Display Guidelines for KVM Switches in Windows 7

December 5, 2012

Abstract

This document provides guidelines for independent hardware vendors (IHVs) of keyboard, video, and mouse (KVM) devices. By following these guidelines, IHVs can provide an optimal user experience in Windows 7 with display devices that are connected to KVM switches. This document also lists a set of specific requirements and recommendations to IHVs on the expected behavior of KVM switches in Windows 7.

This information applies to the Windows 7 operating system.

References, resources, and specifications discussed here are listed at the end of this document.

The current version of this paper is maintained on the Web at:   
 [Display Guidelines for KVM Switches in Windows 7](http://msdn.microsoft.com/library/windows/hardware/gg487352.aspx)

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Document History

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# Introduction

This paper provides guidelines for independent hardware vendors (IHVs) of keyboard, video, and mouse (KVM) switches that connect to display devices. It includes advice from Microsoft about how these devices should work together to provide a good user experience in Windows® 7. The requirements and recommendations are common to all types of connectors and form the basis for new Windows Logo Program (WLP) requirements for KVM switches, which will be available after the release of Windows 7.

To optimize a better user experience with display devices that are connected to a KVM switch, this document discusses all applicable KVM scenarios, tests, and specifications. This information specifies how a KVM switch and the Windows 7 operating system can work together to enhance the user experience with display devices.

The requirements and recommendations in this document for KVM switches focus mostly on video graphics array (VGA) or Digital Video Interface (DVI) connectors. However, the principles and scenarios are relevant to all types of connectors.

**Note**Recommendations for keyboard and mouse devices that are connected to a KVM switch are outside of the scope of this document.

# Overview

Advanced users of Windows computers often use KVM switches to connect the same display device to multiple computers. A KVM switch routes signals or data from the display device to every computer that is connected to the KVM switch.

Figure 1 shows an example of a typical configuration of a KVM switch. In this figure, three computers (PC1, PC2, and PC3) are connected to a KVM switch (S). The KVM switch is connected to one external display device (D1). In this example, the KVM switch is set so that the PC1 is connected to D1.



Figure 1. Typical KVM switch configuration

# User Experience

The following items are critical to achieve a positive user experience in Windows 7:

* The operating system must be aware of the presence of all display devices that are connected to the KVM switch, even as users dynamically connect or disconnect them.
* The operating system must have access to the EDID data from each of the display devices that are connected to the KVM switch.
* When users switch their computer to the display device, the KVM switch must act as a pass-through for Display Data Channel Command Interface (DDC/CI) commands that the operating system issues.
* The KVM switch must pass the EDID data even if users restart their computer while the computer is switched away.

One of the goals of the Windows 7 operating system is to provide a positive experience whenever users connect or configure a display device. To meet this goal, Microsoft established the KVM switch guidelines that are part of the Connecting and Configuring Displays (CCD) feature in Windows 7.

The CCD feature in Windows 7 focuses on streamlining and improving the user experience with the display device setup of the desktop. This feature provides users with the following:

* Robust display device detection:

Windows 7 reliably detects the display device that is connected to a KVM switch whenever users connect or disconnect the device. The operating system also automatically detects the display device connection or disconnection status by using connectors that support Hot Plug Detect (HPD).

Windows 7 has a consistent behavior for display device detection across different IHV-configured computers that use graphic adapters from different manufacturers.

* Reliable persistence:

Windows 7 stores the last-used display device configuration and restores that setting whenever users reconnect the same display device to their computer. Windows 7 stores the configuration settings that are based on the Extended Display Identification Data (EDID) of the display device. If a docking station is part of a portable computer, the last-used display device configuration must persist when the user removes and re-inserts the portable computer.

For more information about EDID, refer to the Video Electronics Standards Association (VESA) specifications.

* A user interface that is smooth, simple, intuitive, and discoverable:

Users must be able to easily connect one or more display devices to their computer and configure them as required. For multiple display devices, the Windows 7 Control Panel supports cloning the desktop on all connected display devices.

The Windows 7 operating system automatically configures the display device with the optimal default settings, which are based on the information from the EDID.

If Windows 7 fails its connectivity check for a display device, users must be able to switch the video projection to another display device that is connected to the computer.

The number of times that Windows 7 sets the desktop mode must be minimized in the scenarios in this document.

For more information about the CCD feature, refer to the WinHEC 2008 presentation “Connecting Projectors and Using Docking Stations with Windows 7.”

# Summary of Issues

In Windows versions earlier than Windows 7, users can experience the following issues when they connect their display devices to a KVM switch**:**

* The operating system does not properly set the native resolution when the display device is connected to the KVM switch.
* Each time users restart their computer, the operating system changes or incorrectly sets the resolution of the display device. This behavior can occur whenever users switch from one computer to another by using a KVM switch.
* The operating system cannot set a resolution that the display device supports.
* When users connect multiple display devices to their computer by using a KVM switch and then restart the computer, the primary desktop and extended desktop are swapped on both display devices and the resolution of the display device changes.

These issues primarily occur when users switch from one computer to another because the operating system acquires different EDID from the KVM switch. Sometimes, when users switch away from one computer, the KVM switch generates an HPD event. The operating system interprets the event as a result of a change in display device. The desktop is moved around and resized on the display device, and the operating system incorrectly changes the display device resolution.

# KVM Scenarios

The following table lists all possible end-user scenarios that use a KVM switch in Windows 7.

**Note**In these scenarios, the term *target computer* refers to the system being tested.

|  |  |  |
| --- | --- | --- |
| Scenario number | Scenario overview | Scenario description, with current results and expected behavior |
| 1. | User wants to install the Windows 7 operating system on the target computer and uses one of the following scenarios: |  |
| 1.1.  1.1  (con-  tinued) | Switches to the target computer before beginning installation. | **Scenario description:**  For this scenario, follow these steps:   1. Switch to the target computer by using the KVM switch. 2. Begin installing the Windows 7 operating system on the target computer. 3. After installation is complete, verify that the native resolution (as defined by the display device IHV) is correctly set on the display device. Note that this occurs only if the KVM switch passes the correct EDID to the target computer throughout the installation process.   **Current Results without KVM Requirements:**  If the KVM switch passes no EDID or its own EDID to the target computer, the operating system incorrectly sets the display device resolution. Therefore, the target desktop is rearranged, moved, and resized, which results in a poor user experience.  **Expected or Correct Results with KVM Requirements:**  The KVM switch sends the correct EDID to the target computer throughout the installation process. This ensures that the operating system correctly sets the native resolution of the display device as defined by the IHV. Therefore, the target desktop does not change, which results in a positive and reliable user experience. |
| 1.2. | Switches away from the target computer during the installation process. | **Scenario description:**  For this scenario, follow these steps:   1. Begin installing the Windows 7 operating system on the target computer. 2. Switch to another computer by using the KVM switch. 3. Wait until the Windows 7 operating system is installed on the target computer and the target computer is restarted. 4. Switch back to the target computer to provide the necessary input during the final stages of installation. 5. Verify that the native resolution is correctly set on the display device. Note that this occurs only if the KVM switch passes the correct EDID to the target computer throughout the installation process.   **Current Results without KVM Requirements:**  If the computer is switched away and the KVM switch does not pass the display device’s EDID, the operating system could potentially reset the display device resolution or layout, which results in a poor user experience.  **Expected or Correct Results with KVM Requirements:**  Windows 7 is optimized for projection and docking scenarios. The KVM switch sends the correct EDID to the target computer throughout installation. This ensures that the operating system correctly sets the native resolution of the display device as defined by the IHV. The target desktop does not change, which results in a positive and reliable user experience. |
| 2. | User wants to restart the operating system on the target computer and uses one of the following scenarios: |  |
| 2.1 | Switches to target computer before restarting the operating system. | **Scenario description:**  For this scenario, follow these steps:   1. Switch to the target desktop by using the KVM switch. 2. Restart the operating system and remain connected to the target computer by using the KVM switch. 3. After the operating system is restarted, verify that the native resolution is correctly set on the display device. Note that this occurs only if the KVM switch passes the correct EDID to the target computer throughout the restart process.   **Note**The **c**urrent and expected results are the same as Scenario 1.1. |
| 2.2 | Switches away from the target computer while it is restarting. | **Scenario description:**  For this scenario, follow these steps:   1. Switch to the target desktop by using the KVM switch. 2. Restart the operating system. 3. Switch to another computer by using the KVM switch or keyboard shortcut. 4. After the target computer is restarted, switch back to it and provide logon credentials. 5. Verify that the native resolution is correctly set on the display device.   **Note**The **c**urrent and expected results are the same as Scenario 1.2. |
| 3. | Enter sleep mode and resume. | **Scenario description:**  Configure the target computer to enter sleep mode in 2 minutes. After configuration, follow these steps:   1. Switch to another computer by using the KVM switch. 2. Allow the target computer to enter sleep mode. 3. Place the target computer in the resume mode while the computer is switched away. 4. After the resume sequence is complete, verify that the native resolution is correctly set on the display device. Note that this occurs only if the KVM switch passes the correct EDID to the target computer throughout the resume process.   **Current Results without KVM Requirements:**  If the KVM switch can handle partial EDID queries from the target computer, either an incorrect EDID or no EDID is sent. If this occurs, the operating system resets the display device resolution and rearranges the target desktop, which results in a poor user experience.  **Expected or Correct Results with KVM Requirements:**  If the KVM can handle partial EDID queries from the target computer, the operating system sets an appropriate resolution, which results in a positive and reliable user experience. |
| 4. | Enter hibernate mode and resume. | **Scenario description:**  Configure the target computer to enter the hibernate mode in 5 minutes. After configuration, follow these steps:   1. Switch to another computer by using the KVM switch. 2. Allow the target computer to enter hibernate mode. 3. Place the target computer in the resume mode while it is switched away. 4. After the resume sequence is complete, verify that the native resolution is correctly set on the display device. Note that this occurs only if the KVM switch passes the correct EDID to the target computer throughout the resume process.   **Note**The **c**urrent and expected results are the same as Scenario 3. |
| 5. | Connect or disconnect the display device to the KVM switch that is connected to the target computer. | **Scenario description:**  For this scenario, use a digital connector that supports HPD, such as a DVI or HDMI connector. Connect the display device directly to the target computer. Verify that the target computer detects the HPD event and automatically configures the display device.  After you verify this, follow these steps:   1. Ensure that no display device is connected to the KVM switch. 2. Set up the KVM switch so that it has connections to multiple computers, including the target computer. 3. Connect the display device to the KVM switch. 4. Verify whether the display device is detected on the target computer. If it is detected, verify that the operating system sets the correct resolution on the display device.   **Note**The **c**urrent and expected results are the same as Scenario 1.1. |
| 6. | Connect a KVM switch to the target computer or power cycle the KVM switch while the computer is connected. | **Scenario description:**  For this scenario, use a digital connector that supports HPD such as a DVI or HDMI connector. Connect the display device directly to the target computer. Verify that the target computer detects the HPD event and automatically configures the display device.  After you verify this, follow these steps:   1. Set up the KVM switch so that it is the only KVM that is connected to the display device. 2. Either connect the KVM switch to the target computer, or power cycle the switch if it is already connected to the target computer. 3. Verify that the operating system detects the display device on the target computer. 4. If detected, verify that the operating system sets the correct resolution on the display device.   **Note**Thecurrent and expected results are the same as Scenario 1.1. |
| 7. | Switch computers by using a KVM switch. | **Scenario description:**  For this scenario, follow these steps:   1. Use the KVM switch to switch away from the target computer to another computer. 2. Switch back to the target computer. 3. Verify that the resolution of the target computer has not changed.   **Current Results without KVM Requirements:**  If the KVM switch generates HPD remove and arrive messages, the target computer interprets these messages to be display device arrival and removal events. If this occurs, the operating system resets the display device resolution and rearranges the target desktop, which results in a poor user experience.  **Expected or Correct Results with KVM Requirements:**  The KVM switch must not generate HPD remove and arrive messages when the user switches the desktop from one computer to another. This ensures that the operating system correctly sets the native resolution of the display device. The target desktop does not change, which results in a positive and reliable user experience. |
| 8. | Dock a portable computer. | For this scenario, one of the computers that is connected to the KVM switch is a docking station that has an external display device.  After you dock a portable computer, the operating system should set the correct resolution of the external display device.  **Note**The **c**urrent and expected results are the same as Scenario 1.1. |
| 9. | Use the Windows Logo+P keyboard shortcut to extend the desktop to another display device that is connected to the KVM switch. | **Scenario description:**  After you use this shortcut, verify that the target computer detects the display device and the operating system sets the correct resolution on the display device as if it were connected directly to the target computer.  This applies to display devices that are connected to the KVM switch by using connectors that do not support automatic HPD.  **Note**The **c**urrent and expected results are the same as Scenario 1.1. |
| 10.  10.  (con-  tinued) | Detect that the operating system sets the correct display device resolution. | **Scenario description:**  For this scenario, the target computer is connected to the display device by using a KVM switch. Follow these steps:   1. From Control Panel, click **Adjust screen resolution**. 2. Click **Detect**. 3. Verify that the operating system sets the correct resolution on the display device.   **Note**This scenario applies to display devices that are connected by using all types of connectors, including connectors that support automatic HPD.  **Current Results without KVM Requirements:**  If the KVM switch passes no EDID or its own EDID to the target computer, the operating system incorrectly sets the display device resolution. Therefore, the target desktop is rearranged, moved, and resized, which results in a poor user experience.  **Expected or Correct Results with KVM Requirements:**  The KVM switch sends the correct EDID to the target computer. This ensures that the operating system correctly sets the native resolution of the display device as defined by the display device IHV. Therefore, the target desktop does not change, which results in a positive and reliable user experience. |
| 11. | Test third-party color calibration tools that use Monitor Command Control Set (MCCS). | **Scenario description:**  Many third-party applications use MCCS commands over the inter-integrated circuit (I2C) interface to configure and calibrate the display device. After you switch the display device to the target computer, these applications should continue to work by being able to send MCCS commands to the display device. Follow these steps:   1. Connect the display device **to** the KVM switch. 2. Switch to the target computer. 3. Run the third-party calibration tools. 4. Verify whether the correct calibration is set on the display device.   **Current Results without KVM Requirements:**  If the KVM switch either changes the MCCS command or does not pass the MCCS command to the target computer, the display device color is incorrectly calibrated. Therefore, the target desktop is changed to an incorrect color format, which results in a poor user experience.  **Expected or Correct Results with KVM Requirements:**  The KVM switch passes the unaltered MCCS command to the target computer when the color is calibrated. This ensures that the operating system correctly sets the color format of the display device as defined by the IHV. Therefore, the target desktop does not change, which results in a positive and reliable user experience. |

# KVM Test Configuration

[KVM Test Cases](#_KVM_Test_Cases) describes a list of specific tests that verify whether KVM switches meet Microsoft requirements and recommendations. These test cases require the following configuration, as shown in Figure 2:

* Two display devices, two desktop computers, and one portable computer that has a docking station.
* The two desktop computers and the docking station that are connected to the same display device by using the KVM switch.
* The desktop computer labeled “PC1” that is the target computer to be tested.
* One display device that is connected to the KVM switch and the other display device that is connected directly to PC1.



Figure 2. Setup for KVM testing

Install the Windows 7 operating system only on PC1 during testing. After installation, verify that the device driver is installed correctly for the graphics adapter on PC1. Figure 3 shows how you can use Device Manager to verify this.

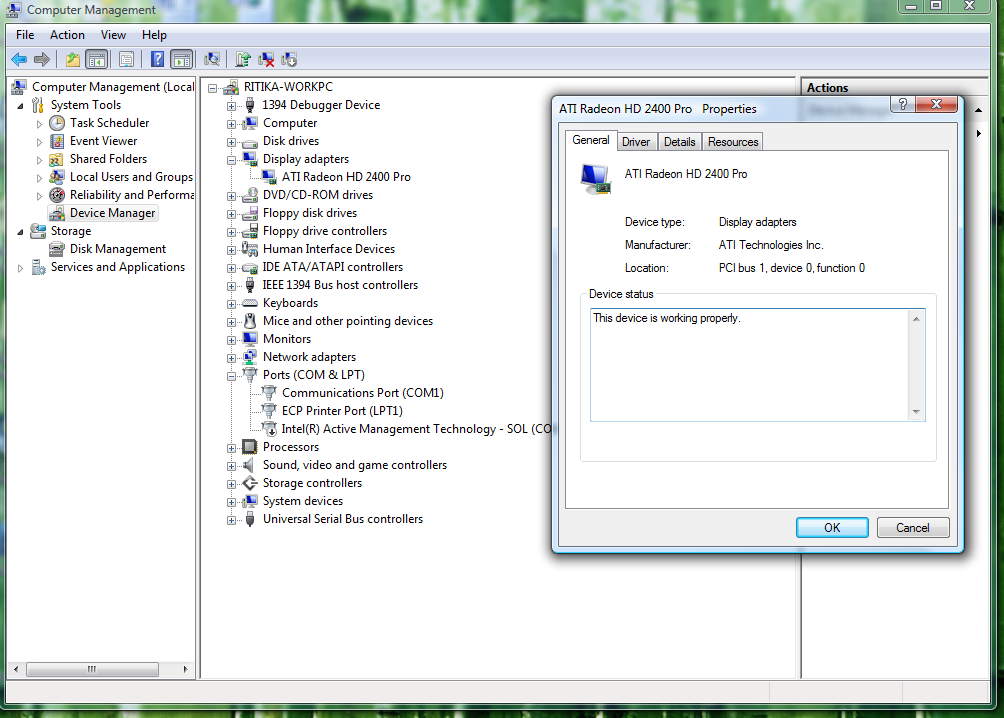


Figure 3: Using Device Manager to verify the correct installation of the graphics adapter

# KVM Test Cases

[KVM Scenarios](#_KVM_SCENARIOS) discusses the various end-user scenarios that use a KVM switch. This section lists all the test cases that we recommend to ensure that your KVM switches meet the goal of Windows 7 to provide a positive user experience.

The KVM test cases are a subset of all the scenarios in [KVM Scenarios](#_KVM_SCENARIOS). A KVM switch that passes the test cases in this section is expected to work for all end-user scenarios.

|  |  |  |  |
| --- | --- | --- | --- |
| Test. number | Test case | Instructions | Pass/fail results |
| 1. | Install Windows 7 on the target computer while it is connected to the display device by using the KVM switch. | 1. Directly connect PC1 to Display1. Install Windows 7 on PC1. Ensure the driver is installed successfully for the graphics adapter. 2. Verify that the EDID that Display1 passed to PC1 is correct. 3. Connect Display1 to the KVM switch as shown in Figure 2. 4. Connect Display2 directly to PC1. 5. Install Windows 7 on PC2. 6. Following the installation and restart of PC2, ensure that the display device driver is installed on PC2 by the Device Manager. 7. Verify that the EDID that was passed to PC2 by using the KVM switch is correct. 8. Verify that PC2 correctly sets the native resolution of Display1. | **PASS:** Native resolution is set for the display device that is connected to the KVM switch.  **FAIL:** The native resolution is not set for the display device that is connected to the KVM switch. |
| 2. | Install Windows 7 on the target computer while the computer is switched away from the display device by using the KVM switch. | 1. Install Windows 7 by directly connecting PC1 to Display1. Ensure that the driver is installed successfully for the graphics adapter. 2. Verify that the EDID that Display1 passed to PC1 is correct. 3. Connect Display1 to the KVM switch, as shown in Figure 2. 4. Connect Display2 directly to PC1. 5. Initiate the installation of Windows 7 on PC1. 6. Switch to PC2 while the installation is proceeding on PC1. 7. Following the installation and restart of PC1, switch back to PC1 from PC2. 8. Ensure that the display device driver is installed by using Device Manager. 9. Verify that the EDID that the KVM switch passed to PC1 is correct. 10. Verify that PC1 set the native resolution of Display1 correctly. | **PASS:** Native resolution is set for the display device that is connected to the KVM switch.  **FAIL:** The native resolution is not set for the display device that is connected to the KVM switch. |
| 3. | Restart the operating system while the system is switched away from the display device. | 1. Note the resolution that is set for Display1 when it is connected to PC1 by using the KVM switch. 2. Switch the KVM to PC2. 3. Restart PC1 while it and PC2 are connected to the KVM switch. 4. After PC1 is restarted, connect it to the KVM switch. 5. Verify the resolution of Display1 when connected to PC1 by using the KVM switch. If the resolution matches the previous resolution, the KVM switch is behaving correctly. | **PASS:** The resolution of Display1 remains the same after the operating system is restarted.  **FAIL:** The resolution for Display1 changes after the operating system is restarted. |
| 4. | Change the resolution, and verify the resolution following resume from sleep and hibernate. | **Note**This test is done primarily on a portable computer/docking station configuration. However, we highly recommend that you perform the same test on PC1.   1. Connect the portable computer that is attached to a docking station to Display1 by using the KVM switch. 2. Put the portable computer into sleep mode. After the portable computer is in the low power state, resume the portable computer. 3. After the computer has resumed, verify that the resolution has not changed. 4. Put the portable computer into hibernate mode. After the portable computer is in the low power state, resume the portable computer. 5. After the computer has resumed, verify that the resolution has not changed. | **PASS:** The resolution of Display1 remains the same after it enters resume mode from sleep or hibernate.  **FAIL:** The resolution of Display1 changes after it enters resume mode from sleep or hibernate. |
| 5. | Switch computers by using the KVM switch. | 1. Change the resolution of Display1 when PC1 is connected to it by the KVM switch. 2. Switch between PC1 and PC2 by using the KVM switch. 3. Go to PC1 and verify that the resolution has not changed. | **PASS:** The resolution remains the same on Display1 when it is connected to PC1 by using the KVM switch.  **FAIL:** The resolution on Display1 changes when it is connected to PC1 by using the KVM switch. |

# KVM Requirements

This section describes a set of requirements of KVM switches. Each requirement defines the expected behavior of KVM switches in Windows 7 and later versions of the Windows operating system.

In addition to the Windows 7 requirements, the VESA and DVI specifications provide similar recommendations or requirements for KVM switches. HDMI and DisplayPort Interface specifications also have recommendations for KVM switches, which are referred to within these specifications as “Repeater Devices” or “Branch Devices”.

**Note**The requirements in this section are mostly relevant for VGA and DVI connectors.

## Requirement ID - Input-0051v1

#### Requirement description:

The KVM switch must correctly pass through the EDID that it received from the connected display device to all computers that are connected to the switch.

#### Group:

Input Devices

#### Details:

All KVM switches must meet the following criteria for the EDID that is receives from the connected display device:

* When the KVM switch identifies a new display device, it must make the EDID from the display device available to each computer that is connected to the switch.
* If the connected display device does not have an EDID, the KVM switch must not provide any EDID to the connected computers.
* The KVM switch must allow I2C command queries for EDID from all connected computers, irrespective of which computer is currently connected to the display device.
* When queried by a computer, the KVM switch must return the accurate EDID from the display device to the querying computer.
* The KVM must respond to partial EDID queries from the computer. A *partial query* refers to a reading of less than 256 bytes, which is the maximum number of bytes that are available in EDID.

#### Supported Scenarios:

KVM switch must support end-user scenarios 1, 2, 5, 6, 7, 8, 9, 10, and 11 in [KVM Scenarios](#_KVM_SCENARIOS).

## Requirement ID - Input-0052v1

#### Requirement description:

The KVM switch must detect the presence or absence of a physical display device that is connected to it.

#### Group:

Input Devices

#### Details:

* When the KVM switch is turned on, it must detect the presence of absence of a display device.
* If the KVM switch detects a display device as connected, the switch must notify each connected computer. This makes it possible for the graphics card in the computer to detect the presence of the display device.
* While the KVM switch is powered on, if users physically connect or disconnect the display device, the KVM switch must detect this action. If the connection state of the display device changes, the KVM switch must notify each connected computer. This makes it possible for the graphics card in the computer to detect the presence of the display device.
* If the user switches the display device from one computer to another, the KVM switch must not generate either a HPD event (for DVI connectors) or a load/signal noise (for VGA connectors). By avoiding these notifications, the computer does not behave as if a new display device were connected or disconnected whenever users switch between computers that are connected to the KVM switch.

#### Supported Scenarios:

KVM switch must support end-user scenarios 3, 4, 5, 6, 7, and 8 in [KVM Scenarios](#_KVM_SCENARIOS).

## Requirement ID - Input-0053v1

#### Requirement description:

The KVM switch passes all I2C calls from the currently connected computer to the display device.

#### Group:

Input Devices

#### Details:

* The KVM switch must comply with the I2C bus specification, which allows easy communication between components that reside on the same circuit board.
* The KVM switch must pass through all I2C commands to the connected display device with no modifications.
* Whenever users switch to a specific computer that is connected to the KVM switch, the operating system must send the I2C commands to the connected display device for that computer. This requirement ensures that all MCCS and DDC commands work as expected.

#### Supported Scenarios:

The KVM switch must support all end-user scenarios in [KVM Scenarios](#_KVM_SCENARIOS).

## Requirement ID - Input-0054v1

#### Requirement description:

The video cable that is provided with the KVM switch conforms to all global standards bodies for computer graphics, high-definition consumer devices, and computer products.

#### Group:

Input Devices

#### Details:

KVM video cables, or video cables that are bundled with KVM switches, must adhere to the following specifications and standards:

* DVI Specification Revision 1.0 (April 1999).

Note  This applies only to DVI cables.

* Enhanced Display Data Channel (E-DDC) Standard Version 1.2 (December 2007).
* DDC/CI Specifications Version 1.1 (October 2004)
* HDMI Specification Version 1.3a Appendix A.1 and A.2 (November 2006).

Note  This applies only to HDMI cables.

* VESA Display Port Standard 1.1a Branch Device Section 5.3 and Section 2.1.4.1 (January 2008).
* Enhanced Extended Display Identification Data - Version 1 Revision 4 (September 2006).

#### Supported Scenarios:

The KVM switch must support all end-user scenarios in [KVM Scenarios](#_KVM_SCENARIOS).

# KVM Recommendations

The following are recommendations for KVM switches in Windows 7. Note that these are recommendations only, not requirements. However, we highly suggest that you follow them.

* The presence of the KVM switch must not prevent the display device from correctly entering power save mode.

If the display device is connected to a KVM switch, all supported power modes of the display device must work as if the display device were connected directly to the computer. If the selected computer is turned off, the KVM switch should keep the display device in power save mode. The KVM switch should be able to remove the display device from power save mode only if necessary, such as when users perform KVM administration.

* The KVM switch must be able to handle partial EDID queries as long as they comply with the appropriate VESA specification.

To reproduce the Partial EDID queries, execute end-user scenarios 3 and 4 in “[KVM Scenarios](#_KVM_SCENARIOS).” These scenarios trigger the computer to query partial EDIDs by using the KVM switch.

When the computer resumes from the low power state, it may not query or read an entire EDID from the display device. Either the computer or its graphics card may choose to read a partial EDID to determine whether the display device has changed when the computer resumes from sleep or hibernate mode. If the computer is using the same display device, it restores the same configuration on the display device that was in place before the computer entered a low power state.

The KVM switch must support this scenario of partial EDID queries from the computer as described “[Requirement ID - Input-0051v1](#_Requirement_ID_-).”

# Conclusion

By adopting the requirements and recommendations in this paper, IHVs can improve the quality of the Windows 7 user experience with display devices and KVM switches.

These requirements and recommendation provide the IHVs with potential avenues of innovation, as well as informing their customers that they fully support the Windows Platform and Windows Hardware Certification.

# Resources

### Microsoft

#### Windows Dev Center – Hardware site:

Home page

<http://msdn.microsoft.com/en-us/windows/hardware/default.aspx>

#### WinHEC 2008:

[Connecting Projectors and Using Docking Stations with Windows 7](http://download.microsoft.com/download/5/E/6/5E66B27B-988B-4F50-AF3A-C2FF1E62180F/MBL-T579_WH08.pptx)

<http://download.microsoft.com/download/5/E/6/5E66B27B-988B-4F50-AF3A-C2FF1E62180F/MBL-T579_WH08.pptx>

### Organization Specifications

Digital Display Working Group (DDWG)

DVI Specification Revision 1.0 (April 1999)

<http://www.ddwg.org>

High Definition Multimedia Interface (HDMI)

HDMI Specification Version 1.3a Appendix A.1 and A.2 (November 2006)

<http://www.hdmi.org>

Next Experience (NXP) Semiconductors

I2C Bus Specification 2.1 (January 2000)

<http://www.nxp.com>

Video Electronics Standards Association (VESA)

* DDC/CI Specifications Version 1.1 (October 2004)
* Enhanced Display Data Channel (E-DDC) Standard Version 1.2 (December 2007)
* Enhanced**Extended Display Identification Data **-**** Version 1 Revision 4 (September 2006)
* VESA Display Port Standard 1.1a Branch Device Section 5.3 and Section 2.1.4.1 (January 2008)

<http://www.vesa.org>

# Appendix: Acronyms

|  |  |  |  |
| --- | --- | --- | --- |
| Acronym | Meaning | | |
| CCD | | Connecting and Configuring Displays |
| DDC/CI | | Display Data Channel Command Interface |
| DDWG | | Digital Display Working Group |
| DVI | | Digital Visual Interface |
| EDID | | Extended Display Identification Data  EDID is a standard published by VESA |
| HDMI | | High-Definition Multimedia Interface |
| HPD | | hot plug detect |
| I2C | | Inter Integrated Circuit - Multi-Master Serial Computer Bus |
| KVM | | keyboard, video, and mouse  **Note**KVM switches are also referred to as *Repeater* or *Branch* devices in the HDMI and Display Port Interface specifications |
| MCCS | | Monitor Control Command Set |
| NXP | | Next eXPerience Semiconductors |
| VESA | | Video Electronics Standards Association |
| VGA | | video graphics array |
| WLP | | Windows Logo Program |