

A Universal Multimedia Display Adapter

Background of the Invention

Field of the Invention

[0001] This invention relates generally to electronic apparatus, circuits, and methods
5 for converting levels and protocols of video signals from video source devices that
comply with one of a group of video transmission interface specifications to the
signal levels and protocols of a high definition multimedia interface (HDMI) for
transmission to a video display.

Description of Related Art

10 [0002] Current multimedia television monitors such as cathode ray tube, liquid
crystal displays, and plasma display are capable of accepting the radio frequency
television signals from the atmosphere or from cable distribution systems.
Additionally, the multimedia monitors may receive "baseband" red, green, and blue
composite video signals with the audio from video sources such as video cassette
15 recorder, digital video disk (DVD) players or video camera recorders (camcorder) for
display. Referring to Fig. 1, the video player **5** and the video camcorder **10** transmit
the baseband **25** red, green, and blue composite video signals with the audio to the
multimedia display unit **15** for presentation. The video camcorder **10** may also
provide signals that comply with the IEEE 1394 high performance serial bus peer-to-
20 peer data transfer protocol specification or the universal serial bus (USB)
specification. These video signals from the camcorder **10** must then be transferred
to another device such as a personal computer (not shown) for conversion to the red,

green, and blue composite video signals for transfer to the multimedia display unit **15**.

[0003] As digital television and high definition television is becoming more available, the new digital video disk players **20** and similar equipment provide output ports that
5 comply with the digital visual interface (DVI) **30** specification as promulgated by the Digital Display Working Group. The multimedia display unit **15** receives the DVI and audio signals **30** for display.

[0004] As commercial and cable television has migrated to high definition digital transmission, equipment manufacturers have cooperated to create the specification
10 for the High-Definition Multimedia Interface (HDMI) to describe transmitting digital television audiovisual signals from DVD players, cable television set-top boxes and other audiovisual sources to television sets, projectors and other video displays. HDMI can carry high quality multi-channel audio data and can carry all standard and high-definition consumer electronics video formats. Further, HDMI can also carry
15 control and status information in both directions.

[0005] Referring to Fig. 2, HDMI system architecture is defined to consist of Sources **35** and Sinks **40**. The HDMI source device **35** communicates with the over HDMI cable and connectors. The HDMI cable and connectors carry four differential pairs that make up the Transition Minimized Differential Signaling (TMDS) data and clock
20 channels **45a**, **45b**, **45c**, and **45d**. These channels **45a**, **45b**, **45c**, and **45d** are used to carry video, audio and auxiliary data. In addition, HDMI cables and connectors carry a digital data (DDC) channel **50**. The DDC **50** is used for configuration and status exchange between a single Source **35** and a single Sink **40**. The optional

Consumer Electronic Control (CEC) line **55** provides high-level control functions between all of the various audiovisual products in a user's environment.

[0006] Video **75**, audio **80** and auxiliary data is transmitted across the three TMDS data channels **45a**, **45b**, and **45c**. The video pixel clock is transmitted on the TMDS clock channel **45d** and is used by the receiver **60** as a frequency reference for data recovery on the three TMDS data channels **45a**, **45b**, and **45c**. Video data is carried as a series of 24-bit pixels on the three TMDS data channels **45a**, **45b**, and **45c**. TMDS encoding converts the 8 bits per channel into the 10 bit DC-balanced, transition minimized sequence which is then transferred by the transmitter **65** serially across the pair at a rate of 10 bits per pixel clock period.

[0007] Video pixel rates can range from 25MHz to 165MHz. Video formats with rates below 25MHz (e.g. 13.5MHz for NTSC) can be transmitted using a pixel-repetition scheme. Up to 24 bits per pixel are transferred. In order to transmit audio and auxiliary data across the TMDS channels **45a**, **45b**, and **45c**, HDMI uses a packet structure. In order to attain the higher reliability required of audio and control data, the data is protected with an error correction code and is encoded using a special error reduction coding to produce the 10-bit word that is transmitted.

[0008] The DDC **50** is used by the Source **35** to read the Sink's Enhanced Extended Display Identification Data (EDID) from the EDID read only memory **70** in order to discover the Sink's configuration and/or capabilities.

[0009] The audio and video is generally a DVI compliant digital video with digital audio such as an MP3 coded audio files or composite analog video with analog audio as transmitted in a base band television signal. Other sources of video such

as from a camcorder or an older video recorder must have an adapter to comply with the HDMI specification. The receiver **60** then converts the TMDS data signals **45a**, **45b**, and **45c** formatted to the HDMI specification to video and audio for the multimedia display unit **15**.

5 [0010] U. S. Patent Application 2002/0005863 (Nagai et al.) describes an image-transmitting-side device. The device has a one-phase to two-phase converter circuit for separating transmitted parallel image data into even and odd data. Two parallel-serial converting circuits convert the parallel even and odd data to two serial streams. A device allows a user to select the resolution mode for the image data to
10 be transmitted. A switch applies the transmitted parallel image data to one of the parallel-serial converting circuits upon selection of the first resolution mode. The switch applies the transmitted parallel image data the one-phase to two-phase converter circuit when the second resolution mode is selected.

 [0011] U. S. Patent Application 2002/0049879 (Eyer) provides a cable and
15 connection with integrated DVI and IEEE 1394-2000 capabilities. The cable is utilized to transmit DVI signals and IEEE 1394-2000 signals over a single cable. A standard DVI cable and a DVI connector are used to integrate a DVI interface with an IEEE 1394-2000 interface. In the preferred embodiment, DVI data is transmitted over the first TMDS link, including channels 0-2, and IEEE 1394-2000 data is
20 transmitted over two twisted pairs within the second TMDS link, including channels 3-5. Preferably, a DVI connector routes the DVI signals to or from the DVI digital signal lines corresponding to the first TMDS link to a DVI receiver circuit or a DVI transmitter circuit, as appropriate, and routes IEEE 1394-2000 signals to or from the DVI digital signal lines corresponding to the second TMDS link to an IEEE 1394-

2000 interface circuit. Each connector at either end of the DVI cable then is in communication with either a DVI transmitter circuit or a DVI receiver circuit, as appropriate, to communicate the DVI video signals, and also with an IEEE 1394-2000 physical interface circuit to communicate the IEEE 1394-2000 signals.

5 [0012] U. S. Patent 6,600,747 (Sauber) describes a video monitor multiplexing circuit. The signal selects one a group of signal interfaces from a computer system to either an analog display or a digital display. The video signals that are in digital format and in analog format are supplied to a circuit that multiplexes the digital signal and the analog signal. The circuits generate an appropriate analog or digital output
10 signal for the display.

[0013] U. S. Patent 6,535,217 (Chih, et al.) teaches an integrated circuit for graphics processing that includes a configurable display interface. The circuit includes video graphics circuitry, a data encoder, transmission circuitry and configuration registers. The video graphics circuitry produces video data that is formatted to drive a display.
15 The data encoder is operably coupled to the video graphics circuitry and encodes the digital video data to produce transmission data. The transmission data is then provided to the transmission circuitry operably coupled to the data encoder. The transmission circuitry combines the transmission data with control information that is retrieved from registers included in the integrated circuit. The transmission circuitry
20 transmits the transmission data over a plurality of differential signals, where the swing amplitude of the differential signals is configured using additional registers included in the integrated circuit.

[0014] U. S. Patent 6,345,330 (Chu) details a communication channel and interface devices for bridging computer interface buses. The device bridges a first computer

interface bus and a second computer interface bus. Each of the first and second computer interface buses have a number of parallel multiplexed address/data bus lines and operate at a clock speed in a predetermined clock speed range having a minimum clock speed and a maximum clock speed.

5 [0015] U. S. Patent 6,216,185 (Chu) describes a personal computer system that has physically separate units and an interconnection between the units. An attached computing module (ACM) contains the core computing power and environment for a computer user. A peripheral console (PCON) contains the power supply and primary input and output devices for the computer system. To form an operational computer
10 system, an ACM is coupled with a PCON. The plug-in module design of the ACM, and the concentration of high-value components therein (both in terms of high-value hardware and high-value files), makes it easy for a user to transport the high-value core between multiple PCON's, each of which can enjoy a relatively low cost. The concentration of a user's core computing environment in a small, portable package
15 also makes it possible for large organizations to perform moves, adds, and changes to personal computer systems with greater efficiency.

Summary of the Invention

[0016] An object of this invention is to provide an interface adapter to convert a video signal having signal levels and format compliant with one of a plurality of video
20 transmission interface specifications to a video signal compliant with a high definition multimedia interface for display upon a video display.

[0017] To accomplish at least this object, the interface adapter has a plurality of input ports in communication with source devices whereby one source device is

selected to provide the video signal. Each of the input ports accepts video signals that comply with one of the plurality of video transmission interface specifications. The interface adapter further has a source selector in communication with the input ports to select one of the input ports to provide the video signal from a desired source device.

[0018] A synchronization device is in communication with the plurality of input ports for receiving and retaining the video signal based on timing signals in compliance with the video transmission interface specification to which the video signal conforms.

10 [0019] A high definition multimedia formatter is in communication with the synchronization device to extract the video signal with a timing signal in compliance with the high definition multimedia interface specification, format the video signal to the voltage levels and format of the high definition multimedia interface. The interface adapter further includes a transition minimized differential signaling driver in communication high definition multimedia formatter to amplify and buffer the video signal in compliance with the high definition multimedia specification for transfer to the output port. The output port transmits the video signal in compliance with the high definition multimedia specification to a video display.

[0020] The interface adapter includes an analog input port in communication with analog video sources to accept an analog video signal. An analog to digital converter is in communication with the analog input port to receive the analog video signal and converts the analog video signal to a digital video signal. The analog to digital converter is in communication with the high definition multimedia formatter to

format the digitized analog video signal to the voltage levels and format of the high definition multimedia interface.

[0021] The interface adapter also has a digital video interface port in communication with a digital video interface video source to receive a digital video interface video signal for transfer to the source selector for optional selection for transfer to the output for transmission to the video display. The interface adapter additionally has a high definition multimedia interface input port in communication with a high definition multimedia interface video source to receive a high definition multimedia interface video signal for transfer to the source selector for optional selection for transfer to the output for transmission to the video display.

[0022] The plurality of video transmission interface specifications comprises a peripheral component interconnect specification, a universal serial bus specification, a personal computer memory card specification, an advanced attachment specification, a flash memory card specification, and high performance serial bus peer-to-peer data transfer protocol specification.

Brief Description of the Drawings

[0023] Fig. 1 is a block diagram of a multimedia audio/visual system of the prior art.

[0024] Fig. 2 is a functional block diagram of the High Definition Multimedia Interface (HDMI) architecture of the prior art.

[0025] Fig. 3 is block diagram of a multimedia audio/visual system of this invention.

[0026] Fig. 4 is block diagram of the display adapter of this invention.

[0027] Fig. 5 is a block diagram of the High Definition Multimedia Interface (HDMI) of this invention.

Detailed Description of the Invention

[0028] The audio/visual interface adapter of this invention includes input ports each of which accepts multiple video signals from video sources having signal levels and formats compliant with one of a plurality of video transmission interface specifications. One of the input ports is selected to provide a video and then convert the video signal to a video signal compliant with HDMI for display upon a video display. The adapter acquires the selected video signal and the places in a synchronization device at with timing signals in keeping with the selected video source. The audio/visual interface adapter then retrieves the video signals from the synchronization adapter with timing signals that comply with the clocking rates of the HDMI specification. The adapter then formats the video signals to comply with the HDMI specification for transmission to the video display.

[0029] Refer now to Fig. 3 for a more detailed discussion of the audio/visual interface adapter of this invention. The audio/visual interface adapter **100** has input ports that receive video signals from a personal computer **145**. The types of the video signals transferred from the personal computer **145** are those formatted to comply with the universal serial bus specification (USB) **146**, advanced attachment specification (ATA) **147**, the peripheral component interconnect specification (PCIX) **148**. The video signal may also transferred from a personal computer memory card specification (PCMCIA) adapter card **150** on a PCMCIA bus or from a flash memory card **155** one the memory card bus **152**. Examples of the flash memory card is the XD-Picture card[™] from Olympus Optical Co., Tokyo Japan, the SD card and Smart

Media Card from SanDisk, Inc., Sunnyvale, CA, and the Memory Stick ® media adapter from Sony Electronics, Inc., San Diego Ca. Another video source is a camcorder **135** that has incorporates a bus **140** that adheres to an IEEE 1394 specified high performance serial bus peer-to-peer data transfer protocol.

5 [0030] The audio/visual interface adapter **100** has an input port that accepts a connection **125** that transmits the red, green, blue composite video and audio from a source such as the video camcorder **105** and the video tape or disk player **110**. A video player such as a DVD player **120** is connected through the DVI or HDMI interface **130** to the input port of the audio/visual interface adapter **100**.

10 [0031] The audio/visual interface adapter **100** has an output port that connects to an HDMI connector and cable **155** to transmit the HDMI formatted video signal to the video display **115**.

[0032] Refer now to Fig. 4 for a description of the structure and function of the HDMI display adapter **100** of this invention. The HDMI display adapter **100** has a PCIX input port **212** that receive video signals from the PCIX bus **148**, a USB input port **208** connected to the USB bus **146**, the ATA input port **204** connected to the ATA bus **147**, a PCMCIA adapter connected to the PCMCIA bus **149**, a flash memory card adapter connected to the memory card bus **152**, and an IEEE 1394 adapter connected to the bus **140** that adheres to an IEEE 1394 specified high performance serial bus peer-to-peer data transfer protocol.

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[0033] The above input ports **202**, ..., **212** are connected to the interface driver/receiver circuit **240** that converts the signal levels of the above input ports **202**, ..., **212** to the levels acceptable by the display adapter micro control unit **220**. The

micro control unit **220** has associated a read only memory **230** containing necessary program process coding and a random access memory **235** for providing data storage space for the received video data from the above input ports **202**, ..., **212**. The timer circuit **225** provides the necessary clocking signals for the appropriate
5 extraction of the video data signals from the video signals received on the above input ports **202**, ..., **212**. The interrupt controller **245** receives interrupt signals for controlling the flow of the video signals through the display adapter **100**.

[0034] Upon determining the desired source from the above input ports **202**, ..., **212**, the micro control unit **220** instructs the interface driver/receiver circuit **240** to acquire
10 the video signal from the selected input port **202**, ..., **212**. The video data is then transferred to the buffer manager **250**. The video data is stored in the buffer manager **250** under the control of a timing signal that complies with specification of the selected input port **202**, ..., **212**.

[0035] The video data is then transferred to the HDMI formatter **255** employing a
15 timing signal that complies with the HDMI specification. The HDMI interface **255** then formats the selected video signal to comply with the HDMI specification and transmits the HDMI formatted video signal on the HDMI connector and cable **155** to the video display **115**.

[0036] The HDMI interface adapter **100** further has an input port **216** that accepts a
20 connection **125** that transmits the red, green, blue composite video and audio and a DVI/HDMI input port **214** connected DVI or HDMI interface **130**. The red, green, blue composite video and audio signals from the input port **216** and the DVI or HDMI compliant signals from the input port **214** are transferred to the HDMI interface. The source select signal **260** is activated to indicate which of the video data signals is to

be converted to the HDMI compliant video signals for transmission on the connector and cable **155** to the video display **115**.

[0037] The structure and function of the HDMI interface circuit **255** is shown in Fig.

5 The video data **300** from the selected input port **202**, ..., **212** is transferred from the interface driver/receiver circuit **240** to the buffer manager **250**. The buffer manager **250** acts as a simultaneous read/write two port memory circuit where the video data **300** from the selected input port **202**, ..., **212** is written to the buffer manager **250** with the interface timing clock signal **315** created from the timer circuit **225**. The HDMI interface **255** creates an HDMI clock that acts as the timing signal
10 for the reading of the video data **322** from the buffer manager **250** to the HDMI formatter **325**. The HDMI formatter **325** constructs the necessary protocol and timing for the video data **325** to comply with the HDMI specification.

[0038] The red, green, blue composite video and audio signals **305** are received from the red, green, blue composite video and audio input port **216** and applied to
15 the analog to digital converter **330** for conversion to digital video signals. These signals are then applied to the HDMI formatter **325** for conversion to video data signals that comply with the protocol and timing of the HDMI specification.

[0039] The output of the HDMI formatter **325** is the input to the source select circuit **335**. The DVI/HDMI video signals **310** are received from the DVI or HDMI input port
20 **214**. Since these signals are already compliant with the HDMI specification (DVI signals are a subset of the HDMI video signals and acceptable on the cables and connectors of the HDMI specification), they are transferred directly to the source selector circuit **335**. The source select signal **260** as generated by the micro control unit **220** determines the source of the video data for display. The selected video

data is transferred from the source selector circuit **335** to the Transition Minimized Differential Signaling (TMDS) transmitter **335**.

[0040] The Transition Minimized Differential Signaling (TMDS) transmitter **335** finalizes the conversion of the video signals to drive the HDMI cable and connectors **155** that carry the four differential pairs that make up the Transition Minimized Differential Signaling (TMDS) data and clock channels **345a**, **345b**, **345c**, and **345d**. These channels **345a**, **345b**, **345c**, and **345d** are used to carry video, audio and auxiliary data.

[0041] In addition, HDMI connectors and cable **155** carries a digital data (DDC) channel **350**. The DDC **350** is used for configuration and status exchange between the HDMI interface **255** and HDMI Sink **365**. The optional Consumer Electronic Control (CEC) line **355** provides high-level control functions between all of the various audiovisual products in a user's environment. The DDC **350** is used by the HDMI interface **255** to read the HDMI Sink's Enhanced Extended Display Identification Data (EDID) from the EDID read only memory **370** in order to discover the HDMI Sink's **365** configuration and/or capabilities.

[0042] The receiver **360** of the HDMI Sink **365** receives the HDMI converted video signals from the HDMI connectors and cable **155** and restores the video signals **385** and audio signals **370** for transmission to the display.

[0043] In summary, the multimedia display adapter of this invention includes a micro controller unit that executes a program process for performing a method for converting a video signal having signal levels and format compliant with multiple video transmission interface specifications to a video signal compliant with a high

definition multimedia interface for display upon a video display. The plurality of video transmission interface specifications includes for example a peripheral component interconnect specification, a universal serial bus specification, a personal computer memory card specification, an advanced attachment specification, a flash memory card specification, and high performance serial bus peer-to-peer data transfer protocol specification. The method begins by providing a plurality of input ports. Each input port is in communication with source devices that transmit video signals that comply with one of the plurality of video transmission interface specifications. One of the input ports is selected to receive one of the video signals. The video signals are retained in a memory devices such as the buffer manager described above based on timing signals in compliance with the video transmission interface specification to which the video signal conforms. The retained video signal is then extracted from the memory device with a timing signal in compliance with the high definition multimedia interface specification. The video signal is then formatted to the voltage levels and protocol in compliance with the high definition multimedia interface, and transmitted to a video display.

[0044] An analog input port is in communication with at least one analog video source to accept an analog video signal. The analog video signal is received from the analog input port and converted to a digital video signal. The digitized analog signal is then formatted to the voltage levels and protocol in compliance with the high definition multimedia interface.

[0045] The HDMI formatted video signals are transferred to a transition minimized differential signaling driver. The Transition Minimized Differential Signaling (TMDS)

driver then amplifies and buffers the video signal in compliance with the high definition multimedia specification for transmission to the video display.

[0046] A digital video interface port is in communication with a digital video interface video source and an HDMI interface port is in communication with an HDMI video source. The video signals are received from digital video interface port and transmitted directly to the video display.

[0047] While this invention has been particularly shown and described with reference to the preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made without departing from the spirit and scope of the invention.

Claims

- 1 1. An interface adapter to convert a video signal having signal levels and format
2 compliant with one of a plurality of video transmission interface specifications to a
3 video signal compliant with a high definition multimedia interface for display upon a
4 video display, said interface adapter comprising:

5 a plurality of input ports in communication with source devices whereby one
6 source device is selected to provide said video signal and each of said
7 input ports accept video signals that comply with one of said plurality of
8 video transmission interface specifications;

9 a synchronization device in communication with the plurality of input ports for
10 receiving and retaining said selected video signal based on timing signals
11 in compliance with the video transmission interface specification to which
12 said video signal conforms;

13 a high definition multimedia formatter in communication with said
14 synchronization device to extract said video signal with a timing signal in
15 compliance with said high definition multimedia interface specification,
16 format said video signal to the voltage levels and format of the high
17 definition multimedia interface; and

18 an output port to transmit said video signal in compliance with said high
19 definition multimedia specification to a video display.
- 1 2. The interface adapter of claim 1 further comprising:

2 a source selector in communication with said input ports to select one of said
3 input port to provide said video signal from one of said source devices.

1 3. The interface adapter of claim 2 further comprising:

2 an analog input port in communication with analog video sources to accept
3 an analog video signal; and

4 an analog to digital converter in communication with said analog input port to
5 receive said analog video signal and convert said analog video signal to a
6 digital video signal and in communication with said high definition
7 multimedia formatter to format said digitized analog video signal to the
8 voltage levels and format of the high definition multimedia interface.

1 4. The interface adapter of claim 1 further comprising

2 a transition minimized differential signaling driver in communication with the
3 high definition multimedia formatter to amplify and buffer said video signal
4 in compliance with said high definition multimedia specification for
5 transfer to said output port.

1 5. The interface adapter of claim 2 further comprising:

2 a digital video interface port in communication with a digital video interface
3 video source to receive a digital video interface video signal for transfer to
4 said source selector for optional selection for transfer to said output for
5 transmission to said video display.

1 6. The interface adapter of claim 2 further comprising:

2 a high definition multimedia interface input port in communication with a high
3 definition multimedia interface video source to receive a high definition
4 multimedia interface video signal for transfer to said source selector for
5 optional selection for transfer to said output for transmission to said video
6 display.

1 7. The interface adapter of claim 1 wherein said plurality of video transmission interface
2 specifications comprises a peripheral component interconnect specification, a
3 universal serial bus specification, a personal computer memory card specification, an
4 advanced attachment specification, a flash memory card specification, and high
5 performance serial bus peer-to-peer data transfer protocol specification.

1 8. A multimedia system comprising:

2 a plurality of source devices whereby each source device provides a video
3 signal that complies with one of said plurality of video transmission
4 interface specifications;

5 a video display having an interface compliant with a high definition multimedia
6 interface specification;

7 an interface adapter in communication with said plurality of source device to
8 receive a selected video signal and to convert said selected video signal
9 having signal levels and format compliant with one of the plurality of video
10 transmission interface specifications to a video signal compliant with a
11 high definition multimedia interface specification for transmission to and
12 display upon the video display, said interface adapter comprising:

13 a plurality of input ports in communication with source devices whereby
14 one source device is selected to provide said selected video signal
15 and each of said input ports accept video signals that comply with one
16 of said plurality of video transmission interface specifications;

17 a synchronization device in communication with the plurality of input ports
18 for receiving and retaining said selected video signal based on timing
19 signals in compliance with the video transmission interface
20 specification to which said video signal conforms;

21 a high definition multimedia formatter in communication with said
22 synchronization device to extract said video signal with a timing signal
23 in compliance with said high definition multimedia interface
24 specification, format said video signal to the voltage levels and format
25 of the high definition multimedia interface; and

26 an output port to transmit said video signal in compliance with said high
27 definition multimedia specification to a video display.

1 9. The multimedia system of claim 8 wherein said interface adapter comprises:

2 a source selector in communication with said input ports to select one of said
3 input port to provide said video signal from one of said source devices.

1 10. The multimedia system of claim 9 wherein said interface adapter comprises:

2 an analog input port in communication with analog video sources to accept
3 an analog video signal; and

4 an analog to digital converter in communication with said analog input port to
5 receive said analog video signal and convert said analog video signal to a
6 digital video signal and in communication with said high definition
7 multimedia formatter to format said digitized analog video signal to the
8 voltage levels and format of the high definition multimedia interface.

1 11. The multimedia system of claim 8 wherein said interface adapter comprises
2 a transition minimized differential signaling driver in communication with the
3 high definition multimedia formatter to amplify and buffer said video signal
4 in compliance with said high definition multimedia specification for
5 transfer to said output port.

1 12. The multimedia system of claim 9 wherein said interface adapter comprises:
2 a digital video interface port in communication with a digital video interface
3 video source to receive a digital video interface video signal for transfer to
4 said source selector for optional selection for transfer to said output for
5 transmission to said video display.

1 13. The multimedia system of claim 9 wherein said interface adapter comprises:
2 a high definition multimedia interface input port in communication with a high
3 definition multimedia interface video source to receive a high definition
4 multimedia interface video signal for transfer to said source selector for
5 optional selection for transfer to said output for transmission to said video
6 display.

1 14. The multimedia system of claim 8 wherein said plurality of video transmission
2 interface specifications comprises a peripheral component interconnect specification,
3 a universal serial bus specification, a personal computer memory card specification,
4 an advanced attachment specification, a flash memory card specification, and high
5 performance serial bus peer-to-peer data transfer protocol specification.

1 15. A method for converting a video signal having signal levels and format compliant with
2 one of a plurality of video transmission interface specifications to a video signal
3 compliant with a high definition multimedia interface for display upon a video display,
4 said method comprising the steps of:

5 providing a plurality of input ports, each input port in communication with
6 source devices that transmit video signals that comply with one of said
7 plurality of video transmission interface specifications;

8 selecting one of the input ports to accept one of said video signals;

9 receiving said video signal from said selected input port;

10 retaining said video signal based on timing signals in compliance with the
11 video transmission interface specification to which said video signal
12 conforms;

13 extracting said retained video signal with a timing signal in compliance with
14 said high definition multimedia interface specification;

15 formatting said video signal to the voltage levels and protocol in compliance
16 with the high definition multimedia interface; and

17 transmitting said video signal in compliance with said high definition
18 multimedia specification to a video display.

1 16. The method of claim 15 further comprising the steps of:

2 providing an analog input port in communication with analog video sources to
3 accept an analog video signal;

4 receiving said analog video signal from said analog input port;

5 converting said analog video signal to a digital video signal; and

6 formatting said digitized analog video signal to the voltage levels and protocol
7 in compliance with the high definition multimedia interface.

1 17. The method of claim 15 further comprising the step of:

2 providing a transition minimized differential signaling driver to amplify and
3 buffer said video signal in compliance with said high definition multimedia
4 specification for transmission to said video display.

1 18. The method of claim 15 further comprising the steps of :

2 providing a digital video interface port in communication with a digital video
3 interface video source;

4 receiving a digital video interface video signal from digital video interface port;
5 and

6 transmitting said digital video interface video signal to the video display.

- 1 19. The method of claim 15 further comprising the steps of :
- 2 providing a high definition multimedia interface port in communication with a
- 3 high definition multimedia interface video source;
- 4 receiving a high definition multimedia interface video signal from high
- 5 definition multimedia interface port; and
- 6 transmitting said high definition multimedia interface video signal to the video
- 7 display.
- 1 20. The method of claim 15 wherein said plurality of video transmission interface
- 2 specifications comprises a peripheral component interconnect specification, a
- 3 universal serial bus specification, a personal computer memory card specification, an
- 4 advanced attachment specification, a flash memory card specification, and high
- 5 performance serial bus peer-to-peer data transfer protocol specification.
- 1 21. An apparatus for converting a video signal having signal levels and format compliant
- 2 with one of a plurality of video transmission interface specifications to a video signal
- 3 compliant with a high definition multimedia interface for display upon a video display,
- 4 said apparatus comprising:
- 5 means for providing a plurality of input ports, each input port in
- 6 communication with source devices that transmit video signals that
- 7 comply with one of said plurality of video transmission interface
- 8 specifications;
- 9 means for selecting one of the input ports to accept one of said video signals;

10 means for receiving said video signal from said selected input port;

11 means for retaining said video signal based on timing signals in compliance

12 with the video transmission interface specification to which said video

13 signal conforms;

14 means for extracting said retained video signal with a timing signal in

15 compliance with said high definition multimedia interface specification;

16 means for formatting said video signal to the voltage levels and protocol in

17 compliance with the high definition multimedia interface; and

18 means for transmitting said video signal in compliance with said high

19 definition multimedia specification to a video display.

1 22. The apparatus of claim 21 further comprising:

2 means for providing an analog input port in communication with analog video

3 sources to accept an analog video signal;

4 means for receiving said analog video signal from said analog input port;

5 means for converting said analog video signal to a digital video signal; and

6 means for formatting said digitized analog video signal to the voltage levels

7 and protocol in compliance with the high definition multimedia interface.

1 23. The apparatus of claim 21 further comprising:

2 means for providing a transition minimized differential signaling driver to
3 amplify and buffer said video signal in compliance with said high definition
4 multimedia specification for transmission to said video display.

1 24. The apparatus of claim 21 further comprising:

2 means for providing a digital video interface port in communication with a
3 digital video interface video source;

4 means for receiving a digital video interface video signal from digital video
5 interface port; and

6 means for transmitting said digital video interface video signal to the video
7 display.

1 25. The apparatus of claim 21 further comprising:

2 means for providing a high definition multimedia interface port in
3 communication with a high definition multimedia interface video source;

4 means for receiving a high definition multimedia interface video signal from
5 high definition multimedia interface port; and

6 means for transmitting said high definition multimedia interface video signal to
7 the video display.

1 26. The apparatus of claim 21 wherein said plurality of video transmission interface
2 specifications comprises a peripheral component interconnect specification, a
3 universal serial bus specification, a personal computer memory card specification, an

4 advanced attachment specification, a flash memory card specification, and high
5 performance serial bus peer-to-peer data transfer protocol specification.

1 27. A medium for retaining a computer program which, when executed on a computing
2 system, performs a program process for converting a video signal having signal
3 levels and format compliant with one of a plurality of video transmission interface
4 specifications to a video signal compliant with a high definition multimedia interface
5 for display upon a video display, said medium for retaining a computer program
6 comprising the steps of:

7 providing a plurality of input ports, each input port in communication with
8 source devices that transmit video signals that comply with one of said
9 plurality of video transmission interface specifications;

10 selecting one of the input ports to accept one of said video signals;

11 receiving said video signal from said selected input port;

12 retaining said video signal based on timing signals in compliance with the
13 video transmission interface specification to which said video signal
14 conforms;

15 extracting said retained video signal with a timing signal in compliance with
16 said high definition multimedia interface specification;

17 formatting said video signal to the voltage levels and protocol in compliance
18 with the high definition multimedia interface; and

19 transmitting said video signal in compliance with said high definition
20 multimedia specification to a video display.

1 28. The medium for retaining a computer program of claim 27 wherein the program
2 process further comprises the steps of:

3 providing an analog input port in communication with analog video sources to
4 accept an analog video signal;

5 receive said analog video signal from said analog input port;

6 converting said analog video signal to a digital video signal; and

7 formatting said digitized analog video signal to the voltage levels and protocol
8 in compliance with the high definition multimedia interface.

1 29. The medium for retaining a computer program of claim 27 wherein the program
2 process further comprises the step of:

3 providing a transition minimized differential signaling driver to amplify and
4 buffer said video signal in compliance with said high definition multimedia
5 specification for transmission to said video display.

1 30. The medium for retaining a computer program of claim 27 wherein the program
2 process further comprises the steps of :

3 providing a digital video interface port in communication with a digital video
4 interface video source;

5 receiving a digital video interface video signal from digital video interface port;
6 and

7 transmitting said digital video interface video signal to the video display.

1 31. The medium for retaining a computer program of claim 27 wherein the program
2 process further comprises the steps of :

3 providing a high definition multimedia interface port in communication with a
4 high definition multimedia interface video source;

5 receiving a high definition multimedia interface video signal from high
6 definition multimedia interface port; and

7 transmitting said high definition multimedia interface video signal to the video
8 display.

1 32. The medium for retaining a computer program of claim 27 wherein said plurality of
2 video transmission interface specifications comprises a peripheral component
3 interconnect specification, a universal serial bus specification, a personal computer
4 memory card specification, an advanced attachment specification, a flash memory
5 card specification, and high performance serial bus peer-to-peer data transfer
6 protocol specification.