ryzen Master will automatically re-start for you to continue.

Enabling cores requires a Windows Shutdown and manual system restart that you will be instructed to initiate, or to cancel.

Ryzen Master requires that the Windows 10 Power Options be configured such that the Power Button mode is set with Fast Boot disabled. This is necessary to allow the processor cores to all be enabled after a system power cycle.

Note: Memory Overclocking Support

Memory overclocking, described in items 5, 6, and 7, is a complex feature requiring coordination of Ryzen Master, motherboard BIOS and memory control hardware on implementation. The Memory overclocking voltages (5), speed (6) and timing parameters (7) will be supported in a future version of Ryzen Master. Until then, these values will be displayed in the Current view and the Profiles for the user in the format they will be offered for control in that future version.

5. Several voltages control how high CPU and memory frequencies can be driven.

    a. CPU Voltage adjusts the core CPU voltage through the VID value. Type in value, use mouse scroll, use up/down keyboard keys or click the up/down button. This voltage is typically the only voltage adjustment needed to raise core speed.

    b. VDDCR_SOC adjusts non-core voltages that primarily influence memory overclocking performance. Type in value, use mouse scroll, use up/down keyboard keys or click the up/down button. This voltage requires a Windows Restart that Ryzen Master will initiate on Apply.

        Note: Some motherboards may apply a voltage offset from the BIOS. In this case the actual CPU voltage may be higher (or lower) than what the CPU VID value suggests. It's always a good idea to monitor the actual voltage level (from the BIOS or with the motherboard vendor's monitoring application).

        Caution: *Raising the CPU Voltage above the stock setting is the single-most contributing factor to reduced life of the processor and/or damage due to transistor over-stress and temperature. Each individual CPU unit may respond to changes in CPU Voltage differently.*

    c. MEM VDDIO is typically set to the overclocking voltage specified by the memory module. MEM VTT is typically set for one half of MEM_VDDIO. When MEM VDDIO is set using AMD Ryzen Master, the VTT value is automatically set to VDDIO/2. However, if the motherboard and its BIOS supports VTT control, the user can adjust VTT to other than VDDIO/2 values after the automatic setting of VDDIO/2. To set the value, type in value, use the mouse scroll, up/down keyboard keys or click the up/down button. This voltage requires a Windows Restart that Ryzen Master will initiate on Apply.

        Note: Motherboards that do not make MEM VDDIO available to AMD Ryzen Master through BIOS will cause AMD Ryzen Master to display "NA" for MEM VDDIO and MEM VTT. Memory clock and timing adjustment may still function within the scope of the fixed memory voltage.

6. Memory Control – Memory Clock

System memory clock adjustment can be made through several means

a. Memory clock horizontal speed slider (move with mouse or use mouse scroll)

b. Keyboard left/right arrow keys can also be used to adjust the memory clock (line feed) A change to the memory clock requires a Windows Restart that Ryzen Master will initiate on Apply.

7. Memory Control – Memory module parameters

System memory timing adjustment can be made using the specifications typically supplied with the memory module for CAS Latency (tCL), Row Precharge Delay (tRP), RAS Active Time (tRAS), Read Row-Column Delay (tRCD). Additionally, Row Cycle Time (tRC), Processor On-Die Termination and CAS Write Latency can be set.

Note that changing the memory clock and/or parameters requires a Windows Restart that Ryzen Master will automatically initiate, then Ryzen Master will automatically open after re-start. However, during the restart, the processor will be attempting to train the memory performance to the new parameters. Most motherboard BIOSes set a limit for the number of failed attempts to train memory, such as five, before the BIOS resets to the prior, known-good memory setting and allows the restart to complete. If your system fails to train memory to your settings, Ryzen Master will automatically start and show operation under the functional memory parameters.

For even more detailed memory overclocking, your motherboard may offer additional control through a BIOS utility.

8. Additional Control

a. Many Ryzen processors feature Simultaneous Multithreading (SMT) operation where some of a core's resources are shared between two threads. This feature accelerates the performance of many applications, but the user may wish to force each core to operate on only one application thread. If the Ryzen processor model supports the SMT feature, this control can turn it off, requiring a Windows Restart that Ryzen Master will automatically initiate then re-open.

b. Extreme Software Acceleration is a feature useful for some extreme application workloads that operate with exceptionally tight code loops. Geekbench is one example. This feature is the default for Ryzen Threadripper processors, thus not active in Ryzen Master. The feature is an option for Ryzen processors. Most applications won't show a noticeable change in performance with this setting.

c. Memory Access Mode provides two settings for applications access to memory when using Ryzen Threadripper processors:

- Distributed Mode modifies how your AMD Ryzen Threadripper processor accesses your PC's RAM to enhance the performance of creative applications (e.g., 3D modeling or viedo rendering). This mode evenly distributes memory requests across your PC's RAM. Even distribution of memory transactions maximizes memory bandwidth, which is often preferred by creative workloads.

- Local Mode modifies how your AMD Ryzen Threadripper processor accesses your PC's RAM to enhance the performance of games. This mode routes memory requests to RAM that is electrically nearest to the processor cores(s) communicating with your graphics card. Using memory with the shortest electrical path to the processor minimizes memory access times, which is often preferred by games.

- Changes to Memory Access Mode must be Applied to take effect.

- This feature is inactive for Ryzen processors that do not support the feature.

d. Legacy Compatibility mode provides a control that may stabilize older games and applications not designed with many cores in mind. Some legacy games fail to launch when presented with >20 logical cores. Other may be not optimally schedule cores and memory.

When turned on with Ryzen or Ryzen Threadripper processors offering >4 physical processors, Legacy Compatibility Mode reduces the active logical processor resources by half. With Ryzen Threadripper processors, the Memory Access Mode is also automatically set to Local mode for further optimization. Ryzen processors function only in Local Mode. When turned off, Legacy Compatibility Mode does not change the state of the Memory Access Mode; the user must decide whether to change that setting. Changes to the Legacy Compatibility Mode must be Applied in the profile to take effect.
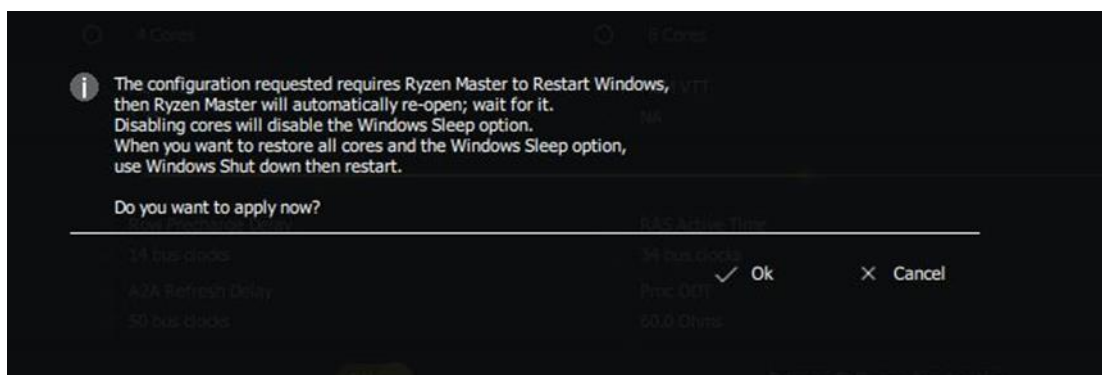
Figure 5. System Restart Pop-up Message

The application of some controls requires a system restart, noted when Figure 5 appears. Click "**OK**" to restart the system or "**Cancel**" if you do not wish to Apply the changes immediately.

Once the system has restarted back to the Operating System, AMD Ryzen Master is automatically launched. It is important to give the OS and AMD Ryzen Master a few moments to initialize after this step. Do not open AMD Ryzen Master manually or you will

get the message that another instance of AMD Ryzen Master is already running, either the automatic one or the one you opened, and the second instance cannot start.

5.3.1   Creator Mode Pre-Configured Profile

Figure 6. Creator Mode Profile

The Creator Mode profile is pre-configured to enable the maximum processor resources and memory access flexibility for modern applications, especially those that scale with logical cores. All controls supported by the processor are active and can be changed:

1. Including Memory Access Mode for Ryzen Threadripper processors.

2. Excluding the Legacy Compatibility Mode. The use of Legacy Compatibility mode is not desirable when an application or multiple, concurrent applications can use the full cores and threads offered by the processor.

The original Creator mode settings can be restored through the Reset Profile command.

The Creator Mode tab name can be edited for other names up to 20 characters.

To create then edit a profile based on Creator Mode, first Apply Creator mode, then switch to Profile 1 or 2, Copy Current to copy the Creator Mode configuration to the profile, then re-configure the profile from there.

5.3.2   Game Mode Pre-Configured Profile

Figure 7. Game Mode Profile

The Game Mode profile is pre-configured for optimal performance for most modern and legacy games with these fixed settings:

1. Legacy Compatibility Mode on, and

2. Memory Access Mode to Local.

With Legacy Compatibility Mode on, core disabling control (3) is not allowed as the cores have been reduces by half of the processor's capacity for processors with more than 4 physical cores.

The remaining profile controls are active and can be reset to the original Game Mode with the Reset Profile command.

If the user wishes to make changes to the fixed settings of the Creator or Game Mode, first Apply either profile to establish that profile as the active configuration, then select Profile 1 or 2 and use the Copy Current command to copy the current configuration to the Profile 1 or 2. From Profile 1 or 2, any control supported by the processor can be changed.

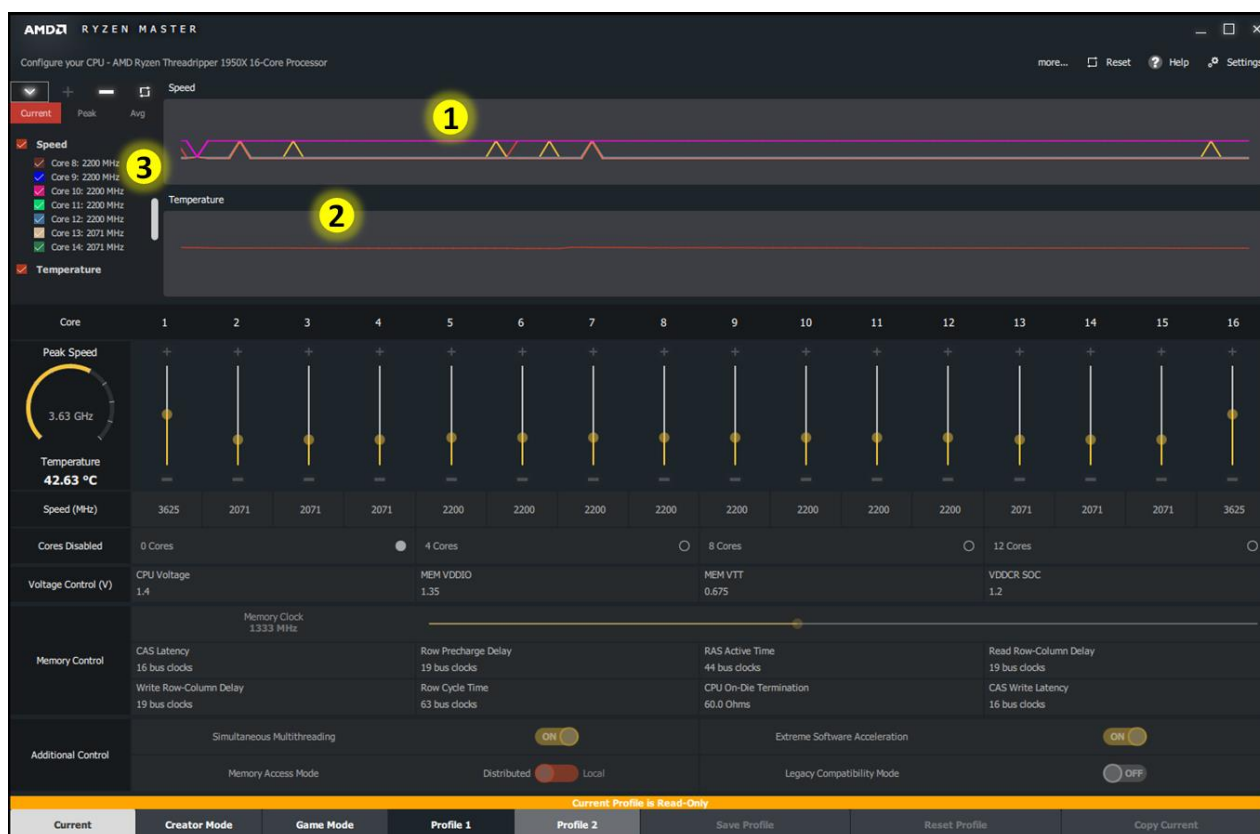## 5.4   CPU Performance and Temperature Histogram

Figure 8. AMD Ryzen™ Master Histogram

AMD Ryzen Master Current view features a Histogram for monitoring the CPU core clock speeds and the CPU temperature. The Histogram can be expanded and minimized by clicking the ∨ and > buttons. The Speed and Temperature histograms may be individually displayed via their respective check boxes. Availability of the Histogram depends on the Live Monitoring configuration in the Settings.

1. The Speed Histogram graph displays the sampled, current (instantaneous) clock speeds of enabled cores. The user may select which of Current, Peak or Avg core clock speeds are displayed for each core in the listing left of the Histogram (3). Each core can be individually displayed (checked) or hidden (unchecked) from the listing and the histogram. Note that the histogram only displays the Current core clock speed. A core's check box color corresponds to that core's line color in the histogram.

    Note also that the cores legend and speed listing may have a vertical scroll bar if the processor supports many cores. The view displays seven cores at a time.

2. The Temperature Histogram displays approximate CPU die temperature averaged across a range of sensors across the die, down to 0C.

5.5   Disabling Cores

The AMD Ryzen Master application allows the user to disable a select number of CPU cores. This may improve overclocking headroom for the remaining CPU cores or can be used to reduce the overall CPU power consumption. Please refer to Chapter 7 for further information on AMD Ryzen processor core configuration.

By default, the CPU runs with all cores enabled. AMD Ryzen Master supports disabling cores in groups.   For example, an 8-core AMD Ryzen processor model can be configured to disable two, four or six cores. A 16-core AMD Ryzen Threadripper processor model can be configured to disable four, eight or twelve cores. Disabling all cores is not supported since the product would cease to function with no enabled cores. Note that disabling cores will disable the Windows Sleep option. When you want to restore all cores and the Windows Sleep option, use Windows Shut down, then restart.
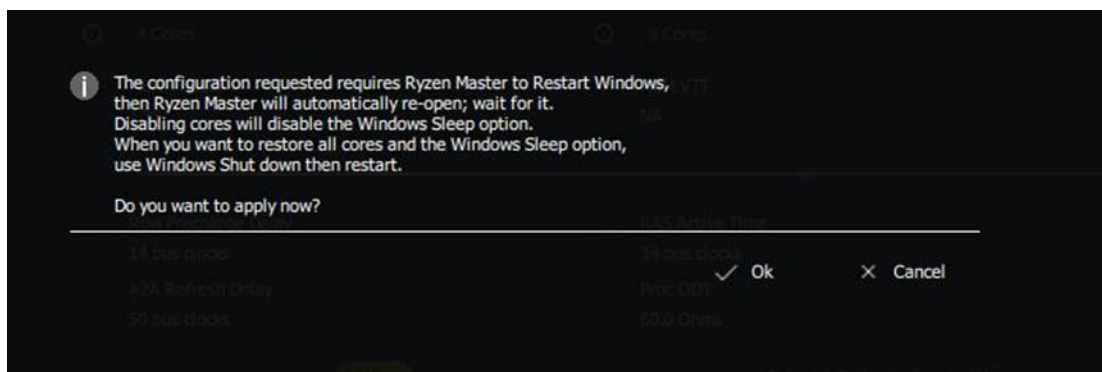

Figure 9. System Restart Pop-up Message

Since Core Disable requires a system reboot the above pop up message will appear. Click "OK" to reboot the system or "Cancel" if you do not wish to disable the cores now.

Once the system has rebooted back to the Operating System, AMD Ryzen Master is <u>automatically</u> launched. <u>It is important to give the OS and AMD Ryzen Master a few moments to initialize after this step.</u> Do <u>not</u> re-start AMD Ryzen Master manually or you will get the message that another instance of AMD Ryzen Master is already running, either the automatic one or the one you opened, and the second instance cannot start.

Note that since the disabled cores have been hidden from the OS, they will not appear as idle or parked in any Windows resource-monitoring application until enabled.

Note also that most applications that report the number of cores or threads, such as benchmarks, sample the CPU resources only when first started and will not register changes to CPU core count or frequency that you change via AMD Ryzen Master. Always re-open such monitoring applications after AMD Ryzen Master changes are applied.

Certain CPU monitoring tools are able to track dynamic changes initiated by AMD Ryzen Master.

In order to re-enable the disabled cores, within a Profile or when applying another Profile with more active cores than the Current configuration, the system must be shutdown via Windows (alternatively the motherboard may initiate a cold reset) and restarted. The following pop-up message will be displayed:
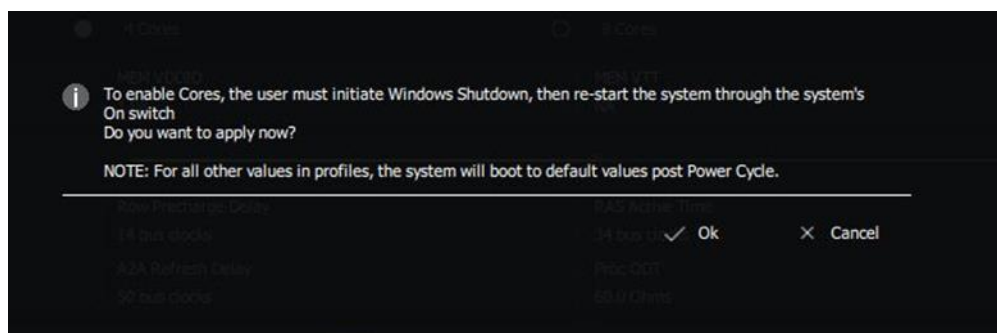

Figure 10. Core Enablement Pop-up Message

Note that Windows® 10 must be configured in the Power Options to disable fast startup when the chassis power button is pressed to turn the system on. Make sure the box is <u>unchecked</u> for "Turn on fast startup"
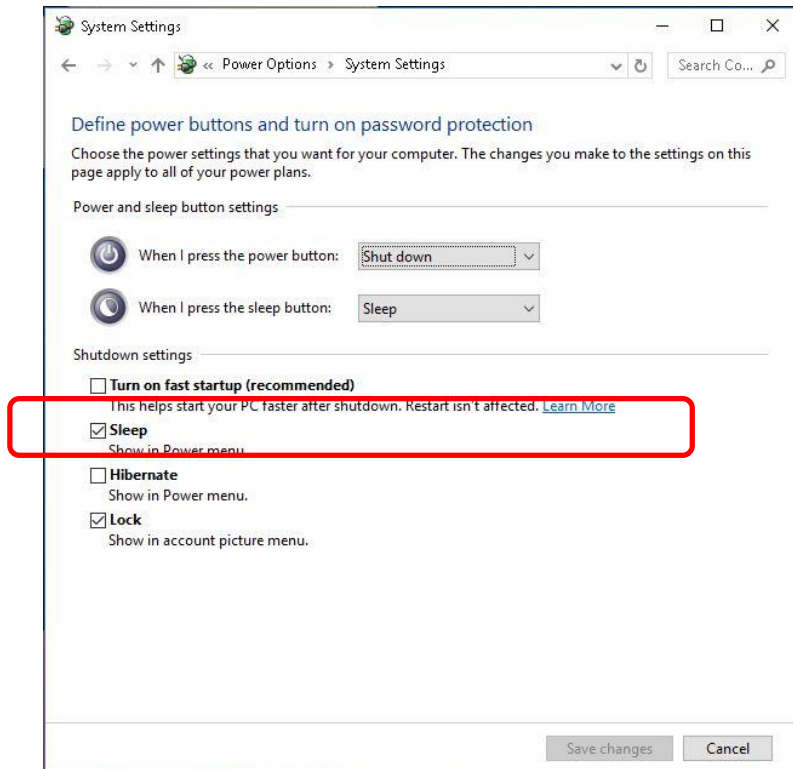

Figure 11. Windows® Power Options Configuration

Chapter 6 CPU Core Configuration

As core counts increase for enthusiast processors, it becomes valuable for the user to have control over how many cores are accessible to software. A performance-tuned system running low thread-count software and four enabled cores might be optimal for one user. Alternatively, a performance-tuned system with all cores enabled might be better for another user.

1. The number of enabled CPU cores may be reduced from the maximum to tune the available number of threads of execution and the associated CPU power requirements and related cooling requirements to achieve maximum performance for given applications.

2. Reduction of the number of enabled CPU cores from the maximum will reduce the current and power consumed by the processor. This power consumption reduction can allow the user to avoid current delivery limitations of the system, avoid processor cooling limitations of the system, and/or allow the enabled CPU cores to operate at lower temperatures and therefore potentially higher frequencies.

3. Through core configuration the number of cores to be enabled is selected by the user and after a system restart, only that number of cores is initialized and reported to the operating system for task scheduling. This is a static assignment of enabled cores per system boot. Note that disabling cores will disable the Windows Sleep option. When you want to restore all cores and the Windows Sleep option, use Windows Shut down, then restart.

4. The AMD Ryzen processor operates all cores at the same operating frequency. This provides uniform performance for each enabled core to the operating system task scheduler. In overclocking mode, each core is supplied power directly from the external VDDCR_CPU supply and therefore at the same voltage.

5. Core configuration allows for cores to be disabled in logical groups. Cores may be disabled in increments of four for Ryzen Threadripper processors and in groups of two for Ryzen processors. For example, a four-core model will allow only two cores to be disabled, leaving two cores active. An eight-core model will allow two, four or six cores to be disabled, leaving no less than two cores active.

6. To re-activate disabled cores, the system must be taken through a Windows Shutdown and restarted. Upon restart, the processor will be returned to stock configuration and all originally available cores will be enabled

Chapter 7   Important Information

7.1   AMD Ryzen™ Master Automatic Update

AMD Ryzen Master 1.1.0 forward provides automatic notification of updated software if the system is connected to the internet. AMD recommends upgrading your AMD Ryzen Master installation for the latest features. Note that some features may require motherboard BIOS support from your motherboard vendor.

Upon installation of Ryzen Master 1.1.0 or later, Windows Task Scheduler is configured to run the Ryzen Master AutoUpdate.exe, found in the Ryzen Master install directory, every 15 days. If a new version of Ryzen Master is available, the user is notified through a Windows pop-up stating that "AMD Updates Available."

7.2   Windows® Power Options

For workloads that can use the full thread capacity of the CPU, the OS power policy should be set to "High performance" or "AMD High Performance" options by the user for maximum performance. For workloads that don't stress the thread capacity, the OS power policy can be left in "Balanced" mode for marginally lower idle power and temperature.

7.3   AMD Ryzen™ Master Processor Resource Consumption

Since AMD Ryzen Master is an application and samples many processor parameters to display real-time performance information, it consumes processor resources but presents a light load at idle. You may notice AMD Ryzen Master taking slightly more resources as a percentage when a heavy workload is running, such as a highly-threaded benchmark. The multi-thread workload of Maxon's CINEBENCH benchmark is a good example of this behavior. This is due to the operating system's higher overhead of thread-context switching between AMD Ryzen Master and the other workload.

If a highly-threaded application can consume all available thread capacity and maximum performance is important, you have several options:

1. If you are using an application to test stability and need AMD Ryzen Master open to continue optimizing the overclocking configuration, you can lower the AMD Ryzen Master process priority as follows:

   • Open Windows 10 Task Manager

- In the Applications tab, locate and right-click on the Ryzen Master Application icon and select 'Go To details' from the menu. You will be taken to the Details tab and the Ryzen Master process will be highlighted. To stabilize the process list, left-click on the column Name heading to sort alphabetically, then scroll down to the AMD Ryzen Master process.

- Right-click on the AMD Ryzen Master process, hover over the Set Priority option and set to 'Below Normal' or 'Low'

- Run your stability test applications. If your application can consume 90% or more of the processing resource, you may notice that AMD Ryzen Master becomes unresponsive as the application is using all the CPU resource it can consume. Under that extreme condition, once the application finishes, or your pause it, AMD Ryzen Master will resume monitoring where it left off when you started the application.

2. If you don't need AMD Ryzen Master open, then simply close it and proceed with your benchmarking and normal operations. The overclocked settings you configured with AMD Ryzen Master will persist after closing AMD Ryzen Master.

Example: When running CINEBENCH for maximum score while over-clocked

- Set the Windows power policy to "High Performance"
- Lower the AMD Ryzen Master priority as described above

Chapter 8 Glossary of Terms

The following table provides further information on the commonly used terms.

Table 1. Glossary of Terms

Term	Description
Active, activated	Refers to an interface control that is responsive to change.
Apply	The function of applying all the changes of a Ryzen Master profile to the active operation of the processor.
AM4	AM4 is an AMD single-socket client infrastructure supporting two channels of DDR4 memory
CCLK	CPU Core Clock
CCX	Core Complex where more than one core shares L3 resources.
Core	The instruction execution unit of the processor when the term Core is used in an x86 core context.
CPU	The total resources of the specific processor model consisting of Cores and cache memory
CoreCOF	Core current operating frequency in MHz
De-activated	An interface control that is not responsive, either due to Ryzen Master setting or a feature not available with the installed processor or motherboard.
FCLK	Data Fabric clock – equal to Memory clock
L1 cache	The level 1 caches (instruction cache and the data cache).
L2 cache	The level 2 caches.
L3 cache	Level 3 Cache.
MEMCLK	Internal and external memory clock
Memory interface	• 2 Unified Memory Controllers (UMC), each supporting one DRAM channel • 2 DDR4 PHYs. Each PHY supports: • 64-bit data • One DRAM channel per PHY, two DIMMs per channel • DDR4 transfer rates from 1333 MT/s to 2667 MT/s • UDIMM, RDIMM, LRDIMM, SODIMM, NVDIMM, Flash DIMM and 3DS support

Table 1. Glossary of Terms (Continued)

Term	Description
Processor	The complete product that encompasses the CPU, memory interface and other computing resources.
Profile	A Ryzen Master set of processor and memory settings intended to be optimized for a class of workload.
P-state	Processor Performance State. P-states are valid combinations of CPU voltage and CPU COF
SMT	Simultaneous Multi-Threading.
Thread	One architectural context for instruction execution.
TR4	TR4 is an AMD single-socket client infrastructure supporting four channels of DDR4 memory
UCLK	Internal Memory Controller clock – equal to Memory clock
VDDCR_CPU	The VDDCR_CPU voltage is the VID-requested VDDCR_CPU supply level.
VDDCR_SOC	The VDDCR_SOC voltage is the VID-requested VDDCR_SOC supply level.

Chapter 9   AMD Ryzen™ Master Application Features History

Table 2 describes the changes to the AMD Ryzen Master application with each revision.

Table 2. AMD Ryzen™ Master Application Features History

Revision	Changes
1.0	Initial Release with Ryzen 7 launch
1.0.1	Eliminated need for HPET service with proper support of system BIOS. Legacy system BIOS without such support will result in AMD Ryzen Master requesting that the user enable HPET.
	Corrected temperature reported for certain models to properly reflect processor temperature.
	Added the processor model name string in the CPU heading.
1.1.0	Updated for new features for Ryzen Threadripper processor supported by motherboards using AMD TR4 BIOS 1.0.0.3 or later.
	Featuring AMD Ryzen Master automatic update notification and installation update.