

(19) Japan Patent Office (JP) (12) JAPANESE UNEXAMINED PATENT APPLICATION PUBLICATION (A)

(11) Patent Application Publication No.
JP 2009-60204 A
(P2009-60204A)

(43) Publication Date: March 19, 2009 (Heisei 21)

(51) Int. Cl.	FI	Theme Code (Reference)
H04N 7/173 (2006.01)	H04N 7/173 630	5C082
G09G 5/00 (2006.01)	G09G 5/00 510S	5C164
G06F 1/18 (2006.01)	G09G 5/00 555D	
G06F 3/00 (2006.01)	G06F 1/00 320J	
	G06F 3/00 A	

Examination Request: Not yet No. of Claims: 17 OL (Total 15 pages)

(21) Application No.	JP 2007-223646 (P2007-223646)	(71) Applicant 000005821 Panasonic Corporation 1006, Kadoma, Kadoma-shi, Osaka-fu
(22) Date of Filing	August 30, 2007 (Heisei 19)	(74) Agent 100072431 Kazuo Ishii, Patent Attorney
		(74) Agent 100117972 Shin'ichi Kawasaki, Patent Attorney
		(72) Inventor Takanori Iwamoto c/o Matsushita Electric Industrial Co., Ltd. 1006, Kadoma, Kadoma-shi, Osaka-fu
		F Term (Reference) 5C082 AA02 BB02 CB01 MM05 5C164 FA17 UA03S UB10P UB21S UB37S UB41P UB71P YA04 YA21

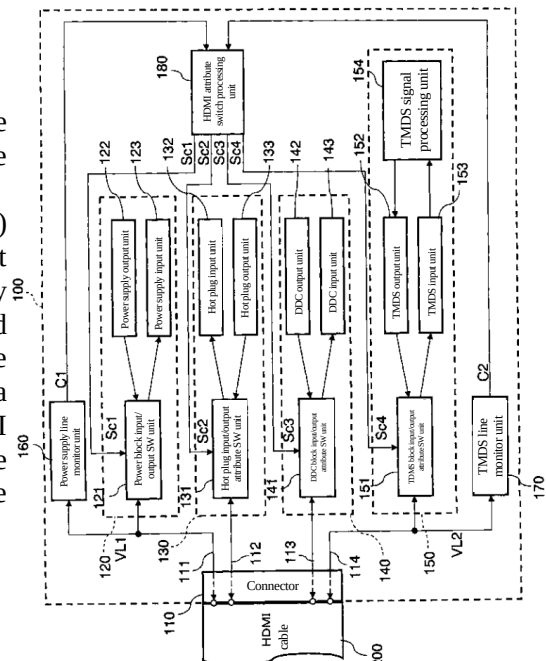
(54) [Title of Invention] SOURCE/SINK DUAL-PURPOSE DEVICE

(57) [Abstract]

[Problem] To provide a source/source/sink dual-purpose device capable of detecting a function attribute of a HDMI device connected to a single connector.

[Resolution Means] In a source/sink dual-purpose device (100) conforming to the HDMI standard, a voltage line monitor unit (160) detects a voltage level (VL1) of a connector power supply line (111) that connects one of first function means and second function means to an external device (20) conforming to the HDMI standard, an TDMS line monitor unit (170) detects a voltage level (VL2) of a TMDS_CLK line, and an HDMI attribute switching unit (180) determines a function (J) of the external device (20) on the basis of the detected two voltage levels (VL1, VL2).

[Selected Drawing] FIG. 1



[Scope of Patent Claims]

[Claim 1]

A source/sink dual-purpose device conforming to the HDMI standard, comprising first function means for realizing a function as a source device and a second function means for realizing a function as a sink device, the source/sink dual-purpose device further comprising a connector for connecting one of the first function means and the second function means to an external device conforming to the HDMI standard, first voltage level monitor means for detecting the voltage level of the power line of the connector, second voltage level monitor means for detecting the voltage level of a TMDS_CLK line of the connector, and function determination means for determining a function of the external device on the basis of the detected two voltage levels.

[Claim 2]

The source/sink dual-purpose device according to claim 1, further comprising operation mode determining means for determining an operation of the first function means and the second function means based on the determined function.

[Claim 3]

The source/sink dual-purpose device according to claim 2, further comprising operation control means for controlling the first function means and the second function means based on the determined operation.

[Claim 4]

The source/sink dual-purpose device according to any of claims 1, 2, and 3, wherein the first voltage level monitor means generate a binary first level signal based on a power source level of the detected power source line and

the second elastic level monitor means generate a binary second level signal based on a voltage level of the detected TMDS_CLK line.

[Claim 5]

The source/sink dual-purpose device according to claim 4, wherein the function determining means determine that the external device is not connected when the first level signal is Low and the second level signal is Low.

[Claim 6]

The source/sink dual-purpose device according to claim 5, wherein the operation mode determining means determine to put the first function means and the second function means into a standby mode.

[Claim 7]

The source/sink dual-purpose device according to claim 6, wherein the operation control means make the first function means and the second function means high impedance.

[Claim 8]

The source/sink dual-purpose device according to claim 4, wherein the function determining means determine that the external device is abnormal when the first level signal is High and the second level signal is High.

[Claim 9]

The source/sink dual-purpose device according to claim 8, wherein the operation mode determining means determine to put the first function means and the second function means into a shunt mode.

[Claim 10]

The source/sink dual-purpose device according to claim 9, wherein the operation control means make the first function means and the second function means high impedance.

[Claim 11]

The source/sink dual-purpose device according to claim 4, wherein the function determining means determine that the external device is a sink when the first level signal is Low and the second level signal is High.

[Claim 12]

The source/sink dual-purpose device according to claim 11, wherein the operation mode determining means determine to put the first function means and the second function means into a source mode.

[Claim 13]

The source/sink dual-purpose device according to claim 12, wherein the operation control means enable the first function means.

[Claim 14]

The source/sink dual-purpose device according to claim 4, wherein the function determining means determine that the external device is the source when the first level signal is High and the second level signal is Low.

[Claim 15]

The source/sink dual-purpose device according to claim 14, wherein the operation mode determining means determine to put the first function means and the second function means into a sink mode.

[Claim 16]

The source/sink dual-purpose device according to claim 15, wherein the operation control means enable the second function means.

[Claim 17]

A source/sink dual-purpose device conforming to the HDMI standard, comprising first function means for realizing a function as a source device and second function means for realizing a function as a sink device,

the source/sink dual-purpose device comprising a connector for connecting one of the first function means and the second function means to an external device conforming to the HDMI standard,

first voltage level monitor means for detecting the voltage level of the power line of the connector,

second voltage level monitor means for detecting the voltage level of a TMDS_CLK line of the connector, and

operation control means for controlling the first function means and the second function means on the basis of the detected two voltage levels.

[Detailed Description of Invention]

[Technical Field]

[0001]

The present invention relates to a source/sink dual-purpose device conforming to the HDMI standard and combines attributes of a source device and a sink device.

[Background Art]

[0002]

In recent years, AV systems conforming to the HDMI (High Definition Multimedia Interface) standard are becoming widespread. HDMI is one of the multimedia interfaces and can transfer video and audio signals from an AV playback device to an AV output device without data compression, and therefore, it does not require a dedicated chip such as a decoder or software. Furthermore, video signals, audio signals, and control signals can be transmitted by a single cable, and thus there are advantages such as being able to simplify the wiring of the device and the like (for example, see patent document 1).

[0003]

An AV system conforming to the HDMI standard is normally configured by connecting a source device that supplies AV signals and a sink device that receives the AV signals via a cable conforming to the HDMI standard (hereinafter referred to as an "HDMI cable"). A device for supplying a video signal or an audio signal such as an STB, a DVD player, or a digital video camera is used as the source device. A device such as a television receiver (hereinafter referred to as "television") or a projector that outputs video or audio is used as the sink device. It is conceivable that these constitute a source/sink dual-purpose device having both a function of the source device and a function of the sink device, such as a television with a built-in DVD player.

[0004]

FIG. 4 illustrates one example of a conceivable source/sink dual-purpose device. The source/sink dual-purpose device 10 includes a sink device corresponding block 11, a source device corresponding block 12, a connector 13a, and a connector 13b. The sink device corresponding block 11 has a function of a sink device, and the source device corresponding block 12 has a function of a source device. The sink device corresponding block 11 and the source device corresponding block 12 are respectively connected to a connector 13a and a connector 13b conforming to the HDMI standard. When the source/sink dual-purpose device 10 is configured as a television with built-in DVD player, the television corresponds to the sink device corresponding block 11

and the DVD player corresponds to the source device corresponding block 12.

[0005]

Thus, in the source/sink dual-purpose device 10 configured as the television with built-in DVD player, a video signal played back by the DVD player is normally displayed as a video by a television display, and an audio signal is output as audio from a speaker of the television. However, there are times when a user would like to view the video on a projector without viewing the video on the television display. Furthermore, it may be desired that the video and audio captured by the digital video camera be played back by a display and a speaker of the source/sink dual-purpose device 10.

[0006]

In order to respond to such desires, it is required to receive a signal from an external source device to the sink device corresponding block 11 provided in the source/sink dual-purpose device 10 and to supply a signal from the source device corresponding block 12 to the external sink device. In order to satisfy such a request, the connectors 13a and 13b described above are provided.

[0007]

Next, an AV system configured by connecting an external sink device or an external source device to the source/sink dual-purpose device 10 will be described with reference to FIG. 5. FIG. 5(A) illustrates an AV system 1a configured by connecting to a source device 20src so that the source/sink dual-purpose device 10 is used as a sink, and FIG. 5(B) illustrates an AV system 1b configured by connecting to a sink device 20snk so that the source/sink dual-purpose device 10 is used as a source. Connectors 21 and 22 conforming to the HDMI standard are also provided at input and output ends of the source device 20src and the sink device 20snk, respectively. Note that the source device 20src and the sink device 20snk are collectively referred to as an external device 20.

[0008]

As illustrated in FIG. 5(A), in the AV system 1a in which the source/sink dual-purpose device 10 is used as a sink of the source device 20src, such as a digital video camera or a DVD player, the sink device corresponding block 11 is connected to the source device 20src via the connector 13a, an HDMI cable 40, and a connector 21 conforming to the HDMI standard. In this case, the video signal and the audio signal played back by the source device (for example, a digital video camera) 20 are transmitted through the HDMI cable 40 to the sink device corresponding block (television) 11 of the source/sink dual-purpose device (for example, a television with built-in DVD player) 10, and the video image is displayed on the built-in display or audio is output from the speaker.

[0009]

As illustrated in FIG. 5(B), in the AV system 1b in which a source/sink dual-purpose device 10 serves as a source for a sink device such as a projector, the source device corresponding block 12 is connected to the sink device 20snk via the connector 13b, the HDMI cable 40, and a connector 22 conforming to the HDMI standard. In this case, the video signal and the audio signal played back in the source device corresponding block (DVD player) 12 are transmitted to a sink device (for example, a projector) 30 via the HDMI cable 40 and are projected as impactful video on a large screen.

[0010]

In an AV system conforming to the HDMI standard, a video signal, an audio signal, and a control signal are transmitted between devices via an HDMI cable, and thus a connector conforming to the HDMI standard is provided at input and output ends of each device. This principle also holds for the source/sink dual-purpose device 10, and the sink device corresponding block 11 and source device corresponding block 12 are respectively connected to the external device 20 via the connectors 13a and 13b (and the HDMI cable 40).

[0011]

However, providing dedicated connectors to each of the sink device corresponding block 11 and the source device corresponding block 12 leads to increased cost and size of the device. Moreover, it is necessary to determine whether the external device 20 connected to the input and output dual-purpose device 10 is the source device, which is on the output side, or the sink device, which is on the input side. Furthermore, it is necessary to correctly select one of the two, namely the connector 13a (sink side) and the connector 13b (source side), to connect the external device 20, which is a troublesome task for the user.

[0012]

Therefore, it is desirable to use a single connector for each block connector. In fact, in the field of AV equipment that does not conform to the HDMI standard, technology is widespread (see patent documents 2 through 4) that uses a single terminal for both the input terminal and the output terminal of video and audio signals to automatically switch the connection state according to the input and output state of the video and audio signals.

[Patent Document 1] JP 2007-79176 A

[Patent Document 2] JP H07-038817 A

[Patent Document 3] JP 2001-086416 A

[Patent Document 4] JP H04-368666 A

[Disclosure of Invention]

[Problem to Be Solved by Invention]

[0013]

Applying the switching art proposed in patent documents 2 through 4 described above, it is also conceivable that the source/sink dual-purpose device conforming to the HDMI standard is switched to the sink or the source according to whether the external device connected to one connector is the sink side or the source side. However, the source/sink dual-purpose device that is the subject of the present invention and the device to be connected are connected by an HDMI cable.

[0014]

The video signal and the audio signal transferred on the HDMI cable, as well as the control signal, are signals according to the HDMI standard. A device conforming to the HDMI standard does not have a function for notifying a connection partner of a function attribute representing whether the device itself is a source or a sink. Therefore, in the source/sink dual-purpose device conforming to the HDMI standard, it is not possible to obtain information relating to a functional attribute indicating whether the device on the connected side is the source or the sink. That is, according to the function attribute of the device connected to one connector, its own source/sink function cannot be automatically switched.

[0015]

Moreover, even were the function attribute of the connected device can be known by some means, problems such as impedance mismatches occur when the input (sink) and output (source) of the source/sink dual-purpose device are simply switched. Thus, the switching are used in general AV equipment cannot be applied to source/sink dual-purpose devices conforming to the HDMI standard.

[0016]

The present invention has been configured in view of such conventional problems, and an object thereof is to provide a source/sink dual-purpose device that can detect a functional attribute of an HDMI device connected to a single connector. To provide a source/sink dual-purpose device capable of automatically switching its own functions according to the detected function attribute of the device.

[Means for Solving Problem]

[0017]

In order to achieve the foregoing object, the source/sink dual-purpose device of the present invention is

a source/sink dual-purpose device conforming to the HDMI standard, provided with first function means for realizing a function as a source device and second function means for realizing a function as a sink device,

a source/sink dual-purpose device conforming to the HDMI standard, provided with a second function means for realizing, being provided with

a connector for connecting one of the first function means and the second function means to an external device conforming to the HDMI standard,

first voltage level monitor means for detecting the voltage level of the power line of the connector,

second voltage level monitor means for detecting the voltage level of a TMDS_CLK line of the connector, and

function determination means for determining a function of the external device on the basis of the

detected two voltage levels.

[0018]

It is preferable that the source/sink dual-purpose device of the present device is further provided with operation mode determining means for determining an operation of the first function means and the second function means based on the determined function. Furthermore, it is preferable that operation control means for controlling the first function means and the second function means based on the determined operation are further provided.

[0019]

Moreover, it is preferable that the first voltage level monitor means generate a binary first level signal based on a power source level of the detected power source line and that the second elastic level monitor means generate a binary second level signal based on a voltage level of the detected TMDS_CLK line.

[0020]

Here, the function determining means determine that the external device is not connected when the first level signal is Low and the second level signal is Low. In this case, the operation mode determining means determines to put the first functional means and the second functional means into a standby mode. That is the operation control means make the first function means and the second function means high impedance.

[0021]

Also, the function determining means determine that the external device is abnormal when the first level signal is High and the second level signal is High. In this case, the operation mode determining means determines to put the first functional means and the second functional means into a shunt mode. That is the operation control means make the first function means and the second function means high impedance.

[0022]

Additionally, the function determining means determine that the external device is a sink when the first level signal is Low and the second level signal is High. In this case, the operation mode determining means determines to put the first functional means and the second functional means into a source mode. That is, the operation control means enables the first function means.

[0023]

Furthermore, the function determining means determine that the external device is a source when the first level signal is High and the second level signal is Low. In this case, the operation mode determining means determines to put the first functional means and the second functional means into a sink mode. That is, the operation control means enables the second function means.

[0024]

Moreover, the second source/sink dual-purpose device of the present invention is a source/sink dual-purpose device conforming to the HDMI standard, provided with first function means for realizing a function as a source device and second function means for realizing a function as a sink device,

the source/sink dual-purpose device being provided with a connector for connecting one of the first function means and the second function means to an external device conforming to the HDMI standard,

first voltage level monitor means for detecting the voltage level of the power line of the connector,

second voltage level monitor means for detecting the voltage level of a TMDS_CLK line of the connector, and

operation control means for controlling the first function means and the second function means on the basis of the detected two voltage levels.

[Effect of Invention]

[0025]

In the present invention, in a source/sink dual-purpose device connected to an external HDMI device via a single connector, the device's own function can be automatically set according to the function or state of the connected HDMI device.

[Best Mode for Carrying Out Invention]

[0026]

Before describing embodiments of the present invention in detail, first, main characteristics of the

present invention will be described. The source/sink dual-purpose device according to the present invention is configured to conform to the HDMI standard and is provided with two monitor units for detecting a state of signals flowing through an HDMI cable. When an external device is connected via an HDMI cable to a connector shared by both a source and a sink of the source/sink dual-purpose device, a function attribute of whether the connected external device conforming to the HDMI standard is the source or the sink is determined on the basis of detection results of two monitor units.

[0027]

The source/sink dual-purpose device switches its own function to the source or the sink according to the determined function attribute of the external device. At this time, the source/sink dual-purpose device 1 adjusts its own impedance so as not to cause an impedance mismatch with the external device. As a result, the source/sink dual-purpose device can function as the source device or the sink device according to the attribute of the device connected to the shared connector, that is, whether it is the sink device or the source device, without a switching operation of the user.

[0028]

FIG. 1 illustrates a configuration of the source/sink dual-purpose device according to an embodiment of the present invention. The source/sink dual-purpose device 100 includes a connector 110, a power supply block 120, a hot plug block 130, a DCC block 140, a TDMS block 150, a voltage line monitor 160, a TDMS line monitor 170, and an HDMI attribute switching processing unit 180.

[0029]

The connector 110 conforms to the HDMI standard and is exclusively connected to either one of another source device 20src (FIG. 5) and a sink device 20snk (FIG. 5) conforming to the HDMI standard via the HDMI cable 200. That is, the connector 110 is shared by the source device 20src and the sink device 20snk. The HDMI cable 200 includes a plurality of lines for transmitting signals and data. Typical lines include a CEC line, a hot plug line, a DDC line, and an HDMC line.

[0030]

The CEC line is used for transmission of control data between the source device and the sink device. The hot plug line is used to determine whether an HDMI cable is connected. The DDC line is used for transmitting EDID (Extended Display Identification Data) data including video format information. The HDMI line is used for transmission of TMDS system video signals and audio signals.

[0031]

The connector 110 is provided with a power source line 111, a hot plug line 112, a DDC line 113, and a TMDS line 114 in forms corresponding to each line of the HDMI cable 200. Of these, a plurality of TMDS lines 114 are normally present, but in FIG. 1, only one line is displayed for simplicity.

[0032]

The power supply block 120 includes a power supply block input/output SW unit 121, a power supply output unit 122, and a power supply input unit 123. The hot plug block 130 includes a hot plug input/output attribute SW unit 131, a hot plug input unit 132, and a hot plug output unit 133. The DCC block 140 includes a DDC block input/output attribute SW unit 141, a DDC output unit 142, and a DDC input unit 143. The TDMS block 150 includes a TDMS input/output attribute SW unit 151, a TDMS output unit 152, a TDMS input unit 153, and a TMDS signal processing unit 154.

[0033]

The source/sink dual-purpose device 100 can function as a source device conforming to the HDMI standard, via a power source output unit 122, a hot plug input unit 132, a DDC output unit 142, a TDMS output unit 152, and a TMDS signal processing unit 154. Conversely, the source/sink dual-purpose device 100 can function as a sink device conforming to the HDMI standard, via a power input unit 123, a hot plug output unit 133, a DDC input unit 143, a TDMS input unit 153, and a TMDS signal processing unit 154.

[0034]

Switching of the source device function and the sink device function in the power supply block 120, the hot plug 130, the DDC block 140, and the TDMS block 150 is performed by switching switches in the power supply block input/output SW unit 121, the hot plug input/output attribute SW unit 131, the DDC block input/output attribute SW unit 141, and the TDMS input/output attribute SW unit 151. Thus, the source device

function unit and the sink device function unit in the source/sink dual-purpose device 100 share the connector 110 for connection with the external device 20.

[0035]

Next, functions of each block will be described. In the power supply block 120, the power supply output unit 122 supplies power to the hot plug input unit 132, the DDC output unit 142, and the TDMS output unit 152 when the source/sink dual-purpose device 100 realizes a source device function.

[0036]

In contrast, when the source/sink dual-purpose device 100 realizes a sink device function, the power input unit 123 supplies power to the hot plug output unit 133, the DDC input unit 143, and the TDMS input unit 152. By providing the power output unit 122 and the power input unit 123 separately, backflow of current from the sink side to the source side can be prevented.

[0037]

The hot plug block 130 is used when determining whether the source/sink dual-purpose device 100 is connected to the HDMI cable 200. The hot plug input unit 132 is used when the source/sink dual-purpose device 100 functions as the source, and the hot plug output unit 133 is used when the source/sink dual-purpose device 100 functions as the sink.

[0038]

In the DDC block 140, when the source/sink dual-purpose device 100 functions as a source, EDID data related to a displayable video format from the sink device 20snk connected to the HDMI cable 200 is transferred to a DDC output unit 142 and stored in a memory (not illustrated). The DDC output unit 142 sets a video format on the basis of a user instruction from the EDID stored in a memory.

[0039]

In a memory (not illustrated) of the DDC input unit 143, when the source/sink dual-purpose device 100 functions as a sink, a displayable video format is stored as the EDID. The EDID stored in the memory is read out by access from the source device 20src when the source/sink dual-purpose device 100 is connected to the source device 20src.

[0040]

In the TDMS block 150, when the source/sink dual-purpose device 100 functions as a source, a TDMS output unit 152 outputs video data and audio data converted into TDMS system data by the TDMS signal processing unit 154 to the sink device 20snk connected to the HDMI cable 200.

[0041]

The TDMS input unit 153 receives the video data and the TDMS system audio data transmitted from the source device 20src connected to the HDMI cable 200 when the source/sink dual-purpose device 100 functions as the sink. The video data and the audio data are transferred from the TDMS input unit 153 to the TDMS signal processing unit 154 and converted into video data and audio data before TDMS processing is performed by the TDMS signal processing unit 154. The problem of impedance mismatch of the TDMS line 114 can be eliminated by providing the TDMS output unit 152 and the TDMS input unit 153 separately.

[0042]

Next, two monitoring units 160 and 170 that monitor the connection state between the HDMI cable 200 and the external device 20 will be described. The power supply line monitor unit 160 repeatedly detects a voltage level VL1 of a power supply line 111 among a plurality of lines connected to the connector 110 at predetermined time intervals to generate a binary level signal (hereinafter, "power supply line level") C1.

[0043]

When the external device 40 to which the connector 110 is connected via the HDMI cable 200 is the source device 20src, the voltage level VL1 of the power source line 111 indicates a High level (5 V). In contrast, when the connected external device 40 is the sink device 20snk, is not connected, or is not operating due to not being energized despite being connected, the voltage level VL1 indicates a low level (0 V). The power supply line level C1 has a value of either High or Low corresponding to the level of the voltage level VL1.

[0044]

The TDMS line monitor unit 170 repeatedly detects a voltage level VL2 of the TDMS line (specifically, a TDMS_CLK line) 114 included in the connector 110 at predetermined time intervals to generate a binary level

signal (hereinafter, "TDMS line level") C2. When the connector 110 is connected to a sink device via the HDMI cable 200, the voltage level VL2 of the TDMS line 114 indicates a High level (3.3 V).

[0045]

In contrast, when the connector 110 is connected to a source device via the HDMI cable 200 or is not connected to another device, the voltage level VL2 indicates a low level (0 V). The TDMS line level C2 has a value of either High or Low corresponding to the level of the voltage level VL2.

[0046]

Operation of the HDMI attribute switching processing unit 180 will be described below with reference to FIG. 2. The HDMI attribute switching processing unit 180 determines a function J of the external device connected to the connector 110 also used for connection between the source device and the sink device based on the power source line level C1 and the TDMS line level C2. Note that "function," in relation to the external device, refers to one of four states of "disconnected," "abnormal," "sink," and "source."

[0047]

"Disconnected" refers to a state in which the external device is not connected or is not energized even when connected. When both of the power supply line level C1 and the TDMS line level C2 are Low, "disconnected" is determined.

[0048]

"Abnormal" refers to a condition in which an external device is connected but is not normal. When both of the power supply line level C1 and the TDMS line level C2 are High, "abnormal" is determined.

[0049]

"Sink" refers to a sink, that is, a state in which an external device on the input side is connected. Note that it goes without saying that the external device is not in an abnormal state and is energized. When the power supply line level C1 is low and the TDMS line level C2 is High, "sink" is determined.

[0050]

"Source" means a source, that is, a state in which an external device on the output side is connected. Note that it goes without saying that the external device is not in an abnormal state and is energized. When the power supply line level C1 is High and the TDMS line level C2 is Low, "source" is determined.

[0051]

The HDMI attribute switching processing unit 180 further determines an operation mode M of the source/sink dual-purpose device 100 based on the determination result of the external device function attribute. Note that "operation mode" refers to which function of "standby," "error processing," "source," or "sink" the source/sink dual-purpose device 100 operates.

[0052]

"Standby" refers to a process for energizing the source/sink dual-purpose device 100 and waiting for connection of the external device. When the function attribute of the external device is determined to be "disconnected", a "standby" mode is determined.

[0053]

"Shunt" refers to a process for stopping the operation of the source/sink dual-purpose device 100 or disconnecting the electrical connection with the external device so as not to be affected by the external device in an abnormal state. When the function attribute of the external device is determined to be "abnormal," a "shunt" mode is determined.

[0054]

"Source" refers to a process for executing a source function built into the source/sink dual-purpose device 100. When the function attribute of the external device is determined to be "sink," a "source" mode is determined.

[0055]

"Sink" refers to a process for executing a sink function built into the source/sink dual-purpose device 100. When the function attribute of the external device is determined to be "source," a "sink" mode is determined.

[0056]

Also, the HDMI attribute switching processing unit 180 outputs control signals Sc1, Sc2, Sc3, and Sc4

instructing realization of function attributes corresponding to the determined operation mode to the power supply block 120, the DDC block 130, the hot plug block 140, and the TDMS block 150, respectively, based on the operation mode determination.

[0057]

Specifically, when determined to be in “standby” mode, the control signals Sc1 to Sc4 control the power supply block input/output SW unit 121, the DDC block input/output attribute SW unit 131, the hot plug input/output attribute SW unit 131, and the TDMS block input/output attribute SW unit 151, respectively, so that the power supply block 120, the hot plug block 130, the DCC block 140, and the TMDS block 150 become high impedance.

[0058]

When the “standby” mode is determined, the control signals Sc1 to Sc4 are controlled similarly to when the “standby” mode is determined. Thus, the DDC block 130, the hot plug block 140 and the TDMS block 150 are protected from abnormal voltage, and malfunction is prevented. Note that it is preferable to cut off the power source of the source/sink dual-purpose device 100 itself.

[0059]

When the “source” mode is determined, the control signal Sc1 switches an input/output attribute of the power supply block 120 to output. That is, the power source block input and output SW unit 121 is controlled so as to connect the power source output unit 122 to the connector 110.

The control signal Sc2 switches an input/output attribute of the hot plug block 130 to an output. That is, the hot plug input/output attribute SW unit 131 is controlled so as to connect the DDC output unit 132 to the connector 110.

The control signal Sc3 switches an input/output attribute of the DCC block 140 to input. That is, the DDC block input and output attribute SW unit 141 is controlled so as to connect the DDC input unit 143 to the connector 110.

The control signal Sc4 switches an input/output attribute of the TDMS block 150 to output. That is, the TDMS input and output attribute SW unit 151 is controlled so as to connect the TDMS output unit 152 to the connector 110.

[0060]

When determined to be the “sink” mode, the control signal Sc1 switches the input/output attribute of the power supply block 120 to output. That is, the power block input and output SW unit 121 is controlled so as to connect the power output unit 122 to the connector 110.

The control signal Sc2 switches an input/output attribute of the hot plug block 130 to an output. That is, the hot plug input/output attribute SW unit 131 is controlled so as to connect the DDC output unit 132 to the connector 110.

The control signal Sc3 switches an input/output attribute of the DCC block 140 to input. In other words, the DDC block input/output attribute SW unit 141 is controlled so as to connect the DDC input unit 143 to the connector 110.

The control signal Sc4 switches an input/output attribute of the TDMS block 150 to output. That is, the TDMS input and output attribute SW unit 151 is controlled so as to connect the TDMS output unit 152 to the connector 110.

[0061]

Note that the information necessary to determine the external device function J and to determine the operation mode M described in FIG. 2, in addition, the control signal Sc of each type of block is stored in a ROM (not illustrated) built into the HDMI attribute switching processing unit 180, and the CPU (not illustrated) reads the necessary information from the ROM to make a determination or decision, and further sends out the control signal. That is, the HDMI attribute switching processing unit 180 realizes the functions of the function determining means, the operation mode determining means, and the operation control means of the present invention.

[0062]

A more specific description of the function switching operation of the source/sink dual-purpose device 100 by the HDMI attribute switching processing unit 180 in the source/sink dual-purpose device 100 will be

given below with reference to the flowchart illustrated in FIG. 3. When power is turned on and the operation of the source/sink dual-purpose device 100 is started, the operation by the HDMI attribute switching processing unit 180 described below is started based on the power source line level C1 and the TDMS line level C2 output at predetermined time intervals from the voltage line monitor unit 160 and the TDMS line monitor unit 170, respectively.

[0063]

First, in step S2, it is determined by the HDMI attribute switching processing unit 180 whether the power source line level C1 is High. In the case of No, that is, when the power line level C1 is determined to be Low, control proceeds to the next step S4. In the case of Yes, that is, when the power line level C1 is determined to be High, control proceeds to step S10.

[0064]

In step S4, it is determined whether the TDMS line level C2 is High. In the case of No, that is, when it is determined that the TDMS line level C2 is low, control proceeds to the next step S6. In the case of Yes, that is, when the TDMS line level C2 is determined to be High, control proceeds to step S16.

[0065]

In step S6, both the power source line level C1 and the TDMS line level C2 are Low, and thus, as described with reference to FIG. 2, it is determined that the external device 20 is “disconnected.” Then, in step S8, the control signals Sc1 to Sc4 are output, and the source/sink dual-purpose device 100 is set to the standby mode. Then, control returns to step S2 described above.

[0066]

In step S10, it is determined whether the TDMS line level C2 is High. In the case of Yes, that is, when it is determined that the TDMS line level C2 is High, control proceeds to step S12. When determined to be No, control proceeds to step S20.

[0067]

In step S12, the power source line level C1 and the TDMS line level C2 are both High, and thus, as described with reference to FIG. 2, the external device 20 is determined to be “abnormal.” Then, in step S14, the control signals Sc1 to Sc4 are output, and the source/sink dual-purpose device 100 is set to the “shunt” mode.

[0068]

In step S16, the power source line level C1 is Low and the TDMS line level C2 is High, and thus, as described with reference to FIG. 2, the external device 20 is determined to be “sink.” Then, in step S18, the control signals Sc1 to Sc4 are output, and the source/sink dual-purpose device 100 is set to the “source” mode.

[0069]

The DDC output unit 132 reads the EDID from the connected sink device 20snk and checks supported video formats. Furthermore, the TDMS block unit 152 applies TMDS encryption processing to the video signal and the audio signal output from the HDCP signal processing unit and outputs the TMDS signal from the HDMI connector 110 to the HDMI cable 200. By going through the above steps, the source/sink dual-purpose device 100 functions as a source device conforming to the HDMI standard.

[0070]

In step S20, the power source line level C1 is High and the TDMS line level C2 is Low, and thus, as described with reference to FIG. 2, the external device 20 is determined to be the “source.” Then, in step S22, the control signals Sc1 to Sc4 are output, and the source/sink dual-purpose device 100 is set to the “sink” mode.

[0071]

Then, the connected source device 20src reads EDID relating to video formats supported by the device itself from the DDC input unit 143. The TDMS input unit 153 decodes the encrypted TMDS signal transferred from the source device 20src and then transfers such to the TMDS signal processing unit 154. The TMDS signal processing unit 154 decodes the video data and the audio data from the transferred TMDS signal. By going through the above steps, the source/sink dual-purpose device 100 functions as a sink device conforming to the HDMI standard.

[0072]

Below, operation of the HDMI attribute switching processing unit 180 will be specifically described for when the external device 20 connected to the source/sink dual-purpose device 100 is in the following five

types of states.

State 1: The external device 20 is not connected to the source/sink dual-purpose device 100, or no current is applied despite being connected.

State 2: The connected external device 20 is abnormal.

State 3: A normal sink device 20snk is connected.

State 4: A normal source device 20src is connected.

State 5: The connection with the external device 20 of state 2 is cut off.

State 6: The connection with the external device 20 of state 3 is cut off.

State 7: The connection with the external device 20 of state 4 is cut off.

State 8: The connection with the external equipment of state 5, state 6, and state 7 is restored.

[0073]

In state 1 (non-connection), the source/sink dual-purpose device 100 is set to a standby mode by processing in step S2 (No), step S4 (No), step S6, and step S8. Then, the source/sink dual-purpose device 100 waits for the external device 20 to be connected while repeating the process of the flowchart of FIG. 3.

[0074]

In state 2 (abnormal), the source/sink dual-purpose device 100 is set to the error processing mode by processing in step S2 (Yes), step S10 (Yes), step S12, and step S14. Then, the source/sink dual-purpose device 100 waits for the abnormality of the external device 20 to recover while repeating the process of the flowchart of FIG. 3.

[0075]

In state 3 (sink), the source/sink dual-purpose device 100 is set to the source mode by the processing in step S2 (No), step S4 (Yes), step S16, and step S18. Then, the source/sink dual-purpose device 100 monitors the state of the external device 20 while repeating the process of the flowchart of FIG. 3. Then, when the state of the external device 20 changes, the operating mode of the device itself is reset in accordance with the change.

[0076]

In state 4 (source), the source/sink dual-purpose device 100 is set to the sink mode by the processing in step S2 (Yes), step S10 (No), step S20, and step S22. Then, the source/sink dual-purpose device 100 monitors the state of the external device 20 while repeating the process of the flowchart of FIG. 3. Then, when the state of the external device 20 changes, the operating mode of the device itself is reset in accordance with the change.

[0077]

In state 5, state 6, and state 7, the processing of state 1 described above is executed when the connection with the external device 20 in each state is cut off.

[0078]

In state 8, when the connection with the external device 20 in each state is restored, processing of any of state 2, state 3, or state 4 is executed according to the state of the external device 20.

[0079]

As described above, it is possible to use a single HDMI connector and automatically switch the attributes of the source device and the sink device without user operation. As a result, it is possible to reduce the cost and size of the device by reducing the number of required components, and to reduce the time and effort of the user to change the HDMI attribute (sink device/source device).

[Industrial Applicability]

[0080]

The source/sink dual-purpose device of the present invention can be widely used in AV devices that conform to the HDMI standard.

[Brief Description of Drawings]

[0081]

[FIG. 1] A functional block diagram illustrating a configuration of the source/sink dual-purpose device according to an embodiment of the present invention

[FIG. 2] An explanatory diagram illustrating the determination content by the HDMI attribute switching processing unit of FIG. 1

[FIG. 3] A flowchart illustrating an operation of the HDMI attribute switching processing unit of FIG. 1

[FIG. 4] A block diagram representing a configuration of a conceivable source/sink dual-purpose device.

[FIG. 5] An explanatory diagram of an AV system in which an external sink device is connected to the source/sink dual-purpose device illustrated in FIG. 4.

[Description of Reference Numerals]

[0082]

10, 100 Source/sink dual-purpose device

110 HDMI Connector

111 Power source line

120 Power supply block

121 Power source block input/output SW unit

122 Power source output unit

123 Power input unit

130 Hot plug

131 Hot plug input/output attribute SW unit

132 Hot plug input unit

133 Hot plug output unit

140 DDC block

141 DDC block input/output attribute SW unit

142 DDC output unit

143 DDC input unit

150 TMDS block

151 TDMS input/output attribute SW unit

152 TDMS output unit

153 TDMS input unit

154 TDMS signal processing unit

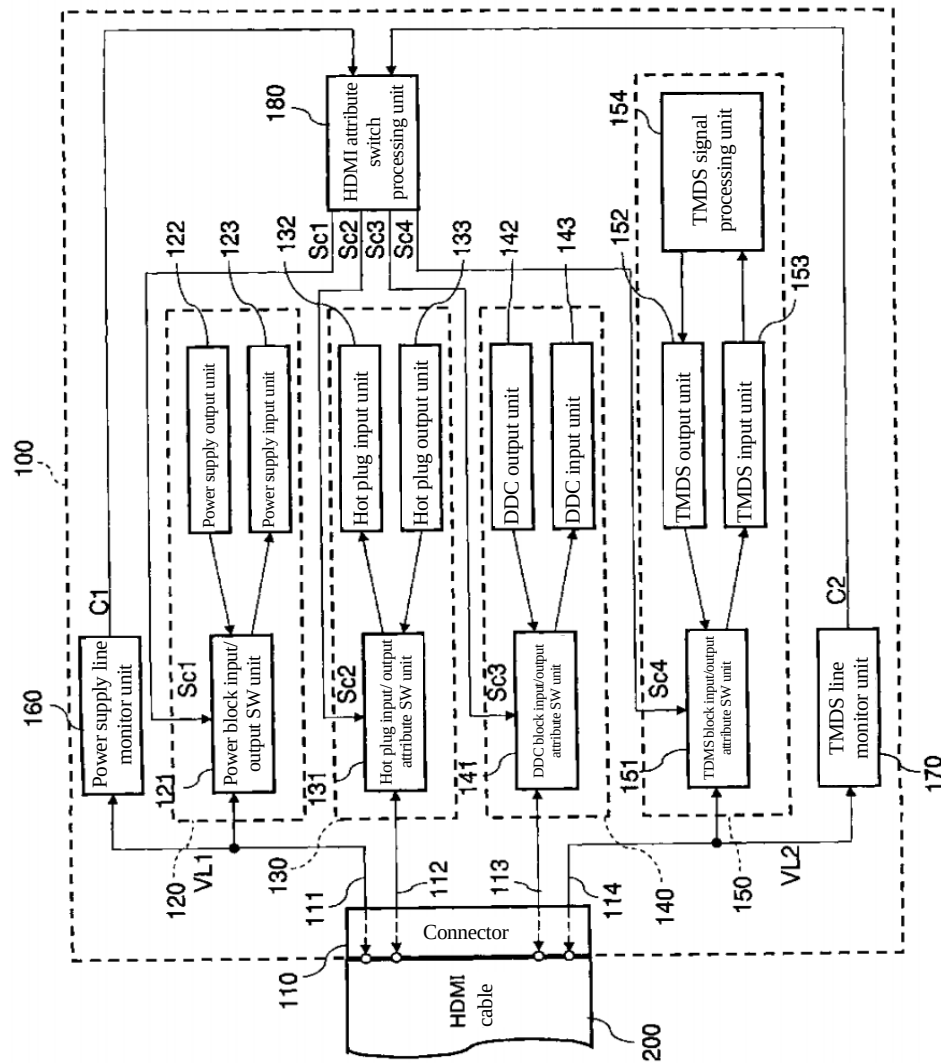
160 Voltage line monitoring unit

170 TMDS line monitoring unit

180 HDMI attribute switching processing unit

200 HDMI cable

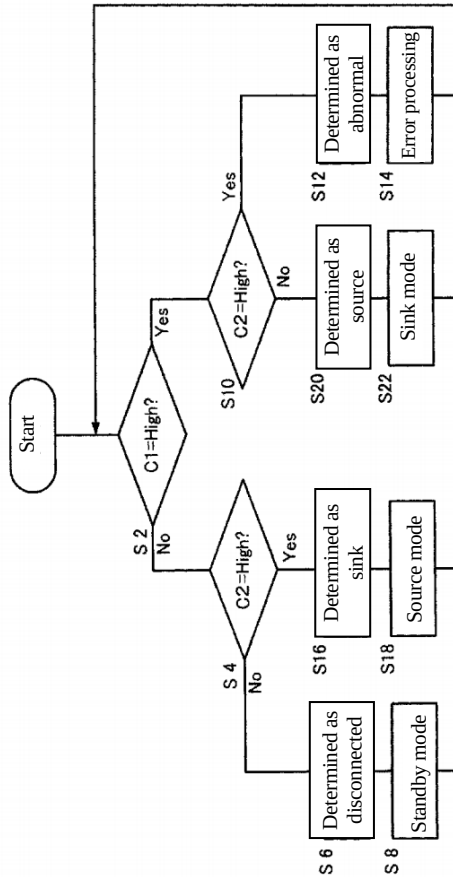
[FIG. 1]



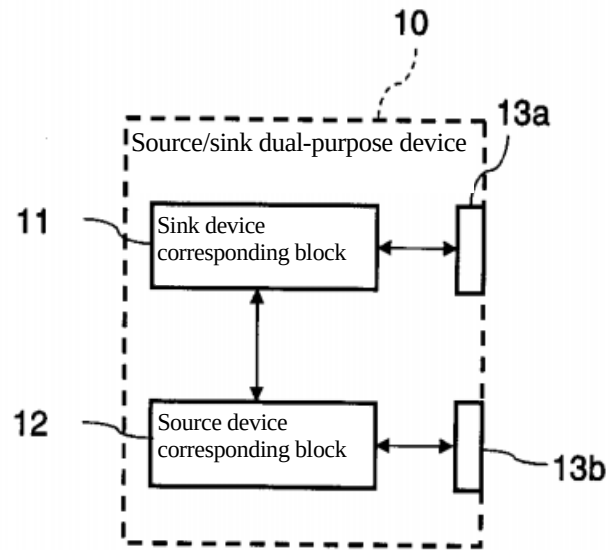
[FIG. 2]

C1	C2	J	M	Sc	
Power line level	TMDS CLK line level	External device function determination	Operation mode determination	Control Signal	
Low	Low	Disconnected	Standby	Sc1	High Impedance
				Sc2	High Impedance
				Sc3	High Impedance
				Sc4	High Impedance
High	High	Error	Shunt	Sc1	High Impedance
				Sc2	High Impedance
				Sc3	High Impedance
				Sc4	High Impedance
Low	High	Sink	Source	Sc1	Power supply output unit
				Sc2	Hot plug input unit
				Sc3	DCC output unit
				Sc4	TMDS output unit
High	Low	Source	Sink	Sc1	Power supply input unit
				Sc2	Hot plug output unit
				Sc3	DDC input unit
				Sc4	TMDS input unit

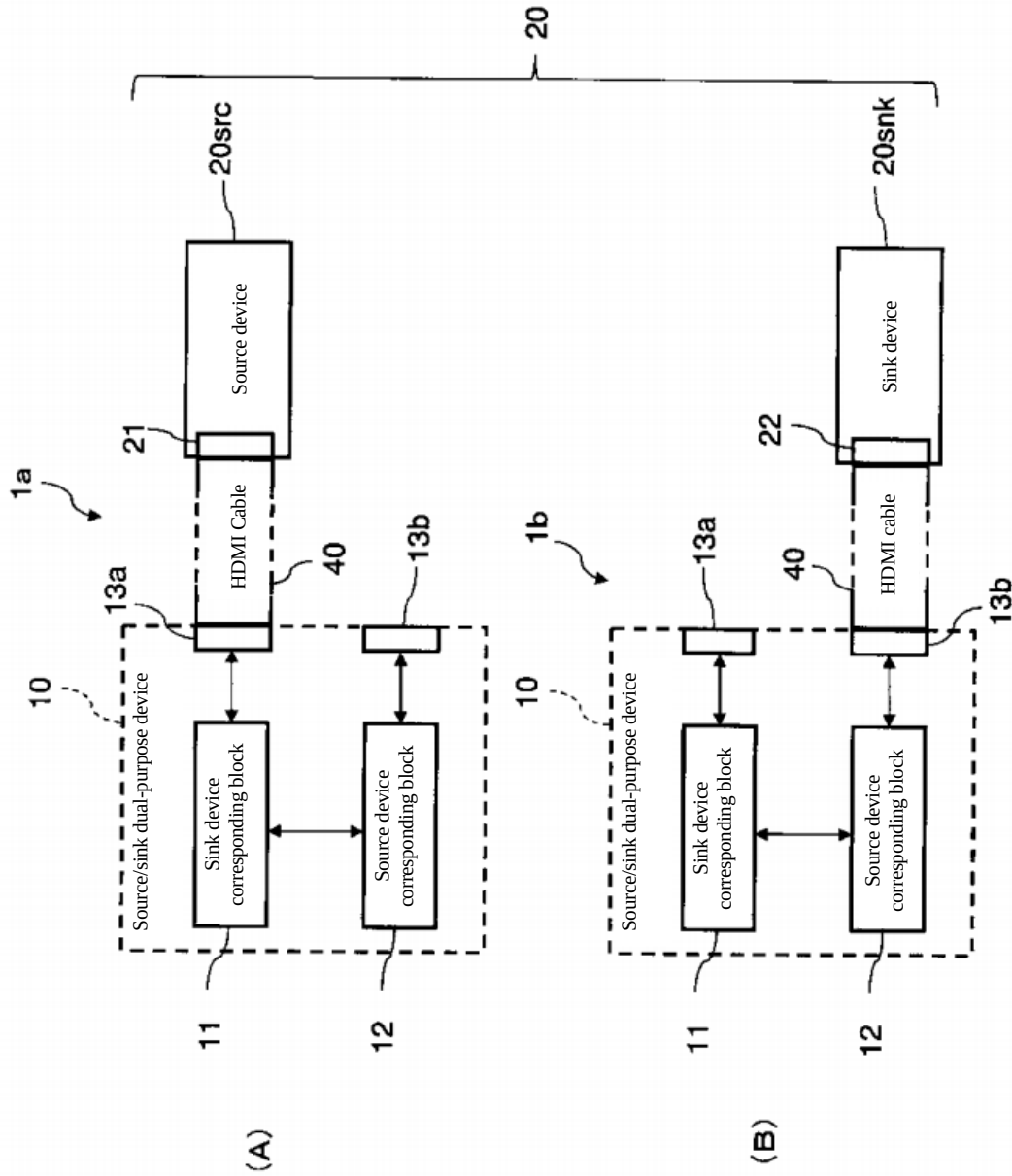
[FIG. 3]



[FIG. 4]



[FIG. 5]





DECLARATION OF TRANSLATOR

I, Eric Vance, hereby declare as follows:

1. I personally performed the attached translation from Japanese into English of the patent that is entitled ソース／シンク 兼用機器 in Japanese and SOURCE/SINK DUAL-PURPOSE DEVICE in English (also attached).
2. The attached translation is, to the best of my knowledge, a true, full and accurate translation of the attached Japanese document.
3. I am competent to perform this translation, because I have a baccalaureate degree in Japanese and 7 years of experience as a Japanese to English translator.
4. I declare under the penalty of perjury under the laws of the United States that the foregoing is true and correct; and further declare that I am aware that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 1001 of Title 18 of the United States Code.

Dated: 6/11/2024

A handwritten signature in black ink, appearing to read "Eric Vance", written over a horizontal line.

Eric Vance