VESA®

VESA PC Theatre Interconnectivity Standard

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VESA PC Theatre Interconnectivity Standard

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Purpose

The purpose of this document is to define a PC Theatre Interconnectivity (PCTI) standard that allows Personal Computer and Consumer Electronics manufacturers to produce PC Theatre computer and display products that are compatible, work together as a single system, are easy to use, and support automatic configuration. The PC Theatre Interconnectivity standard was created using existing VESA and USB standards as building blocks to support identification of the display by the PC, bi-directional communication, display control by the PC, sharing of the display's resources by the PC, and transportation of audio and video between the display and PC.

Summary

As the PC and TV converge, a new product category will be created. The VESA PC Theatre Interconnectivity Standard allows both Personal Computer and Consumer Electronics companies to develop products that are compatible, self configuring, work together as a single system, and are easy to use. The focus of this standard is the interface between the PC and the large-screen display.

PREFACE

Scope

This standard is intended to define an interface between a PC (or simple computing device such as a set-top box) and display that will enable manufacturers to build PC Theatre products that are compatible, work together as a single system, are easy to use, and support automatic configuration. This standard does not address issues such as a common IR protocol or control of consumer electronics devices such as VCRs and A/V receivers.

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Clarifications and application notes to support this standard may be written. To obtain the latest standard and any support documentation, contact VESA.

If you have a product that incorporates PC Theatre functionality, you should ask the company that manufactured your product for assistance. If you are a manufacturer, VESA can assist you with any clarification you may require. All comments or reported errors should be submitted in writing to VESA using one of the following methods.

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Acknowledgments

The PC Theatre Interconnectivity Standard is the result of expert input from many sources. VESA acknowledges and thanks the PC Theatre Committee members who contributed to and combined the industry expertise that resulted in this standard.

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1.1. SUMMARY

As the PC and TV converge, a new product category will be created. The VESA PC Theatre Interconnectivity Standard allows both Personal Computer and Consumer Electronics companies to develop products that are compatible, self configuring, work together as a single system, and are easy to use. The focus of this standard is the interface between the PC (and simple computing device such as a set-top box) and the large-screen display.

1.2. BACKGROUND

The TV and PC are converging to create a new category of entertainment products. These products will give the consumer more entertainment options by combining the best features of a PC and TV in a truly converged environment that is as easy to use as a standard TV. The computing power of a PC Theatre system coupled with a large-screen display make this an excellent living room platform for digital and interactive services that are available now, and new services that will be available in the future.

As this new product category grows, Consumer Electronics (CE) companies will include monitor functionality in their TVs. At the same time, Personal Computer (PC) manufacturers will add TV functionality to their computers. This increased functionality in both the TV and PC greatly increases the value to the consumer.

Since there are no standards for this new product category, products from different manufacturers will be incompatible. In order for the consumer to have confidence in this new product, and for this new category to grow, open industry standards that are based on today's technology must be established. Such standards will allow companies from both the PC and CE industries to develop compatible PC Theatre products. The consumer must be able to select a display and a PC from different manufacturers and use them together as a system without the need for custom cables and complicated setup procedures. In addition, the PC Theatre standards must be completely compatible with existing standards so PC Theatre displays and computers may be used with standard PC and CE products.

The VESA PC Theatre Committee has been established to address the new interoperability standards required for PC Theatre and to serve as a focal point to work with other standards bodies.

1.3. OBJECTIVES OF STANDARD

The primary goal of this document is to define a PC Theatre Interconnectivity (PCTI) Standard that allows PC and CE manufacturers to produce PC Theatre computer and display products that are compatible, work together as a single system, are easy to use, and support automatic configuration. The PC Theatre Interconnectivity Standard has been created using existing VESA and USB standards as building blocks to support identification of the display by the PC, bi-directional communication, display control by the PC, sharing of the display's resources by the PC, and transportation of audio and video between the display and PC.

1.4. REFERENCE DOCUMENTS

This specification refers to the following documents:

VESA Display Data Channel (DDC) Standard, Version 3.0, September 15, 1997

VESA Extended Display Identification (EDID) Standard, Version 3.0, November 13, 1997

VESA Monitor Control Command Set (MCCS) Standard, V 1.0

VESA Display Power Management Signaling (DPMS) Standard Version 1.1, August 20, 1993

VESA Plug and Display (P&D) Standard, Version 1.0, June 11, 1997

VESA Display Monitor Timing Specifications (DMTS), Version 1.7, December 18, 1996

Universal Serial Bus Specification, Version 1.0, January 15, 1996

USB Class Definition for Human Interface Devices (HID) Specification, Version 1.0, December 12, 1996

Universal Serial Bus (USB) Monitor Control Class Specification, Version 1.0, January 5, 1998

Universal Serial Bus Device Class Definition for Audio Devices, Version 1.0, March 18, 1998

Universal Serial Bus Device Class Definition for Audio Data Formats, Version 1.0, March 18, 1998

Universal Serial Bus HID Usage Tables, Version 1.0, October 30, 1997

IEEE Standard for a High Performance Serial Bus, 1394-1995

1.5. APPLICABILITY OF GOVERNMENT REGULATIONS

Government mandated requirements such as Closed Caption Decoding and V-Chip parental control are beyond the scope of this standard.

When the display is in stand-alone mode, product features such as channel mapping and government mandated features such as Closed Caption Decoding and V-Chip will be implemented and controlled by the display's internal controller.

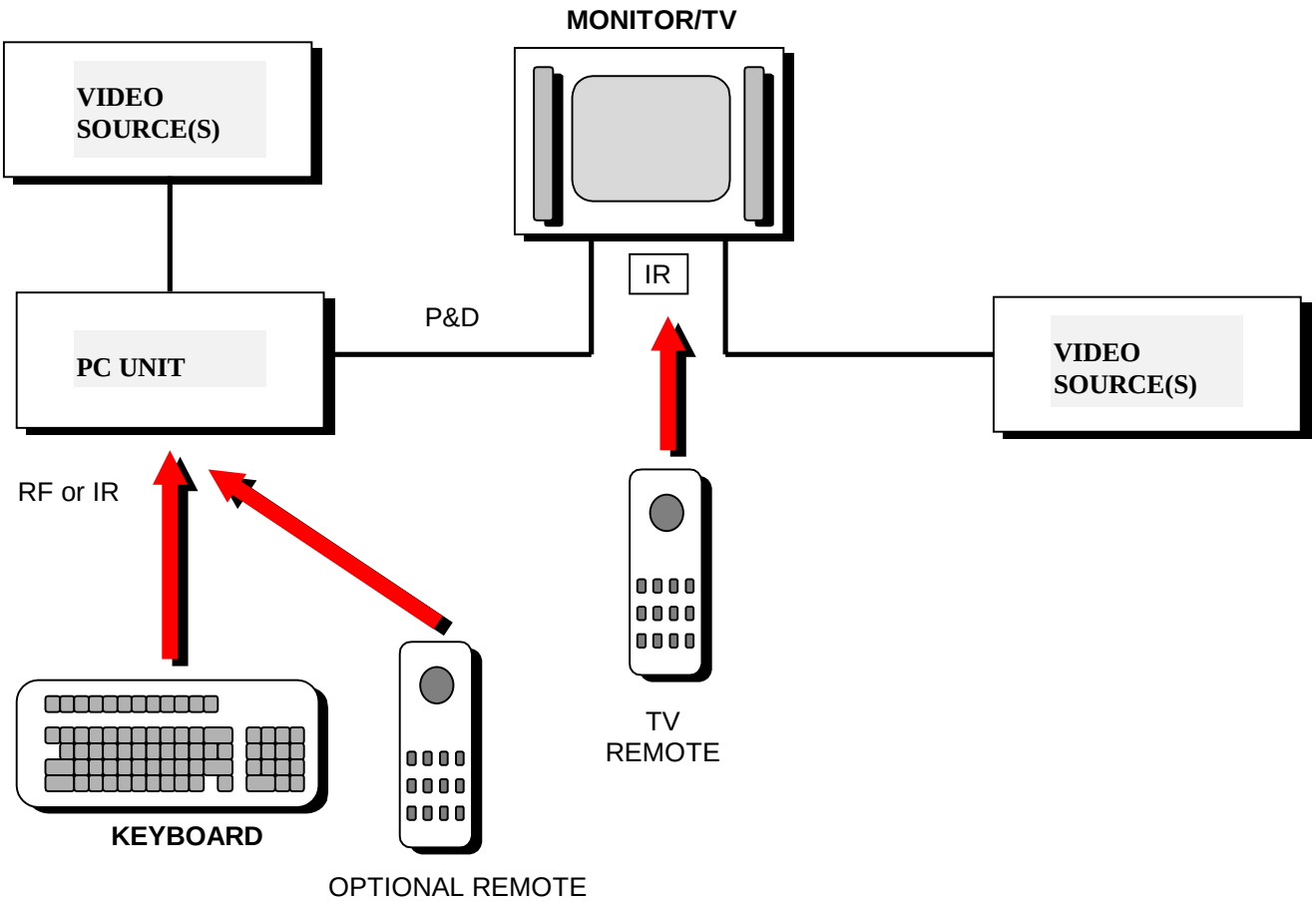
When the display is in slave-mode and the PC has complete control of the tuner and stores the channel map, the host computing device and application software will be responsible for the channel mapping, Closed Caption Decoding, and V-Chip requirements.

2. DEFINITION OF PC THEATRE

PC Theatre is a consumer entertainment system that merges computing and traditional forms of media and entertainment content. This system combines the best features of a TV and multimedia PC, delivering more entertainment options in a truly converged environment. The consumer may watch TV, use the PC, or do both at the same time.

A minimum PC Theatre system consists of two main parts, a display and a computing device. A simple diagram of one possible implementation of a PC Theatre system is shown in Figure 1. The PC Theatre Interconnectivity Standard is primarily concerned with the interface between the PC and display.

Figure 1: PC Theatre System Diagram



The display has the same functionality as a standard VGA monitor with enhancements for displaying TV video. Optionally, the display may also have all the functionality of a stand-alone TV, including the capability to display standard interlaced TV video.

The PC is a typical multimedia system with USB support and a video subsystem capable of combining PC and TV video. The PC may also include IEEE 1394-1995 functionality.

3. PC THEATRE INTERCONNECTIVITY

This chapter describes the interconnectivity between a PC Theatre system unit and display. This interconnectivity is defined using existing VESA and USB standards as building blocks to support identification of the display by the PC, bi-directional communication, display control by the PC, sharing of the display's resources by the PC, and transport of audio and video between the display and PC.

3.1. OVERVIEW

The key points of the PC Theatre interface are as follows:

- The PC and display are connected using a VESA Plug and Display (P&D) Standard V1.0 connector.
- The PC drives the display with a standard RGB or TMDS video signal.
- The PC and display support two different viewing modes: one configured for the display of PC graphics, and the other configured for the display of TV video.
- The PC and display support at least 480 active lines per frame of progressively scanned video.
- The PC and display support VESA Display Data Channel (DDC) V3.0 and Extended Display Identification Data (EDID) V3.0 Standards for identification of the display's capabilities.
- The PC and display support VESA Display Power Management Signaling (DPMS) Standard V1.1 for PC control of the display's power state.
- The PC and display support the USB Monitor Control Class Specification V1.0 and VESA Monitor Control Command Set (MCCS) Standard (proposal) for software control of the display by the PC.
- The display and PC use separate analog audio cables to transport stereo audio from the PC to the display and optionally from the display to the PC. The PC must also support the USB Device Class Definition for Audio Devices specification V1.0 and USB Device Class Definition for Audio Data Formats specification V1.0 for the support of USB audio.
- All user input (remote, keyboard, gamepads, display front button panel) is passed from the display to the PC for processing (when the display is in a slave mode) over USB according to the USB Class Definition for Human Interface Devices (HID) specification V1.0, and the USB HID Usage Tables specification V1.0. The display may also support a stand-alone mode where user input is processed internally.

3.2. PHYSICAL P&D CONNECTION

The VESA P&D Standard V1.0 combines many signals into one connector with support for digital displays (TMDS), analog displays (RGB), IEEE-1394, USB, and DDC. The main advantages of this connector are virtually any type of display can be supported and all required signals for PC Theatre can be supported, thus only one cable is required between the PC and display.

The P&D connector supports the following signals:

- Standard analog video signals (RGB, H & V sync) for support of analog displays
- Transmission Minimized Digital Signaling (TMDS) video for support of digital displays
- IEEE 1394-1995 pair for support of digital video and audio paths to and from the display
- USB, 12 Mb/s for support of PC control of the display, sending user input from the display to the PC, and audio paths to and from the display
- DDC2B for identification of the display's capabilities

The PC Theatre system unit is required to support the P&D-A/D connector. The P&D-A/D connector is shown in Figure 2.

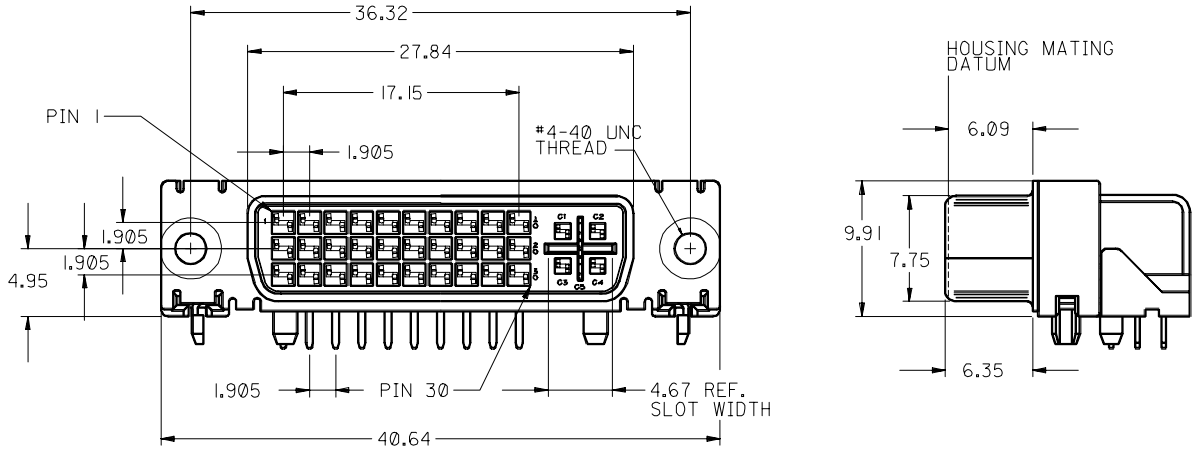


Figure 2 - P&D-A/D Connector

The display is required to support either the P&D-A or P&D-D connector. The P&D-A connector is to be used on analog monitors. The P&D-A connector is shown in Figure 3. Note the connector shown is the P&D-A receptacle and not the plug that is required for the monitor cable.

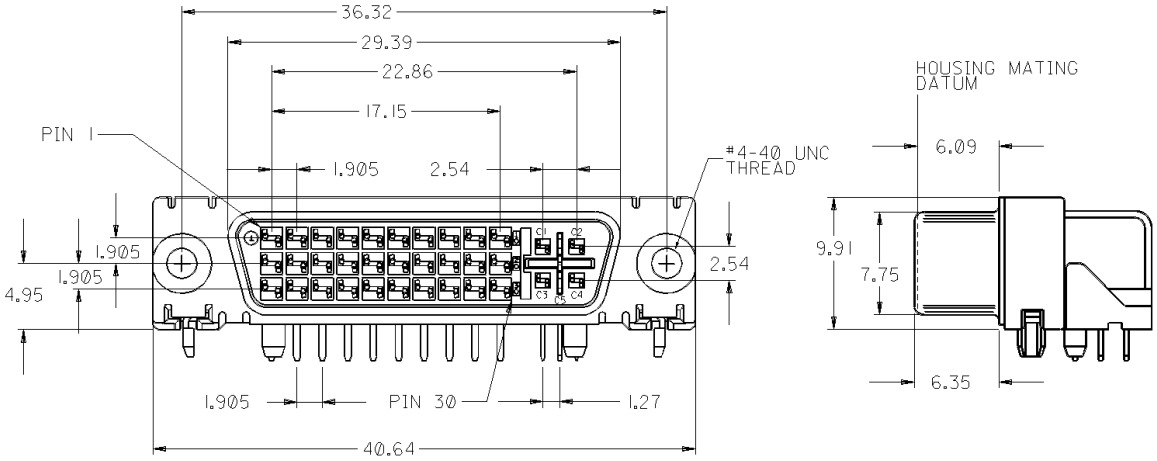


Figure 3 - P&D-A Connector

The P&D-D connector is to be used on digital monitors. This connector is shown in Figure 4. Note the connector shown is the P&D-D receptacle and not the plug that is required for the monitor cable.

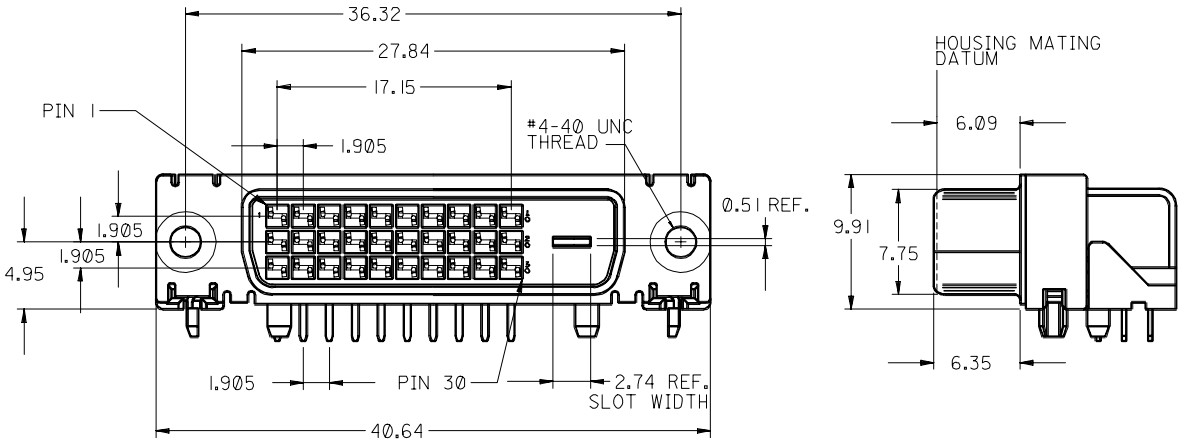


Figure 4 - P&D-D Connector

The support of the P&D standard is required for PC Theatre products. If the display or computer does not use a P&D connector, an adapter cable must be included that combines the supported signals into a P&D connector.

The P&D-A/D connector on the system unit will support both the P&D-A (analog) and P&D-D (digital) monitor connectors. Figure 5 explains the interaction between the different connectors in the P&D family.

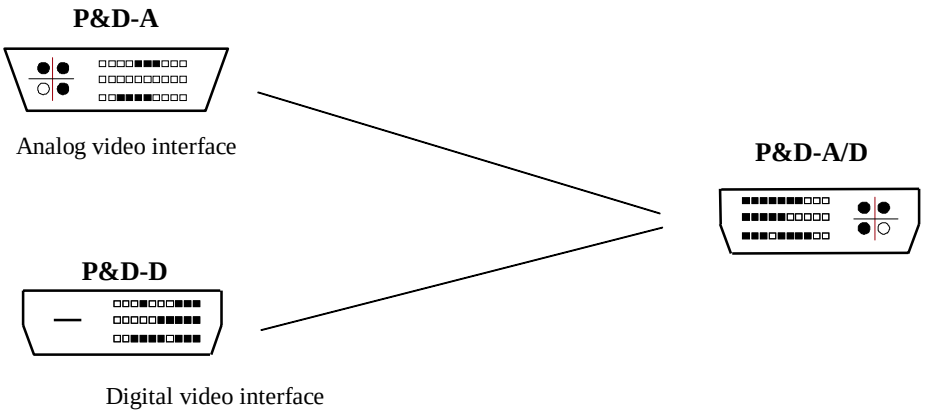


Figure 5 - P&D Connector Family

3.3. PC THEATRE SIGNAL INTERFACE

The following section describes the interconnectivity signals required for PC Theatre functionality.

3.3.1. **Overview**

The PC Theatre system unit is required to support the signal interfaces and connectors listed in Table 1.

SIGNAL	CONNECTOR	SIGNAL USE
RGB (H&V sync)	P&D	Analog video to drive display
TMDS	P&D	Digital video to drive display
USB	P&D	Control of display, return of user input, and support of USB audio
DDC	P&D	For EDID support to identify display
Stereo Analog Audio Output	Stereo 3.5 mm jack	Stereo analog audio output for amplifier in display
Stereo Analog Audio Input	Stereo 3.5 mm jack	Stereo analog audio input for support of tuner or connector panel in display
Composite Input	Composite video connector (yellow)	Composite video source input. A S-video connector may be substituted if an adapter for Composite video support is supplied with the product.

Table 1 – Required PC Signal Interfaces and Connectors

NOTE: If the P&D connector is not supported, a P&D adapter must be supplied with the product.

The PC Theatre display is required to support the signal interfaces and connectors listed in Table 2.

SIGNAL	CONNECTOR	SIGNAL USE
RGB (H&V sync) or TMDS	P&D	Analog or digital video to drive display
USB	P&D	Control of display, return of user input, and optional audio support
DDC	P&D	For EDID support to identify display
Stereo Analog Audio Input	Two RCA jacks	Stereo analog audio input

Table 2 – Required Display Signal Interfaces and Connectors

The diagram in Figure 6 shows the PC Theatre signal interfaces between the PC and display.

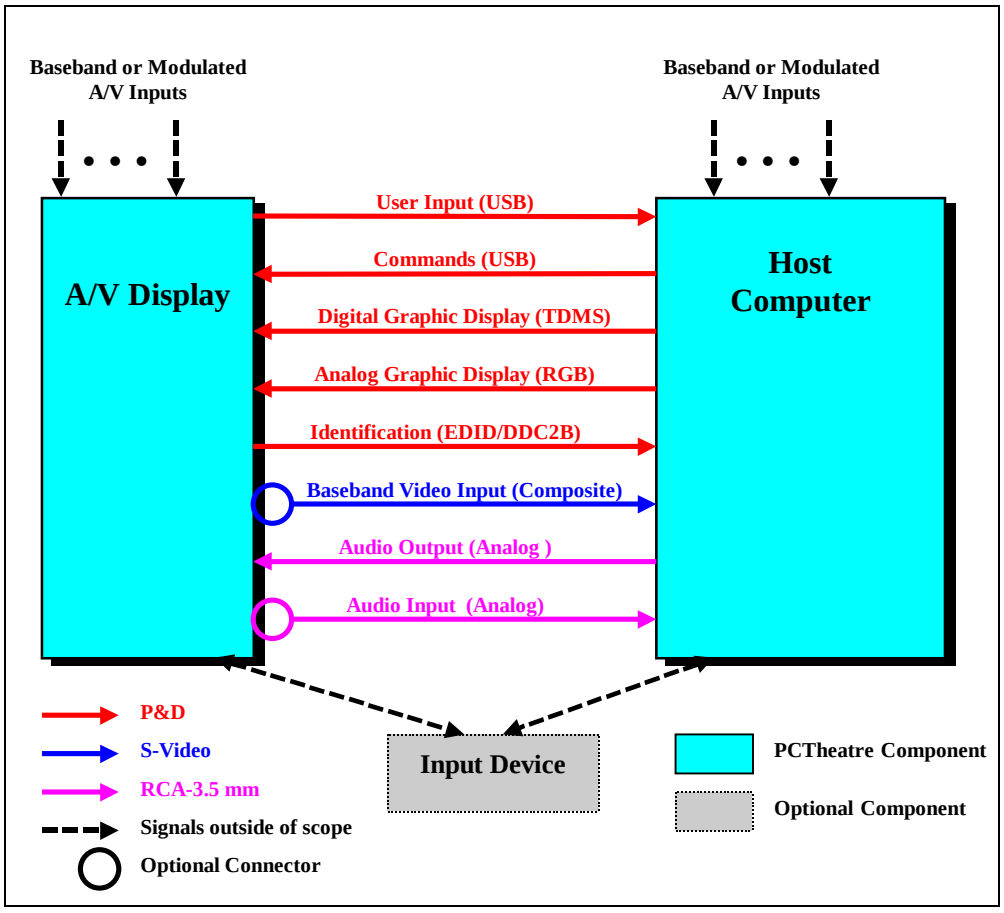


Figure 6 – P&D Interconnectivity Signal Interfaces

3.3.2. Required Individual P&D Connector Signals

The individual P&D signals in the following Tables are required for PC Theatre functionality. The required signals for the PC must support both digital and analog displays. The signals required for the display are different depending on the type of display.

3.3.2.1. **System Unit Required P&D-A/D Signals**

The support of the individual signals listed in Table 3 is required for the system unit P&D-A/D connector.

PIN	SIGNAL
1	TMDS Data2 +
2	TMDS Data2 -
3	TMDS Data2 Return
4	Sync return
5	Horizontal sync (TTL)
6	Vertical sync (TTL)
7	TMDS Clock Return
8	Hot Plug Detection (+5VDC input)
11	TMDS Data1 +
12	TMDS Data1 -
13	TMDS Data1 Return
14	TMDS Clock +
15	TMDS Clock -
16	USB data +
17	USB data -
18	USB/1394 common mode shield
21	TMDS Data0 +
22	TMDS Data0 -
23	TMDS Data0 Return
25	DDC return
26	DDC data (SDA)
27	DDC clock (SCL)
28	+5 VDC (output)
C1	Red Video
C2	Green Video
C4	Blue Video
C5	Video Return

Table 3 – Required System Unit P&D-A/D Connector Signals

3.3.2.2. **Analog Display Required P&D-A Signals**

The support of the individual signals listed in Table 4 is required for an analog display with the P&D-A connector. Note the analog audio and S-video paths specified in the original EVC specification are not supported with the P&D-A version of the connector.

PIN	SIGNAL
4	Sync return
5	Horizontal sync (TTL)
6	Vertical sync (TTL)
8	Hot Plug Detection (+5VDC output to display)
16	USB data +
17	USB data -
18	USB/1394 common mode shield
25	DDC return
26	DDC data (SDA)
27	DDC clock (SCL)
28	+ 5V DC (input to display)
C1	Red Video
C2	Green Video
C4	Blue Video
C5	Video Return

Table 4 – Required Analog Display P&D-A Signals

3.3.2.3. **Digital Display Required P&D-D Signals**

The support of the individual signals listed in Table 5 is required for the digital display P&D-D connector.

PIN	SIGNAL
1	TMDS Data2 +
2	TMDS Data2 -
3	TMDS Data2 Return
7	TMDS Clock Return
8	Hot Plug Detection (+5VDC output to PC)
11	TMDS Data1 +
12	TMDS Data1 -
13	TMDS Data1 Return
14	TMDS Clock +
15	TMDS Clock -
16	USB data +
17	USB data -
18	USB/1394 common mode shield
21	TMDS Data0 +
22	TMDS Data0 -
23	TMDS Data0 Return
25	DDC return
26	DDC data (SDA)
27	DDC clock (SCL)
28	+ 5V DC (input to display)

Table 5 – Required Digital Display P&D-D Connector Signals

3.3.3. **Recommended P&D Connector Signals**

The support of the signals in Table 6 is optional, but recommended to support IEEE 1394-1995 for the transportation of digital audio and video.

PIN	SIGNAL
9	1394 TPA*
10	1394 TPA
19	1394 Vg
20	1394 Vp
29	1394 TPB
30	1394 TPB*

Table 6 – Recommended Signals for PC and Display

3.3.4. **Required Analog Audio and Video Signals for System**

In addition to the signal support required on the P&D connector, the system unit must also provide support for separate analog audio and video connectors.

3.3.4.1. **Specifications for Analog Audio Support**

The following specifications shall apply for analog audio support:

1. Source impedance - 1K ohm maximum
2. Load impedance - 10K ohm minimum
3. Amplitude - 2V RMS maximum, 0.5V RMS nominal

3.3.4.2. **System Unit Required Analog Audio Connectors**

The PC must support a line-level stereo analog audio output on a 3.5 mm stereo jack using standard pin assignments. This audio output connector is used to support a separate analog audio cable to drive the audio amplifier in the display.

In addition, the PC must also support a line-level stereo audio input on a second 3.5 mm stereo jack using standard pin assignments. This audio input connector is used to support a separate audio cable for input of audio.

3.3.4.3. **Display Required Analog Audio Connectors**

The display must support a line-level stereo analog audio input on two RCA jacks.

If video output to the PC is supported, the display must also support two RCA jacks for audio output and a composite video connector for video output.

3.3.4.4. **System Unit Video Connector**

The host must support a Composite video connector for Composite video input. A S-video connector may be substituted for the Composite connector if an adapter is provided for a Composite video support.

3.4. COMMUNICATION INTERFACE

The communication interface is used by the PC to identify and control the display. This interface is implemented using the required DDC-2B, and USB communication links.

3.4.1. **Communication Protocol**

3.4.1.1. **DDC2B**

The VESA DDC-2B standard is a simple interface that is based on the I^2C bus. This interface allows the PC to read and write to the monitor's memory space. The PC is always the master and the display is always the slave. Only the PC may initiate a communication transaction. The interface is used during the boot-up process to allow the PC to query the display for information on its functionality. This information is then used to configure the operating system and video system. DDC2B support is required in both the PC and display. Refer to the DDC2B section of the VESA DDC Standard V3.0 for more information.

3.4.1.2. **USB**

The Universal Serial Bus (USB) is a bi-directional serial bus that operates at speeds of 1.5 and 12 Mb/s. The bi-directional functionality of this bus enables both the PC and the display to initiate a communication transaction. This functionality allows the display to inform the PC about events such as a button press on the display's front panel. The PC and display are required to support the USB Monitor Control Class Specification V1.0 and VESA Monitor Control Command Set (MCCS) Standard V1.0 for software control of the display by the PC. The PC and Display are also required to support the USB Class Definition for Human Interface Devices (HID) specification V1.0, and the USB HID Usage Tables specification V1.0 for transportation of user input from the display back to the PC. In addition, the PC must support the USB Device Class Definition for Audio Devices specification V1.0 and USB Device Class Definition for Audio Data Formats specification V1.0 for the support of USB to transport audio.

3.4.1.3. **IEEE 1394-1995**

IEEE 1394-1995 is a high-speed bi-directional serial bus that is capable of speeds greater than 1 Gb/s. This bus is intended to be used to transport video and may also be used to control the display or transport audio. Refer to the IEEE 1394-1995 specification for more information. Support of IEEE 1394-1995 is optional for PC Theatre. Hereafter in this document, IEEE 1394-1995 is referred to as IEEE-1394 or just 1394.

3.4.2. **Multiple Communication Protocol Support**

Control of the display by the PC is required over USB according to the requirements of the USB Monitor Control Class specification V1.0 and VESA Monitor Control Command Set (MCCS) Standard V1.0. In addition to USB, display control may by supported over DDC2B and 1394. Assuming the PC supported DDC-2B, USB, and 1394 display communication, the recommended method of establishing communication with the display is to first attempt to communicate with the 1394 interface. If this fails, the PC should then attempt to establish communication with the USB interface. If this fails, the PC should then attempt to establish communication with the DDC-2B interface. If this fails, the PC should assume the display does not support software control and disable the software user control interface.

If communication between the PC and display is established, the PC requests the supported controls of the display and configures the user interface accordingly. This communication process is described in the block diagram shown in Figure 7.

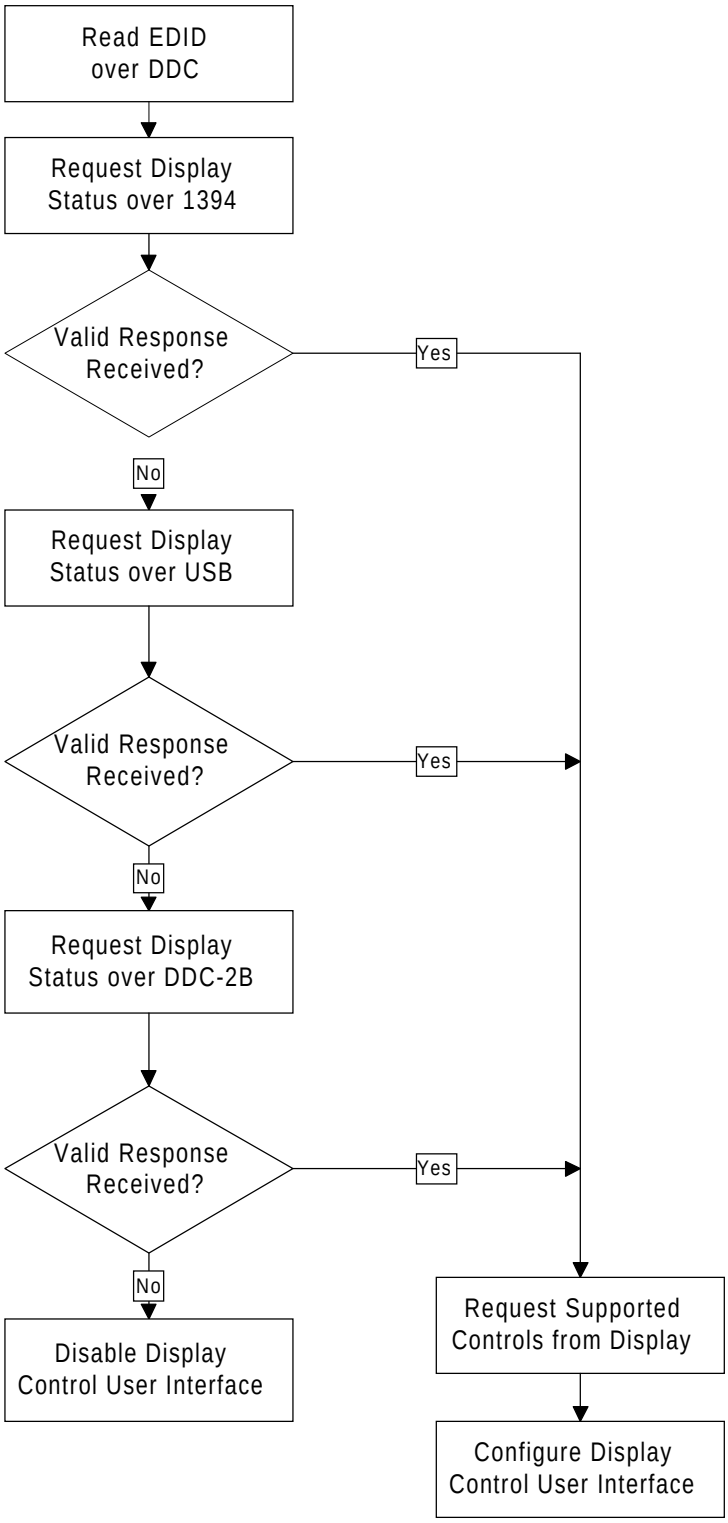


Figure 7: Display Communication Procedure

3.4.3. **Identification of Display**

Support of the VESA Extended Display Identification Data (EDID) Standard V3.0 is required to communicate the display's capabilities to the PC. This information is stored in the display as a condensed memory block.

With this information, the operating system and PC video subsystem can configure themselves for use with the display. The support of EDID structure Version 1.1 is required for all PC Theatre products. In addition, EDID Structure version 2.0 is required for the system unit and digital displays. Version 2.0 of EDID resides at a different memory address in the monitor to allow both EDID Versions 1.1 and 2.0 to be supported together. Note that if EDID structure Version 2.0 is supported, Version 1.1 support is still required. EDID structure Version 2.0 contains additional information that is required for displays that have additional functionality such as a digital video interface and support of USB. Note the EDID structure version and the version of the EDID standard is not the same. Refer to EDID Standard Version 3.0 for information about EDID structures 1.1 and 2.0.

3.4.4. **Supported Controls Information**

The PC must also query the display for the supported controls over USB according to the USB Monitor Control Class Definition specification V1.0 and VESA Monitor Control Command Set (MCCS) Standard V1.0 requirements. For each supported control, the display must be capable of reporting the type (continuous or discrete), the maximum value (the minimum value is assumed to be zero), and the current value. This information is used by the PC to configure the user control interface. This user control interface presents a graphical user interface (GUI) of the supported controls. Only the appropriate user controls that are supported by the display are presented to the user.

3.4.5. **Manufacturer Specific Controls**

The display manufacturer has the option of reporting the support of controls to the PC. If the display manufacturer wants to process the user input and generate the OSD internally for a specific control when the display is in slave mode, the display simply does not report the support of the control to the PC. For this unreported control, the display is required to intercept the user commands for this control, process the commands internally, and generate the OSD internally.

3.5. CONTROLS

The VESA Monitor Control Command Set (MCCS) Standard V1.0 gives a complete list of display controls. This specification is written to be protocol-independent and is used as the basis for the USB Monitor Control Class Definition and the VESA DDC Command Interface (DDC/CI) specifications.

3.5.1. **Required Controls for Flat Panel Displays**

The display controls in Table 7 are required for PC Theatre operation with flat panel displays. Note that some of these controls do not apply to all display technologies. If the display technology does not support, or has great difficulty supporting a specific control, this control can be considered optional. The Brightness and Contrast controls are needed to adjust the display for viewing computer graphics in PC mode and full screen video in TV mode. The Volume and Balance controls are required to provide the minimum control of the audio amplifier in the display. Note the audio controls are not listed in the USB Monitor Control Class Definition specification and VESA Monitor Control Command Set (MCCS) Standard V1.0. These controls are listed in the USB Audio Class Definition for Audio Devices specification.

Note: Some controls do not apply to all display technologies.

COMMAND	DESCRIPTION / VALUE
Brightness	Continuous control. Increasing this value increases the brightness level of the display. Unipolar setting: 00h=min
Contrast	Continuous control. Increasing this value increases the contrast level of the display. Unipolar setting: 00h=min
Volume	Continuous control. Increasing this value causes the volume in the left and right audio channels to increase. Unipolar setting: 00h=mute
Balance	Continuous control. Increasing this value maximizes the volume in the right audio channel and the volume in the left audio channel is decreased. Bipolar setting: 00h=max left channel, min right channel

Table 7 – Required Flat Panel Display Controls for PC Theatre

3.5.2. **Required Controls for CRT Displays**

The display controls in Table 8 are required for PC Theatre operation with CRT displays. The Brightness and Contrast controls are needed to adjust the display for viewing computer graphics in PC mode and full screen video in TV mode. The geometry controls are required to provide the minimum amount of raster position and size adjustment for a high quality display. The overscan control is required to adjust the display so the edges are not visible in full screen TV mode. This is required to hide noise commonly found on the edge of the picture. The Volume and Balance controls are required to provide the minimum control of the audio amplifier in the display.

COMMAND	DESCRIPTION / VALUE
Brightness	Continuous control. Increasing this value increases the brightness level of the display. Unipolar setting: 00h=min
Contrast	Continuous control. Increasing this value increases the contrast level of the display. Unipolar setting: 00h=min
Vertical Position	Continuous control. Increasing this value moves the image toward the top of the display. Bipolar setting: 00h=max down
Vertical Size	Continuous control. Increasing this value increases the distance between the top and bottom of the image. Bipolar setting: 00h=min size
Horizontal Position	Continuous control. Increasing this value moves the image toward the right side of the display. Bipolar setting: 00h=max left
Horizontal Size	Continuous control. Increasing this value increases the distance between the left and right sides of the image. Bipolar setting: 00h=min size
Overscan	Non-continuous control. This control is used to switch the display into an overscan mode. Note: The display should always power-up into an underscanned mode. The display should not go into an overscanned mode until instructed to do so by the PC.
Volume	Continuous control. Increasing this value causes the volume in the left and right audio channels to increase. Unipolar setting: 00h=mute
Balance	Continuous control. Increasing this value maximizes the volume in the right audio channel and the volume in the left audio channel is decreased. Bipolar setting: 00h=max left channel, min right channel

Table 8 – Required CRT Display Controls for PC Theatre

3.5.3. **Recommended Controls**

The controls in Table 9 are highly recommended for PC Theatre functionality in addition to the required controls listed in the previous tables.

Note: Some controls do not apply to flat panel technologies.

COMMAND	DESCRIPTION / VALUE
Tilt control	Continuous control. Increasing this value rotates the image in a clockwise direction. Bipolar setting: 00h=max counter clockwise
Color Temperature	Continuous or non-continuous control. This control is used to change the color temperature of the display.
TV Mode	Non-continuous control. This control is used to switch the display into a mode that enhances the video for watching TV.
Stand Alone Mode	Non-continuous control. This control is used to switch the display from a stand-alone mode to a slave mode. Stand-alone mode: 1. Generate OSD internally 2. Process user input internally 3. Disable USB control interface Slave mode: 1. Disable OSD 2. Pass all user input to PC for processing 3. Enable USB control interface
Disable On Screen Display (OSD)	Non-continuous control. This control is used to enable the OSD when in slave mode. This is to allow the display to generate the OSD instead of the PC.

Table 9 – Recommended Display Controls for PC Theatre

3.5.4. **Optional Controls**

For a complete list of optional controls, refer to the VESA Monitor Control Command Set (MCCS) Standard V1.0. Note that an address block has been reserved for manufacturer specific controls in this standard.

3.5.5. **PC Minimum Display Control Support**

The PC is required to support all CRT controls listed in Table 8, and all recommended controls listed in Table 9. Support for these controls on the PC includes the ability to query the display for supported controls over USB, configure and present a user interface, and send control commands to the display over USB.

3.5.6. **Display Control Storage**

The display is not required to store the control settings used for each mode. The PC will update the display settings after each mode change.

3.6. USER INPUT

The user input from the display's front button panel and remote control is passed back to the PC, via USB for processing according to the USB Class Definition for Human Interface Devices (HID) specification V1.0, and the USB HID Usage Tables specification V1.0. Sending all user input to the PC for processing allows the display and PC to act as one system with a common user interface. This requires the front button panel and IR receiver to operate as USB devices. Note that this does not mean the front button panel and IR receiver have to be actual USB devices. The display is only required to present a USB control interface to the PC, but may control these devices internally with an I^2C or other type of control bus.

3.6.1. USB Communication for User Input

The communication between the PC and the display (button panel and IR receiver) is standardized to insure compatibility. The USB Class Definition for Human Interface Devices (HID) specification V1.0 defines the communication and the USB HID Usage Table specification V1.0 specifies the address values to be used for each control. Refer to these specifications for more information. Note the manufacturer is free to use any IR or RF protocol for wireless input devices, as they are not specified in this standard.

3.6.2. PC Support for User Input over USB

For PC Theatre functionality, the input controls in Table 10 must be supported on the PC. Support for these user controls requires the ability to receive these controls over USB, decode the control commands according to the USB HID Usage Table specification V1.0, present the appropriate user interface, and responding to the control either internally or sending a control command to the display. Note that the controls listed in Table 10 is the minimum list of controls that must be supported by the PC and support of additional control codes is recommended.

USAGE NAME	DESCRIPTION
Digits 0 - 9	Digits for the random selection of television channels or other applications.
Volume UP/DOWN	Volume Control.
Channel UP/DOWN	Sequential channel changing via Up/Down commands.
Power	Power control for system. Power down does not necessarily represent lack of system power.
Mute	Instant volume mute.
Menu	Initiates on-device-display main menu. Sets a mode where the other menu controls are active. A subsequent menu press will cancel the mode.
Menu Pick	Pick item from an on -screen menu.
Menu UP/DOWN/LEFT/RIGHT	Menu navigation controls.

Table 10 – Required Minimal Display Support for HID

3.7. DPMS

The VESA Display Power Management Signaling (DPMS) Standard V1.1 specifies the operation of low power states in the display. DPMS can be used by the PC to control the power-state of the display.

3.7.1. **DPMS Modes**

The modes of DPMS are ON, STANDBY, SUSPEND, and ACTIVE-OFF. When both the horizontal and vertical syncs are active, the display is fully active and in the ON state. The display enters the STANDBY state when only the vertical sync is active. In this mode, the screen is blanked, but the display remains fully active. The display enters the SUSPEND state when only the horizontal sync is active. In this mode the display either enters a very low power state or the ACTIVE-OFF state. In the ACTIVE-OFF state, neither the horizontal nor vertical syncs are active. In this mode, the display's electronics should be completely shut down, with the exception of the microcontroller, USB interface, and IR receiver. If both of the syncs are restored, the display enters the ON state.

STATE	H SYNC	V SYNC	REQUIREMENT	POWER SAVINGS
On	Active	Active	Mandatory	None
Standby	No	Active	Mandatory – PC Only	Minimal
Suspend	Active	No	Mandatory – PC Only	Substantial
Off	No	No	Mandatory	Maximum

Table 11: DPMS Modes

Refer to the VESA Display Power Management Signal (DPMS) Standard, Version 1.0, Revision 1 for more information.

3.7.2. **PC DPMS Requirements**

The PC is required to support all four DPMS states (ON, STANDBY, SUSPEND, and ACTIVE-OFF). The PC is required to read the EDID data from the display to determine the supported DPMS modes.

For digital displays that only support ACTIVE-OFF, it is recommended that the TMDS transmitter be turned off for all DPMS modes.

3.7.3. **Display DPMS Requirements**

The display is required to provide minimum DPMS support. Minimum support in the display would be only two modes: a fully active mode and a low power mode. Note that only minimum DPMS support is required in the display, but full support is recommended.

The display is only required to monitor the vertical sync line. If this sync line is active, the display shall be fully active for the ON and STANDBY modes. If the vertical sync is not active, the display shall enter a low power state to support SUSPEND and ACTIVE-OFF modes. In this low power mode, the power LED on the front panel shall be extinguished (or change color) and the microcontroller, USB interface, and IR receiver shall remain active. Refer to the USB Specification V1.1 for information about USB power management.

Both analog and digital displays shall go into a low power state if any of the video data or timing signals are out of range or are invalid. It is recommended that an OSD be used to communicate the problem to the consumer.

3.8. VIDEO

3.8.1. Specialized TV and PC Video Modes

The PC Theatre display and PC are required to support two modes of operation: TV and PC. Each mode must be configured for the best video quality of the mode. The PC mode is to be displayed with the best settings for computer graphics. Likewise, the TV mode is to be displayed with the best settings for TV video.

Special video enhancements may be used in TV mode for video that is more like that of a standard TV. Examples of such video enhancements are velocity scan modulation, white peaking, black stretch, and flesh tone correction.

The **Display-Mode** control in the VESA Monitor Control Command Set (MCCS) Standard V1.0 is to be used by the PC to enable these display video enhancements in TV mode and disable them in PC mode.

3.8.2. Required Video Modes

Table 12 contains the required video modes that must be supported by both the PC and display.

Format	Horizontal Frequency (kHz)	Vertical Frequency (Hz)	Standard Type
640 x 350	31.5	70	Industry Standard
640 x 400	31.5	70	Industry Standard
720 x 400	31.5	70	Industry Standard
640 x 480	31.5	59.95, 60	Industry Standard
720 x 480	31.5	59.94	VESA (proposed)

Table 12: Required Video Modes

3.8.3. Additional Video Modes

In addition to the required video modes listed in Table 12, support of the video modes listed in Table 13 should also be considered for the PC Theatre host and display.

Format	Vertical Frequency (Hz)	Standard Type
640 x 480	72, 75, 85	VESA
720 x 576 (for PAL support)	50	IEC 1146 ITU-R Report 624-4
800 x 600	59.94, 60, 72, 75, 85	VESA
1024 x 768	59.94, 60, 70, 75, 85	VESA
1280 x 1024	59.94, 60, 75, 85	VESA

Table 13: Additional Video Modes

3.8.4. **Digital TV Support**

Digital TV support is recommended for both the PC Theatre host and display. Refer to the ATSC specifications for information about the digital television formats.

3.8.5. **Video Standards**

Detailed information about video modes is beyond the scope of this standard. Refer to the following standards for more information about the video modes listed in Tables 12 and 13.

VESA Display Monitor Timing Specifications (DMTS), Version 1.7, December 18, 1996

Digital Television Standard for HDTV Transmission, ATSC A/53, 1995

Guide to the Use of the Digital Television Standard for HDTV Transmission, ATSC A/54, 1995

Program for System Information for Terrestrial Broadcast and Cable, ATSC A/65, 1997

Basic Parameter Values For The HDTV Standard For The Studio And For International Programme Exchange - Section 11A - Characteristics of Systems for Monochrome and Colour Television, ITU-R BT.709, 1990

National Television Standards Committee (NTSC), ITU-R Report 624-4, 1990

PAL (Phase Alternating Line), Video Cameras (PAL/SECAM/NTSC) - Methods of Measurement - Part 1: Non-Broadcast, Single-Sensor Cameras, First Edition, IEC 1146; ITU-R Report 624-4, 1994

3.9. SHARED RESOURCES

The computer and display share resources to prevent unnecessary duplication of components.

3.9.1. **Television Tuner**

If the display has an optional television tuner, the PC can make use of this device to provide Picture-In a-Picture (PIP) functionality. The display can support software control of the tuner and a video multiplexer via USB. The PC sends USB commands to the tuner, and uses the **Output Source Select 1** control in the VESA Monitor Control Command Set (MCCS) Standard

V1.0 to select it as the output video source. The composite video is sent to the PC through a separate cable to the Composite Video input connector

The PC and display may also support USB television tuner controls that allow the PC to control the tuner in the display. Note that for these controls the channel map is stored and controlled by the PC. Any USB tuner command extensions will be developed under the auspices of the USB Device Working Group.

3.9.2. **Connector Panel**

The use of the display's connector panel by the PC greatly increase the flexibility and expandability of the system. If the desired video source is connected to the display, the PC can select the source via USB with the **Output Source Select 1** control in the VESA Monitor Control Command Set (MCCS) Standard V1.0 and receive the composite video through separate cable to the Composite Video input connector.

4. SYSTEM CONFIGURATION

The PC and display have many possible configurations depending upon the price-point and level of functionality required. This chapter describes two possible configurations. The first configuration describes the minimum support required for PC Theatre functionality. The second configuration describes optional support that may be added for full PC Theatre functionality.

4.1. MINIMUM SYSTEM UNIT AND DISPLAY CONFIGURATION

This section describes the minimum configuration for the required functionality of a PC Theatre system.

4.1.1. PC Minimum Support

The PC is required to support the following functionality:

- USB (12 Mb/s)
- Audio (USB and Analog)
- P&D-A/D connector with signals support listed in Table 3
- A/V subsystem

4.1.1.1. USB

The PC is required to support a root USB hub and the software required for 12 Mb/s USB functionality. The PC is required to support the USB Monitor Control Class Specification V1.0 and VESA Monitor Control Command Set (MCCS) Standard V1.0 for software control of the display by the PC. This control of the display includes querying the monitor for supported controls, configuring to support all controls, and providing a user interface to allow the consumer to adjust the display settings. The PC is also required to support the USB Class Definition for Human Interface Devices (HID) specification V1.0, and the USB HID Usage Tables specification V1.0 for transportation of user input from the display back to the PC. In addition, the PC must support the USB Device Class Definition for Audio Devices specification V1.0 and USB Device Class Definition for Audio Data Formats specification V1.0 for the support of USB to transport audio

4.1.1.2. Audio

The PC must support both USB and analog stereo audio output to the display. For USB Audio, the PC must be capable of sending uncompressed linear 16-bit stereo audio to the display via USB according to the USB Device Class Definition for Audio Data Formats specification V1.0. The PC must first query the display to determine if USB audio is supported before this functionality is enabled. The PC must also support a line-level analog audio output. The connector for this output shall be a 3.5 mm stereo audio jack. The PC shall control the display's audio amplifier via USB for both USB and analog audio monitors according to the USB Device Class Definition for Audio Devices specification V1.0.

4.1.1.3. P&D-A/D Connector

The PC shall use the P&D-A/D connector with support for both analog and digital displays. The required signal support is listed in Table 3.

4.1.1.4. **A/V Subsystem**

The PC A/V subsystem must be capable of combining PC and TV video sources and sending the combined video to the display. This A/V subsystem must be capable of processing video and audio from the optional internal tuner, the optional tuner in the display, and input through the rear connector panel. The PC must support at least one Composite video input connector. The PC shall support two 3.5 mm stereo jacks for input and output of line-level stereo audio.

4.1.2. **Display Minimum Support**

The display is required to support the following functionality:

- USB Control (1.5 Mb/s)
- Analog Audio Amplifier
- Standard VGA monitor electronics

4.1.2.1. **USB**

The display must support 1.5 Mb/s USB functionality to enable control by the PC. Note that the minimum support of 1.5Mb/s does not allow down-steam USB connectors or audio to be supported. The display shall provide a standard HID monitor control interface to the PC according to the USB Monitor Control Class Specification V1.0, and be capable of reporting supported controls, reporting current status, and receiving control commands from the PC.

4.1.2.2. **Audio Amplifier**

The display is required to support a stereo audio amplifier to process analog audio received from the computer. For analog audio input, the display must support two RCA audio connectors on the back panel. Note analog audio requires an additional cable between the PC and display. The audio amplifier shall act as a separate USB device and shall follow the requirements of the USB Device Class Definition for Audio Devices specification V1.0.

4.1.2.3. **Monitor Electronics**

The display must support the video electronics of a standard monitor. The display shall receive either analog RGB video or digital TMDS video through the P&D connector and display the video according to the user settings.

4.1.2.4. **Minimum Support Block Diagram**

The block diagram in Figure 8 is the PC Theatre system with the minimum required functionality. Note that key subsystems of the display are represented as blocks in order to simplify the diagram. The **Display Electronics** block represents all the functionality of a standard VGA monitor. The **Control Electronics** block represents the display microcontroller communication and control functionality. The **USB Hub** is shown to be part of the **Control Electronics** as this functionality can be integrated into the main display microcontroller.

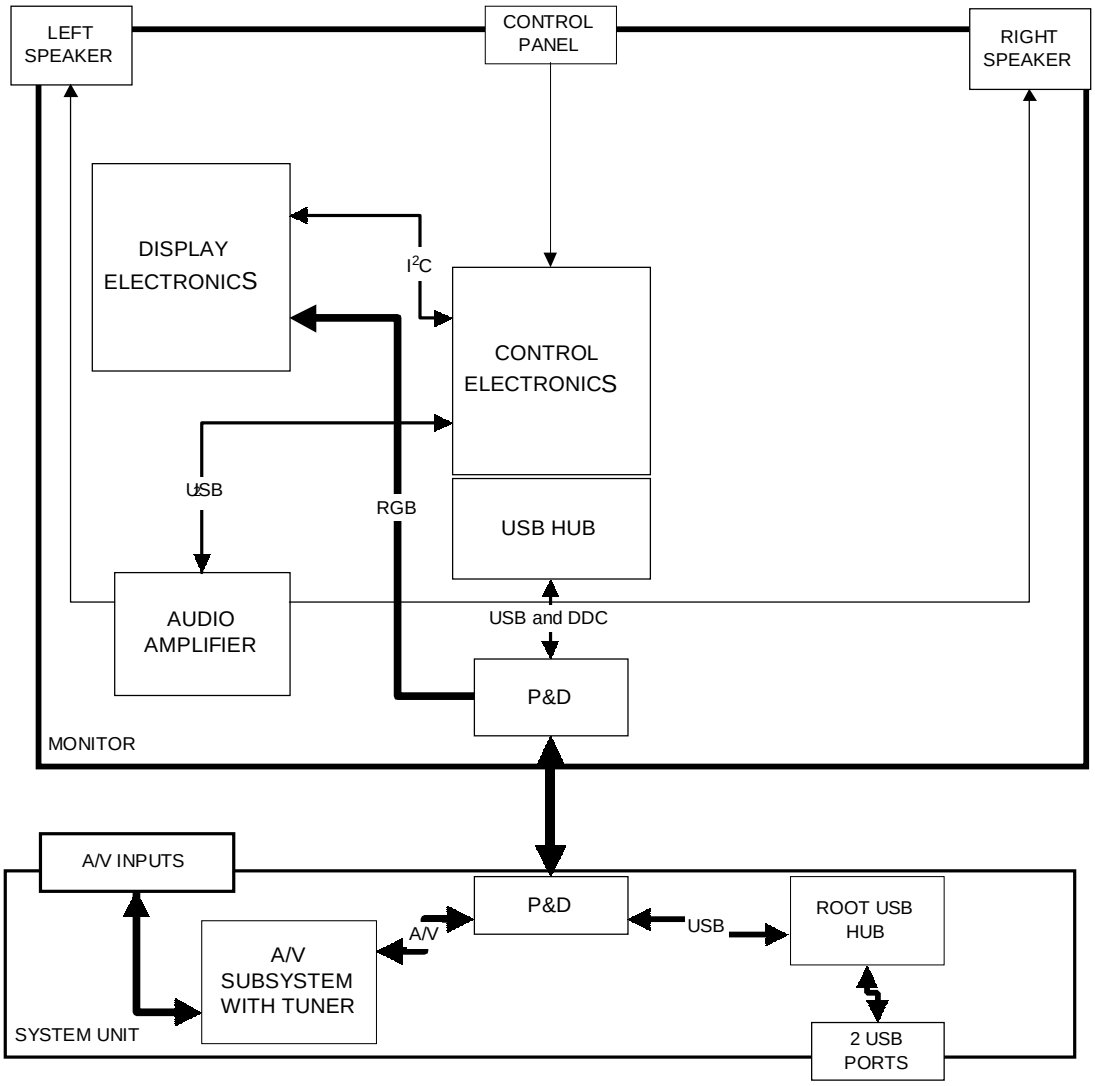


Figure 8: Block Diagram of PC Theatre with Minimum Support

4.2. FULL SYSTEM UNIT AND DISPLAY CONFIGURATION

This section describes additional features for the full functionality of a PC Theatre system.

4.2.1. Additional PC Functionality

The PC may support the following features that are in addition to the required functionality:

- Additional USB Connectors
- Additional A/V Connectors
- Tuner
- IEEE-1394 Support

4.2.1.1. USB Connectors

In addition to USB support through the P&D connector, the PC may support USB connectors on the front and rear panel.

4.2.1.2. Additional A/V Connectors

In addition to the single Composite Video connector that must be supported, the PC may also support other video connectors (Composite and S-video) on the front and/or rear panels.

4.2.1.3. Tuner

The PC may support an internal tuner for watching TV without the need for a tuner in the display.

4.2.1.4. IEEE-1394

The PC may provide support for IEEE-1394 to the display through the P&D connector. In addition, the PC may support 1394 connectors on the front and/or rear panels.

4.2.2. Additional Display Functionality

The display may support the following features that are in addition to the required functionality:

- Stand-alone TV Functionality
- Front Button Panel
- Remote Control and IR Receiver
- USB Connectors and Audio Support
- IEEE-1394 Support

4.2.2.1. Stand Alone TV Functionality

The display may support two modes of operation: stand-alone mode and slave mode. In stand-alone mode, the display operates as a standard TV. In addition to the standard monitor electronics, the display shall also include a video and audio subsystem capable of providing stand-alone TV functionality. This subsystem shall include a tuner (or tuners), A/V connectors on the back panel, and video and audio multiplexers. This subsystem has two modes of operation. When in stand-alone mode, this subsystem provides the functionality necessary for stand-alone TV operation. When connected to a PC Theatre computer and in slave-mode, the video from the tuner or A/V connectors shall be selected and sent down to the computer for processing. In slave mode, the display passes all user input to the PC for processing, disables the On Screen Display (OSD), displays the VGA video from the PC, and responds to USB commands from the PC.

4.2.2.2. Front Button Panel

The display front panel can include buttons for Channel-Up, Channel-Down, Volume-Up, Volume-Down, Menu, Select, Power, etc. These buttons on the front panel have two modes of operation. When the display is in stand-alone mode, the display electronics respond directly to a button press. When the display is connected to a PC Theatre computer and in slave mode, the display shall send a USB command to the PC when a button was pressed and not generate an OSD internally. The USB command shall be sent according to the requirements of the USB Class Definition for Human Interface Devices (HID) specification V1.0, and the USB HID Usage Tables specification V1.0. The computer shall then process the user input.

4.2.2.3. Remote Control and IR Receiver

The display may include a remote control and IR or RF receiver. The receiver also has two modes of operation. When the display is in stand-alone mode, the receiver data from the remote is processed internally. When the display is connected to a PC Theatre computer and in slave mode, the remote button presses are sent as USB commands to the system unit according to the requirements of the USB Class Definition for Human Interface Devices (HID) specification V1.0, and the USB HID Usage Tables specification V1.0. The system unit shall then process the user input.

4.2.2.4. USB Connectors and Audio Support

The display may include a 12 Mb/s USB hub and external USB connectors. The connectors may be on the front and/or rear panel. Note that USB connectors must always be connected to the PC regardless of the display's power state (On or Active-Off) and operational mode (stand-alone or slave). The display may also support USB audio. For USB audio support, the audio amplifier shall receive the uncompressed linear stereo 16-bit USB audio stream through the P&D connector according to the requirements of the USB Device Class Definition for Audio Data Formats V1.0.

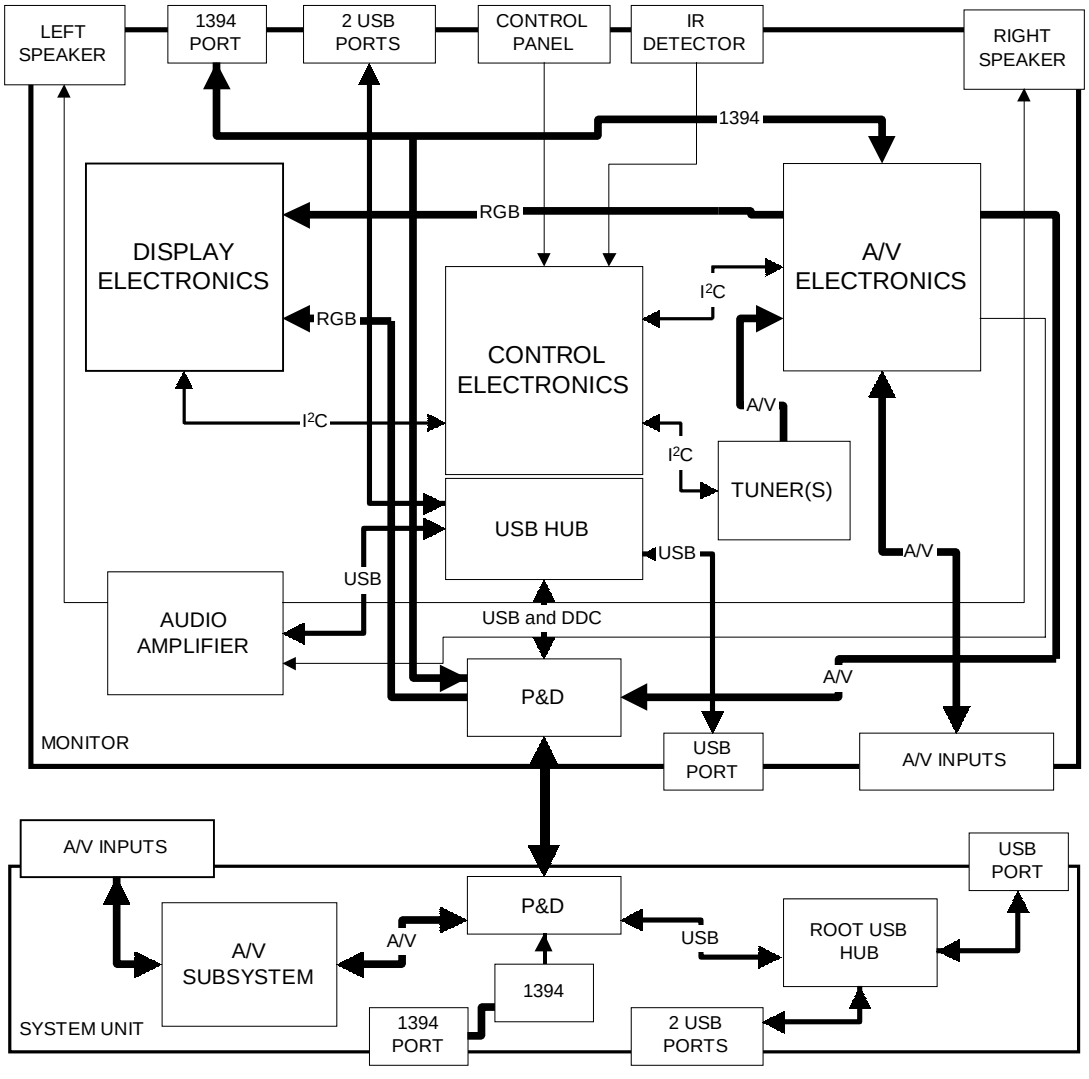
4.2.2.5. IEEE-1394

The display may support IEEE-1394 video processing and connectors on the front and/or rear panel. Note that 1394 connectors must always be connected to the PC regardless of the display's power state (On or Active-Off) and operational mode (stand-alone or slave).

4.2.2.6. PC Theatre Optional Support Block Diagram

The block diagram in Figure 9 is of a PC Theatre system with optional features. Note that key subsystems of the display are represented as blocks in order to simplify the diagram. The **Display Electronics** block represents all the functionality of a standard VGA monitor. The **A/V Electronics** block represents the additional functionality that would need to be added to a monitor to support stand-alone TV functionality. The **Control Electronics** block represents the display microcontroller communication and control functionality. The **USB Hub** is shown to be part of the **Control Electronics** as this functionality can be integrated into the main display microcontroller.

Figure 9: Block Diagram of PC Theatre System with Optional Features



5. PC THEATRE OPERATIONAL PROCEDURES

This chapter describes at a high level the operational procedures required for the PC and display to provide PC Theatre functionality and to insure compatibility. Refer to the appropriate VESA or USB specification for more information.

5.1. PC THEATRE HOST STARTUP PROCEDURES

This section describes the startup procedures for a PC Theatre computing device as it initializes itself.

The PC Theatre system startup procedures are as follows:

1. Determine if an active display is connected to the system. This is determined by checking to see if the voltage on pin 8 of the P&D connector is greater than +2 VDC.
2. Attempt to read the 256 KB EDID data structure 2.0 at the I^2C slave address of A2h.
3. If the read was successful, determine if the EDID 2.0 data is valid by checking the checksum of the EDID structure.
4. If the EDID 2.0 data is valid, parse and store the data.
5. With the parsed EDID 2.0 data, configure the video subsystem and activate appropriate video interface (RGB or TMDS).
6. If the attempt to read the EDID 2.0 data fails, attempt to read the 128 KB EDID data structure 1.1 at the I^2C slave address of A0h.
7. Determine if the EDID 1.1 data is valid by checking the checksum of the EDID structure.
8. If EDID 1.1 data is valid, parse and store data.
9. With parsed data, configure the video subsystem and activate the appropriate video interface (RGB or TMDS). For a digital display, assume the default configuration of 24 bit MSB-aligned RGB TFT.
10. If the attempt to read the EDID 1.1 data fails, assume the display does not support DDC and use default RGB video settings.
11. Request status from HID monitor control device via USB.
12. If a valid response is received from the display, request the list of supported controls and the type and range of each control.
13. With the data of supported controls, configure the display control panel user interface.
14. Check the list of monitor supported controls to determine if a tuner is supported.
15. If tuner controls are supported, configure the user interface to use the tuner and configure the video subsystem to receive the video through the Composite video connector.
16. Check the list of monitor supported controls to determine if the **Output Source Select** control is supported.
17. If this output control is supported, configure the user interface to use the rear connector panel of the display and configure the video subsystem to receive the video through the Composite video connector.
18. Check to see if the default control values of the display are stored internally.
19. If the default values have not been stored internally, restore the default values of the display using the **RestoreFactoryDefault** or **RestoreSaved** command (if supported). Read all of the displays picture quality and geometry control settings and store them internally as the defaults. Repeat the process for each supported **DisplayMode** (Productivity, Games, Movies).
20. Request the status of the USB audio amplifier in the display.
21. If a valid response is received, request the supported audio controls and configure internal audio subsystem to send USB audio to the display using a supported format (compressed, uncompressed, number of channels, etc).
22. If a valid USB response is not received, assume display does not support PC Theatre functionality and disable the user interface.

23. If the display is in Stand-alone mode, use the Display Transition procedures to change the display to Slave mode.

5.2. PC THEATRE DISPLAY STARTUP PROCEDURES

This section describes the startup procedures for a PC Theatre display as this device initializes itself.

The PC Theatre display startup procedures are as follows:

1. Perform normal initialization procedures for either a standard monitor or TV.
2. Set all controls using internally stored settings.
3. For a stand-alone TV, set the status of the internal **Operation Mode** control to **Stand-alone** and operate as a standard TV.
4. If the display does not support stand-alone operation, set the status of the internal **Operation Mode** control to **Slave** and operate as a standard monitor.

5.3. PC THEATRE HOST TRANSITION PROCEDURES

This section describes the mode transition procedures for a PC Theatre host as this device transitions the display from stand-alone mode to slave mode or slave mode to stand-alone mode.

5.3.1. Host Transition of Display to Slave Mode

The PC Theatre host procedures for transitioning the display from stand-alone mode to slave mode are as follows:

1. Send an **Operation Mode** command to the display to switch to **Slave** mode. This enables the PC to control the display.
2. Read back the status of the **Operation Mode** control. Do not send other USB commands to the display until the status of this control indicates **Slave** mode. Repeat the read process if necessary.
3. Send an **Input Source Select** command to switch the display to the **P&D** input. This enables the PC to drive the video input of the display.
4. If the computer is in TV mode, and the controls are supported, send a **Scan Format** command to switch the display to **Overscan** and a **Display Mode** command to switch the display to **Movies** which enables the TV video enhancements. In addition, disable internal screen savers and DPMS operation.
5. If the computer is in PC mode, and the controls are supported, send a **Scan Format** command to switch the display to **Underscan** and a **Display Mode** command to switch the display to **Productivity** which disables the TV video enhancements.
6. Send appropriate video quality and geometry commands to the display for the current mode.

5.3.2. Host Transition of Display to Stand Alone Mode

The PC Theatre host procedures for transitioning the display from slave mode to stand-alone mode are as follows:

1. Send **Operation Mode** command to the display to switch to **Stand-alone** mode.
2. Disable USB command communication to the display.

5.4. PC THEATRE DISPLAY TRANSITION PROCEDURES

This section describes the mode transition procedures for a PC Theatre display as this device transitions from stand-alone mode to slave mode or slave mode to stand-alone mode.

5.4.1. Transition of Display to Slave Mode

The PC Theatre display procedures for transitioning from stand-alone mode to slave mode are as follows:

1. Wait until internal transition is complete before reporting the status of the **Operation Mode** command as set to **Slave**.
2. Enable the reception of other USB commands from the PC.
3. Enable DPMS operation of the display.
4. Disable internal processing of user input from remote and front button panel.
5. Send all user commands to the PC for processing over USB.
6. Disable internal OSD.

5.4.2. Transition of Display to Stand Alone Mode

The PC Theatre display procedures for transitioning from slave mode to stand-alone mode are as follows:

1. Wait until internal transition is complete before reporting the status of the **Operation Mode** command as set to **Stand-Alone**.
2. Disable the reception of all USB commands except Operation Mode and status from the PC.
3. Disable DPMS operation of the display.
4. Enable internal processing of user input from remote and front button panel.
5. Disable sending all user commands to the PC.
6. Enable internal generation of user interface.
7. Restore internal default values for picture quality and geometry.
8. Switch **Input Source Select** to **Tuner.**
9. Resume normal TV operation.

5.5. PC THEATRE HOST NORMAL OPERATION PROCEDURES

This section describes the normal operation procedure for a fully active PC Theatre host.

The PC Theatre host normal operation procedures are as follows:

1. Process all user input from keyboard, mouse, gamepad, and display.
2. Display the appropriate user interface.
3. Control internal subsystems.
4. Send control commands to the display.

5.6. PC THEATRE DISPLAY NORMAL OPERATION PROCEDURES

This section describes the normal operation procedure for a PC Theatre display.

5.6.1. Display Normal Operating Procedures for Stand Alone Mode

The PC Theatre display normal operation procedures for stand-alone mode are as follows:

1. Process all user input internally.
2. Display appropriate user interface.
3. Send appropriate control commands to internal subsystems.

5.6.2. Display Normal Operating Procedures for Slave Mode

The PC Theatre display normal operation procedures for stand-alone mode are as follows:

1. Send all user input to the PC for processing.
2. Disable internal display of user interface.
3. Disable internal control of display subsystems.

5.7. PC THEATRE HOST SHUT DOWN PROCEDURES

This section describes the shutdown procedure for a PC Theatre host as this device transitions to a sleep mode.

The PC Theatre display shutdown procedures are as follows:

1. Send **Operation Mode** command to the display to switch to **Stand-alone** mode.
2. Perform normal shut down procedures for a PC.

5.8. PC THEATRE DISPLAY SHUT DOWN PROCEDURES

This section describes the shutdown procedure for a PC Theatre display as this device transitions to a sleep mode.

The PC Theatre display shutdown procedure is as follows:

1. If the display is in **Slave** mode, pass the user shutdown command to the PC for processing.
2. If the display is in **Stand-alone** mode, perform normal shutdown procedures.
3. Ignore all USB commands from the PC after shutdown.

APPENDIX A – Terms and Abbreviations

ATSC	Advanced Television Systems Committee
CEMA	Consumer Electronic Manufacturers Association
CRT	Cathode Ray Tube
DDC	(VESA) Display Data Channel
DDC2B	Simplest of the DDC modes defined in the VESA DDC standard
DDC/CI	(VESA) Display Data Channel Command Interface
DPMS	(VESA) Display Power Management Signaling
DVD	Digital Versatile (or Video) Disk
EDID	(VESA) Extended Display Identification Data
EVC	(VESA) Enhanced Video Connector
HDTV	High Definition TV
IEEE	Institute of Electrical and Electronic Engineers
IEEE-1394	Standard for high performance serial bus
I^2C™	Trademark of Philips used to refer to Inter IC or I^2C bus
IR	Infrared
LCD	Liquid Crystal Display
MCCS	Monitor Control Command Set
MicroCross™	Trademark of Molex for quasi-coaxial section of the P&D connector
MSB	Most Significant Bit
NTSC	National Television Standards Committee
OSD	On Screen Display
P&D™	Trademark of VESA for Plug and Display standard
PAL	Phase Alternating Line - Video standard
PanelLink™	Trademark of Silicon Image for their TMDS technology
RF	Radio Frequency
RGB	Red, Green, Blue video signals
SECAM	Sequential Couleur avec Memoire - Video standard
SCL	Serial Clock - I2C clocking signal
SDA	Serial Data - I2C data signal
TFT	Thin Film Transistor (LCD)
TMDS™	Transition Minimized Differential Signaling–Trademark of Silicon Image
TTL	Transistor-transistor Logic
USB	Universal Serial Bus
VESA	Video Electronic Standards Association
VGA	Video Graphics Adapter

End of PC Theatre Standard