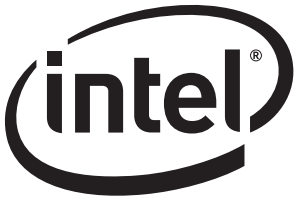

Intel® Desktop Board DH67BL

Performance Tuning Guide

Revision 1.0

February 2011
Order Number: G26416-001

WARNING

Altering clock 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.

Contents

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1 Introduction

Performance tuning of Intel® Desktop Board DH67BL enables useful gains that can enhance overall system performance for gaming, video editing, computation, performance benchmarking, and other uses.

This guide focuses on using the BIOS for performance tuning of Intel Desktop Board DH67BL. The main performance tuning focus area is Intel® HD Graphics. The procedures and examples included in this guide are for reference only and may not work in all situations and system configurations.

Intel Desktop Board DH67BL is designed with a number of enhancements to support performance tuning while protecting the user from overheating or damaging board components.

These enhancements include:

- Fan speed control — the processor and system fan speeds automatically increase when elevated temperatures are sensed.
- Processor thermal protection — the current applied to the processor is automatically reduced when the thermal protection temperature set point is reached.
- Processor voltage regulation thermal protection — the voltage regulation system current is automatically reduced when the thermal protection temperature set point is reached.

2 2nd Generation Intel® Core™ Processor Family and Intel® H67 Express Chipset General Concepts

2.1 Architecture

Intel Desktop Board DH67BL is an Intel® H67 Express chipset-based desktop board in microATX form factor. It supports the 2nd generation Intel® Core™ i7 processors, Intel® Core™ i5 processors, and other Intel® processors in the LGA1155 package. The board features DVI-I and HDMI* connectors, and supports dual independent display for processors with Intel® HD Graphics. Powered by the 2nd generation Intel Core processors, Intel Desktop Board DH67BL delivers a superb visual performance for sharper images, richer color, and life-like audio and video.

Intel Desktop Board DH67BL also offers premium features, such as two SATA 6 Gb/s ports, two USB 3.0 ports with 5 Gb/s link speed, and Intel® Rapid Storage Technology (Intel® RST) for RAID 0, 1, 5, and 10, which provides new levels of protection, performance, and expandability. A simplified system block diagram is shown in Figure 2.1.

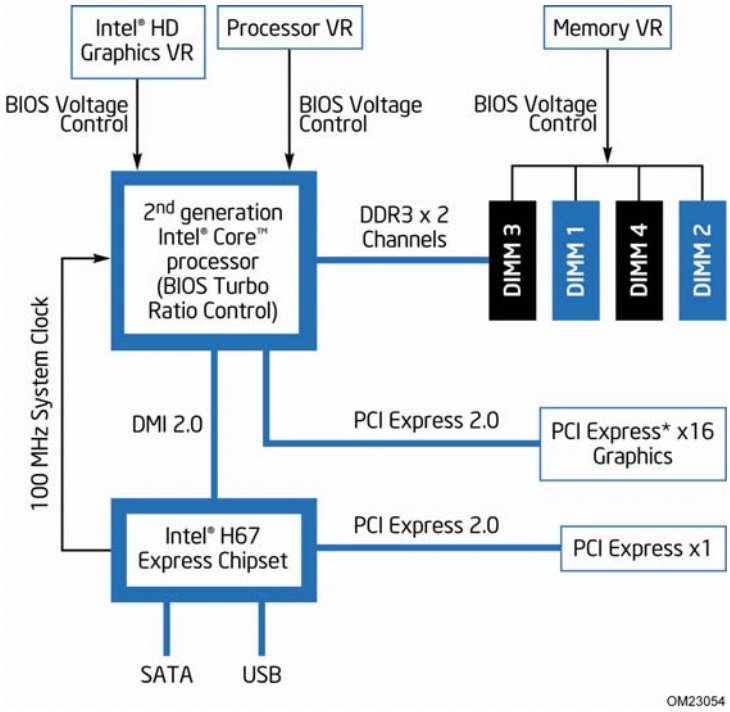

Figure 2.1. Simplified Block Diagram

3 Intel® Desktop Board DH67BL Performance Tuning Using BIOS Setup

3.1 Hardware Considerations for Performance Tuning

3.1.1 System Cooling

Performance tuning may result in additional system heat generation. Increased cooling capability may be required to allow performance tuning and operation of a performance tuned system while maintaining stable operation. Considerations for increasing cooling capability may include, but are not limited to, chassis type, selection of air or liquid cooling, processor cooler design, memory module design, and overall system airflow. Extreme performance tuning requires system designs with increasingly sophisticated cooling capabilities. It is beyond the scope of this guide to provide detailed recommendations for system cooling.

⚠ **CAUTION**

Cooling induced moisture condensation will result in risk for electrical shorting and subsequent damage to the board and/or the system.

3.2 Accessing BIOS Setup

The BIOS setup screen can be accessed at system startup by pressing the F2 key at the BIOS screen prompt. It is advisable to run the latest BIOS revision to ensure that performance features are at the highest level of optimization. The latest version BIOS can be obtained from http://downloadcenter.intel.com. Instructions for loading the BIOS into the board can also be found at this location.

Before initiating performance tuning, ensure that the BIOS setup defaults have been loaded by pressing F9 while in BIOS setup mode and then pressing F10 to save those settings.

3.3 Obtain the Latest Drivers

For the Intel HD Graphics performance settings to function properly, you will need to install the graphics driver for Intel Desktop Board DH67BL. The latest graphics driver version can be obtained from http://downloadcenter.intel.com. Instructions for loading the graphics driver can also be found at this link. The generic driver included on the Microsoft Windows* 7 installation disk will not contain drivers that enable Intel HD Graphics performance tuning.

3.4 Recovering from an Unstable System

Should performance values be set beyond the point of stable system operation, the system may exhibit a failure to boot, a blue screen, a system hang, or a recovery screen. A common Intel HD Graphics instability includes a windows driver crash that may require a system reboot. Exceeding the system stability limits is normal during the performance tuning process and restoring system operation using a BIOS configuration jumper or power removal may be required as explained in the sections below.

3.4.1 BIOS Configuration Jumper

For a POST failure, you will need to perform a recovery using the BIOS configuration jumper that is provided on the motherboard to boot into BIOS in safe mode. You will need to open the system chassis to access the jumper. Please refer to the *Intel Desktop Board DH67BL Product Guide* for additional information on using the BIOS jumper for recovery purposes.

3.4.2 Remove Power and Reboot

For a system hang, resetting your system or removing and reapplying power will allow the system to initiate a reboot. During reboot, press the F2 key to enter BIOS to adjust performance settings in BIOS to restore system stability.

3.5 Intel Desktop Board DH67BL Performance Tuning Process

There are numerous possibilities for desktop board performance tuning. The approach presented is a general starting point and may not be suitable for all cases.

Desktop board performance tuning is an iterative process. The settings for one parameter may affect which settings will work for another parameter. For example, increasing the graphics max multiplier may require an adjustment to the graphics voltage overrides setting to maintain Intel HD Graphics stability.

A full Intel HD Graphics and memory tuning sequence may consist of the steps outlined below. Depending on your objective, it may not be necessary to complete all of the steps in the sequence. Further information for each step is documented in Sections 3.5.1 through 3.5.5. Checking system stability appears frequently in the performance tuning process. The setting and checking iterative process serves as a feedback mechanism to help determine the point where system instability occurred and the setting causing the instability can quickly be indentified.

1. Configure the BIOS for Performance Tuning.
2. Set graphics max multiplier and voltage.
3. Check stability and adjust the multiplier and voltage as needed.
4. Tune memory and check stability (Optional).
5. Reduce voltage, current, and power and check stability (Optional).
6. Save custom defaults settings.

3.5.1 Configure the BIOS for Performance Tuning

Performance tuning options are located in the BIOS Setup menu section labeled "Performance". Reading and agreeing to the disclaimer by selecting "Yes", as shown in Figure 3.1, allows the detailed BIOS performance menu to be displayed.

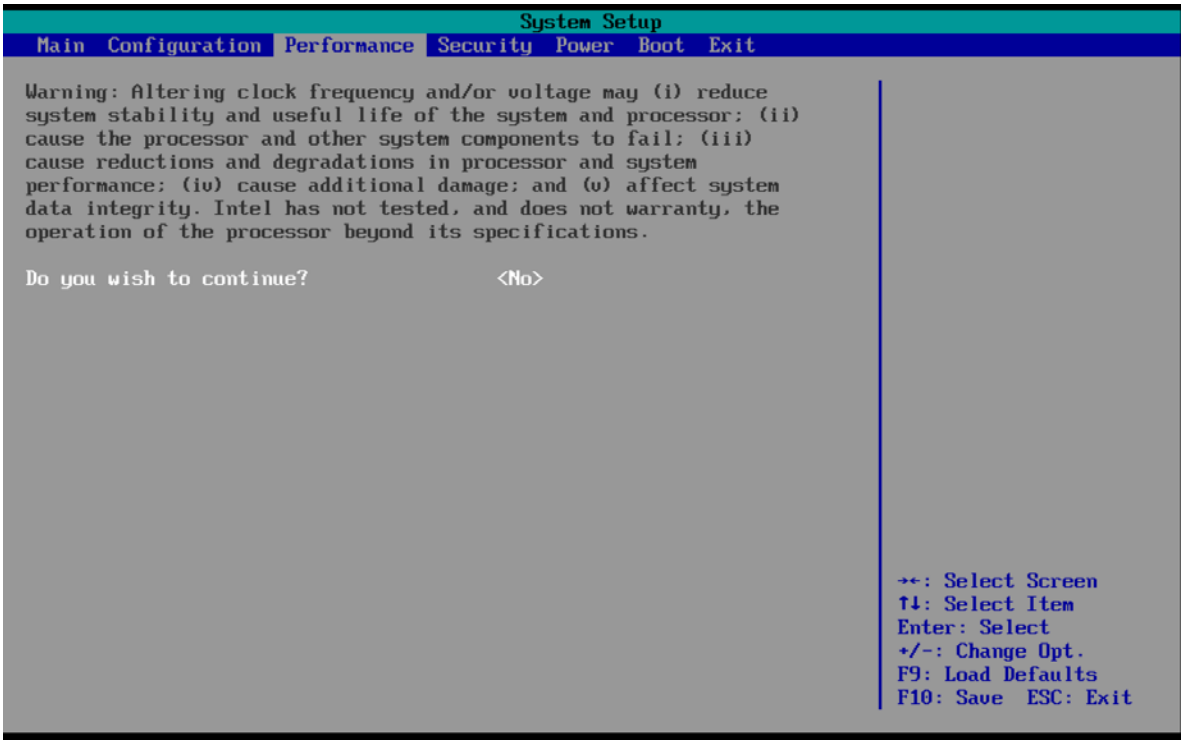

Figure 3.1. Performance Tuning Disclaimer

Under the Performance menu, processor tuning options are under the “Processor Overrides” section shown in Figure 3.2 below. Also see Appendix A for a table summarizing these settings and their effects. Sections 3.5.1.1 through 3.5.1.7 include guidelines for setting the processor override parameters.

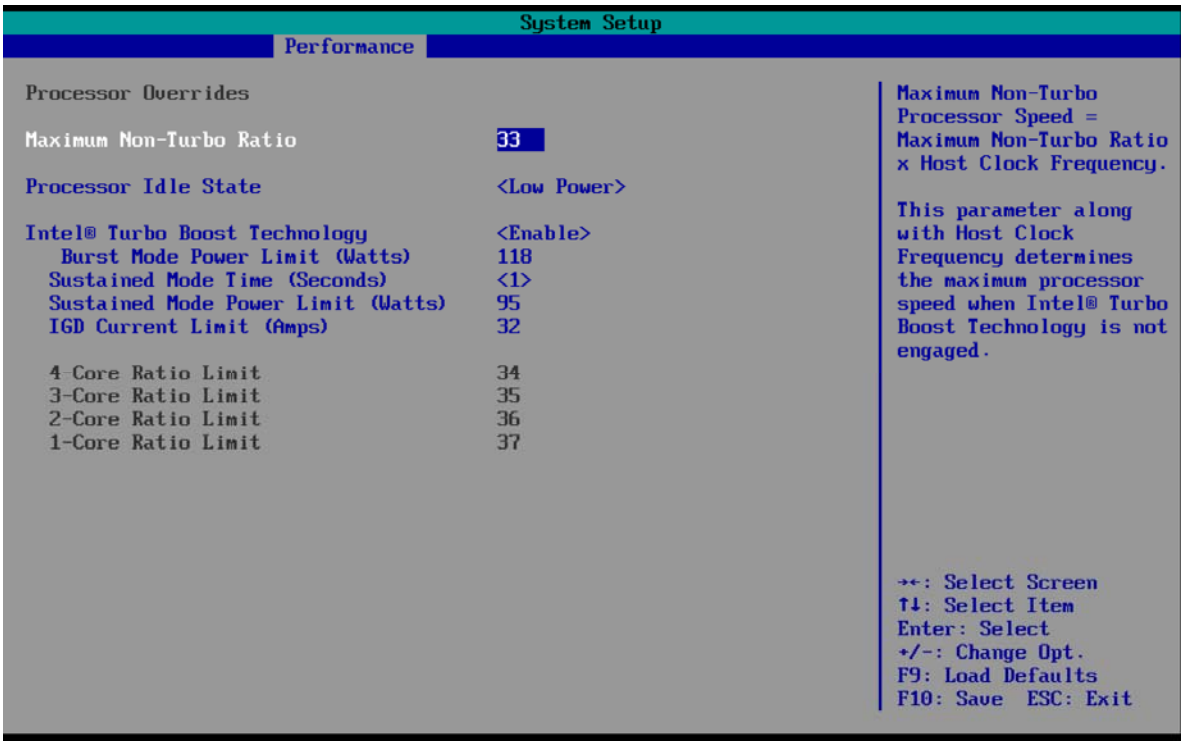

Figure 3.2. Processor Overrides with Default Settings

3.5.1.1 Graphics Voltage and Multiplier

These two BIOS options provide the key tools to tune the Intel HD Graphics core performance from the default values to what can be allowed by the installed processor thermal solution and individual processor.

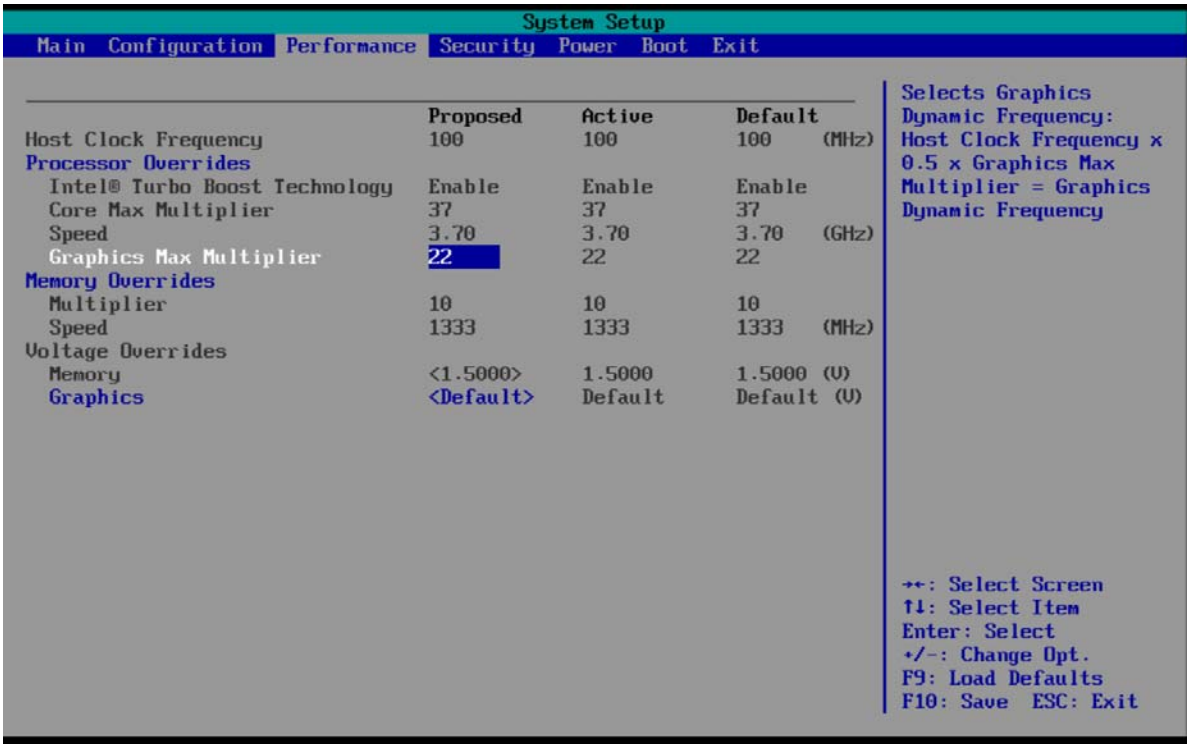

Figure 3.3. Graphics Multiplier Setting

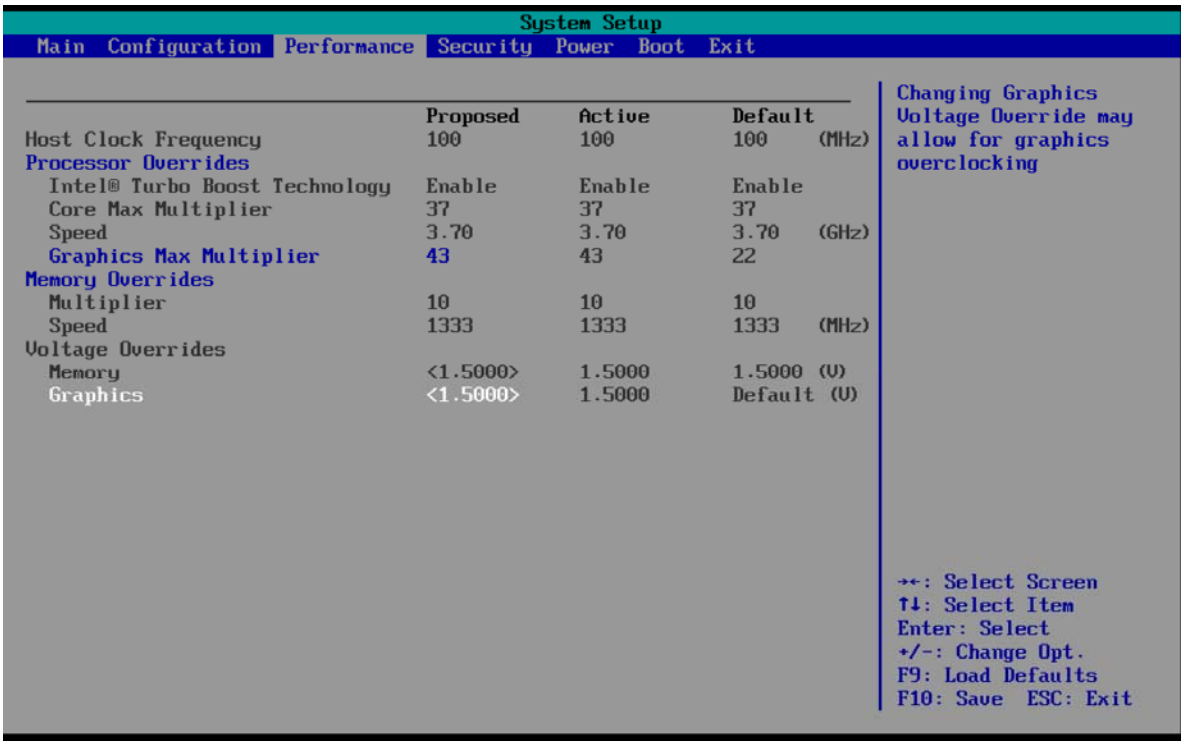

Figure 3.4. Graphics Voltage Setting Adjusted

3.5.1.2 Intel® Turbo Boost Technology

Ensure that Intel® Turbo Boost Technology is set to Enable for top performance.

3.5.1.3 Burst Mode Power Limit

The Intel HD Graphics is a factor in the amount of power used. If Intel HD Graphics is overclocked and this value is not increased, this may limit turbo performance of the processor cores as Intel HD Graphics may take more of the power budget.

3.5.1.4 Sustained Mode Time

This is the time window in which the real time burst mode power is averaged to create the Sustained Mode Power Limit below. One second is a good initial setting. Setting this time too long will exceed the capability of the processor heat sink and may result in excess processor heating and subsequent throttling (frequency reduction) to reduce the temperature. A longer time interval in sustained mode may result a longer time interval out of sustained mode while accumulated processor heat is being dissipated.

3.5.1.5 Sustained Mode Power Limit

Set the Sustained Mode Power Limit (TDP) for turbo mode. You will have to adjust the TDP to suit your environment such that the processor does not throttle due to excess processor heating at peak performance conditions. If the processor temperature increases steadily while running under load, the processor cooling capability to dissipate heat is being exceeded and you will need to reduce the TDP power limit to prevent throttling. The Intel HD Graphics is a factor in the amount of power used. If Intel HD Graphics is overclocked and this value is not increased, this may limit turbo performance of the processor cores as Intel HD Graphics may take more of the power budget.

3.5.1.6 IGD Current Limit

This is a sister function to TDC. TDC is the amount of current allowed from the processor VR for the execution cores, IGD current is the amount of current allowed from the graphics VR for the Intel HD Graphics portion. It may need to be increased to not limit Intel HD Graphics overclocking. Thermals will need to be monitored to ensure throttling does not occur.

3.5.1.7 Recommended Power Settings

Leave Enhanced Intel SpeedStep® Technology and Processor C States enabled in the BIOS as shown in Figure 3. Turbo ratios require Enhanced Intel SpeedStep Technology enabled in order to function. Disabling C states prevents the processor from entering 1, 2, or 3 core ratios.

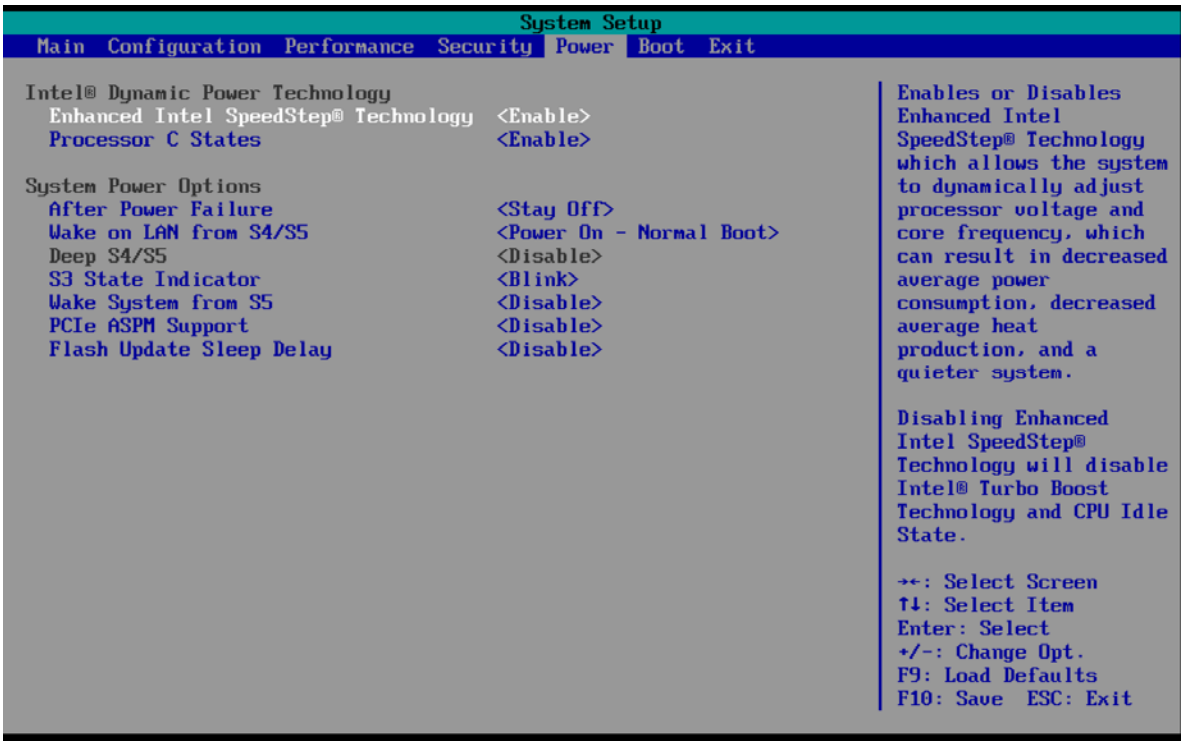

Figure 3.5. Power Settings

3.5.2 Check Stability

Establishing stability should be done frequently during the performance tuning process. A good initial check of system stability is to see if the system can boot into the operating system. If the system has become unstable, refer to Section 3.4 for recovery options.

When the system can successfully boot into the operating system, various software applications can be used to stress the processor, memory, and other systems. When processor cores are idle, 2nd generation Intel® Core™ processors will operate at a reduced multiplier value. While running in the operating system, the application of a heavy load will bring all processor cores out of the idle and run them at the multiplier values selected in the BIOS setup. Heavy loads can be applied by using commonly available processor and memory stress testing software.

During stress testing, look for erratic software behavior, a blue screen or a system hang. Any of these are indications of system instability. Solutions to instability include revising the performance settings described in the various areas of Section 3.5. For processor stability issues, revising voltage, amperage, or wattage settings upward or revising turbo ratios and/or system clock frequency downward or a combination of these changes will be required.

If processor temperature is steadily increasing during stress testing or processor throttling is occurring then more tuning efforts are required to eliminate the throttling. Solutions may include improved processor cooling capability and/or revising the performance settings.

When system stability has been established with stress testing software, it's recommended that you check system stability again using your usual software applications to confirm performance and stability for your daily use.

3.5.3 Tune Memory

A wide variety of memory timing parameters can be adjusted in the BIOS setup as described in Appendix B.

In addition, DIMM socket population will also affect system performance. Intel Desktop Board DH67BL has two independent memory channels which are indicated by blue or black memory DIMM sockets. For best performance, all sockets should be populated with memory matched by manufacturer, size, speed, and type. This matching allows the processor to access data across each of the memory channels concurrently.

3.5.3.1 Memory Performance Options

The Memory Overrides menu contains all the memory timing options that can be adjusted.

NOTE

For each of the timings, except the multipliers, lower number settings correspond with higher performance and potentially less memory system stability.

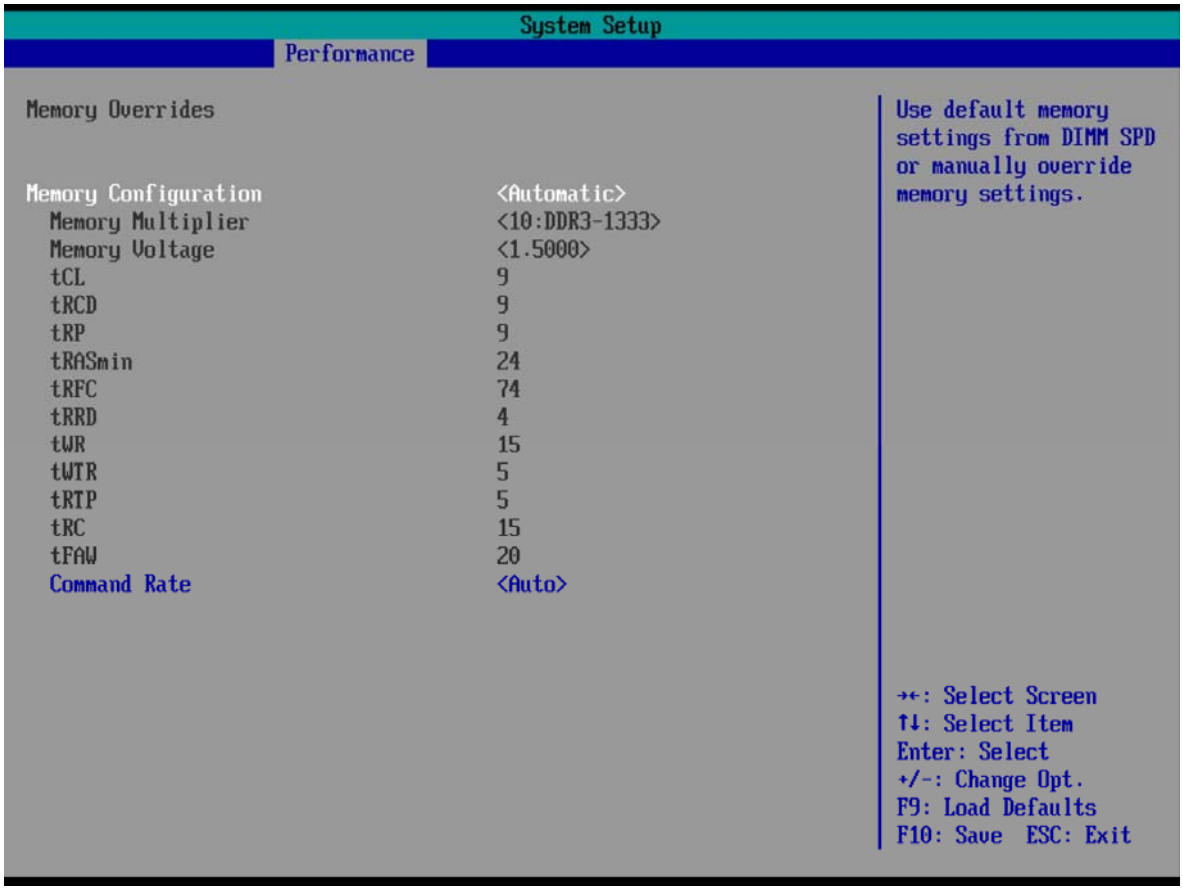

Figure 3.6. Memory Overrides

3.5.4 Reduce Voltage, Current, and Power

Gradually reduce voltage, current, and power settings that were made in the applicable portions of Sections 3.5.1.3 through 3.5.1.7 while checking stability. When instability is encountered, increase the setting(s) as needed to restore stable operation.

3.5.5 Save Custom Defaults Settings

The Intel Desktop Board DH67BL BIOS allows storing one set of parameter settings (profile) at any given time. The most recently loaded profile will remain resident in the BIOS, until changes are made by the user.

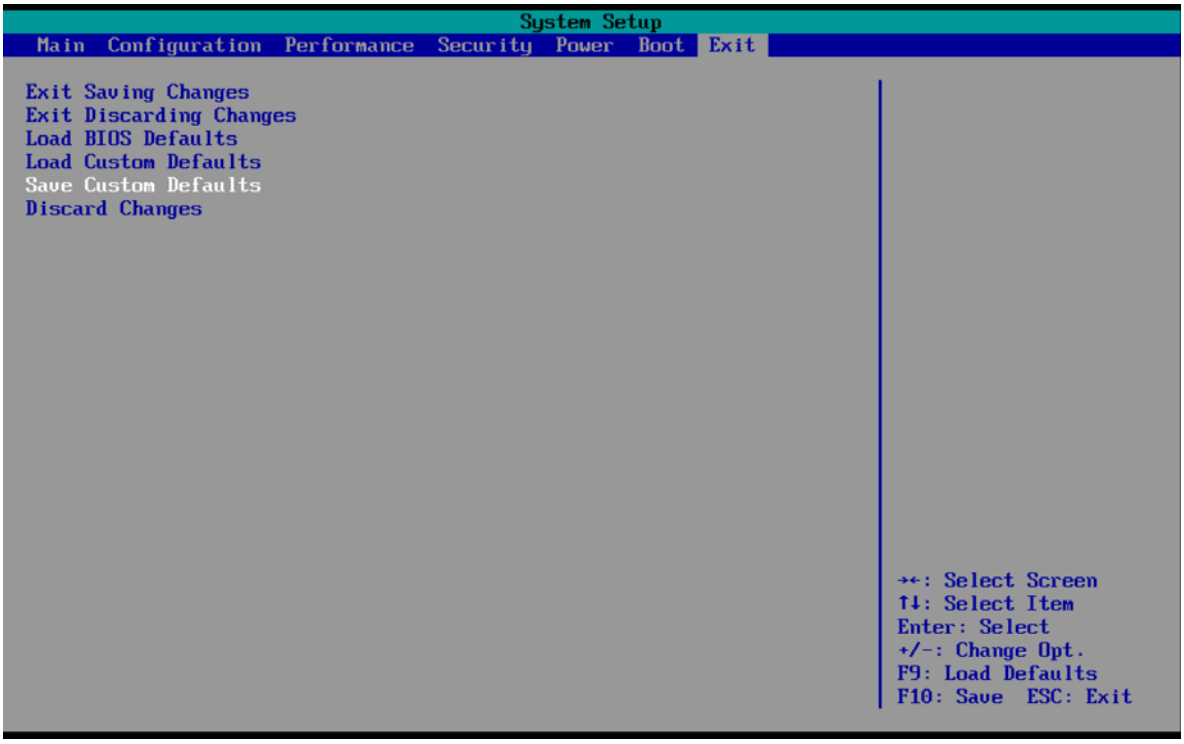

Figure 3.7. Using the BIOS to Store Current Performance Settings

4 Performance Tuning Examples

4.1 1800 MHz Intel® HD Graphics Frequency Using Graphics Max Multiplier

Figure 4.1 shows the BIOS settings to achieve an Intel HD Graphics frequency of 1800 MHz.

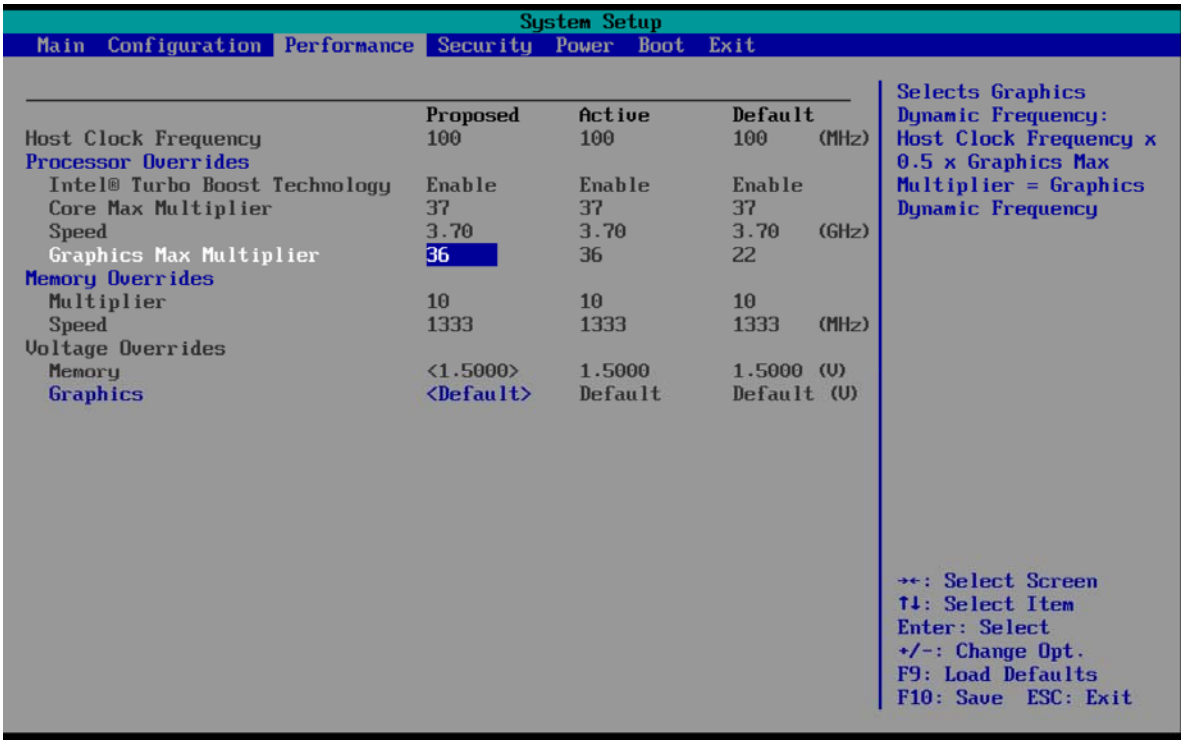

Figure 4.1. 1800 MHz Intel HD Graphics Frequency Using Graphics Max Multiplier

4.2 2150 MHz Intel HD Graphics Frequency Using Graphics Max Multiplier and Graphics Voltage Overrides

Figure 4.2 shows the BIOS settings to achieve an Intel HD Graphics frequency of 2150 MHz. The graphics voltage overrides had been increased from default value to 1.5000 V.

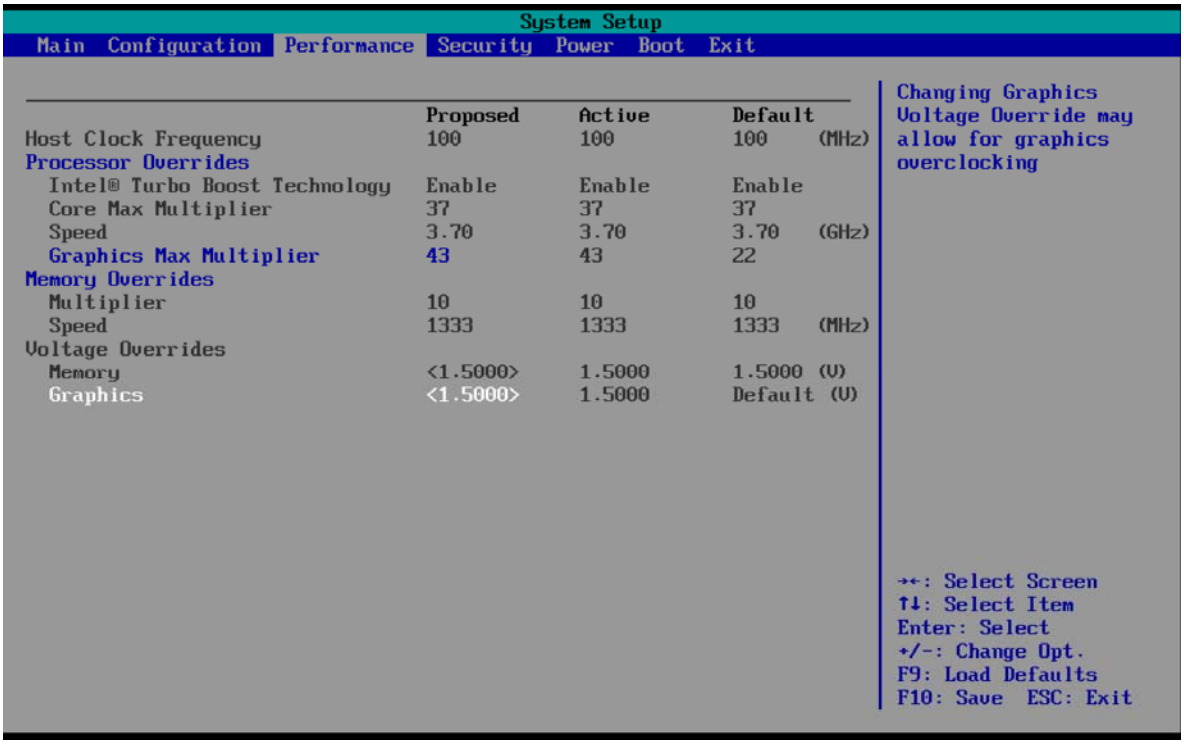

Figure 4.2. 2150 MHz Intel HD Graphics Frequency Using Graphics Max Multiplier and Graphics Voltage Overrides

A Parameter Descriptions for BIOS Performance Settings

Table A-1. BIOS Performance Settings

Setup Option	Description
Graphics Max Multiplier	Used to set the maximum Graphics Multiplier. Works with the built in Graphics Turbo Boost capability. When graphics are not stressful the core will operate at the default Frequency. Host Clock Frequency * 0.5 * Graphics Max Multiplier = Graphics Dynamic Frequency.
Graphics	Adjusts the Graphics VR to increase the voltage applied to the graphics core to allow for faster graphics frequency to improve playability in 3D applications.
Maximum Non-Turbo Ratio	Used to set the maximum non-turbo processor speed. Processor speed = the maximum non-turbo ratio * host clock frequency. Maximum allowed value is processor dependent. For example, a value of 34 is the maximum for a 2nd generation Intel Core i7-2600K processor.
CPU Idle State	When Intel Turbo Boost Technology is set to enable, the high performance selection forces the operating system to request the use of Intel Turbo Boost Technology ratios at all times. Low power setting will allow the operating system to adjust processor ratios downward when Enhanced Intel SpeedStep Technology is set to enable.
Intel Turbo Boost Technology	Enabling Intel Turbo Boost Technology also enables Enhanced Intel SpeedStep Technology and automatically allows processor cores to run faster than the base operating frequency if the core(s) is operating below power, current, and temperature specification limits.
Burst Mode Power Limit (Watts)	The Burst Mode Power Limit is the power (in watts) that can be used by the processor when Burst Mode is active.
Sustained Mode Time (Seconds)	This is time in which the Burst Mode Power is averaged to calculate the Sustained Mode Power limit.
Sustained Mode Power Limit (Watts)	Sustained Mode Power Limit is the power (in watts) that can be used by the processor when Sustained Mode is active.
4-Core Ratio Limit	Displays the core multiplier to be used when four processor cores are in use.
3-Core Ratio Limit	Displays the core multiplier to be used when three processor cores are in use.
2-Core Ratio Limit	Displays the core multiplier to be used when two processor cores are in use.
1-Core Ratio Limit	Displays the core multiplier to be used when one processor core is in use.

B Parameter Descriptions for Memory Performance Settings

NOTE

All multiplier values listed in Table B-1 are applied to the single 100 MHz (default) host clock.

Table B-1. Memory Performance Settings

Setup Option	Description
Performance Memory Profiles	Automatic setting uses specification compliant values provided by the memory module. If the memory module supports XMP, there will be additional selections for each profile stored in the module. Selecting a profile will populate all the settings with values recommended by the DIMM manufacturer. Selecting Manual Mode after XMP allows the user to change each of the settings.
Memory Multiplier	Allows selection of memory ratio from a list of choices. The memory frequency is the ratio * 133.3 MHz. The maximum ratio is 10 for Desktop Boards based on the Intel® H6-series PCH.
tCL	Column address strobe (CAS) Latency: The amount of time in cycles between sending a read command and the time to act on it.
tRCD	Row address strobe (RAS) to CAS Delay: The amount of time in cycles for issuing an active command and the read/write commands.
tRP	RAS Precharge Time: This is the minimum time between active commands and the read/writes of the next bank on the memory module.
tRASmin	Minimum RAS Active Time: The amount of time between a row being activated by precharge and deactivated.
tRFC	RAS Refresh Cycle Timing: This determines the amount of cycles to refresh a row on a memory bank.
tRRD	RAS to RAS Delay: The amount of cycles that it takes to activate the next bank of memory.
tWR	Write Recover Time: The amount of cycles that are required after a valid write operation and precharge.
tWTR	Write to Read Delay: The amount of cycles required between a valid write command and the next read command.
tRTP	Controls the number of clocks that are inserted between a row precharge command and an activate command to the same rank.
Memory Voltage	Changes the voltage applied to the memory.
Command Rate	The amount of time that commands can be issued.
tRC	Determines the minimum number of clock cycles used to complete row activation to precharging of the active row.
tFAW	Specifies the time window where four activates are allowed in the same rank.