

# Overclocking Assistant (Performance Tuning Guide) for Intel® NUC Kit NUC6i7KYK

June 2016



## **WARNING**

*Altering Gfx frequency and/or voltage may (i) reduce system stability and useful life of the system and processor; (ii) cause the processor and other system components to fail; (iii) cause reductions in system performance; (iv) cause additional heat or other damage; and (v) affect system data integrity. Intel has not tested and does not warranty the operation of the processor beyond its specifications.*



## **WARNING**

*Altering PC memory frequency and/or voltage may (i) reduce system stability and useful life of the system, memory and processor; (ii) cause the processor and other system components to fail; (iii) cause reductions in system performance; (iv) cause additional heat or other damage; and (v) affect system data integrity. Intel assumes no responsibility that the memory included, if used with altered clock frequencies and/or voltages, will be fit for any particular purpose. Check with the memory manufacturer for warranty and additional details.*

## **Objective**

The Purpose of this performance tuning guide is intended for validation and system characterization purposes only.

## **Processor Graphics (GT) Performance**

Processor Graphics Performance is becoming another key vector of overclocking within certain form factors and usage models. Due to the fact that a single processor package shares the same space for processor cores, graphics cores, and the System Agent (including the memory controller), one must be very careful when balancing which subsystems to tune so as to create the most benefit to the end-user.

Overclocking of the Processor Graphics subsystem on the Skylake processor is controlled through graphics turbo, the reference clock, and memory tuning. It is also affected by the overclocking lock out and the voltage regulator. Each of these features is critical to successfully obtaining higher performance from the Processor graphics cores.

The processor graphics is divided into two sections: “slice” and “unslice”.

- The “slice” (can be more than one) holds the graphic compute/execution cores (EUs).
- The “unslice” holds various fixed-function and shared HW portions of the graphics.

## GT Overclock Performance

The default setting for GFX Slice and Unslice is 950MHz. To change this:

1. Press **F2** during boot to enter BIOS Setup.
2. Click the **Advanced** button.
3. Select **Performance > Graphics**.
4. In the General Settings pane:
  - Increase **GT Slice Overclocking Frequency** to **24** (set to 1200MHz)
  - Increase **GT Slice Domain Voltage Offset** to **0.15** (might need to adjust depending on requested GT frequency)
  - Increase **GT Unslice Overclocking Frequency** to **24** (set to 1200MHz)
  - Increase **GT Unslice Domain Voltage Offset** to **0.15** (might need to adjust depending on requested GT frequency)



5. Press **F10** and click **Yes** to save and exit BIOS Setup.

## Memory Overclock Performance

Memory performance tuning is controlled via several platform mechanisms. Beyond this, the platform is also capable of supporting manual overrides to the memory frequency, timings, and voltage levels of both the integrated memory controller (iMC) and the DIMMs.

If you are going to try overclocking the module, you will have to decide which is more important – the speed or the timings. In most cases you cannot have both.

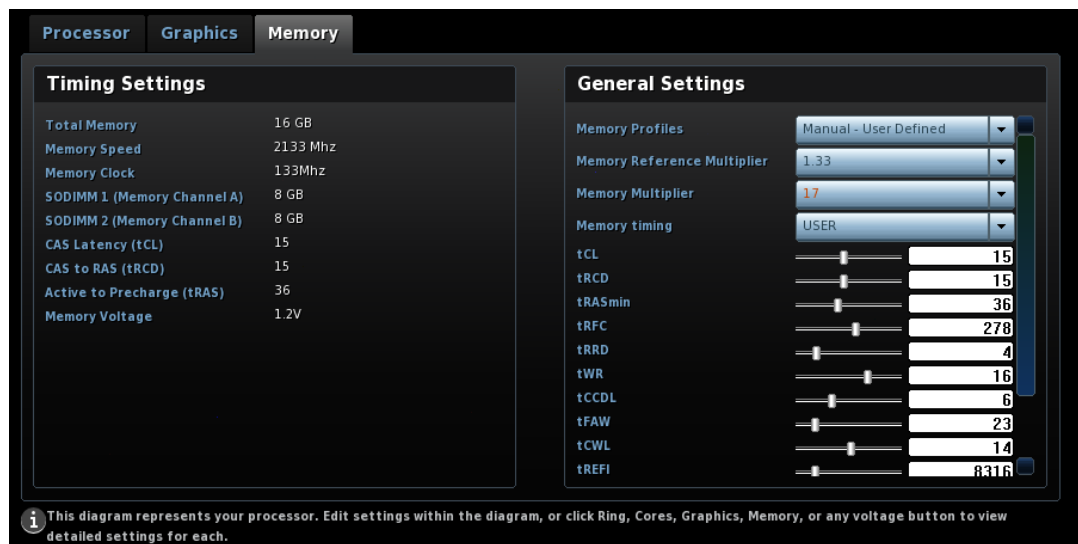
Follow the settings below if you want to overclock your memory. **Note:** some memory modules don't allow any overclocking.

DDR4 Frequency QCLK	Memory Reference Multiplier (133MHZ/100MHz)	Memory Multiplier
1600	1.33	12
1600	1	16
1700	1	17
1733	1.33	13
1800	1	18
1867	1.33	14
1900	1	19
2000	1.33	15
2000	1	20
2100	1	21
2133	1.33	16
2200	1	22
2267	1.33	17
2300	1	23
2400	1.33	18
2400	1	24
2500	1	25
2533	1.33	19
2667	1.33	20
2700	1	27
2800	1.33	21
2800	1	28
2900	1	29
2933	1.33	22
3000	1	30
3067	1.33	23
3100	1	31
3200	1.33	24

## Manual Memory Overclocking Example

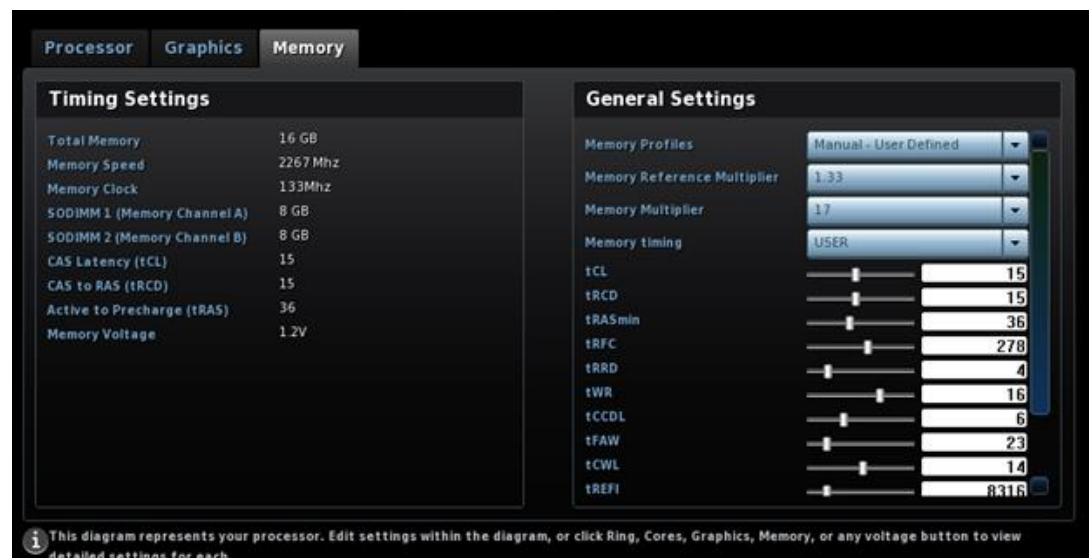
Example: You have a DDR4 2133 module and want to overclock to 2267 MHz. Using the settings shown in the table above, in order to overclock to 2267 MHz, you need to set the Memory Reference Multiplier at 1.33 and the Memory Multiplier at 17.

1. Press **F2** during boot to enter BIOS Setup.
2. Click the **Advanced** button
3. Select **Performance > Memory**.
4. Change Memory Profiles to **Manual- User Defined**.
5. Change **Memory Multiplier** to **17**.
6. If you want to change the timing, change **Memory Timing** to **USER** (otherwise leave it set to Auto).



7. Press **F10** and click **Yes** to save and exit BIOS Setup.

BIOS now shows the memory speed is 2267MHz instead of 2133 MHz. You can use tools such as CPU Z to confirm this.



## Memory XMP Example

Intel® Extreme Memory Profiles are traditionally designed with two distinct performance profiles:

- **Profile 1** is used for the enthusiast/certified settings and is the profile that is tested under the Intel® Extreme Memory Certification program.
- **Profile 2** is designed to host the extreme or fastest possible settings that have no guard band and may or may not work on every system.

Note: Extreme Memory Profiles are not always defined as overfrequency/over-voltaged parts. In some cases, Extreme Memory Profiles can be used to define extremely power savvy settings or extremely fast latencies.

1. Press **F2** during boot to enter BIOS Setup.
2. Click the **Advanced** button.
3. Select **Performance > Memory**.
4. Change **Memory Profiles** to **Profile 1** or **Profile 2** (depending on your module).
5. Press **F10** and click **Yes** to save and exit BIOS Setup.

The screenshot displays the BIOS Memory configuration interface. At the top, navigation tabs include Home, Main, Devices, Cooling, Performance (selected), Security, Power, and Boot. Below these are sub-tabs for Processor, Graphics, and Memory (selected). The interface is divided into two main sections: Timing Settings and General Settings.

**Timing Settings**

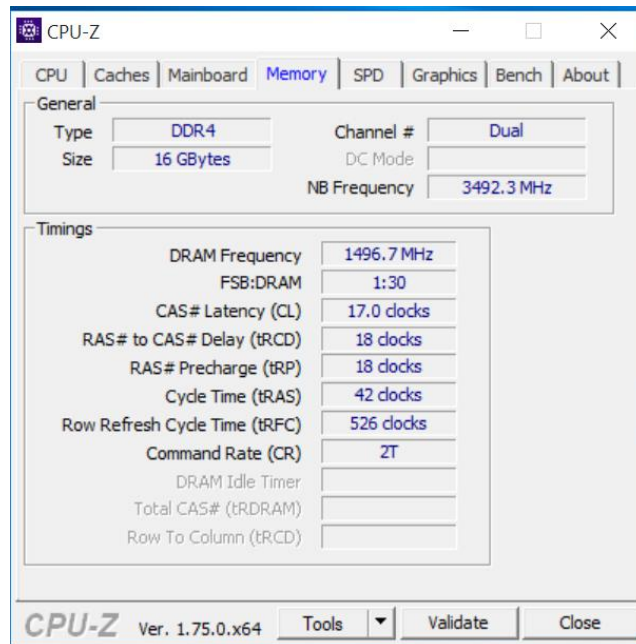
Total Memory	16 GB
Overridden Memory Speed	3200 Mhz
Memory Clock	133Mhz
SODIMM 1 (Memory Channel A)	8 GB
SODIMM 2 (Memory Channel B)	8 GB
XMP Version	2.0
CAS Latency (tCL)	18
CAS to RAS (tRCD)	18
Active to Precharge (tRAS)	45
Memory Voltage	1.35V

**General Settings**

Memory Profiles	Profile 1: XMP-3003
Memory Reference Multiplier	1.33
Memory Multiplier	24
Memory Voltage	1.35V
Memory timing	Automatic
tCL	17
tRCD	17
tRASmin	39
tRFC	421
tRRD_L	6
tRRD_S	4
tWR	18
tCCDL	6

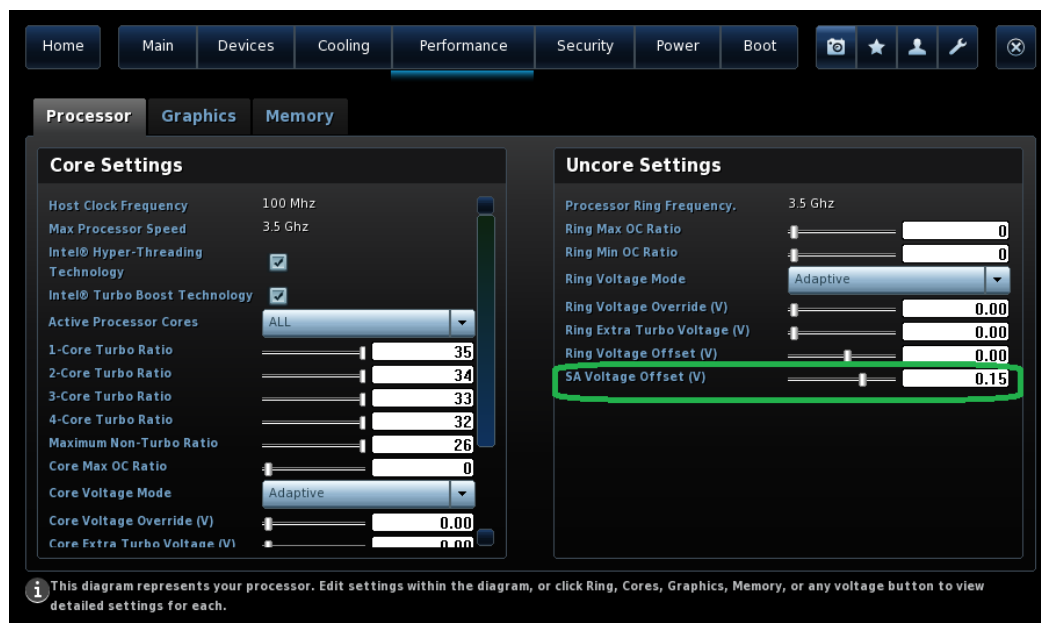
i This diagram represents your processor. Edit settings within the diagram, or click Ring, Cores, Graphics, Memory, or any voltage button to view detailed settings for each.

You can use tools such as CPU Z to check the memory speed.



Set the Voltage System Agent in BIOS Setup, based on the requested memory speed above 2993MHz, if board is not stable. Intel will not provide guidance on this voltage. You can try from 50mv to 200mv.

1. Press **F2** during boot to enter BIOS Setup.
2. Click the **Advanced** button.
3. Select **Performance > Processor**.
4. Increase SA Voltage (for example 0.15v = 150mv).
5. Press **F10** and click **Yes** to save and exit BIOS Setup.



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