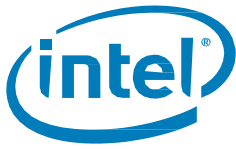# Intel® Solid State Drive 6 Series for PCIe* with NVMe*

Installation Guide

October 2016

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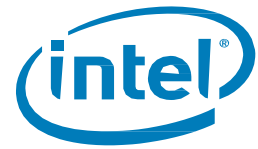
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Contents

Revision History

Revision Number	Description	Revision Date
001	Initial release.	October 2016

1 Overview

This guide describes how to install the Windows operating system into the Intel® SSD 6 Series (Intel® Solid State Drives 600P, Pro 6000P and E 6000P Series). This guide describes how to implement these PCIe* with NVMe* Interface SSDs as a bootable medium in their computing platform.

The information in this document is not applicable if the SSD is being used as a secondary storage device rather than the primary boot device. This guide assumes that you have a general understanding of UEFI and the boot process.
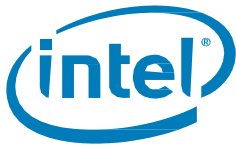
NVMe is a scalable non-volatile memory host interface that can help increase efficiency and reduce latency, and at the same time deliver high access to storage media connected via the PCIe bus, resulting in increased overall bandwidth. NVMe leverages today's existing technology with PCI Express* (PCIe). This high bandwidth bus technology is a data transport feature that has become an industry standard for a wide range of motherboard vendors today.

Terminology

Abbreviation	Term	Definition
CSM	Compatibility Support Module	A UEFI firmware feature that enables legacy BIOS-style booting by emulating a BIOS environment.
NVMe	Non-Volatile Memory Express	The next-generation specification used to access SSDs through the PCI Express* bus.
PCIe	Peripheral Component Interconnect Express	A standard connection found on most systems that supports the high speed of the NVMe SSD.
UEFI	Unified Extensible Firmware Interface	A specification for system firmware, meant to replace legacy BIOS, that provides software layer between the operating system and the system firmware.

References

Document	Location
NVMe Specification 1.2	http://nvmexpress.org/wp-content/uploads/NVM_Express_1_2_Gold_20141209.pdf
UEFI Specification	http://uefi.org/specifications

2   System Requirements

2.1   Software

2.1.1   Determining Compatibility

The information and instructions in this guide apply only to Intel® SSD 6 Series PCIe* with NVMe* Interface. Check that you have the latest instructions and compatibility information before attempting to install the Intel® SSD.

Booting from an NVMe SSD is not guaranteed to work on every system configuration. Specific requirements must be met for a successful boot. To support the required UEFI NVMe driver, your system's firmware must be based on UEFI 2.3.1 or later. If your system was purchased after 2012 or shipped with Windows* 8.1 or Windows 10 pre-installed, it most likely supports UEFI. Check with your system vendor to verify.

2.1.2   UEFI BIOS Compatibility

Booting from an NVMe PCIe SSD is only supported on a system that supports UEFI, a new system firmware that endeavors to improve upon legacy BIOS and standardize system processes, such as booting, loading drivers, and more.

It is important that the operating system installer is booted in UEFI mode. Booting in UEFI allows the installer to create an entry in the UEFI boot menu and create an UEFI system partition on the boot device that will contain the bootloaders of installed operating systems. The boot manager will continue by searching the UEFI system partition for a valid operating system bootloader. This bootloader is then executed to load the operating system.

Windows 7 does not support native UEFI booting without a Compatibility Support Module. As a result, system compatibility is limited and varies by vendor.

To properly boot Windows 7 from an NVMe SSD, your system must support loading UEFI drivers when the Compatibility Support Module is enabled. Make sure to check that:

- Your motherboard vendor support website to find the latest UEFI BIOS for your particular motherboard.

- The system BIOS settings to ensure that your motherboard is configured to boot from UEFI devices. This is often the default on most modern motherboards. For the best chance of success, disable the legacy boot.

For maximum optimization, it is recommended to utilize PCIe Gen 3X4. If you have motherboard configurations with Gen 2 hardware, it will still be able to utilize NVMe PCIe SSDs, but they will not get the optimum peak performance from the SSD. See the OEM's manual for PCIe and further motherboard specifications.
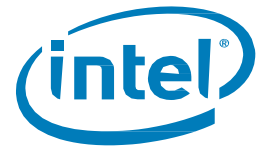
Table 1:   Windows Compatibility

| OS	Support	Additional Notes
Windows 10	Supported	Native NVMe support
Windows 8.1	Supported	Native NVMe support
Windows 7	Limited Support	Limited system compatibility and requires additional drivers

2.2   Hardware

NVMe hardware support is growing and becoming more of an industry standard specification, but there may be a number of motherboards on the market that are not properly configured to boot from NVMe SSDs. Successful motherboard BIOS configurations vary widely and are heavily dependent on the motherboard manufacturer. There is no specific set of options that will guarantee a successful boot. Usually, the settings of a typical motherboard will need to be adjusted. See the OEM's manual for further specific instructions on NVMe hardware compatibility.

NOTE: For Windows 7 installation RST method 2 (see section 3.2), 6th generation platforms and newer are required to properly utilize the Intel RST driver for PCIe NVMe SSDs.

2.2.1 M.2 – M Key Hardware Requirements

A small M.2 (80mm) form factor offers a wide range of capacities and plugs into M.2 – M key slots on major motherboards (see Figure 1). Be sure that your motherboard has a M.2 PCIe slot for product installation.

Figure 1:   M.2 Form Factor with M Key Insert
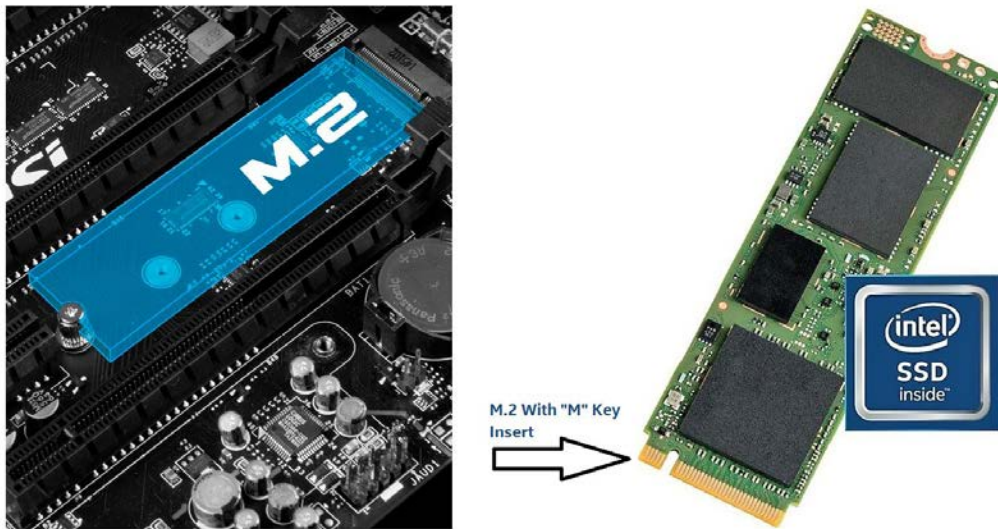
2.2.2 Enabling the Compatibility Support

This is an example of how to configure the BIOS for CSM support in addition to configuring the boot options to enable UEFI.

Example

ASUS Z97 BIOS Configuration

Specifications

Motherboard	ASUS Maximus VII Gene*
Chipset	Intel® Z97 Chipset
BIOS Revision	1002 (7/08/2014)

Compatibility Notes

EFI is a requirement across all windows installations and CSM needs to be enabled for the Windows 7 operating system.
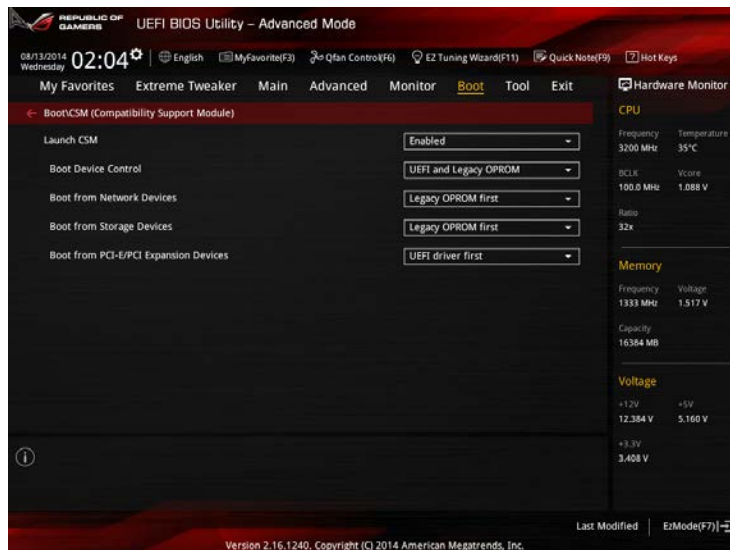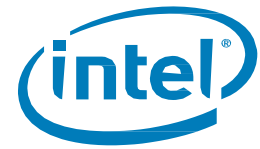
Windows 8.1/10

Boot options must be configured to UEFI.

Windows 7

1. Open CSM (Compatibility Support Module) under the Boot tab.

2. Verify that **Launch CSM** is *Enabled*.

3. Set **Boot from PCI-E/PCI Expansion Devices** to *UEFI driver first*.

Figure 2:   Required Configuration for Windows 7 Boot Support

3   Windows Install Process

The Windows 8.1* and Windows 10* operating systems offer native support for Intel® SSD 6 Series and have a standard installation process. To properly install, do the following:

1. Ensure that your BIOS is configured to EFI (see section 2.2.2).

2. Create a USB install key and copy over with ISO images into the "sources" directory.

3. Boot the Windows operating system using the SSD.

For the Windows 7* operating system, this support was added at a later time via a Windows Update. As a result, the Windows 7 installation will not detect the SSD unless this update is made.

The two methods for installing the Windows operating system are:

Method 1

For this installation, you will create a Windows 7 installer to a USB Flash drive or rewriteable DVD media, update the Windows 7 install file with DISM commands, and replace the Windows 10 files with those in Windows 10 ISO.

For more details, see **Method 1: Windows 7 Installation using DISM with Windows Hotfix**.

Method 2

For this installation, after ensuring that your BIOS is configured to CSM, inject USB drivers into the Windows 7 ISO image, copy over the ISO images and downloaded RST driver files into an USB install key, and boot the Windows operating system using the SSD.
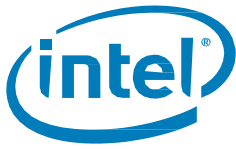
For more details, see **Method 2: Windows 7 Installation with RST Driver**.

Disclaimer: Any links provided for third party tools or sites are offered for your convenience and should not be viewed as an endorsement by Intel of the content, products, or services offered there. Intel does not offer support for any third party tool mentioned here.

3.1   Method 1: Windows 7 Installation using DISM with Windows Hotfix

3.1.1   Requirements for Microsoft* Hotfix

- Windows 7 SP1 x64.iso

  Use the current Windows 7 ISO downloaded image or install files from original installation DVD.

- Windows 10.iso

  https://www.microsoft.com/en-us/software-download/windows10

- Microsoft* Hotfixes

  https://support.microsoft.com/en-us/kb/2990941

  https://support.microsoft.com/en-us/kb/3087873

  Microsoft update solution will be emailed once requested through the links noted above.

- Follow the DISM commands in the command line to mount the required files.

  To use the DISM process, acquire the Windows 8.1 ADK or later.

Intel recommends using the DISM commands within the Command Prompt (see section 3.1.3).

For the GUI method, you can use third party applications, such as Ntlite* (https://www.ntlite.com/download/)

- Attain a tool to zip and unzip files (7 zip tool link located below for reference)

7-Zip* at http://www.7-zip.org

3.1.2 Preparing Windows 7 Install Key

First you must create the bootable media to start the process of installing Windows 7 into the SSD. The main item needed is a Windows 7 ISO, which can be downloaded from Microsoft or properly extracted using an existing Windows 7 DVD install disk.
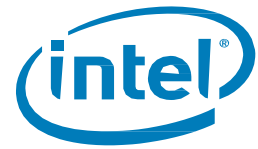
Downloaded Windows 7 ISO

1. Prepare the USB key as a bootable key.

2. Extract the ISO files to the prepared USB install key.

DVD Media

1. Prepare the USB key as a bootable key.

2. Copy files from the DVD to the prepared USB install key.

3.1.3 Modify Windows 7 Install Files using DISM Utility

1. Create a temporary working directory, such as C:\Win7USB.

2. In your working directory, make two sub-directories called "Hotfix" and "Mount."

3. Extract your Hotfix files into your "Hotfix" subdirectory. You should have the following files:

   Windows6.1-KB2990941-*-x64.msu

   Windows6.1-KB3087873-*-x64.msu

4. From your Windows 7 install key , copy the "install.wim" file from the "sources" directory on your install key to the working directory `C:\Win7USB`.

5. Open a command prompt as administrator, and change to your working directory.

   For example: `cd C:\Win7USB`

6. Based on the version of Windows 7 you have available, determine which index number to modify.

   Choose the index that matches the Windows 7 version you have. To determine the index, run the command:

   `dism /get-wiminfo /wimfile:install.wim`

Using index 3 for this example:

7. Modify the "install.wim" file by running the following commands:

   `dism /mount-wim /wimfile:install.wim /index:3 /mountdir:mount`

   `dism /image:mount /add-package: [Path of the hotfix files]`
   i.e. C:\Win7USB\Hotfix

   `dism /get-packages /image:mount`

   `dism /unmount-wim /mountdir:mount /commit`

8. Copy the updated "install.wim" in the working directory back to the "sources" directory on your install key.

3.1.4 Extracting Necessary Windows 10 Files

1. Open win 10 ISO with zip tool.

2. Extract the "boot.wim" and "setup.exe" files from the "sources" directory to the Windows 7 "sources" directory on your USB install key.

   When prompted to overwrite, be sure to replace Windows 7 files with Windows 10 files.

   Your windows 7 USB key is now configured properly for windows installation.
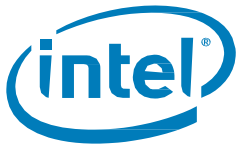
3.2   Method 2: Windows 7 Installation with RST Driver

This installation requires the Intel 6th Generation platform and newer with the PCIe* storage remapping option.

NOTE: If your platform does not meet all requirements for this method, use Method 1.

3.2.1   Requirements for the RST Driver Installation

- Windows* 7 SP1 x64.iso

  Use the current Windows 7 ISO downloaded image or install files from original installation DVD.

- Attain a tool to zip and unzip files.

  7-Zip* tool link located at http://www.7-zip.org

- Intel RST Drivers

  http://www.intel.com/content/www/us/en/support/technologies/intel-rapid-storage-technology-intel-rst.html

- USB Drivers

  https://downloadcenter.intel.com/product/65855/Intel-USB-3-0-eXtensible-Host-Controller-Driver

  NOTE: If you are unable to see the drive directory on the USB key install after injecting the USB drivers into the windows 7 ISO image via DISM commands, please consult your motherboard manufacturer to obtain the necessary USB drivers and preform the injection process with the appropriate USB drivers.

  Intel recommends using the DISM commands within the Command. For the GUI method, you can use applications such as Intel's NUC Utility: (https://downloadcenter.intel.com/download/25476/Windows-7-USB-3-0-Creator-Utility?product=89190)

3.2.2   BIOS Setup

RST requires the PCIe storage remapping option. It is limited to the Intel 6th Generation platform and newer, so be sure to check with your motherboard vendor or user manual before applying this method. Changing ports with RST PCIe storage remapping option will allow NVMe to be properly utilized. You will get boot ability after the ports are properly remapped.

Figure 3 shows the UEFI BIOS advanced settings' additional options that are specific to the Intel RST platform. By toggling the RAID support controls, it diverts control of the connected device over to RST.

NOTE: This figure example shows two drives on the BIOS configuration: one via PCIe_3 and the other via the U.2/M.2 Hyper Kit adapter. The same process is used for a single drive configuration.
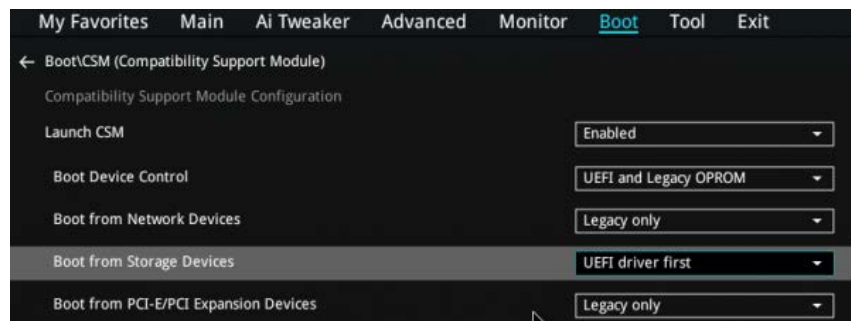
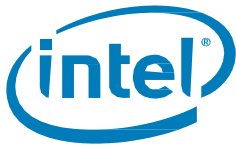**Figure 3:   Intel RST BIOS: Advanced Example**
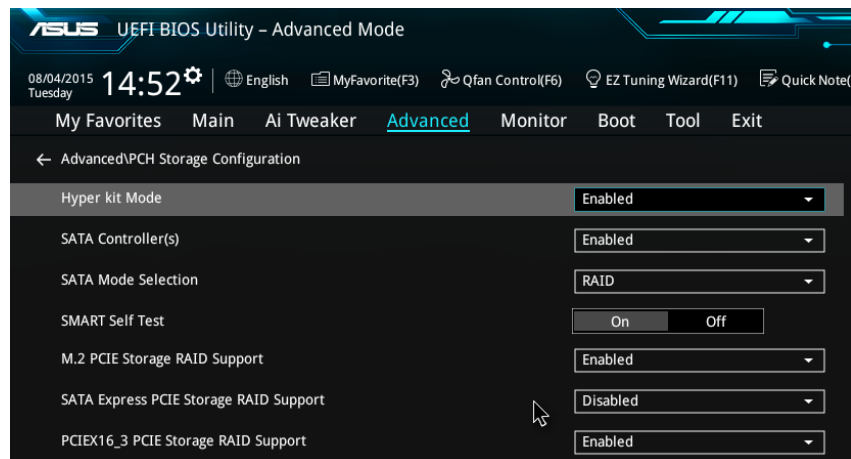
In Figure 4, the Intel boot settings are selected to have UEFI driver first. This is important for booting the Intel SSD as your primary bootable device.

Figure 4:   Intel RST BIOS: UEFI Boot

3.2.3 Installation

1. Install the USB Driver on the Windows 7 ISO image.

   For more information, see **USB 3.0 Driver Inject**.

2. To boot to the Windows installer, use the Windows ISO via either of these methods:

   - USB install key and copy Windows DVD installer files, or

   - The DVD installer media.

   After the Windows installer boots, you will be prompted to locate additional drivers.

3. Browse to your USB flash drive or optical drive with RST drivers on it.

   After the driver is installed, the SSD should show as a drive option to install Windows.

4. Install Windows as normal and update all drivers with motherboard disk, or download from vendor's site.

3.2.4 USB 3.0 Driver Inject

NOTE: USB 3.0 drivers are backward compatible with USB 2.0.

Using the DISM commands, the provided USB drivers must be injected into the windows 7 ISO image. The following steps are vital in order to see the RST drive directories on the USB install key.

1. Create a temporary working directory , such as `C:\Win7USB`

2. In your working directory, create two sub-directories called "USBDriver" and "Mount."

3. Extract your USB driver files into your "USBDriver" subdirectory.

4. From your Windows 7 install key , copy the "install.wim" and "boot.wim" files from the "sources" directory on your install key to the working directory `C:\Win7USB`.

5. Open a command prompt as administrator, and change to your working directory.
   For Example: `cd C:\Win7USB`

6. Based on the version of Windows 7 you have available, determine which index number to modify.

   Choose the index that matches the Windows 7 version you have. To determine the index, run the following command:

   `dism /get-wiminfo /wimfile    :install.wim`

   To modify "boot.wim" after modifying "install.wim" run the following command and follow subsequent steps:

   `dism /get-wiminfo /wimfile:boot.wim`

   Using index 3 for this example:

```
C:\Win7USB>dism /get-wiminfo /wimfile:install.wim

Deployment Image Servicing and Management tool
Version: 6.1.7600.16385

Details for image : install.wim

Index : 1
Name : Windows 7 HOMEBASIC
Description : Windows 7 HOMEBASIC
Size : 11,710,161,360 bytes

Index : 2
Name : Windows 7 HOMEPREMIUM
Description : Windows 7 HOMEPREMIUM
Size : 12,222,587,449 bytes

Index : 3
Name : Windows 7 PROFESSIONAL
Description : Windows 7 PROFESSIONAL
Size : 12,131,063,436 bytes

Index : 4
Name : Windows 7 ULTIMATE
Description : Windows 7 ULTIMATE
Size : 12,285,492,779 bytes

The operation completed successfully.

C:\Win7USB>
```
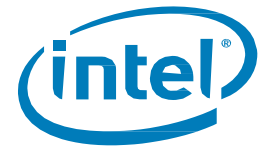
7. Modify the "install.wim" file by running these commands:

   `dism /mount-wim /wimfile:install.wim /index:3 /mountdir:mount`

   `dism /image:mount /add-package: [Path of the USBDriver files]`
   i.e `C:\Win7USB\USBDriver`

   `dism /get-packages /image:mount`

   `dism /unmount-wim /mountdir:mount /commit`

8. Modify the "boot.wim" file by running these commands:

```
dism /mount-wim /wimfile:boot.wim /index:3 /mountdir:mount
```

```
dism /image:mount /add-driver:C:\Win7USB\USB3 /recurse
```

```
dism /get-drivers /image:mount
```

```
dism /unmount-wim /mountdir:mount /commit
```

9. Now take your updated "install.wim" and "boot.wim" in the working directory and copy it back to the "sources" directory on your install key.
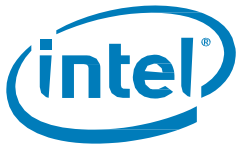
4   Installation System Confirmation

After the drive boots on its own, then it is conformed that the drive will boot as a bootable medium.

For further management, SSD utility software tools are provided. Some tools that are available are listed below to help confirm that the installation was done appropriately.

- **CrystalDiskInfo***

  CrystalDiskInfo is a software tool for SSDs that provides complete report of SMART data, as well as a current temperature and health status. Linked with a user interface, this tool allows you to monitor the state of your solid state drive. This tool can also be utilized to gather basic information such as buffer size, firmware, and serial numbers. More advanced options such as command time out, end-to-end error reads, and relocation event count can be utilized for determining drive endurance and enabling analysis over the life of the drive.

  http://download.cnet.com/CrystalDiskInfo/3000-2086_4-10832082.html

- **CrystalDiskMark***

  CrystalDiskMark is a benchmark software tool that allows you to measure sequential reads/writes as well as other benchmarking options for further management. This tool is useful because it allows you check if your drive is running at optimal levels, displaying the results in a user-friendly graph interface, and refers to common benchmarking figures such as MB/s and IOPS. This is an essential tool for testing key features, such as read/write speeds for large files up to 512KB and requires minimal configuration.

  http://download.cnet.com/CrystalDiskMark/3000-2094_4-75330576.html