

Energy consumption of seven Intel chipset motherboards

Executive summary

Intel Corporation (Intel) commissioned Principled Technologies (PT) to run a set of energy consumption tests on systems with the following seven Intel chipset motherboards:

- Asus P5B-VM SE with Intel G965 chipset
- Asus P5E-VM DO with Intel Q35 chipset
- Asus P5K-VM with Intel G33 chipset
- Gigabyte GA-G33M-S2L with Intel G33 chipset
- Intel DQ35JOE with Intel Q35 chipset
- Intel DQ45CB with Intel Q45 chipset
- Intel DQ45EK with Intel Q45 chipset

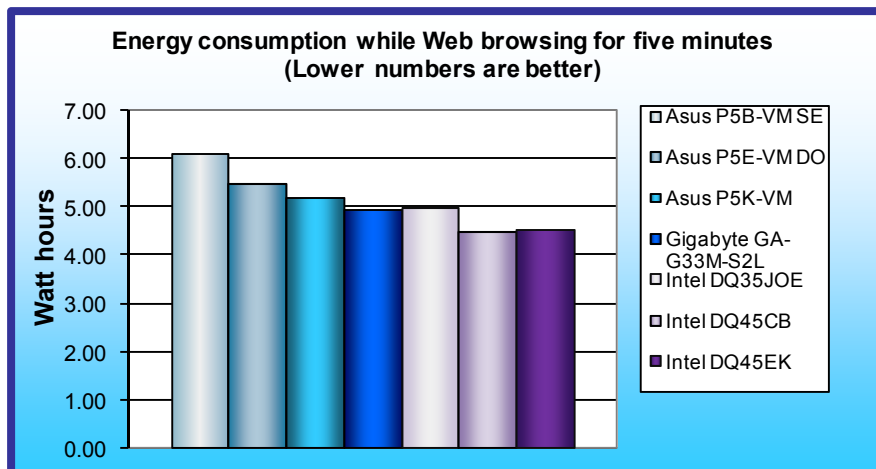
The goal of the testing was to gauge the energy consumption of each motherboard. Intel specified the test motherboards and provided the Intel DQ45CB and the Intel DQ45EK motherboards. PT purchased the remaining motherboards and all parts in order to build each system. PT executed the tests. Appendix A provides the details of the test system configurations.

We used an Extech Power Analyzer to measure energy consumption during the following four custom tests:

- System power consumption while idle
- System power consumption while Web browsing
- System power consumption while running the Microsoft Office 2007 Excel Monte Carlo workload
- System power consumption while running the Microsoft Office 2007 Word to PDF conversion with Microsoft Windows Defender Custom Scan workload.

KEY FINDINGS

- The Intel DQ45EK motherboard-based system consumed from 2.3 percent to 51.3 percent less energy than the systems with the three Asus motherboards, the Gigabyte motherboard, and the Intel DQ35JOE motherboard. (Figures 1 through 4.)
- The Intel DQ45CB motherboard-based system consumed from 1.1 percent to 33.3 percent less energy than the systems with the three Asus motherboards, the Gigabyte motherboard, and the Intel DQ35JOE motherboard. (Figures 1 through 4.)



As Figure 1 shows, compared to the three Asus motherboard-based systems, the Gigabyte motherboard-based system, and the Intel DQ35JOE system, the Intel DQ45CB motherboard-based system consumed from 9.3 percent to 26.4 percent less energy while Web browsing for five minutes and the Intel DQ45EK motherboard-based system consumed from 8.5 percent to 25.8 percent less energy.

Figure 1: Energy consumption in watt-hours for the seven test systems while Web browsing for five minutes. Lower numbers are better.

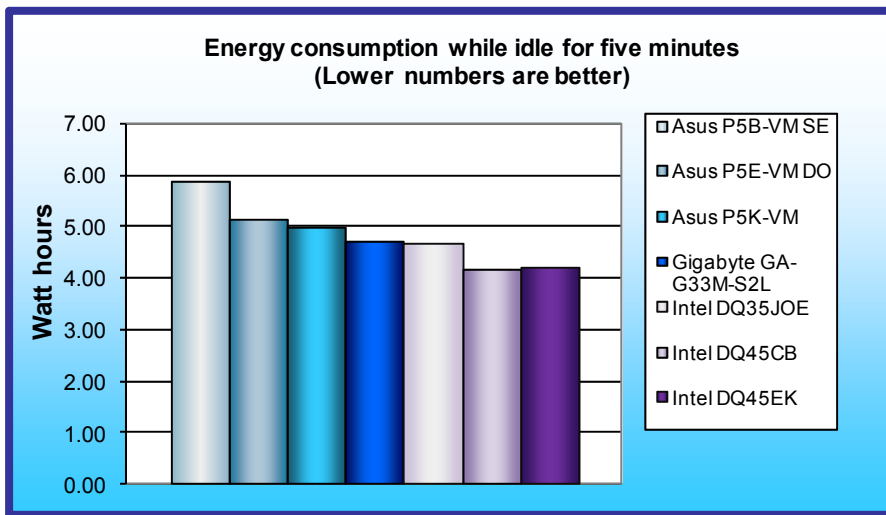


Figure 2: Energy consumption in watt-hours for the seven test systems while idle for five minutes. Lower numbers are better.

As Figure 2 shows, compared to the three Asus motherboard-based systems, the Gigabyte motherboard-based system, and the Intel DQ35JOE system, the Intel DQ45CB motherboard-based system consumed from 10.3 percent to 28.9 percent less energy while idle for five minutes and the Intel DQ45EK motherboard-based system consumed from 9.4 percent to 28.2 percent less energy.

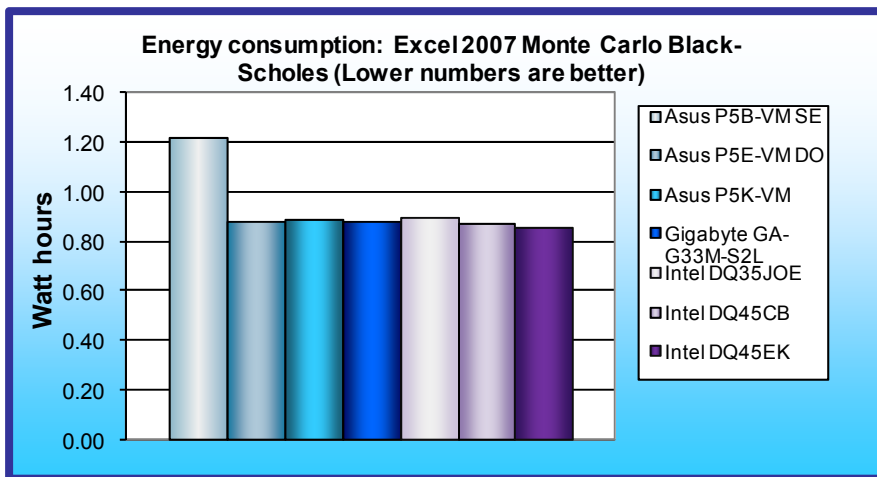


Figure 3: Energy consumption in watt-hours for the seven test systems while running the Microsoft Office 2007 Excel Monte Carlo workload. Lower numbers are better.

As Figure 3 shows, compared to the three Asus motherboard-based systems, the Gigabyte motherboard-based system, and the Intel DQ35JOE system, the Intel DQ45CB motherboard-based system consumed from 1.1 percent to 28.7 percent less energy while running the Microsoft Office 2007 Excel Monte Carlo workload and the Intel DQ45EK motherboard-based system consumed from 2.3 percent to 29.5 percent less energy.

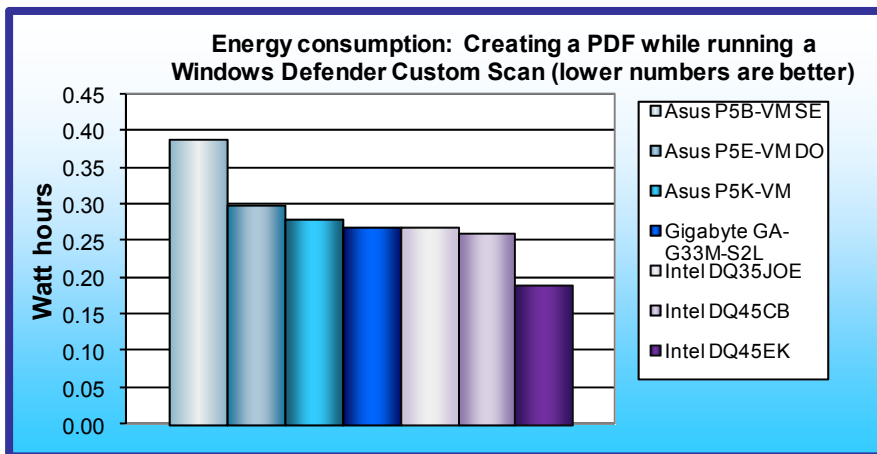


Figure 4: Energy consumption in watt-hours for the seven test systems while running the Microsoft Office 2007 Word to PDF conversion with Microsoft Windows Defender Custom Scan workload. Lower numbers are better.

As Figure 4 shows, compared to the three Asus motherboard-based systems, the Gigabyte motherboard-based system, and the Intel DQ35JOE system, the Intel DQ45CB motherboard-based system consumed from 3.7 percent to 33.3 percent less energy while running the Microsoft Office 2007 Word to PDF conversion with Microsoft Windows Defender Custom Scan workload and the Intel DQ45EK motherboard-based system consumed from 29.6 percent to 51.3 percent less energy.

Test results

Figure 5 presents energy consumption measurements (the median of three or five runs for each test) for the systems with the seven motherboard models. (In the event of a tie, we chose the run with the higher energy consumption. If the energy consumption score was also tied, we then chose the first run we executed with those scores.) Because energy consumption results represent the energy the systems used when completing the workload, lower is better.

We used the Extech Instruments 380803 Power Analyzer to gauge energy consumption. The Extech Power Analyzer is an external unit that connects to a host computer through a RS-232 communications cable. The device also has an AC power cable that powers the system under test. We used the Extech Power Analyzer to monitor the average AC energy consumption of each system while running the four custom tests. We then multiplied the Extech's average AC power score by the time the workload took to complete to calculate the Workload Energy Consumption (WEC) in watt-seconds. We divided the WEC watt-seconds score by 3,600 (the number of seconds in an hour) to calculate the WEC Watt-hours we report below. The Idle and Web browsing tests ran for a fixed amount of time (five minutes) while the other tests ran as long as necessary to complete the task.

Test	Asus P5B-VM SE	Asus P5E-VM DO	Asus P5K-VM	Gigabyte GA-G33M-S2L	Intel DQ35JOE	Intel DQ45CB	Intel DQ45EK
Idle for five minutes	5.88	5.14	4.97	4.73	4.66	4.18	4.22
Web browsing for five minutes	6.13	5.48	5.20	4.97	4.99	4.51	4.55
Microsoft Office Excel 2007 Monte Carlo Black-Scholes	1.22	0.88	0.89	0.88	0.90	0.87	0.86
Microsoft Office Word 2007 creating a PDF while running a Windows Defender Custom Scan	0.39	0.30	0.28	0.27	0.27	0.26	0.19

Figure 5: Energy consumption in watt-hours for the seven test systems. Lower numbers are better.

Test methodology

This section discusses some differences in the configurations of the test systems, and details the methodologies we followed in testing them. We ran the tests three or five times, and report the median of those runs.

Configurations

PT purchased and built each system as identical as possible with the only difference being the motherboards. Each system consisted of:

- Intel Core 2 Duo Processor E8600 (3.33GHz, 1333MHz FSB, 6MB L2 Cache). (Note that the Asus P5B-VM SE motherboard would only run the Intel Core 2 Duo E8600 processor at 2.66GHz with a FSB of 1066MHz)
- Corsair XMS2 2GB 240-pin DDR2 PC2-6400 CL=5
- Seagate ST3320620AS Barracuda 320 NCQ SATA2 7200RPM
- Lite-On DH-16D3S SATA DVD-ROM
- Linkworld 536-09-c2228u ATX Mid Tower Computer Case with 430W power supply

For detailed system configurations, see Appendix A.

Initial setup

To get the most accurate and repeatable results possible, we started with a clean hard disk, and set up all the test systems using the following procedures.

Installing Microsoft Windows Vista Ultimate with Service Pack 1

Use the following process to install and configure a clean version of Windows Vista Ultimate SP1 on each system:

1. Enter the BIOS of each system and make sure:
 - a. The processor is running at the correct speed.

- b. The hard drive controller is set to AHCI.
 - c. The RAM speed is set correctly.
2. Save and exit BIOS.
3. Go to each manufacturer's website, and download the F6 storage driver. Copy this file to a USB flash drive for later use in the installation.
4. Install Windows Vista Ultimate SP1.
 - a. Boot to a Windows Vista Ultimate SP1 DVD.
 - b. When prompted, press any key to boot from CD or DVD.
 - c. At the language and preference screen, accept the default options, and click Next.
 - d. Click Install now.
 - e. Do not enter a Product key. Uncheck Automatically activate Windows when I'm online, and click Next.
 - f. At the Do you want to enter your product key now? screen, click No.
 - g. Select Windows Vista Ultimate, and check I have selected the edition of Windows that I purchased.
 - h. Click Next.
 - i. Check I accept the license terms.
 - j. Click Next.
 - k. At the Which type of installation do you want? screen, select Custom (advanced).
 - l. Click Load Driver.
 - m. Insert the USB flash drive with the F6 driver.
 - n. Browse to the USB flash drive, and click OK.
 - o. Once Windows detects the driver, click Next.
 - p. Click Drive options (advanced).
 - q. Select the destination Disk for the operating system.
 - r. Click New.
 - s. Use the entire hard disk as the new partition, and click Apply.
 - t. Once the system finishes creating the disk, click Next.
 - u. Fill in the Username and Password fields, and click Next.
 - v. Fill in the computer name field, and click Next.
 - w. When presented with the option to enable Automatic Updates, click Ask me later.
 - x. Select the correct time zone, date, and time, and click Next.
 - y. At the Thank you screen, click Start.
 - z. When the Windows Vista Ultimate SP1 installation completes, close the Welcome Center Dialog.
5. Download drivers from each of the manufacturer's websites.
6. Install drivers in the following order:
 - a. Chipset inf driver
 - b. Graphics driver
 - c. Management Engine Interface driver (if applicable)
 - d. Active Management Technology driver (if applicable)
 - e. LAN driver
 - f. Audio driver
 - g. Intel Matrix Storage Manager driver (if applicable)
7. Turn off automatically scheduled disk defragmentation.
 - a. Click Start.
 - b. Click All Programs.
 - c. Click Accessories.
 - d. Click System Tools.
 - e. Click Disk Defragmenter.
 - f. Uncheck the box next to Run on a schedule.
 - g. Click Close.
8. Turn off automatic Indexing.
 - a. Click Start.
 - b. Select Control panel.
 - c. Click System and Maintenance.
 - d. Click Indexing Options.
 - e. Click Modify.
 - f. At the User Account Control warning, click Allow.

- g. Click Show all locations.
 - h. Under Summary of selected locations, highlight each Included Location listed, which will automatically take you to the indexed location.
 - i. Under Change selected locations, uncheck the boxes next to each indexed location.
9. Turn off User Account Control.
 - a. Click Start.
 - b. Select Control panel.
 - c. Click User Accounts and Family Safety.
 - d. Click User Accounts.
 - e. Click Turn User Account Control on or off.
 - f. Uncheck the box next to Use User Account Control to help protect your computer.
 - g. Click restart now.
 10. Set the test resolution.
 - a. Right-click on the desktop.
 - b. Select Personalize.
 - c. Click Display Settings.
 - d. Set the resolution to 1,280 x 1,024.
 - e. Click OK.
 11. Set the following Power Management settings.
 - a. Click Start.
 - b. Select Control Panel.
 - c. Select Appearance and Personalization.
 - d. Under Personalization, click Change screen saver.
 - e. From the Screen saver drop-down menu, select None.
 - f. Click Change power settings.
 - g. Leave the default Balanced power scheme.
 - h. Click Change plan settings.
 - i. From the Turn off the display and Put the computer to sleep drop-down menus, select Never.
 - j. Click OK.
 - k. Click Save changes.
 - l. Close the Power Options window.
 - m. Click OK on the Screen Saver Settings.
 12. Disable system notifications:
 - a. Click Start.
 - b. Select Control Panel.
 - c. Click Security.
 - d. Select Security Center.
 - e. From the left panel, select Change the way Security Center alerts me.
 - f. Select Don't notify me and don't display the icon.
 - g. Close the Windows Security Center window.
6. Run Windows Update, and download all available updates through 09/11/08.
 7. Defragment the hard drive.
 - a. Click Start.
 - b. Click All Programs.
 - c. Click Accessories.
 - d. Click System Tools.
 - e. Click Disk Defragmenter.
 - f. Click Defragment now.
 - g. When disk defragmentation has finished, click Close.

Capturing an image of the hard drive

We used Symantec's Ghost product to capture an exact image of the hard disk. Each time we ran a new benchmark or test on a machine, we used the Ghost image to return that machine to the above configuration (Windows Vista Ultimate SP1). After re-imaging, we installed the software necessary to run each test, and rebooted. We followed this process to capture the image:

1. Insert a bootable Ghost CD.

2. Power down the computer.
3. Attach an external USB hard disk.
4. Power on the computer.
5. At the Symantec Ghost screen, click OK.
6. Select Local→Disk→To Image.
7. Click OK.
8. Select the Primary disk, and click OK.
9. Select the external hard disk in the copy image to drop-down box, name the file *BASE*, and click Save.
10. At the Compress Image dialog, select High.
11. At the Proceed dialog, select Yes.
12. When the ghost image is complete, click OK, and exit Ghost.
13. Power down the computer.
14. Disconnect the USB hard disk.
15. Reboot the computer.

Extech Power Analyzer setup and test procedure

We did the following to set up the Extech Power Analyzer and software:

1. Power off each computer under test.
2. Connect the power cord from the computer under test to the Power Analyzer's output load power outlet.
3. Plug the power cord from the Power Analyzer's input voltage connection into a power outlet.
4. Connect a separate host computer to the Power Analyzer using an RS-232 cable. This computer will monitor and collect the power measurement data.
5. Turn on the Extech Power Analyzer by pressing the green On/Off button.
6. Turn on the host computer.
7. Insert the Extech software installation CD into the host computer, and install the software as follows:
 - a. Using Windows Explorer, browse to the Extech Power Analyzer installation CD, and click on the Setup.exe.
 - b. At the Welcome to the Power Analyzer screen, click OK.
 - c. At the installation screen, leave the default installation directory, and click the icon button to begin installation.
 - d. At the Setup has completed successfully screen, click OK.
8. Launch the Extech Power Analyzer software by clicking Start→All Programs→Power Analyzer.
9. At the Select COM port dialog, click OK.
10. From the top menu, select Option→COM. Select COM1.
11. Exit the Extech Power Analyzer software.

We did the following to measure energy consumption during a test:

1. Power on the computer under test, and make sure you have prepped it to run a test.
2. On the host computer, launch the Extech Power Analyzer software by going to Start→All Programs→Power Analyzer.
3. From the top menu, click Option→Sample Rate. Type 1.0, and click OK.
4. From the top menu, click File→Name.
5. In the Name field, type a name that appropriately describes the platform and configuration, and click OK.
6. To begin recording power, click File→Start Recording→Now (Auto) at the same time you start a test.
7. To stop recording power, click File→End Recording at the same time you stop a test.

To view the power measurement data, double-click on the My Computer desktop icon and select the C: drive→Program Files→Power Analyzer. When the program launches, select the test name selected earlier, and double-click that file name. To open the file, select Excel as the program for viewing the data. This is the file you will use to calculate the average power usage. We calculate average power usage by doing the following:

1. Use Windows Explorer to locate the log file. By default, Windows saves the log file in C:\Program Files\Power Analyzer.
2. Open the log file with Microsoft Excel.
3. Insert a column by right-clicking on column E, and clicking Insert.
4. In cell E1, type =value(left(D1,7)), and press Enter.

5. Scroll down to the last row in column E, and press Ctrl + Shift + Up. This should select the entire E column.
6. Press Ctrl + D to fill in column E.
7. Select cell A1, and press Ctrl + F.
8. In the Find What Field, type olw, and click Find Next. This will find any outliers that may have occurred during the test.
9. Delete any row that produced an outlier.
10. In an empty cell, type =average(e:e), and press Enter. This is the Average Power Draw in Watts.

Idle power consumption

We performed the following steps to set up and run this test:

Setting up the test

1. Reset the system to the base test image.
2. On the host computer, launch the Extech Power Analyzer software by clicking Start→All Programs→Power Analyzer.
3. From the top menu, click Option→Sample Rate. Type 1.0, and click OK.
4. From the top menu, click File→Name.
5. In the Name field, type a name that appropriately describes the platform and configuration, and click OK.

Running the test

1. Wait 10 minutes after the computer has booted into Windows to allow processes to settle down.
2. Start the Extech Power Analyzer by clicking File→Start Recording→Now (Auto).
3. Record idle power consumption for five minutes.
4. Stop the Extech Power Analyzer by clicking File→End Recording.
5. Record the results.
6. Repeat the steps two more times, rebooting between runs.

Web browsing power consumption

For repeatability, PT created web content and a Java-based script that automatically browses the created web pages at set intervals.

We performed the following steps to set up and run this test:

Setting up the test

1. On a host computer running Windows 2003 Server, copy the created web content.
2. Reset the system under test to the base test image.
3. Copy the java-based script to the desktop.
4. Verify the web page is functioning by launching Internet Explorer, and typing in the web address of the host web server.
5. At the Phishing Filter pop-up, select Turn off phishing filter.
6. Close Internet Explorer.
7. Reboot the computer.
8. On the host computer, launch the Extech Power Analyzer software by clicking Start→All Programs→Power Analyzer.
9. From the top menu, click Option→Sample Rate. Type 1.0, and click OK.
10. From the top menu, click File→Name.
11. In the Name field, type a name that appropriately describes the platform and configuration, and click OK.

Running the test

1. Wait 10 minutes after the computer has booted into Windows to allow processes to settle down.
2. Double-click the Java-based script, while at the same time starting the Extech Power Analyzer by clicking File→Start Recording→Now (Auto).
3. Record web browsing power consumption for five minutes.
4. Stop the Extech Power Analyzer by clicking File→End Recording.
5. Record the results.
6. Repeat the steps two more times, rebooting between runs.

Microsoft Office Excel 2007 Monte Carlo Black-Scholes

Intel provided the file this test uses: MonteCarloBlackScholesOptionPricing.xlsm. The file size is 70.1 MB (73,607,121 bytes).

We performed the following steps to set up and run this test:

Setting up the test

1. Reset the system to the base test image.
2. Copy the MonteCarloBlackScholesOptionPricing.xlsm test file to the Documents directory.
3. Install Microsoft Office 2007 Ultimate Edition with default settings:
 - a. At the Enter your Product Key screen, enter the product key, and click Continue.
 - b. At the License Agreement screen, select I accept the terms of this agreement, and click Continue.
 - c. At the Microsoft Office Ultimate 2007 has been successfully installed screen, click Close.
4. Launch Microsoft Office Excel 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Excel 2007.
5. Select I want to activate the software over the Internet, and click Next.
6. Click Finish.
7. Uncheck Search Microsoft Office Online for Help content when I'm connected to the Internet, and click Next.
8. Select I don't want to use Microsoft Update, and click Finish.
9. From the top left, click on the Microsoft Office button.
10. Click Excel Options.
11. From the left column, click Trust Center.
12. Click the Trust Center Settings button.
13. From the left column, click Macro Settings, and select Enable all macros.
14. Click OK.
15. Close Excel.
16. Reboot the computer.
17. On the host computer, launch the Extech Power Analyzer software by clicking Start→All Programs→Power Analyzer.
18. From the top menu, click Option→Sample Rate. Type 1.0, and click OK.
19. From the top menu, click File→Name.
20. In the Name field, type a name that appropriately describes the platform and configuration, and click OK.

Running the test

1. Wait 10 minutes after the computer has booted into Windows to allow processes to settle down.
2. Launch Microsoft Office Excel 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Excel 2007.
3. Press Ctrl + O.
4. Locate the MonteCarloBlackScholesOptionPricing.xlsm workload file, and click Open.
5. Press Ctrl + R, while at the same time starting the Extech Power Analyzer by clicking File→Start Recording→Now (Auto).
6. When the results dialog appears, stop the Extech Power Analyzer by clicking File→End Recording.
7. Record the results, and click OK to close Excel.
8. Repeat the steps four more times without rebooting between runs.

Microsoft Office Word 2007 creating a PDF while running a Windows Defender Custom Scan

PT provided the files this test uses: Office11 Install Guide.doc and Windows Defender Workload. The file sizes are as follows:

- Office11 Install Guide.doc - 3.64 MB (3,819,008 bytes)
- Windows Defender Workload - 26.4 MB (27,767,601 bytes)

A stopwatch is required for this test. We performed the following steps to set up and run this test:

Setting up the test

1. Reset the system to the base test image.
2. Install Adobe Acrobat Reader 9.0 with default settings:
 - a. Go to <http://www.adobe.com/products/acrobat/readstep2.html>.
 - b. Uncheck install Google Toolbar, and click Download.
 - c. Install the Active X control.
 - d. Click Install.
 - e. Click Finish.
 - f. Launch Adobe Acrobat Reader.
 - g. Click Agree at the license agreement screen.
 - h. Close Adobe Acrobat Reader.
3. Copy the Windows Defender workload to C:\DefenderWorkload1.
4. Make four more copies of this workload, renaming them to DefenderWorkload2 to DefenderWorkload5.
5. Copy the Office11 Install Guide.doc test document to the desktop.
6. Install Microsoft Office 2007 Ultimate Edition with default settings:
 - a. At the Enter your Product Key screen, enter the product key, and click Continue.
 - b. At the License Agreement screen, select I accept the terms of this agreement, and click Continue.
 - c. At the Microsoft Office Ultimate 2007 has been successfully installed screen, click Close.
7. Launch Microsoft Office Word 2007 by clicking Start→All Programs→Microsoft Office→Microsoft Office Word 2007.
8. Select I want to activate the software over the Internet, and click Next.
9. Click Finish.
10. Uncheck Search Microsoft Office Online for Help content when I'm connected to the Internet, and click Next.
11. Select I don't want to use Microsoft Update, and click Finish.
12. Close Word.
13. Install the 2007 Microsoft Office Add-on: Microsoft Save as PDF by going to <http://www.microsoft.com/downloads/details.aspx?FamilyId=F1FC413C-6D89-4F15-991B-63B07BA5F2E5&displaylang=en>.
14. Reboot the computer.
15. On the host computer, launch the Extech Power Analyzer software by clicking Start→All Programs→Power Analyzer.
16. From the top menu, click Option→Sample Rate. Type 1.0, and click OK.
17. From the top menu, click File→Name.
18. In the Name field, type a name that appropriately describes the platform and configuration, and click OK.





Running the test

1. Wait 10 minutes after the computer has booted into Windows to allow processes to settle down.
2. Open the Office11 Install Guide.doc.
3. Launch Windows Defender by clicking Start→All Programs→Windows Defender.
4. Next to Scan in the Windows Defender menu, click the drop-down menu.
5. From the drop-down menu, choose Custom Scan.
6. Next to Scan selected drives and folders, click the radio button.
7. Click Select.
8. Browse to the Windows Defender workload directory by expanding C:\, and checking the box next to DefenderWorkload n , where n is equal to the current test run.
9. Click OK.
10. In Word 2007, click the Office Button.
11. To the right of Save As, click the arrow. A dialog box titled Save a copy of the document will open.
12. Select PDF.
13. Prepare the stopwatch.
14. Bring Windows Defender to the foreground.
15. Click Scan Now, while at the same time starting the Extech Power Analyzer by clicking File→Start Recording→Now (Auto). (Windows Defender reports the time elapsed under Scan Statistics.)
16. Immediately switch to Word 2007 (alt-Tab), and simultaneously click the Publish button in the Publish as PDF dialog box, and start the stopwatch.

17. When Adobe Acrobat Reader 9 completes loading the newly created PDF file, stop the stopwatch.
18. Record this time as the PDF creation test's result.
19. Bring Windows Defender to the foreground.
20. When the Windows Defender scan finishes, stop the Extech Power Analyzer by clicking File→End Recording.
21. Record the scan time Windows Defender reports as the scan time's test result.
22. Delete the Office11 Install Guide.pdf file.
23. Repeat the steps four more times, rebooting between runs.

Appendix A – Test system configuration information




Figures 6 and 7 provide detailed configuration information about each of the systems, which we list in alphabetical order.

System	Asus P5B-VM SE with Intel G965 chipset	Asus P5E-VM DO with Intel Q35 chipset	Asus P5K-VM with Intel G33 chipset	Gigabyte GA-G33M-S2L with Intel G33 chipset
				
General				
Processor and OS kernel: (physical, core, logical) / (UP, MP)	1P2C2L / MP	1P2C2L / MP	1P2C2L / MP	1P2C2L / MP
Number of physical processors	1	1	1	1
Single/Dual Core processors	Dual	Dual	Dual	Dual
System power management policy	Balanced	Balanced	Balanced	Balanced
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
CPU				
Vendor	Intel	Intel	Intel	Intel
Name	Core 2 Duo	Core 2 Duo	Core 2 Duo	Core 2 Duo
Model number	E8600	E8600	E8600	E8600
Stepping	A	A	A	A
Socket type and number of pins	LGA 775	LGA 775	LGA 775	LGA 775
Core frequency (GHz)	2.66	3.33	3.33	3.33
Front-side bus frequency	1066	1333	1333	1333
L1 cache	2 x 32 KB + 2 x 32 KB	2 x 32 KB + 2 x 32 KB	2 x 32 KB + 2 x 32 KB	2 x 32 KB + 2 x 32 KB
L2 cache	6 MB	6 MB	6 MB	6 MB
Platform				
Vendor	Asus	Asus	Asus	Gigabyte
Motherboard model number	P5B-VM SE	P5E-VM DO	P5K-VM	GA-G33M-S2L
Motherboard chipset	Intel G965	Intel Q35	Intel G33	Intel G33
Motherboard revision number	X.XX	1.XX	1.XX	XX
Motherboard serial number	C88B647-00293	CB1BCKX-00526	C7CBABZ-01659	8G5303
Bios name and version	American Megatrends 1008 (10/21/2008)	American Megatrends 0803 (07/23/2008)	American Megatrends 0902 (06/20/2008)	Award F3e (04/02/2008)
BIOS settings	Default (AHCI not an option)	AHCI enabled	AHCI enabled	AHCI enabled
Memory module(s)				
Vendor and model number	Corsair CM2X1024-6400C5DHX	Corsair CM2X1024-6400C5DHX	Corsair CM2X1024-6400C5DHX	Corsair CM2X1024-6400C5DHX
Type	PC2-6400	PC2-6400	PC2-6400	PC2-6400
Speed (MHz)	800	800	800	800

System	Asus P5B-VM SE with Intel G965 chipset	Asus P5E-VM DO with Intel Q35 chipset	Asus P5K-VM with Intel G33 chipset	Gigabyte GA-G33M-S2L with Intel G33 chipset
Speed running in the system (MHz)	800	800	800	800
Timing/Latency (tCL-tRCD-tRP-tRASmin)	5-5-5-18	5-5-5-18	5-5-5-18	5-5-5-18
Size	2048 MB	2048 MB	2048 MB	2048 MB
Number of memory module(s)	2 x 1024 MB	2 x 1024 MB	2 x 1024 MB	2 x 1024 MB
Chip organization (Single-sided, Double-sided)	Double-sided	Double-sided	Double-sided	Double-sided
Channel (Single/Dual)	Dual	Dual	Dual	Dual
Hard disk				
Vendor and model number	Seagate ST3320620AS	Seagate ST3320620AS	Seagate ST3320620AS	Seagate ST3320620AS
Size	320 GB	320 GB	320 GB	320 GB
Buffer Size	16 MB	16 MB	16 MB	16 MB
RPM	7,200	7,200	7,200	7,200
Type	SATA 3.0Gb/s	SATA 3.0Gb/s	SATA 3.0Gb/s	SATA 3.0Gb/s
Controller	Intel 82801HB (ICH8/R)	Intel 82801IH (ICH9DH)	Intel 82801IB (ICH9)	Intel 82801IB (ICH9)
Driver	Microsoft 6.0.6001.18000 (06/21/2006)	Intel 7.5.0.1017 (03/21/2007)	Intel 8.3.0.1008 (01/13/2007)	Intel 8.3.0.1008 (01/13/2007)
Operating system				
Name	Windows Vista Ultimate	Windows Vista Ultimate	Windows Vista Ultimate	Windows Vista Ultimate
Build number	6001	6001	6001	6001
Service Pack	1	1	1	1
File system	NTFS	NTFS	NTFS	NTFS
Kernel	ACPI x86-based PC	ACPI x86-based PC	ACPI x86-based PC	ACPI x86-based PC
Language	English	English	English	English
Microsoft DirectX version	10	10	10	10
Graphics				
Vendor and model number	Intel GMA 3000	Intel GMA 3100	Intel GMA 3100	Intel GMA 3100
Type	Integrated	Integrated	Integrated	Integrated
Chipset	Intel G965 Express Chipset	Intel Q35 Express Chipset	Intel G33 Express Chipset	Intel G33 Express Chipset
BIOS version	1371	1471	1471	1508
Total Available Graphics Memory	358 MB	286 MB	286 MB	286 MB
Dedicated Video Memory	0 MB	0 MB	0 MB	0 MB
System Video Memory	64 MB	128 MB	128 MB	128 MB
Shared System Memory	294 MB	158 MB	158 MB	158 MB
Resolution	1280 x 1024	1280 x 1024	1280 x 1024	1280 x 1024
Driver	Intel 7.14.10.1147 (12/12/2006)	Intel 7.14.10.1437 (02/11/2008)	Intel 7.14.10.1437 (02/11/2008)	Intel 7.14.10.1437 (02/11/2008)

System	Asus P5B-VM SE with Intel G965 chipset	Asus P5E-VM DO with Intel Q35 chipset	Asus P5K-VM with Intel G33 chipset	Gigabyte GA-G33M-S2L with Intel G33 chipset
Sound card/subsystem				
Vendor and model number	Realtek High Definition Audio	Realtek High Definition Audio	Realtek High Definition Audio	Realtek High Definition Audio
Driver	Realtek 6.0.1.5397 (04/10/2007)	Realtek 6.0.1.5443 (07/10/2007)	Realtek 6.0.1.5371 (02/06/2007)	Realtek 6.0.1.5653 (06/27/2008)
Ethernet				
Vendor and model number	Attansic L1 Gigabit	Intel 82566DM-2	Marvell Yukon 88E8056	Realtek RTL8168B
Driver	Attansic 1.0.5600.1115 9 (11/15/2006)	Intel 9.9.13.0 (06/19/2007)	Marvell 10.51.1.9 (12/06/2007)	Realtek 6.208.729.200 8 (07/29/2008)
Optical drive(s)				
Vendor and model number	Lite-On DH16D3S	Lite-On DH16D3S	Lite-On DH16D3S	Lite-On DH16D3S
Type	DVD-ROM	DVD-ROM	DVD-ROM	DVD-ROM
Interface	SATA	SATA	SATA	SATA
Dual/Single layer	Dual	Dual	Dual	Dual
USB ports				
Number	10	12	12	12
Type	USB 2.0	USB 2.0	USB 2.0	USB 2.0
IEEE 1394 ports				
Number	0	2	2	0
Monitor				
LCD type	ViewSonic OptiQuest Q7	ViewSonic OptiQuest Q7	ViewSonic OptiQuest Q7	ViewSonic OptiQuest Q7
Screen size	17"	17"	17"	17"
Refresh rate	60 Hz	60 Hz	60 Hz	60 Hz

Figure 6: Detailed system configuration information for the test systems.

System	Intel DQ35JOE with Intel Q35 chipset	Intel DQ45CB with Intel Q45 chipset	Intel DQ45EK with Intel Q45 chipset
			
General			
Processor and OS kernel: (physical, core, logical) / (UP, MP)	1P2C2L / MP	1P2C2L / MP	1P2C2L / MP
Number of physical processors	1	1	1
Single/Dual Core processors	Dual	Dual	Dual
System power management policy	Balanced	Balanced	Balanced
Processor power-saving option	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology	Enhanced Intel SpeedStep Technology
CPU			
Vendor	Intel	Intel	Intel
Name	Core 2 Duo	Core 2 Duo	Core 2 Duo
Model number	E8600	E8600	E8600
Stepping	A	A	A
Socket type and number of pins	LGA 775	LGA 775	LGA 775
Core frequency (GHz)	3.33	3.33	3.33
Front-side bus frequency	1333	1333	1333
L1 cache	2 x 32 KB + 2 x 32 KB	2 x 32 KB + 2 x 32 KB	2 x 32 KB + 2 x 32 KB
L2 cache	6 MB	6 MB	6 MB
Platform			
Vendor	Intel	Intel	Intel
Motherboard model number	BOXDQ35JOE	DQ45CB	DQ45EK
Motherboard chipset	Intel Q35	Intel Q45	Intel Q45
Motherboard revision number	AAD82085-801	AAE30148-205	AAE30149-205
Motherboard serial number	BQJO803003NJ	AZCB837009UQ	AZEK838002GS
Bios name and version	Intel JOQ3510J.86A.0942.2008.0807.1958	Intel CBQ4510H.86A.0061.2008.1010.1506 (10/10/2008)	Intel CBQ4510H.86A.0061.2008.1010.1506 (10/10/2008)
BIOS settings	AHCI enabled	AHCI enabled	AHCI enabled
Memory module(s)			
Vendor and model number	Corsair CM2X1024-6400C5DHX	Corsair CM2X1024-6400C5DHX	Corsair CM2X1024-6400C5DHX
Type	PC2-6400	PC2-6400	PC2-6400
Speed (MHz)	800	800	800
Speed running in the system (MHz)	800	800	800

System	Intel DQ35JOE with Intel Q35 chipset	Intel DQ45CB with Intel Q45 chipset	Intel DQ45EK with Intel Q45 chipset
Timing/Latency (tCL-tRCD-tRP-tRASmin)	5-5-5-18	5-5-5-18	5-5-5-18
Size	2048 MB	2048 MB	2048 MB
Number of memory module(s)	2 x 1024 MB	2 x 1024 MB	2 x 1024 MB
Chip organization (Single-sided, Double-sided)	Double-sided	Double-sided	Double-sided
Channel (Single/Dual)	Dual	Dual	Dual
Hard disk			
Vendor and model number	Seagate ST3320620AS	Seagate ST3320620AS	Seagate ST3320620AS
Size	320 GB	320 GB	320 GB
Buffer Size	16 MB	16 MB	16 MB
RPM	7,200	7,200	7,200
Type	SATA 3.0Gb/s	SATA 3.0Gb/s	SATA 3.0Gb/s
Controller	Intel 82801IH (ICH9DH)	Intel ID2E10 (ICH10DO)	Intel ID2E10 (ICH10DO)
Driver	Intel 8.5.0.1032 (07/20/2008)	Intel 8.6.0.1007 (09/12/2008)	Intel 8.6.0.1007 (09/12/2008)
Operating system			
Name	Windows Vista Ultimate	Windows Vista Ultimate	Windows Vista Ultimate
Build number	6001	6001	6001
Service Pack	1	1	1
File system	NTFS	NTFS	NTFS
Kernel	ACPI x86-based PC	ACPI x86-based PC	ACPI x86-based PC
Language	English	English	English
Microsoft DirectX version	10	10	10
Graphics			
Vendor and model number	Intel GMA 3100	Intel GMA 4500	Intel GMA 4500
Type	Integrated	Integrated	Integrated
Chipset	Intel Q35 Express Chipset	Intel Q45 Express Chipset	Intel Q45 Express Chipset
BIOS version	1653	1666	1666
Total Available Graphics Memory	286 MB	764 MB	764 MB
Dedicated Video Memory	0 MB	32 MB	32 MB
System Video Memory	128 MB	96 MB	96 MB
Shared System Memory	158 MB	636 MB	636 MB
Resolution	1280 x 1024	1280 x 1024	1280 x 1024
Driver	Intel 7.15.10.1545 (08/14/2008)	Intel 7.15.10.1591 (10/28/2008)	Intel 7.15.10.1591 (10/28/2008)
Sound card/subsystem			
Vendor and model number	Realtek High Definition Audio	SoundMax Integrated Digital HD Audio	SoundMax Integrated Digital HD Audio
Driver	Realtek 6.0.1.5683 (08/12/2008)	Analog Devices 6.10.1.6520 (07/10/2008)	Analog Devices 6.10.1.6520 (07/10/2008)
Ethernet			
Vendor and model number	Intel 82566DM-2	Intel 82567LM-3	Intel 82567LM-3

System	Intel DQ35JOE with Intel Q35 chipset	Intel DQ45CB with Intel Q45 chipset	Intel DQ45EK with Intel Q45 chipset
Driver	Intel 9.12.17.0 (02/06/2008)	Intel 10.3.45.0 (07/22/2008)	Intel 10.3.45.0 (07/22/2008)
Optical drive(s)			
Vendor and model number	Lite-On DH16D3S	Lite-On DH16D3S	Lite-On DH16D3S
Type	DVD-ROM	DVD-ROM	DVD-ROM
Interface	SATA	SATA	SATA
Dual/Single layer	Dual	Dual	Dual
USB ports			
Number	12	12	10
Type	USB 2.0	USB 2.0	USB 2.0
IEEE 1394 ports			
Number	2	2	0
Monitor			
LCD type	ViewSonic OptiQuest Q7	ViewSonic OptiQuest Q7	ViewSonic OptiQuest Q7
Screen size	17"	17"	17"
Refresh rate	60 Hz	60 Hz	60 Hz

Figure 7: Detailed system configuration information for the test systems.

About Principled Technologies

We provide industry-leading technology assessment and fact-based marketing services. We bring to every assignment extensive experience with and expertise in all aspects of technology testing and analysis, from researching new technologies, to developing new methodologies, to testing with existing and new tools.

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Our founders, Mark L. Van Name and Bill Catchings, have worked together in technology assessment for over 20 years. As journalists, they published over a thousand articles on a wide array of technology subjects. They created and led the Ziff-Davis Benchmark Operation, which developed such industry-standard benchmarks as Ziff Davis Media's Winstone and WebBench. They founded and led eTesting Labs, and after the acquisition of that company by Lionbridge Technologies were the head and CTO of VeriTest.



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