



Intel® Solid-State Drive Toolbox

User Guide

May 2015

Tool Version 3.3.0



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Revision History

Revision	Description	Revision Date
001	Initial release for software version 3.0	September 2011
002	Update for software version 3.3.0	May 2015



1 Introduction

1.1 About Intel® Solid-State Drive Toolbox

The Intel Solid-State Drive Toolbox is drive management software that allows you to view current drive information for Intel® Solid-State Drives, including:

- [Drive Health](#)
- [Estimated Life Remaining](#)
- [SMART attributes](#) (also available for hard disk drives and non-Intel® SSDs)
- [Drive Details](#) (also available for hard disk drives and non-Intel SSDs)
- [Optimize the performance of an Intel SSD](#) using Trim functionality (a command that allows an operating system to inform an SSD which blocks of data are no longer considered in use and can be deleted)
- [Run Quick](#) and [Full diagnostic scans](#) to test the read and write functionality of an Intel SSD
- [Check and tune your system settings](#) for optimal Intel SSD performance, power efficiency, and endurance
- [View your system information](#) and hardware configuration, such as central processing unit (CPU), chipset, controller name and driver versions
- [Update the firmware](#) on an Intel SSD
- [Run Secure Erase](#) on a secondary Intel SSD

1.2 Using the Home Screen

The home screen shows an icon (containing a picture and the assigned drive letter and capacity) for each Intel® Solid-State Drives (Intel® SSDs), as well as any other drives (hard disk drives and non-Intel SSDs) installed in your system.

Click on the icon of the drive you want to manage. If your system contains multiple drives, use the arrows to the left and right of the drive icons to scroll through and select a drive.

Note: If a drive contains a partition or is installed as a cache, it appears as a separate drive, with its own icon, on the home screen. See [Identifying a Drive](#) for more details.

Drive Summary information appears for the selected drive (Information varies depending on the type of drive selected).

- [Model](#)
- [Firmware Version](#)
- [Serial Number](#)
- [Drive Details](#)
- [Drive Capacity](#)



- [Drive Health](#)
- [Estimated Life Remaining](#)
- [SMART Details](#)

Click an option on the left side of the screen to run a task on the selected drive. (Available tasks vary depending on the type of drive selected.)

- [Intel SSD Optimizer](#)
- [Quick Diagnostic Scan](#)
- [Full Diagnostic Scan](#)
- [Secure Erase](#)
- [Firmware Update](#)
- [System Tuner](#)
- [System Information](#)

Click **Refresh** to [rescan](#) for drives and refresh all information displayed in the Intel SSD Toolbox.

Click **Export** to export and save SMART attributes, drive details, and system information for the selected drive to a .csv file on your system.

Click **For more information** to access the Intel SSD website and view the latest information on Intel SSDs.

If updates or other actions are recommended on the selected Intel SSD, the following icon appears next to an option on the home screen: 

Tip: you can move your mouse pointer over this icon wherever you see it in the Intel SSD Toolbox to view the recommended action.

Related Sections

[Scanning for Drives](#)

[Identifying a Drive](#)

1.3 Scanning for Drives

Upon startup, the Intel SSD Toolbox scans for all available drives installed in the system including Intel SSDs, non-Intel SSDs, and hard disk drives (HDDs). Icons for all located drives will appear on the home screen.

If your system contains multiple drives, use the arrows to the left and right of the drive icons to scroll through and select a drive.

To rescan the system for drives, click **Refresh** on the home screen or exit Intel SSD Toolbox and start the program again.

If a drive installed in the system is not appearing on the home screen, see [Troubleshooting - Drives](#).

Related Sections

[Identifying a Drive](#)

[Viewing Drive Health](#)

[Viewing Estimated Drive Life Remaining](#)



1.4 Identifying a Drive

An icon for each drive, labeled with the drive letter and capacity, appears on the home screen. If your system contains multiple drives, use the arrows to the left and right of the drive icons to scroll through and select a drive.

Information displayed for a drive may include:

Assigned drive letter (drive partitions and drives installed as a cache appear as separate drives and may contain assigned drive letters)

Usable capacity

Note: The total usable capacity of an Intel SSD may be less than the total physical capacity because a small portion of the capacity is used for NAND flash management and maintenance purposes.

Move and hold the mouse pointer over a drive icon or click on the drive for more information.

If a drive installed in the system does not appear on the home screen, see [Troubleshooting - Drives](#).

Drives containing partitions

If a drive contains a partition, the partition appears as a separate drive on the home screen and may or may not be assigned a drive letter.

Drives installed as a cache using Intel® Rapid Storage Technology (Intel® RST)

If a drive is installed as a cache using Intel® RST, the drive appears as a separate drive on the home screen without an assigned drive letter. Intel SSD Toolbox identifies this type of drive as a RAID volume member (a specific drive in a RAID volume).

Drives part of a RAID array using Intel® RST

If a drive is installed as part of a RAID array using Intel® RST, the drive appears as a separate drive on the home screen. Move the mouse over the drive to identify if it is the RAID volume (all drives in the RAID array) or a RAID volume member (a specific drive in a RAID volume).

Note: RAID volumes and RAID volume members have limited functionality in Intel SSD Toolbox.

Drives part of dynamic partitions

If a drive is part of a dynamic partition, the drive appears as a separate drive on the home screen.

Note: You can run Intel SSD Optimizer on *simple dynamic partitions* only. See your system documentation for identifying partition types.

Related Section

[Identifying Security State of an Intel SSD](#)

[Identifying the NAND Lithography of an Intel SSD](#)

2 Viewing Basic Drive Information

2.1 Model Information

On the home screen, model information, such as device type, bus architecture, controller mode, form factor, and capacity is available for each drive.

The Model Number, Firmware Version and the Serial Number are always displayed for the selected drive in the Drive Summary section.

More detailed information is available by moving and holding the mouse pointer over a drive icon. For Intel SSDs, this information includes a reference to the NAND lithography. For example:

- If the number includes **G1**, the SSD is based on 50nm NAND lithography. **Note:** *The Intel SSD Optimizer does not run on these SSDs. See [Intel SSD Optimizer Requirements](#) for more information.*
- If the number includes **G2** or **A2**, the SSD is based on 34nm NAND.
- If the number includes **G3**, the SSD is based on 25nm NAND.
- If the number includes **A3**, the SSD is based on 20nm NAND.

2.2 Firmware Version

On the home screen, the Drive Summary section shows the version of firmware currently installed on the selected Intel SSD.

If the selected Intel SSD contains an older version of firmware than what is included with this version of the Intel SSD Toolbox, the following icon appears next to the Firmware Update option:



To check if a newer firmware version is available for your Intel SSD, see [Checking for Firmware Updates](#).

Note: To update firmware on an Intel® X25-E Solid-State Drive or Intel® Solid-State Drive 510 Series, use the Intel® SATA Solid-State Drive Firmware Update Tool available at <http://www.intel.com/go/ssdfirmware>. The Intel SSD Toolbox Firmware Update option does not update firmware on these SSDs.

2.3 Serial Number

On the home screen, the Drive Summary section shows the Serial Number of the selected drive. This information can be useful when contacting technical support.



2.4 Drive Health

On the home screen, The SMART Summary section displays the Drive Health information of the selected Intel SSD as measured by supported [SMART](#) attributes.

- Good (green) - All SMART attributes are above their threshold levels.
- Warning (red) - One or more SMART attributes has moved beyond the threshold level and reached the final value. It is recommended to back up all data and consider replacing the SSD.

Note: Drive Health is reported for Intel SSDs only with SMART enabled.

Related Section

[Viewing Estimated Life Remaining](#)

2.5 Estimated Life Remaining

On the home screen, the SMART Summary section displays the Estimated Life Remaining of the selected Intel SSD.

Endurance calculations are estimated and may vary. The estimation shown is based on the applied workload and is not accurate if the workload changes. Estimates are based on your usage to date and will not extend or reduce the SSD warranty period.

Note: Estimated Life Remaining is reported for Intel SSDs only with SMART enabled.

Related Section

[Viewing Drive Health](#)

2.6 Drive Capacity

On the home screen, the capacity pie chart reports the amount of used and free space available on the selected Intel SSD.

The pie chart appears for Intel SSDs with valid partitions only. The pie chart does not appear for SSDs without a valid partition or for SSDs installed as a cache.

Note: The total usable capacity may be less than the total physical capacity because a small portion of the capacity is used for NAND flash management and maintenance purposes.

Related Sections

[Viewing Drive Health](#)

[Viewing Estimated Life Remaining](#)



2.7 Identifying NAND Lithography of an Intel SSD

To identify the NAND lithography of an Intel SSD:

1. Select the Intel SSD on the home screen.
2. Click **Drive Details**.
3. Scroll down and view Model Number (Word 27-46):
 - If the number includes **G1**, the Intel SSD is based on 50nm NAND lithography. Note: The Intel SSD Optimizer does not run on these SSDs.
 - If the number includes **G2** or **A2**, the SSD is based on 34nm NAND.
 - If the number includes **G3**, the SSD is based on 25nm NAND.
 - If the number includes **A3**, the SSD is based on 20nm NAND.

Note: You can also move the mouse pointer over the Intel SSD on the home screen to view this information, which is displayed as part of the [model number](#).

Related Section

[Identifying Security State of an Intel SSD](#)

2.8 Identifying the Security State of an Intel SSD

To identify the security state of an Intel SSD†:

1. Select the Intel SSD on the home screen.
2. Click **Drive Details**.
3. Scroll down and view **Security Status** (Word 128).
 - Bit 0 indicates the Security Mode feature set supported. If set to 1, security is supported.
 - Bit 1 indicates security enabled. If set to 1, the security is enabled.
 - Bit 2 indicates security locked. If set to 1, the security is locked.
 - Bit 3 indicates security frozen. If set to 1, the security is frozen.

See the [ATA-7 Specification](#) for more information.

†Not applicable for NVMe* drives.

Related Section

[Identifying the NAND Lithography of an Intel SSD](#)



3 Obtaining Drive, SMART, and System Information

3.1 Drive Details

The Drive Details screen displays standard identification data for the selected drive. The information displayed is generated by an [ATA IDENTIFY DEVICE](#) or [NVMe IDENTIFY](#) command, depending on the attached drive.

Scroll down to view all values on the screen. Details shown for each value include:

- **Word:** Identifies the word(s) assigned to a specific value.
- **Description:** Provides the name and bit information (if needed) for each value.
- **Hex value:** Reports the hexadecimal value for each piece of drive information.

The following are commonly referenced values. For complete descriptions of all values, see the [ATA specifications](#).

- **Serial Number** (Word 10-19): Identifies production information about the selected drive.
- **Firmware Version** (Word 23-26): Version of firmware installed on the selected drive.
- **Model Number** (Word 27-45): Model of the selected drive.

For Intel SSDs, the model number contains reference to the [NAND lithography](#).

- **Security Status** (Word 128): Security state of the selected drive.
 - Bit 0 indicates the Security Mode feature set supported. If set to one, security is supported.
 - Bit 1 indicates security enabled. If set to one, the security is enabled.
 - Bit 2 indicates security locked. If set to one, the security is locked.
 - Bit 3 indicates security frozen. If set to one, the security is frozen.

See the ATA-7 Specification for more information.

Note: To reissue the ATA IDENTIFY DEVICE or NVMe IDENTIFY command and display updated information for the selected drive, return to the home screen and click **Refresh**.

Related Sections

[Exporting Drive Details](#)

[Reference Documents](#)



3.2 Exporting Drive Details

On the home screen, click **Export** to save [SMART attributes](#), [drive details](#), and [system information](#) for the selected drive to a .csv (comma-separated values) file, which can be opened in a program such as Microsoft Excel*.

Related Section

[Viewing Drive Details](#)

3.3 SMART Attributes

The SMART Details screen shows Self-Monitoring, Analysis, and Reporting Technology (SMART) attributes on the selected drive. Recommended actions (if any) appear next to each attribute.

Each drive operates under a predefined set of SMART attributes and corresponding threshold values, of which the drive should not pass during normal operation†. Each attribute has a *raw* value (defined by the manufacturer) and a *normalized* value. See the [ATA specifications](#) and [NVMe* specifications](#) for a complete description of each SMART attribute.

Scroll down to view the SMART attributes supported by the selected drive.

Details shown for each SMART attribute include:

- **ID:** The hexadecimal name of the SMART attribute.
- **Description:** The name of the SMART attribute.
- **Raw:** The raw value assigned to the SMART attribute by the drive manufacturer.
- **Normalized:** The value of an attribute adjusted to a scale spanning typical increments of 100 to 1, or 200 to 1.
- **Threshold†:** The lowest acceptable normalized value for the drive.
- **Action:** Identifies whether the system can use the drive for processing.

Descriptions of some SMART attributes are shown below. These attributes vary depending on the Intel SSD or other drive selected. Your SSD or drive may not support some of these attributes. For more details on each attribute, see the [ATA specifications](#) and [NVMe* specifications](#).

ID	Attribute and Description
03	<p>Spin Up Time</p> <p>For Intel SSDs, reports a fixed value of zero (0).</p> <p>The average time it takes the spindle to spin up. (Since an SSD has no moving parts, this attribute reports a fixed Raw value of zero (0) and a fixed Normalized value of 100.)</p>



ID	Attribute and Description
04	Start/Stop Count For Intel SSDs, reports a fixed value of zero (0). This type of event is not an issue for SSDs. However, hard disk drives can experience only a finite number of these events, and therefore, must be tracked.
05	Re-allocated Sector Count The raw value shows the number of retired blocks since leaving the factory (grown defect count).
09	Power-On Hours Count The raw value reports the cumulative number of power-on hours over the life of the device. Note: The On/Off status of the Device Initiated Power Management (DIPM) feature affects the number of hours reported. <ul style="list-style-type: none">• If DIPM is turned on, the recorded value does not include the time that the device is in a <i>slumber</i> state.• If DIPM is turned off, the recorded value should match the clock time, as all three device states are counted: <i>active</i>, <i>idle</i>, and <i>slumber</i>.
0C	Power Cycle Count The raw value reports the cumulative number of power-cycle events (power on/off cycles) over the life of the device.
AA	Available Reserved Space Reports the number of reserve blocks remaining. The normalized value begins at 100 (64h), which corresponds to 100 percent availability of the reserved space. The threshold value for this attribute is 10 percent availability.
AB	Program Fail Count The raw value shows total count of program fails. The normalized value, beginning at 100, shows the percent remaining of allowable program fails.
AC	Erase Fail Count The raw value shows total count of erase fail. The normalized value, beginning at 100, shows the percent remaining of allowable erase fails.
AE	Unexpected Power Loss Reports number of unclean shutdowns, cumulative over the life of the SSD. An “unclean shutdown” is the removal of power without STANDBY IMMEDIATE as the last command (regardless of PLI activity using capacitor power). Also known as “Power-off Retract Count” per magnetic-drive terminology.



ID	Attribute and Description
B8	<p>End-to-End Error Detection Count</p> <p>Reports number of errors encountered during Logical Block Address (LBA) tag checks within the SSD data path. The normalized value begins at 100 and decrements by 1 for each LBA tag mismatch detected. The threshold value is 90.</p>
BB	<p>Uncorrectable Error Count</p> <p>The raw value shows the count of errors that could not be recovered using Error Correction Code (ECC).</p>
BE	<p>Temperature - Airflow (Case)</p> <p>Reports the SSD case temperature in degree Celsius. The raw value is as follows:</p> <ul style="list-style-type: none"> • Byte 0 = Current case temperature (°C) • Byte 2 = Recent minimum case temperature (°C) • Byte 3 = Recent maximum case temperature (°C) <p>The normalized value is 100. Case temperature is calculated based on an offset from internal temperature sensor.</p>
C0	<p>Unsafe Shutdown Count (Power-off Retract Count)</p> <p>The raw value reports the cumulative number of unsafe (unclean) shutdown events over the life of the device. An unsafe shutdown occurs whenever the device is powered off without STANDBY IMMEDIATE being the last command.</p>
C2	<p>Temperature - Device Internal</p> <p>Reports internal temperature of the SSD. Temperature reading is the value direct from the internal sensor. The raw value is the current temperature. The normalized value is the results equation $\min(150 - \text{current temp}, 100)$.</p>
C7	<p>CRC Error Count</p> <p>The total number of encountered SATA interface Cyclic Redundancy Check (CRC) errors.</p>
E1	<p>Host Writes</p> <p>The raw value reports the total number of sectors written by the host system. The raw value increases by 1 for every 65,536 sectors written by the host.</p>
E2	<p>Timed Workload, Media Wear</p> <p>Measures the wear seen by the SSD (since reset of the Timed Workload Timer, attribute E4), as a percentage of the maximum rated cycles.</p>
E3	<p>Timed Workload, Host Read/Write Ratio</p> <p>The percentage of I/O operations that are read operations (since reset of the Timed Workload Timer, attribute E4).</p>
E4	<p>Timed Workload Timer</p> <p>Measures the elapsed time (number of minutes) since starting this workload timer.</p>



ID	Attribute and Description
E8	Available Reserved Space Reports the number of reserve blocks remaining. The normalized value begins at 100 (64h), which corresponds to 100 percent availability of the reserved space. The threshold value for this attribute is 10 percent availability.
E9	Media Wearout Indicator Reports the number of cycles the NAND media has undergone. The normalized value declines linearly from 100 to 1 as the average erase cycle count increases from 0 to the maximum rated cycles. Once the normalized value reaches 1, the number will not decrease, although it is likely that significant additional wear can be put on the device.
F1	Total LBAs Written Counts sectors written by the host.
F2	Total LBAs Read Counts sectors read by the host.

Note: To reissue the ATA IDENTIFY DEVICE command or the NVMe IDENTIFY command and refresh the SMART information for the selected drive, click **Refresh** on the home screen.

†Threshold values not applicable to NVMe* drives.

Related Sections

[Exporting SMART Attributes](#)

[Viewing Drive Details](#)

[Exporting Drive Details](#)

3.4 Exporting SMART Attributes

On the home screen, click **Export** to save [SMART attributes](#), [drive details](#), and [system information](#) for the selected drive to a .csv (comma-separated values) file, which can be opened in a program such as Microsoft Excel*.

Related Sections

[Viewing SMART Attributes](#)

3.5 System Information

The System Information screen shows details about your computer's operating system and hardware configuration, such as central processing unit (CPU), chipset, and controller name and driver version.

This information can be useful for troubleshooting purposes.

Related Sections

[Viewing Drive Details](#)

[Viewing SMART Details](#)



4 Optimizing your Intel SSD

4.1 About the Intel® SSD Optimizer

The Intel SSD Optimizer helps an Intel SSD retain its out-of-box performance by removing deleted data files from NAND flash management blocks on the SSD using Trim functionality (a command that allows an operating system to inform an SSD which blocks of data are no longer considered in use and can be deleted).

For example, when you delete a file on your system, the operating system marks the file for deletion but does not physically erase the file. Because an SSD does not know which files are deleted, the SSD continues to think all files contain valid data. This situation causes the SSD to continue managing deleted files in addition to valid data in the SSD.

By running the Intel SSD Optimizer, the tool identifies which files you have deleted and communicates that information to the SSD. This notification allows the SSD to clean up internal management space, thus eliminating the need to manage the deleted files.

You can [schedule](#) the Intel SSD Optimizer to run automatically on a weekly, daily, or monthly basis or you can [manually run](#) it at any time.

Related Sections

[Intel SSD Optimizer Requirements](#)

[Scheduling the Intel SSD Optimizer](#)

[Running the Intel SSD Optimizer Manually](#)

4.2 Intel® SSD Optimizer Requirements

The Intel SSD Optimizer runs on Intel SSDs only. All Intel SSDs are supported except first-generation (G1 50nm) Intel SSDs. To identify your Intel SSD, see [Identifying NAND Lithography of an Intel SSD](#).

Before running the Intel SSD Optimizer, make sure the Intel SSD has the latest firmware installed. See [Checking for Firmware Updates](#).

Note the following before running or scheduling the Intel SSD Optimizer:

- Do not run the Intel SSD Optimizer when a backup is in progress
- Do not run the Intel SSD Optimizer if the Intel SSDs are in a RAID configuration †
- The Intel SSD Optimizer does not support Windows 8*/Windows Server 2012* Storage Spaces*, nor any individual drive that is a member of a Storage Space
- Make sure Intel SSD Optimizer sessions are scheduled to run when the computer is on. The Intel SSD Optimizer does not wake up or turn on the computer to run a scheduled session



Notes:

- **If your computer uses Microsoft Windows* 7 or 8 and the standard Microsoft AHCI driver**
If your computer uses this configuration (the default setup for normal configurations without RAID), you do not need to run the Intel SSD Optimizer because Windows 7 and 8 natively implement Trim functionality.
- **If your computer uses Windows 7 or 8 and Intel® Matrix Storage Manager version 8.x or Intel® Rapid Storage Technology (Intel® RST) driver version 9.5 or earlier**
If your computer uses this configuration (which can be used in place of the Microsoft AHCI driver), Trim functionality is not implemented. You must use Intel SSD Optimizer to run Trim.
- **If your computer uses Windows 7 and Intel® Rapid Storage Technology (Intel® RST) 9.6 or later**
If your computer uses Intel® Rapid Storage Technology (Intel® RST) driver version 9.6 or later, Intel SSD Optimizer is not required to run Trim. Intel® RST supports the Windows 7 and Windows 8 Trim command, but for non-RAID/Storage Space configurations only.

† The Intel SSD Optimizer can be used on a drive in a RAID array if all of the following conditions are true:

- The drives are configured as RAID0
- Version 11.0 or later of Intel® Rapid Storage Technology (RST) is installed
- All drives in the RAID array are Intel SSDs that support Trim
- The array is healthy
- The operating system is not Windows 8 or Windows Server 2012

Related Sections

[Manually Running the Intel SSD Optimizer](#)

[Scheduling the Intel SSD Optimizer](#)

4.3 Manually Running the Intel® SSD Optimizer

Note the following before manually running the Intel SSD Optimizer:

- Do not run the Intel SSD Optimizer when a backup is in progress.
- Do not run the Intel SSD Optimizer if the Intel SSDs are in a RAID configuration. †
- The Intel SSD Optimizer does not support Windows 8/Windows Server 2012 Storage Spaces, nor any individual drive that is a member of a Storage Space

To run the Intel SSD Optimizer:

1. Select the Intel SSD on the home screen.
2. Click **Intel SSD Optimizer**.
3. Click **Run**.



4. Review the text describing the Intel SSD Optimizer requirements, and then click **Start**.

If you receive a warning message stating the Intel SSD Optimizer has detected the presence of either RAID or encryption on the selected Intel SSD, review the following:

- If the Intel SSD is *not* in a RAID configuration but is encrypted, click **Accept** to continue running the Intel SSD Optimizer on the selected SSD. See [Troubleshooting - Intel SSD Optimizer](#) for more information.
- If the Intel SSD is in a RAID configuration, click **Decline** to stop running the Intel SSD Optimizer. The Intel SSD Optimizer cannot run on Intel SSDs in a RAID configuration.† See [Troubleshooting - Intel SSD Optimizer](#) for more information.

The Intel SSD Optimizer starts. A progress bar shows the status of the tool.

† The Intel SSD Optimizer can be used on a drive in a RAID array if all of the following conditions are true:

- The drives are configured as RAID0
- Version 11.0 or later of Intel® Rapid Storage Technology (RST) is installed
- All drives in the RAID array are Intel SSDs that support Trim
- The array is healthy
- The operating system is not Windows 8 or Windows Server 2012

Related Sections

[Intel SSD Optimizer Requirements](#)

[Scheduling the Intel SSD Optimizer](#)

4.4 Scheduling the Intel® SSD Optimizer

Note the following before setting a schedule:

- Make sure Intel SSD Optimizer sessions are scheduled to run when the computer is on. The Intel SSD Optimizer does not wake up or turn on the computer to run a scheduled session.
- Do not schedule the Intel SSD Optimizer to run when a backup is in session.
- Do not run the Intel SSD Optimizer if the Intel SSDs are in a RAID configuration. †

To schedule the Intel SSD Optimizer:

1. [Manually run](#) the Intel SSD Optimizer one time to verify it runs successfully. Once the manual run is successful, you can set an automated scheduled operation.
2. On the home screen, select the Intel SSD you want to schedule with the Intel SSD Optimizer.
3. Click **Intel SSD Optimizer**.
4. Click **Schedule**.

If your computer contains more than one Intel SSD, you can apply the schedule to all supported Intel SSDs by clicking **All Supported Intel SSDs**.

5. Set the schedule (including day, time, and frequency).



6. Click **Add**.
7. Review the requirement text and click **Schedule**.

The schedule appears on the screen.

If you receive a warning message stating the Intel SSD Optimizer has detected the presence of either RAID or encryption on the selected Intel SSD, review the following:

- If the Intel SSD is *not* in a RAID configuration but is encrypted, click **Accept** to continue running the Intel SSD Optimizer on the selected SSD. See [Troubleshooting - Intel SSD Optimizer](#) for more information.
 - If the Intel SSD is in an unsupported RAID configuration,† click **Decline** to stop running the Intel SSD Optimizer. The Intel SSD Optimizer cannot run on Intel SSDs in a RAID configuration. See [Troubleshooting - Intel SSD Optimizer](#) for more information.
7. Exit the Intel SSD Optimizer or return to the home screen.

The Intel SSD Optimizer runs at the scheduled time. When the session starts, an icon appears in the Windows* task tray notifying you the Intel SSD Optimizer is running. Upon completion, the icon disappears.

† The Intel SSD Optimizer can be used on a drive in a RAID array if all of the following conditions are true:

- The drives are configured as RAID0
- Version 11.0 or later of Intel® Rapid Storage Technology (RST) is installed
- All drives in the RAID array are Intel SSDs that support Trim
- The array is healthy
- The operating system is **not** Windows 8 or Windows Server 2012

Related Sections

[Intel SSD Optimizer Requirements](#)

[Running the Intel SSD Optimizer Manually](#)

4.5 Removing a Scheduled Intel® SSD Optimizer Session

To remove a scheduled Intel SSD Optimizer session:

1. Click **Intel SSD Optimizer**.
2. Click **Schedule**.
3. Click **Remove** next to the schedule you want to delete.

Related Sections

[Intel SSD Optimizer Requirements](#)

[Manually Running the Intel SSD Optimizer](#)



5 Running Diagnostic Scans

5.1 Quick Diagnostic Scan

Run the Quick Diagnostic scan to test the basic functionality of the selected Intel SSD. The scan takes approximately three minutes to complete and performs two tests:

- Read Scan - checks 1.5 GB of the Intel SSD for READ errors.
- Data Integrity Scan - creates 1 GB of random data, writes the data to unused areas of the Intel SSD, and then compares it for data integrity (**Note:** *the Data Integrity Scan cannot be run on a Windows 8/Windows Server 2012 Storage Space, nor on any individual SSD that is a member of a Storage Space*).

The scan requires:

- A minimum of 5 GB of free space to run.
- A partitioned area to create and validate random data.

Note: Other Intel SSD Toolbox options (such as the home screen or SMART Details screen) may be accessed while the scan is running, but no other tests (such as Intel SSD Optimizer or Full Diagnostic Scan) may be started.

1. Click **Run**.
2. View the progress on the screen.

To stop the scan, click **Cancel**.



5.2 Full Diagnostic Scan

Run the Full Diagnostic scan to perform an overall health evaluation on the selected Intel SSD.

The scan performs two tests:

- Read Scan - checks every logical block address (LBA) for READ errors.
- Data Integrity Scan - uses free space to write random data and read it back to ensure data integrity (**Note:** the Data Integrity Scan cannot be run on a Windows 8/Windows Server 2012 Storage Space, nor on any individual SSD that is a member of a Storage Space).

The scan can take an hour or more to complete (depending on the amount of free space on the Intel SSD). The test can run in the background.

The scan requires:

- A minimum of 5 GB of free space to run.
- A partitioned area to create and validate random data.

Note: Other Intel SSD Toolbox options (such as the home screen or SMART Details screen) may be accessed while the scan is running, but no other tests (such as Intel SSD Optimizer or Quick Diagnostic Scan) may be started.

1. Click **Run**.
2. View the progress on the screen.

To stop the scan, click **Cancel**.

Related Sections

[Running Quick Diagnostic Scan](#)



6 Updating Firmware

6.1 Checking for Firmware Updates

If your Intel SSD contains an older version of firmware than the version included with this release of the Intel SSD Toolbox, the following icon appears next to the Firmware Update option on the home screen:



The Intel Update Manager, if you elected to install it along with the SSD Toolbox, will periodically check for the availability and provide notification of any new versions of the Intel SSD Toolbox (which includes any new firmware version available for the installed Intel SSDs).

To manually check for a newer version:

1. Note the firmware version of the selected Intel SSD (on the home screen).
2. Click Firmware Update.
3. Click **Check For Updates** to open the Intel Download Center.
4. View the Intel SSD Firmware table and check if the selected Intel SSD is running the latest firmware version.
5. If a newer firmware version is available, download and install Intel SSD Toolbox.
6. Update the firmware following the instructions in [Using Firmware Update](#).

Related Sections

[Using Firmware Update](#)

6.2 Using Firmware Update

The Firmware Update option updates the selected Intel SSD to the latest firmware available with this version of the Intel SSD Toolbox. To check for a newer version, click **Check For Updates** at the bottom of the Firmware Update screen.

Notes:

- 1) The firmware update functionality is not available if ATA Security is enabled on the selected SSD—whether it is locked or unlocked. Please ensure that ATA Security (also known as HDD or SSD Password) is disabled before proceeding. See your computer's documentation for instructions.
- 2) To update firmware on an Intel® X25-E Solid-State Drive or Intel® Solid-State Drive 510 Series, use the Intel® SATA Solid-State Drive Firmware Update Tool available at <http://www.intel.com/go/ssdfirmware>. The Intel SSD Toolbox Firmware Update option does not update firmware on these SSDs.



To update the firmware on an Intel SSD:

1. Back up the Intel SSD.

Perform a complete system backup on the Intel SSD to make sure no data is lost during the firmware update process. Intel is not responsible for any data loss that might occur during or after a firmware update on an Intel SSD.

2. Close all open applications except Intel SSD Toolbox.
3. Select the Intel SSD you want to update on the home screen.
4. Click **Firmware Update**.
5. Click **Update** to update the selected Intel SSD with the firmware version included with this release of Intel SSD Toolbox. Minimize system use during this operation.
6. Reboot your system once the update is complete.

Related Sections

[Checking for Firmware Updates](#)

[Troubleshooting - Firmware Update](#)



7 Tuning Your System

7.1 System Tuner

Use the System Tuner to check your system and adjust settings to improve the performance, power, and endurance of the selected Intel SSD. If your system requires tuning, the following icon appears next to System Tuner on the home screen:



To run the System Tuner:

1. Select the Intel SSD on the home screen.
2. Click **System Tuner**.

The System Tuner displays services that can be optimized for use with the selected Intel SSD. If a service is available and can be optimized, **Tune!** appears next to the service name.

- **Intel® Rapid Storage Technology (Intel® RST) Write Cache**

For best performance, Intel recommends enabling Write Back cache in Intel® RST/Intel® Matrix Storage Manager console.

Note: This service appears on the System Tuner screen only if your system has an Intel® RST RAID volume configuration containing only Intel SSD RAID volume members.

- **Superfetch*/Prefetch**

In Microsoft Windows Vista* and Windows 7*, Superfetch* tracks and copies your most frequently used applications to system memory to reduce load times. Superfetch is based on the similar Prefetch feature available in Windows XP. Superfetch/Prefetch is not needed on an Intel SSD under Windows 7 or Windows Vista, and should be disabled for optimal performance.

In Microsoft Windows 8*, Superfetch functions differently than in previous versions of Windows, and should not be disabled for an Intel SSD.

- **ReadyBoost***

In Microsoft Windows Vista, ReadyBoost is a feature that uses any flash memory device connected to your system as a drive for disk caching. It is also used to facilitate SuperFetch. In Windows 7 and Windows 8, ReadyBoost is part of SuperFetch. In Windows XP, ReadyBoost is not installed. ReadyBoost is not needed on an Intel SSD and should be disabled for optimal performance.



- **Device Initiated Power Management (DIPM)**

For Intel SSDs installed in mobile systems, DIPM is the most efficient power management method for managing SATA link power. With DIPM, link management is handled by the SSD (the SSD knows best how long a specific command might take to complete and is best equipped to request a link power management state change while processing the command). DIPM should be enabled on Intel SSDs for optimal performance.

- **Defragmenter**

Microsoft Windows Disk Defragmenter rearranges files stored on a disk to occupy contiguous storage locations to increase access speed and optimize the time it takes to read and write files to and from the disk. In Windows Vista, Windows 7 and Windows 8, Disk Defragmenter should be disabled on Intel SSDs. In Windows XP, Disk Defragmenter cannot be disabled. In this operating system, make sure to unschedule Disk Defragmenter on any Intel SSD(s).

3. Click **Tune!** next to the setting you want to optimize.

Additionally, depending on your system configuration and operating system, perform these tasks to optimize performance:

- [Dual-drive systems \(HDD + SSD\)](#)
- [SSD-only systems](#)
- [Mobile systems with shock sensor](#)
- [Intel SSDs in RAID Configurations Using Intel® Rapid Storage Technology Driver](#)
- [Mobile systems without Intel® Rapid Storage Technology or Intel® Matrix Storage Manager](#)

Related Sections

[Additional Tips for Optimizing Performance](#)

[Changing System Tuner Settings](#)



7.2 Additional Tips for Optimizing Performance

In addition to running the System Tuner, perform these tasks (depending on your system configuration and operating system) to optimize the performance of an Intel SSD:

- [Dual-drive systems \(HDD + SSD\)](#)
- [SSD-only systems](#)
- [Mobile systems with shock sensor](#)
- [Intel SSDs in RAID Configurations](#)
- [Mobile systems without Intel Rapid Storage Technology or Intel Matrix Storage Manager](#)

Related Sections

[Running System Tuner](#)

7.2.1 Dual-Drive Systems

If you have an Intel SSD installed as part of a dual-drive configuration (SSD + hard disk drive), review these tips to help optimize performance of the Intel SSD:

- Install your most frequently used applications on the Intel SSD.
- Run and schedule Disk Defragmenter on the hard disk drive only.
- Make sure Disk Defragmenter does not run, and is not scheduled to run, on the Intel SSD. In Windows* XP, this requires that you check the following:

Open Windows XP Scheduled Tasks and search for defrag.exe or other third-party defragmenter tools and make sure the tool is not scheduled to run. (Scheduled Tasks is available in **Start > All Programs > Accessories > System Tools**. See the Windows XP documentation for instructions.)

Related Sections

[Running System Tuner](#)

7.2.2 SSD-only Systems

If you have an Intel SSD installed as the only drive in your system, make sure Disk Defragmenter does not run (and is not scheduled to run) on the Intel SSD.

In Windows* XP, this requires that you open Windows XP Scheduled Tasks and search for defrag.exe or other third-party defragmenter tools and make sure the tool is not scheduled to run.

Scheduled Tasks is available in **Start, All Programs, Accessories, System Tools**. See the Windows XP documentation for instructions.

Related Sections

[Running System Tuner](#)



7.2.3 Mobile Systems with Shock Sensor

If you have an Intel SSD installed in a mobile system with shock sensor, make sure the shock sensor on the mobile system is disabled.

Note: Intel SSDs are not affected with performance degradation caused by shock or vibration in specified limits, and therefore, can run with the shock sensor disabled. See the *Intel Solid-State Drive Product Specification* for your Intel SSD for specified limits. See your system documentation for information on disabling this feature.

Related Sections

[Running System Tuner](#)

7.2.4 Intel SSDs in RAID Configurations Using Intel® Rapid Storage Technology Driver

To obtain higher performance from RAID configurations consisting of Intel SSDs and Intel® Rapid Storage Technology (Intel® RST), make sure Intel® RST Write Back Cache is enabled.

Note: Enabling Write Back Cache increases the chance of system data loss during a power-loss event. (However, all data written to the SSD will be committed to NAND during a power-loss event.) See your system documentation for information on enabling or disabling this feature.

Related Sections

[Running System Tuner](#)

7.2.5 Mobile Systems without Intel® Rapid Storage Technology or Intel® Matrix Storage Manager

To obtain higher performance on mobile systems with an Intel SSD without Intel Rapid Storage Technology or Intel Matrix Storage Manager, enable DIPM (Device Initiated Power Management) on your mobile system. See your system documentation for instructions.

Related Sections

[Running System Tuner](#)



7.3 Changing System Tuner Settings

System Tuner can [configure services](#) to optimize your system for use with an Intel SSD. To change a service back to its original setting once optimized, you must manually configure the service.

For complete instructions on all services, see your operating system documentation.

Changing Device Initiated Power Management (DIPM)†

The System Tuner enables DIPM in mobile systems.

This section explains how to disable DIPM on mobile systems in Microsoft Windows* 7. For instructions on other operating systems, see the system documentation that came with your operating system.

Note: For Intel SSDs installed in mobile systems, DIPM is the most efficient power management method for managing SATA link power. Intel recommends DIPM be enabled on Intel SSDs for optimal performance.

To use these instructions, the selected Intel SSD must be connected to an AHCI controller.

To manually disable DIPM in Windows 7:

1. Start the Registry Editor (open the Windows Start menu and type **regedit** in the Search field).
2. Navigate to the following entry:
HKEY_LOCAL_MACHINE\SYSTEM\ControlSet001\Control\Power\PowerSettings\0012ee47-9041-4b5d-9b77-535fba8b1442\0b2d69d7-a2a1-449c-9680-f91c70521c60
3. Right-click **Attributes** in the right pane and select **Modify**.
4. Change the Attributes value to **1**.
5. Click **OK**.
6. Reboot the system.
7. Open the Windows Control Panel and select **Power Management** or **Power Options**.
8. Click **Change plan settings** next to **Balanced**.
9. Click **Change advanced power settings**.
10. Expand the Hard Disk option.
11. Expand the **AHCI Link Power Management - HIPM/DIPM** option.
12. Change the **On battery** or **Plugged in** setting to **HIPM**.
13. Click **OK**.



Changing Disk Defragmenter

The System Tuner disables Disk Defragmenter in Microsoft Windows Vista*.

For instructions on enabling Disk Defragmenter in Windows Vista, see your operating system documentation.

Note: In Windows XP*, Disk Defragmenter cannot be disabled.

†Not applicable for NVMe* drives.

Related Sections

[Additional Tips for Optimizing Performance](#)

[Running System Tuner](#)



8 Performing a Secure Erase

8.1 About Secure Erase

Secure Erase permanently deletes all data on an Intel SSD. To run Secure Erase, the Intel SSD must be installed as a secondary SSD in your system.

 **CAUTION:** Secure Erase is an unrecoverable operation that permanently deletes all data on an Intel SSD. Secure Erase eliminates not only the user data section of the SSD, but also the reserve data area, rendering data remnants virtually unrecoverable. Secure Erase is an addition to the existing *format drive* command available in computer operating systems. Once you run Secure Erase on an Intel SSD, there is no possibility to recover data from the SSD.

On Intel SSDs containing 25nm and later NAND Flash Memory, retired blocks are also erased. See [Identifying NAND Lithography on an Intel SSD](#) for help with identifying your Intel SSD.

Notes:

- On Intel SSDs supporting encryption, the encryption key used in randomizing data is re-generated after Secure Erase
- Secure Erase is not available for Windows* 8 systems
- Secure Erase is not available if ATA Security is enabled on the selected SSD—whether it is locked or unlocked.†

†Not applicable for NVMe* drives.

Related Sections

[Secure Erase Requirements](#)

[Deleting a Partition](#)

[Running Secure Erase](#)



8.2 Secure Erase Requirements

Note: The Secure Erase functionality is not available on Windows* 8 systems.

To run Secure Erase on an Intel SSD:

- The SSD must be the secondary drive in the system. Secure Erase cannot be run from a bootable SSD or on an SSD with a partition.
- All drive passwords (ATA Security) must be disabled for the SSD†. See your computer's documentation for instructions.
- The system must allow access to the SATA power cable connected to the SSD.
- All partitions must be removed from the SSD.
- Back up any data onto another drive if you want to keep any of the data on the Intel SSD.

†Not applicable on NVMe* drives.

Related Sections

[Deleting a Partition](#)

[Running Secure Erase](#)

8.3 Deleting a Partition

These instructions describe how to delete a partition on an Intel SSD in Microsoft Windows* in preparation for running Secure Erase on the SSD.

These steps logically delete a partition, which makes all data unavailable on the SSD. These steps can be performed while Intel SSD Toolbox is running.

1. In Windows, right-click **Computer**, click **Manage** and then **Disk Management**.
2. Select the Intel SSD that contains the partition.
3. Locate the partition on the Intel SSD (indicated by a drive letter).
4. Right-click on the partition and select **Delete Partition** or **Delete Volume**.
5. Confirm the deletion, if prompted.
6. Exit the Windows Disk Management screen.
7. After deleting the partition, click **Refresh** on the Intel SSD Toolbox home screen.

Related Sections

[Running Secure Erase](#)



8.4 Running Secure Erase

Run Secure Erase to permanently delete all data on a secondary Intel SSD installed in your system.

 **CAUTION:** Secure Erase is an unrecoverable operation that permanently deletes all data on an Intel SSD. Secure Erase eliminates not only the user data section of the SSD, but also the reserve data area, rendering data remnants virtually unrecoverable. Secure Erase is an addition to the existing *format drive* command available in computer operating systems. Once you run Secure Erase on an Intel SSD, there is no possibility to recover data from the SSD.

1. [Review the requirements](#) before running Secure Erase.
2. [Delete all partitions](#) on the Intel SSD to be erased.
3. Select the Intel SSD on the home screen and view the Drive Summary information to verify the Intel SSD is the drive you want to erase.
4. Click **Secure Erase**.
5. Click **Erase**.

If a Secure Frozen Warning message appears†:

A Secure Frozen Warning message indicates the SSD is in the SECURITY FREEZE LOCK state. Secure Erase cannot be performed on an SSD when it is in this state. To prepare the SSD for the removal of the SECURITY FREEZE LOCK state, the Intel SSD Toolbox sends the STANDBY IMMEDIATE command to the SSD, which results in the warning message.

To remove the SECURITY FREEZE LOCK state and continue with the Secure Erase process:

- a. Power-cycle the SSD by removing the SATA power cable from the SSD and quickly reconnecting it while the Intel SSD Toolbox is running. Depending on your system configuration, this may require that you physically remove the SSD from the system.

Note: It is recommended you perform this process quickly to make sure the system continues to recognize the SSD.

- b. After unplugging and plugging in the SSD, click **OK**.

The Intel SSD Toolbox rescans the system for the SSD. Once the SSD is detected, continue with Step 6.

If the SSD is not detected, click **OK** on the Selected Drive Not Found message. The Intel SSD Toolbox home screen appears and scans the system for drives. Once the Intel SSD is detected, select the Intel SSD on the home screen and click **Secure Erase**.

If the Security warning message appears again, repeat the power-cycling process (steps a and b), making sure to quickly remove and reconnect the SATA power cable. If the Secure Frozen Warning message continues to appear, this indicates that power-cycling the drive is not removing the SECURITY FREEZE LOCK state on this system. If this is the case, Intel SSD Toolbox cannot run Secure Erase on this system. Intel recommends obtaining a drive utility with Secure Erase and running Secure Erase from that utility.

If the SSD is not detected and does not appear on the home screen, open the Windows Device Manager and rescan the system for drives (right-click **Computer** > **Manage** > **Device Manager**, then right-click **Disk Drives** > **Scan for hardware changes**).



After scanning the system, click **Refresh** on the Intel SSD Toolbox home screen and try the Secure Erase procedure again, making sure to quickly remove and reconnect the SATA power cable.

6. Click **Run**.

Secure Erase starts on the selected Intel SSD. A progress bar shows the status of the operation. The process can take 1 to 2 minutes, depending on the capacity of the SSD.

 **CAUTION:** Your system may appear to stop responding during this operation. Do not power off or disconnect power from your system during the operation, as this can damage the SSD.

7. When complete, [create an active partition and format the SSD](#).
8. Click **Refresh** on the home screen to view the Intel SSD.

†Not applicable for NVMe* drives.

Related Sections

[Secure Erase Requirements](#)

[Deleting a Partition](#)

[Creating a Partition](#)



8.5 Creating a Partition

These instructions describe how to create and format a partition on an Intel SSD in Microsoft Windows* 7. These instructions can be helpful for preparing an SSD after performing a Secure Erase. For more information or instructions for other operating systems, see the documentation for your operating system.

1. Right-click **Computer** > **Manage** > **Disk Management**.
2. Select the Intel SSD on which you want to create a partition and click **New Simple Volume**.
3. Click **Next** when the New Simple Volume Wizard starts.
4. Enter the information for the partition (size of partition, drive letter).
5. Click **Next**.
6. Select an option to format the partition, and then click **Next**.
7. Click **Finish**.



9 Troubleshooting

9.1 Troubleshooting - Drives

Drive does not appear on the home screen

If a drive installed in the system does not appear on the home screen:

- Check power to the drive.
- For SATA drives, check the SATA cable connection and make sure the cable is properly connected to the drive and the host system.
- For NVMe* drives, check that the drive is properly socketed in the CPU direct attached PCIe* slot.
- Click **Refresh** on the home screen.
- Reboot the system and restart the Intel SSD Toolbox.

If the problem persists, contact Intel.

SMART information does not appear for a selected drive

If the SMART Details option is not available for a selected drive, make sure SMART is enabled on the drive.

Drive Health or Estimated Life Remaining does not appear for a selected drive

Drive Health and Estimated Life Remaining information appears for Intel SSDs only with SMART enabled.

9.2 Troubleshooting - Firmware Update

If you encounter an issue updating the firmware on an Intel SSD or if the firmware update fails, use the Intel® Solid-State Drive Firmware Update Tool located at:

<http://www.intel.com/go/ssdfirmware>

Note: The Firmware Update option in the Intel SSD Toolbox can be used to update the firmware on Intel SSDs only. All Intel SSDs are supported except:

- Intel® X25-E Solid-State Drive
- Intel® Solid-State Drive 510 Series

For these SSDs, use the Firmware Update Tool mentioned above.



9.3 Troubleshooting - Intel® SSD Optimizer

Tool is not supported on the selected drive

This error message may appear when trying to run the Intel SSD Optimizer if the selected Intel SSD does not have the latest firmware installed or if the SSD lithography is 50nm (G1).

1. [Check the lithography](#) of the Intel SSD to make sure it is supported by the Intel SSD Optimizer.
2. [Check the firmware](#) to make sure the Intel SSD is using the latest version.

Cannot run the Intel SSD Optimizer on RAID configurations

The Intel SSD Optimizer cannot run on Intel SSDs in RAID configurations, except when the following conditions are all true:

- The drives are configured as RAID0
- Version 11.0 or later of Intel® Rapid Storage Technology (RST) is installed
- All drives in the RAID array are Intel SSDs that support Trim
- The array is healthy
- The operating system is not Windows 8 or Windows Server 2012

The Intel SSD Toolbox checks for RAID configurations at startup. However, because not all RAID configurations can be detected at startup, the tool runs a second check when starting the Intel SSD Optimizer. If the selected Intel SSD is in an unsupported RAID configuration, the tool displays this error message.

If the second check does not detect a RAID configuration, the SSD may still be part of a RAID configuration or the SSD may be using an encryption scheme. In this case, the Intel SSD Toolbox displays a warning screen and prompts you to identify whether the SSD is part of a RAID configuration or is encrypted.

- If the SSD is encrypted and is not in a RAID configuration, click **Accept** to run the Intel SSD Optimizer on the selected SSD.
- If the SSD is in an unsupported RAID configuration, click **Decline** to stop the Intel SSD Optimizer.



10 Additional Information

10.1 Related Publications

For more information on Intel Solid-State Drives, go to <http://www.intel.com/ssd>.

10.2 Reference Documents

Document	Document No./Location
ATA-7 Volume 1 Specification, April 2004	http://www.t13.org/Documents/UploadedDocuments/docs2007/D1532v1r4b-AT_Attachment_with_Packet_Interface_-_7_Volume_1.pdf
SATA Rev 2.6 Specification, February 2007	http://www.sata-io.org
NVMe* Rev 1.0c, February 2012	http://www.nvmexpress.org