| | |
|---|---|
| United States Patent Application Publication | 20250265217 |
| Kind Code | A1 |
| Publication Date | August 21, 2025 |
| Inventor(s) | HUANG; Yishao-Max et al. |


# APPARATUSES, SYSTEMS, AND METHODS FOR PROVIDING COMMUNICATION BETWEEN MEMORY CARDS AND HOST DEVICES


## Abstract

A data transmission apparatus includes: a first port and a second port which are selected by a first control signal; a first signal path and a second signal path which are selected by a second control signal. When a memory card satisfies a first condition, the first control signal selects the first port and the second control signal selects the first signal path, the data transmission apparatus connects the host device and the memory card via the first port and the first signal path and works in a first transmission mode. When the memory card satisfies a second condition, the first control signal selects the second port and the second control signal selects the second signal path, the data transmission apparatus connects the host device and the memory card via the second port and the second signal path and works in a second transmission mode.



**Inventors:** **HUANG; Yishao-Max (Suzhou City, CN), YU; Xiaoguang (Suzhou City, CN), AKAGI; Katsutoshi (Suzhou City, CN), WANG; Hongzhang (Suzhou City, CN), LI; Zhenlun Allen (Suzhou City, CN)**

**Applicant:** **SUZHOU BAYHUB ELECTRONICS TECHNOLOGY CO., LTD.** (Suzhou City, CN)



**Family ID:** **1000008578376**

**Assignee:** **SUZHOU BAYHUB ELECTRONICS TECHNOLOGY CO., LTD. (Suzhou City, CN)**

**Appl. No.:** **19/201260**

**Filed:** **May 07, 2025**

## Foreign Application Priority Data

| | | |
|---|---|---|
| CN | 202110246450.9 | Mar. 05, 2021 |

## Related U.S. Application Data

parent US continuation 18605394 20240314 parent-grant-document US 12321303 child US 19201260
parent US continuation 17684759 20220302 parent-grant-document US 11971838 child US 18605394

---

## Publication Classification

**Int. Cl.:** **G06F13/42** (20060101)

**U.S. Cl.:**

CPC **G06F13/4221** (20130101); **G06F13/4234** (20130101); G06F2213/0026 (20130101)

---

## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a continuation application of U.S. patent application Ser. No. 18/605,394, filed on Mar. 14, 2024, which is a continuation application of U.S. patent application Ser. No. 17/684,759, filed on Mar. 2, 2022, now U.S. Pat. No. 11,971,838, which claims priority to and the benefit of Chinese Patent Application No. CN202110246450.9, filed on Mar. 5, 2021. The disclosures of the above applications are hereby incorporated herein by reference in their entirety.

FIELD
[0002] The present disclosure relates to the technical field of data transmission, especially to a data transmission system, a data transmission apparatus, and a data transmission method.

---

## Description

BACKGROUND
[0003] The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.
[0004] With the development of science and technology, many electronic devices are used in our lives and data processing increases accordingly. Therefore, external memory cards are used frequently. In this condition, data information is stored in external memory cards, users can read or write data from or into the external memory card, for example, SD card. SD cards are in constant updating process to improve transmission speed, and different types of memory cards have different transfer protocols. So, the electronic device can adapt to all kinds of SD card and works in the best transfer rate is necessary. For example, the normal SD card works in normal transmission mode and the high-speed SD card works in high-speed transmission mode.
[0005] FIG. **1** shows a conventional data transmission system **100**. The data transmission apparatus **110** provides communication between normal SD card and/or high-speed SD card and host device **102**. As shown in FIG. **1**, the data transmission apparatus **110** includes a PCIE switch **1002** and a transfer controller **1006**. Wherein the PCIE switch **1002** includes a PCIE-PHY1, a PCIE-PHY2, a PCIE-PHY3 and an analysis module **1004**. Specifically, when the memory card **104** supports normal transmission mode, e.g., SD3.X-SD.6.X, the analysis module **1004** determines the transmission mode of the memory card **104** by analyzing a data packet sent from the host device

**102**. If the memory card **104** is of SD3.X-SD.6.X type which supports normal transmission mode, the analysis module **1004** selects a signal path between the PCIE switch **1002** and the transfer controller **1006** according to physical layer PCIE-PHY1 for performing communication between the host device **102** and the memory card **104**. On the contrary, if the memory card **104** is of SD7.X type which supports high-speed transmission mode, the analysis module **1004** selects the signal path between the PCIE switch **1002** and the transfer controller **1006** according to physical layer PCIE-PHY2 for performing communication between the host device **102** and the memory card **104**. The PCIE switch in FIG. **1** is very expensive and has a complex circuit design. So, a data transmission apparatus which saves PCIE switch when providing communication between the host device and the memory card of all kinds of type is necessary.

[0006] FIG. **2** shows another conventional data transmission system **200** which solves the shortcomings of the highly expensive PCIE switch in FIG. **1**. As shown in FIG. **2**, the data transmission apparatus **210** includes a PCIE-PHY **202**, a transfer controller **204**, and a signal selecting module **206**. The signal selecting module **206** is configured to receive a signal at a level from a memory card **104** to determine the type of the memory card **104**, for example, determining whether the memory card supports a normal transmission mode or a high-speed transmission mode. Specifically, the memory card **104** which supports a normal transmission mode will return a signal at a low level to the data transmission apparatus **210**, while the memory card **104** which supports a high-speed transmission mode will return a signal at a high level to the data transmission apparatus **210**. The signal selecting module **206** determines the type of the memory card **104** according to the level of the signal sent from the memory card **104**. When the memory card **104** supports the normal transmission mode, the signal selecting module **206** connects with the host device **102** via the transfer controller **204** and the PCIE-PHY **202**. Otherwise, the signal selecting module **206** connects with the host device **102** directly. As described in FIG. **2**, the data transmission apparatus **210** needs at least two signal paths to connect with two interfaces of the host device **102**, wherein each signal path (PCIE bus) includes PCIE root complex, the two signal paths connect with two PCIE root complexes in the host device **102**. However, the number of PCIE interfaces in the host device **102** used to connect external devices is limited, so saving PCIE interfaces is important.

[0007] More important, there are some other shortcomings disclosed in prior art as above. If the memory card **104** is of SD4.X-SD6.X type that supports UHSII mode, the host device **102** communicates with the memory card **104** in UHSI transmission mode, as the host device **102** cannot identify if the memory card **104** supports USHII mode. To solve this problem, the data transmission apparatus disclosed below can support the high-speed transmission mode, the normal transmission mode which includes USHII transmission mode and USHI transmission mode. According to the data transmission apparatus in this invention, the data transmission apparatus performs different transmission modes for different types of the memory cards, which does not increase PCIE switch and saves PCIE interfaces too.

## SUMMARY

[0008] This section provides a general summary of the disclosure and is not a comprehensive disclosure of its full scope or all of its features.

[0009] Disclosed are embodiments of a data transmission apparatus for providing communication between a memory card and a host device. The data transmission apparatus comprises: a first port connected to a control module in the data transmission apparatus, and controlled by a first control signal; a second port connected to a card signal selecting module in the data transmission apparatus, and controlled by the first control signal; a first signal path connected to the control module and the card signal selecting module, wherein the data transmission apparatus implements signal transmission between the control module and the card signal selecting module by the first signal path, wherein a second control signal is used to control the first signal path; and a second signal path connected to the host device and the card signal selecting module, wherein the host device transmits signals to the card signal selecting module by the second signal path, wherein the

second control signal is used to control the second signal path. When the memory card satisfies a first condition, the first control signal selects the first port to be turned on, the second control signal selects the first signal path to transmit signals, the data transmission apparatus connects the host device and the memory card via the first port and the first signal path, and the data transmission apparatus works in a first transmission mode. When the memory card satisfies a second condition, the first control signal selects the second port to be turned on, the second control signal selects the second signal path to transmit signals, the data transmission apparatus connects the host device and the memory card via the second port and the second signal path, and the data transmission apparatus works in a second transmission mode.

[0010] In other embodiments, a data transmission method for providing communication between a host device and a memory card is provided. The data transmission method comprises: generating, by a data transmission apparatus, a first control signal, and connecting the host device to the data transmission apparatus; wherein the data transmission apparatus generates a second control signal connecting the data transmission apparatus to the memory card; and in response to the memory card satisfying the first condition, the first control signal tuning on a first port and selecting a first signal path according to a second control signal, the data transmission apparatus connecting the host device and the memory card via the first port and the first signal path, and the data transmission apparatus working in a first transmission mode, in response to the memory card satisfying the second condition, the first control signal turning on a second port and the data transmission apparatus selecting the second signal path according to the second control signal, the data transmission apparatus connecting the host device and the memory card via the second port and the second signal path, and the data transmission apparatus working in a second transmission mode.

[0011] In another embodiment, a data transmission system which includes a host device, a data transmission apparatus and a memory card is provided. The data transmission system includes: a first control signal configured to control a signal path between the host device and the data transmission apparatus; a second control signal configured to control another signal path between the data transmission apparatus and the memory card; wherein when the memory card satisfies a first condition, the data transmission apparatus works in a first transmission mode, wherein in the first transmission mode, the first control signal selects a first port to be turned on and the second control signal selects a first signal path to transmit signals, the data transmission apparatus connects the host device and the memory card via the first port and the first signal path; and wherein when the memory card satisfies a second condition, the data transmission apparatus works in a second transmission mode, wherein in the second transmission mode, the first control signal selects a second port to be turned on and the second control signal selects a second signal path to transmit signals, and the data transmission apparatus connects the host device and the memory card via the second port and the second signal path.

[0012] In another embodiment, a method for switching signal path in a data transmission system is provided. When the memory card is decoupled from the data transmission system, the method for switching signal path includes: a data transmission apparatus maintaining turning on of a first port if the decoupled memory card satisfies a first condition, and a host device connecting with a control module in the data transmission apparatus; and the data transmission apparatus maintaining turning on a second port if the decoupled memory card satisfies a second condition and waiting a period of time before disconnection with the second port and turning on the first port.

[0013] Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

## DRAWINGS

[0014] The features and advantages of embodiments of the claimed subject matter will become apparent as the following detailed description proceeds, and upon reference to the drawings, where

like numerals depict like parts, and in which:
[0015] FIG. **1** shows a conventional data transmission system **100**.
[0016] FIG. **2** shows another conventional data transmission system **200**.
[0017] FIG. **3** shows an example of a data transmission system **300** which includes a host device, a data transmission apparatus and a memory card, in accordance with an embodiment of the present invention.
[0018] FIG. **4** shows an example of another data transmission system **400** which includes a host device, a data transmission apparatus and a memory card, in accordance with an embodiment of the present invention.
[0019] FIG. **5** shows an example of a mode selection and switch module **306** in the data transmission apparatus **310** shown in FIG. **3**, in accordance with an embodiment of the present invention.
[0020] FIG. **6** shows a flowchart of an example of a data transmission method for providing communication between a host device and a memory card, in accordance with an embodiment of the present invention.
[0021] FIG. **7** shows another flowchart of an example of a data transmission method for providing communication between a host device and a memory card, in accordance with an embodiment of the present invention.
[0022] FIG. **8** shows another flowchart of an example of a data transmission method for providing communication between a host device and a memory card, in accordance with an embodiment of the present invention.
[0023] FIG. **9** shows a flowchart of an example of a method for switching signal path, in accordance with an embodiment of the present invention.
[0024] The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

## DETAILED DESCRIPTION

[0025] The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.
[0026] Reference will now be made in detail to the embodiments of the present invention. While the invention will be described in combination with these embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims.
[0027] Furthermore, in the following detailed description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. However, it will be recognized by one of ordinary skill in the art that the present invention may be practiced without these specific details. In other instances, well-known methods, procedures, components, and circuits have not been described in detail to avoid obscuring aspects of the present invention.
[0028] FIG. **3** shows an example of a data transmission system **300** which includes a host device **102**, a data transmission apparatus **310** and a memory card **104**, in accordance with an embodiment of the present invention. As shown in FIG. **3**, the data transmission system **300** includes a host device **102**, a data transmission apparatus **310** and a memory card **104**. The host device can be, but is not limited to, a host in an electronic device capable of reading data from or writing data to the memory card. By way of example, the electronic device may be a MacBook, PC, digital camcorder, IPAD etc. The data transmission apparatus **310** includes an analog signal switch module **3021**, an analog signal switch module **3022**, a control module **304**, a mode selection and a switch module **306** and a card signal selecting module **308**. The memory card **104** can be, but is not limited to, memory card of SD3.X - - - SD7.X type, wherein the memory card of SD3.X - - - SD6.X type

supports a normal transmission mode. In other words, the host device **102** communicates with the memory card **104** via the data transmission apparatus **310** in the normal transmission mode which includes UHSI (Ultra High Speed I) transmission mode and UHSII (Ultra High Speed II) transmission mode. UHSI transmission mode and UHSII transmission mode are both named as the normal transmission mode as below. Specifically, the data transmission apparatus **310** communicates with the memory card of SD3.X type in UHSI transmission mode and communicates with the memory card of SD4.X-SD6.X type in UHSII transmission mode. However, the data transmission apparatus **310** communicates with the memory card of SD7.X type in a High-speed transmission mode. In present application, the data transmission apparatus **310** switches transmission mode between the normal transmission mode and the high-speed transmission mode according to the type of the memory card **104** and takes full advantage of the ability of the memory card **104**.

[0029] The data transmission apparatus **310** in accordance with an embodiment of the present invention can be used as a data transmission chip in a computer and provides communication between the computer and external memory card. The data transmission chip can be a card reader controller. The data transmission apparatus **310** can be used in any electronic equipment that needs data transmission, for example: digital camcorder, mobile phone, computer, etc.

[0030] The host device **102** includes an SD card slot which acts as an interface between the host device **102** and the memory card **104**. The pins of the SD card connect with pins of the SD card slot and perform data transmission.

[0031] As shown in FIG. **3**, the analog signal switch module **3021** connects with the host device **102** via a signal path **321**. The signal path **321** can be a PCIE (peripheral component interconnect express) bus. In one embodiment, the analog signal switch module **3021** is a high-speed multiplexer (MUX). It should be understood by the person having ordinary skill in the art that the analog signal switch module **3021** can be another device which can perform the function of MUX. The analog signal switch module **3021** connects with the control module **304** via a signal path **3005**, and the card signal selecting module **308** selects a signal path **3009** to communicate with the mode selection and switch module **306** when the memory card **104** supports the normal transmission mode. The data transmission apparatus **310** works in a first transmission mode when the memory card supports normal transmission mode. The analog signal switch module **3021** selects a signal path **3001** to connect with the card signal selecting module **308**, the analog signal switch module **3021** connects with the analog signal switch module **3022** via a signal path **3011**, and the analog signal switch module **3022** connects with the memory card **104** via a signal path **3223** when the memory card supports a high-speed transmission mode, wherein the analog signal switch module **3021** and the analog signal switch module **3022** are both the same MUX modules. The data transmission apparatus **310** works in a second transmission mode when the memory card supports the high-speed transmission mode. In one embodiment, the card signal selecting module **308** which is a low-speed MUX connects to the memory card **104** via the signal path **3221**, is configured to select the signal path **3001** or the signal path **3009**.

[0032] Specifically, the level of the response signal from the memory card **104** is a high level when the memory card **104** supports the normal transmission mode, it is also referred to as that the memory card **104** satisfies a first condition. On the other hand, the level of the response signal from the memory card **104** is a low level when the memory card **104** supports the high-speed transmission mode, it is also referred to as that the memory card **104** satisfies a second condition. Wherein the response signal sent from the memory card **104** is triggered by a command signal sent from a control module **304**, it will be described in FIG. **4** as below.

[0033] As disclosed above, the data transmission apparatus **310** provides communication between the host device **102** and different types of memory card **104**, in accordance with an embodiment of the present invention. The card signal selecting module **308**, and the analog signal switch modules **3021** and **3022** select corresponding signal paths to transmit data which solves the problem of high

cost of PCIE switch in conventional technology and solves the problem of using two PCIE paths. The data transmission apparatus **310** improves transmission efficiency and decreases the cost of providing communication between the host device and the memory card accordingly.

[0034] FIG. **4** shows an example of another data transmission system **400** which includes a host device **102**, a data transmission apparatus **310** and a memory card **104**, in accordance with an embodiment of the present invention. The signals shown in FIG. **4** will be described as below which includes the name and function information.

TABLE-US-00001 No. Name Description 1 PERSET# is used to reset memory card, and defined by PCIE 2 PCIE TX± PCIE TX± signal, send differential output 3 PCIE RX± PCIE RX± signal, receive differential input 4 REFCLK+/RCLK+ reference clock signal 5 REFCLK−/RCLK− reference clock signal 6 CLKREQ# clock request signal 7 SWITCH_CTRL_1 the first control signal 8 CLK clock signal sent by a control module 9 CMD command signal sent by a control module 10 SWITCH_CTRL_2 the second control signal 11 VDD1 power, 2.7 V-3.6 V 12 VDD2 power, 1.7 V-1.95 V 13 VDD3 power, 1.14 V-1.30 V 14 DATA3-DATA0 data signals 15 D1±/D0± data signals 16 RESET# reset signal 17 CD# card detection signal

[0035] In one embodiment, as shown in FIG. **4**, the initial transmission mode of the data transmission apparatus **310** which is set to support the normal transmission mode, but is not limited to, it can be set to support the high-speed transmission mode too, it is just used to describe this invention. First, the control module **304** receives a card detection signal CD # and obtains a low level of the card detection signal CD # when the memory card **104** is inserted, the mode selection and switch module **306** turns on the power VDD1 and provides power VDD1 to the memory card **104**. The port A in the analog signal switch module **3021** and the analog signal switch module **3022** are turned on, the card signal selecting module **308** selects a first signal path **315**. The port A is also named as the first port. More specifically, the mode selection and switch module **306** sends a first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port A, and then, the root complex in the host device **102** connects with the control module **304** via the signal path **321** and the signal path **313**. At the same time, the mode selection and switch module **306** sends a second control signal SWITCH_CTRL_2 to the card signal selecting module **308** to select the first signal path **315**.

[0036] Further, the control module **304** sends a clock signal CLK and a command signal CMD to the memory card **104**, and the memory card **104** returns a response signal CMD8 (not shown in FIG. **4**) to inform the type of the memory card **104**. The control module **304** determines if the memory card **104** supports the high-speed transmission mode, and can be powered by power VDD3, for example, the memory card **104** can be powered by a voltage power with 1.2 V. Moreover, the level of the response signal CMD8 will be a low level if the memory card **104** supports the normal transmission mode, for example, SD card: SD3.X-SD6.X. Thus, the data transmission apparatus **310** works in the first transmission mode. Otherwise, the level of the response signal CMD8 will be a high level if the memory card **104** supports the high-speed transmission mode, for example, SD card: SD7.X. In this condition, the control module **304** stops sending a clock signal CLK to the memory card **104** and instructs the mode selection and switch module **306** to turn on power VDD2 or power VDD3 to power the memory card **104**. Moreover, the mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn off the port A, and the port B (also called the second port) is turned off too. The host device **102** finds signal loss from the PCIE device (not shown in FIG. **4**) in the control module **304** via the PCIE TX± signal. The root complex in the host device **102** determines whether the PCIE device was decoupled or lost. After a while, the host device **102** uninstalls drive software for the memory card **104** which supports the normal transmission mode, and the host device **102** is reported as hot plug events happened by the root complex. And then, the mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal

switch module **3022** to turn on the port B. It should be understood by the person having ordinary skill in the art that the steps of turning on the port B are not limited to so. It will be described in detail below.

[0037] Further, the mode selection and switch module **306** sends the second control signal SWITCH_CTRL_2 to the card signal selecting module **308**, and the card signal selecting module **308** drives a reset signal RESET # to low level. The mode selection and switch module **306** selects the clock request signal CLKREQ # to be transmitted and detects if the memory card **104** has enabled CLKREQ # to low level, and the card signal selecting module **308** selects the second signal path **312** according to the second control signal SWITCH_CTRL_2 when the level of the CLKREQ #signal is low level. While the root complex of the host device **102** determines as hot plug events happened and connects with the memory card **104** via the PCIE path (the signal path **321**, the signal path **311** and the signal path **3223**). The host device determines that a new PCIE device is inserted and will install Non-Volatile Memory express (NVME) drive. On the contrary, the mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on port A when the clock request signal CLKREQ # is high level. Meanwhile, the root complex in the host device **102** connects with the control module **304** via the signal path **321**, the port A and the signal path **313**, and determines as hot plug events happened. The host device **102** determines that a new PCIE device is inserted and installs drive software which supports the normal transmission mode. And the card signal selecting module **308** turns on the first signal path **315** via the second control signal SWITCH_CTRL_2, and the data transmission apparatus **310** works in the normal transmission mode, also called as the first transmission mode.

[0038] Further, when the data transmission apparatus **310** works in the first transmission mode, the control module **304** sends the clock signal CLK and a command signal ACMD41 (not shown in FIG. **4**) to the memory card **104** wherein the command signal ACMD41 is a standard SD card protocol definition command, then the memory card **104** will return a feedback signal which includes attribute and drive ability of the memory card **104** after receiving the command signal ACMD41, for example, the drive ability of the memory card **104** including the memory card **104** supports UHSI mode or UHSII mode, etc.

[0039] Specifically, the control module **304** transmits the data signals DATA3-DATA0 to the memory card **104** via the signal path **314**, **315** and **3221** when the memory card **104** supports UHSI mode, for example, the memory card **104** is a SD card of SD 3.X type. However, the control module **304** transmits the data signals D1+/D0+ to the memory card **104** via the signal path **316** and **3223** when the memory card **104** supports UHSII mode, and transmits the reference clock signal RCLK± via the signal path **314**, **315** and **3221**, for example, the memory card **104** is one of the SD card of SD 4.X-SD6.X type.

[0040] In another embodiment, the data transmission apparatus **310** works in the first transmission mode by default when the memory card **104** is inserted. First, the control module **304** stops sending the clock signal CLK to the memory card **104**, and provides power VDD1, power VDD2 or power VDD3 to the memory card **104**. Second, the mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn off the port A, and the port B (also called second port) is turned off too. Finally, the host device **102** finds signal loss from PCIE device (not shown in FIG. **4**) in the control module **304** via the PCIE TX± signal. The root complex in the host device **102** determines that PCIE device was decoupled or lost. After a while, the host device **102** uninstalls drive software of the memory card which supports the normal transmission mode, and the host device **102** is reported as hot plug events happened by the root complex. And then, the mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port B. Also, the mode selection and switch module **306** sends the second control signal SWITCH_CTRL_2 to the card signal selecting module

**308**, and the card signal selecting module **308** drives the reset signal RESET # to low level. The mode selection and switch module **306** sends the clock request signal CLKREQ # and detects if the memory card **104** has enabled CLKREQ # to low level, the card signal selecting module **308** selects the second signal path **312** to transmit the reference clock signal REFCLK± and the clock request signal CLKREQ # via the second control signal SWITCH_CTRL_2 when the level of CLKREQ # is low. While the root complex of the host device **102** determines as hotplug events happened and connects with the memory card **104** via the PCIE path (the signal path **321**, the signal path **311** and the signal path **3223**). The host device determines that a new PCIE device is inserted and installs a Non-Volatile Memory express (NVME) drive. On the contrary, if the clock request signal CLKREQ # is high level, the mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port A. Meanwhile, the root complex in the host device **102** connects with the control module **304** via the signal path **321**, the port A and the signal path **313**, and the host device **102** is reported as hotplug events happened. The host device **102** determines that a new PCIE device is inserted and installs drive software for the memory card **104** which supports normal transmission mode. And the card signal selecting module **308** selects the first signal path **315** to transmit the data signals DATA3-DATA0 and the reference clock signal RCLK± sent from the control module **304** via the second control signal SWITCH_CTRL_2, the data transmission apparatus **310** works in the normal transmission mode, also referred to as the first transmission mode. As disclosed in this embodiment, the data transmission apparatus **310** determines the type of the memory card **104** according to the level of clock request signal CLKREQ # and performs a mode switch between the first transmission mode and the second transmission mode.

[0041] In another embodiment, the data transmission apparatus **310** works in the second transmission mode when the memory card satisfies the second condition. The control module **304** in the data transmission apparatus **310** detects if the memory card **104** is decoupled or not according to the card detection signal CD #. Specifically, the host device **102** finds signal loss from PCIE device (not shown in FIG. **4**) in the control module **304** via PCIE TX+ signal. The root complex in the host device **102** determines that PCIE device was decoupled or lost. The mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn off the port B, and the port A is turned off too. After a while, the root complex of the host device **102** determines as hot removal events happened, and the host device **102** uninstalls the Non-Volatile Memory express (NVME) drive. The mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turns on the port A. Meanwhile, the root complex in the host device **102** connects with the control module **304** via the signal path **321**, the port A and the signal path **313**, and the host device is reported as hotplug events happened. The host device **102** determines that a new PCIE device is inserted and installs drive software for the memory card **104** which supports normal transmission mode. And the card signal selecting module **308** selects the first signal path **315** to transmit the data signals DATA3-DATA0 and the reference clock signal RCLK± sent from the control module **304** via the second control signal SWITCH_CTRL_2, and turns off the power VDD2 or power VDD3.

[0042] As embodiment disclosed above, the data transmission apparatus **310** which works in the first transmission mode by default or works in the second transmission mode by default is not the limitation of this invention.

[0043] FIG. **5** shows an example of a mode selection and switch module **306** in the data transmission apparatus **310** shown in FIG. **3**, in accordance with an embodiment of the present invention. As shown in FIG. **5**, the mode selection and switch module **306** includes a switch control unit **3062**, a common-mode voltage control unit **3064**, a state machine **3066** and a mode detection unit **3068**. The switch control unit **3062** is configured to generate a first control signal

SWITCH_CTRL_1 to turn on/off the port A or the port B in the analog signal switch module **3021** and the analog signal switch module **3022** and generates a second control signal SWITCH_CTRL_2 to control the signal path **312** or the signal path **315**.

[0044] The common-mode voltage control unit **3064** is configured to output different common-mode voltage levels according to different kinds of memory cards **104**. In one embodiment, the data transmission apparatus **310** configures a parameter configuration register to set different kinds of parameters to control the common-mode voltage.

[0045] The state machine **3066** is configured to receive external signals and monitor the state of the port A or the port B in the analog signal switch module **3021**, the analog signal switch module **3022** and the state of the switch (not shown in FIG. **4**) in the card signal selecting module **308**. That is, the state machine **3066** records and stores the state of the analog signal switch module **3021**, the analog signal switch module **3022** and the card signal selecting module **308**, including the states of the port A, the port B, the signal path **312** and the signal path **315**. The mode detection unit **3068** is configured to determine the type of the memory card **104** according to the response signal CMD8.

[0046] FIG. **6** shows a flowchart of an example of a data transmission method **600** for providing communication between a host device and a memory card, in accordance with an embodiment of the present invention. FIG. **6** is described in combination with FIG. **3** and FIG. **4**. Although specific steps are disclosed in FIG. **6**, such steps are examples. That is, the present invention is well suited to perform various other steps or variations of the steps recited in FIG. **6**. As shown in FIG. **6**, the data transmission method **600** includes steps **601**-**619** as below:

[0047] At step **601**: a memory card **104** is inserted into a card slot in the host device **102**, for example, a SD card of SD3.X-SD7.X type. The data transmission apparatus **310** works in a first transmission mode by default.

[0048] At step **603**: The data transmission apparatus **310** determines the type of the memory card **104**. The details of steps can refer to the description of FIG. **4**. The control module **304** sends a command signal CMD to the memory card **104**, and the memory card **104** returns a response signal CMD8 to inform the type of the memory card **104**. For example, the memory card **104** supports a first transmission mode when the level of the response signal CMD8 is low level; otherwise, the memory card **104** supports a second transmission mode.

[0049] At step **605**: the data transmission apparatus **310** determines if the memory card **104** satisfies a first condition, if it is, performs step **613**.

[0050] At step **607**: the mode selection and switch module **306** sends a first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port B if the memory card **104** satisfies a second condition.

[0051] At step **609**: the mode selection and switch module **306** sends a second control signal SWITCH_CTRL_2 to the card signal selecting module **308** to control the second signal path **312**.

[0052] At step **611**: PCIE paths connection succeed, the host device **102** connects with the memory card **104** via signal paths **321**, **311**, **312**, **3221** and **3223**. The data transmission apparatus **310** works in the second transmission mode.

[0053] At step **613**: The data transmission apparatus **310** satisfies the first transmission mode.

[0054] At step **615**: The data transmission apparatus **310** detects if the memory card **104** supports UHSII mode, if it is, performs step **619**, if not, performs step **617**.

[0055] At step **617**: The data transmission apparatus **310** works in UHSI mode.

[0056] At step **619**: The data transmission apparatus **310** works in UHSII mode.

[0057] Specifically, the data transmission method shown above is performed by each module within the data transmission apparatus **310**. The mode selection and switch module **306** sends a first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port A or the port B. Also, the mode selection and switch module **306** sends a second control signal SWITCH_CTRL_2 to the card signal selecting module **308** to control selecting of a first signal path **315** or a second signal path **312**. The first condition

includes the memory card **104** supporting the transmission characters of SD3.X-SD6.X, the first transmission mode is referred to as the normal transmission mode too; the second condition includes the memory card **104** supporting the transmission characters of SD7.X, the second transmission mode is referred to as the high-speed transmission mode too.

[0058] FIG. **7** shows another flowchart of an example of a data transmission method **700** for providing communication between a host device **102** and a memory card **104**, in accordance with an embodiment of the present invention. FIG. **7** is described in combination with FIG. **3** and FIG. **4**. Although specific steps are disclosed in FIG. **7**, such steps are examples. That is, the present invention is well suited to perform various other steps or variations of the steps recited in FIG. **7**. As shown in FIG. **7**, the data transmission method **700** includes steps **701-723** as below.

[0059] At step **701**: a memory card **104** is inserted into a card slot in the host device **102**, for example, a memory card of SD3.X-SD7.X type. The data transmission apparatus **310** works in a first transmission mode by default.

[0060] At step **703**: the analog signal switch module **3021** and the analog signal switch module **3022** turn off the port A according to the first control signal SWITCH_CTRL_1 sent from the mode selection and switch module **306**.

[0061] At step **705**: the mode selection and switch module **306** sends a second control signal SWITCH_CTRL_2 to the card signal selecting module **308** to control a first signal path **315**, and the card signal selecting module **308** drives a reset signal RESET # to low level.

[0062] At step **707**: the card signal selecting module **308** selects the second signal path **312** for transmitting a clock request signal CLKREQ #.

[0063] At step **709**: the mode selection and switch module **306** detects if the memory card **104** has enabled the clock request signal CLKREQ # to low level. If it is, performs step **713**, if not, performs step **711**.

[0064] At step **711**: the level of the clock request signal CLKREQ # is high level. The data transmission apparatus **310** determines that the memory card **104** supports the first transmission mode, or the memory card satisfies the first condition. The mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port A, the card signal selecting module **308** selects the first signal path **315** via the second control signal SWITCH_CTRL_2.

[0065] At step **713**: the level of the clock request signal CLKREQ # is low level. The data transmission apparatus **310** determines that the memory card **104** supports the second transmission mode, or the memory card **104** satisfies the second condition. The mode selection and switch module **306** sends the first control signal SWITCH_CTRL_1 to the analog signal switch module **3021** and the analog signal switch module **3022** to turn on the port B.

[0066] At step **715**: the card signal selecting module **308** selects the second signal path **312** for transmitting reference clock signal REFCLK± according to the second control signal. The root complex of the host device **102** determines as hotplug events happened and connects with the memory card **104** via PCIE path (the signal path **321**, the signal path **311** and the signal path **3223**). The host device determines that a new PCIE device is inserted and installs Non-Volatile Memory express (NVME) drive.

[0067] At step **717**: The data transmission apparatus **310** works in the second transmission mode, the memory card **104** satisfies the second condition.

[0068] At step **719**: The data transmission apparatus **310** detects if the memory card **104** supports UHSII mode, if it is, performs step **723**, if not, performs step **721**.

[0069] At step **721**: The data transmission apparatus **310** works in UHSI mode.

[0070] At step **723**: The data transmission apparatus **310** works in UHSII mode.

[0071] FIG. **8** shows another flowchart of an example of a data transmission method **800** for providing communication between a host device **102** and a memory card **104**, in accordance with an embodiment of the present invention. FIG. **8** is described in combination with FIG. **4**. Although

specific steps are disclosed in FIG. **8**, such steps are examples. That is, the present invention is well suited to perform various other steps or variations of the steps recited in FIG. **8**. As shown in FIG. **8**, the data transmission method **800** performed by the data transmission apparatus **310** includes steps **801**-**824** as below:

[0072] At step **801**: the mode selection and switch module **306** in the data transmission apparatus **310** turns on the power VDD1 and provides power VDD1 to the memory card **104** when the memory card **104** is inserted into the host device **102**.

[0073] At step **802**: the control module **304** in the data transmission apparatus **310** sends a clock signal CLK to the memory card **104**.

[0074] At step **803**: the control module **304** sends a command signal CMD to the memory card **104**. The memory card **104** returns a response signal CMD8 to the control module **304** after receiving the command signal CMD. The control module **304** determines the type of the memory card **104**, for example, the memory card **104** satisfies a first condition, e.g. is of SD3.X-SD6.X type; or the memory card **104** satisfies a second condition, e.g. is of SD7.X type.

[0075] At step **804**: the control module **304** detects if the memory card **104** supports the high-speed transmission mode. If it is, performs step **805**; if not, performs step **816**.

[0076] At step **805**: the control module **304** stops sending the clock signal CLK to the memory card **104**.

[0077] At step **806**: the mode selection and switch module **306** detects if the memory card **104** supports power VDD3. If it is, performs step **807**; if not, performs step **809**.

[0078] At step **807**: the control module **304** detects if the host device **102** supports power VDD3, if it is, the mode selection and switch module **306** provides power VDD3 to the memory card **104**; if not, performs step **809**.

[0079] At step **808**: the mode selection and switch module **306** turns on power VDD3, performs step **810**.

[0080] At step **809**: the mode selection and switch module **306** provides power VDD2 to the memory card **104**, and performs step **812**.

[0081] At step **810**: the control module **304** gets into a waiting state and waits for a predetermined period of time and performs **813**.

[0082] At step **811**: the mode selection and switch module **306** turns off power VDD3, performs step **809**.

[0083] At step **812**: the control module **304** gets into a waiting state and waits for a predetermined period of time after the mode selection and switch module **306** provides power VDD2 to the memory card **104**, performs step **814**.

[0084] At step **813**: the mode selection and switch module **306** detects if the level of the clock response signal CLKREQ #returned from the memory card **104** is low level. If it is, performs step **817**; if not, performs step **811**.

[0085] At step **814**: the mode selection and switch module **306** detects if the level of the clock response signal CLKREQ #returned from the memory card **104** is low level. If it is, performs step **817**; if not, performs step **815**.

[0086] At step **816**: the data transmission apparatus **310** satisfies the first transmission mode, the memory card **104** satisfies a first condition.

[0087] At step **817**: the signal PERSET #which is used to reset the memory card **104** is disabled high level effective by the mode selection and switch module **306**. The data transmission apparatus **310** sends a reference signal REFCLK± to the memory card **104** and performs step **818**.

[0088] At step **818**: the data transmission apparatus detects if the PCIE path connection succeed or not, i.e., the second signal path **312** and the signal path **311** are selected or not, if it is, performs step **819**; if not, performs step **815**.

[0089] At step **819**: the data transmission apparatus **310** works in the second transmission mode, performs step **820**.

[0090] At step **820**: the data transmission apparatus **310** detects if receiving a command to turn off the power VDD2 and/or power VDD3. If it is, performs **821**; if not, performs **819**.
[0091] At step **821**: the mode selection and switch module **306** turns off power VDD2 and power VDD3, performs step **802**.
[0092] At step **822**: The data transmission apparatus **310** detects if the memory card **104** supports UHSII mode, if it is, performs step **824**, if not, performs step **823**.
[0093] At step **823**: The data transmission apparatus **310** works in UHSI mode.
[0094] At step **824**: The data transmission apparatus **310** works in UHSII mode.
[0095] It should be understood by the person having ordinary skill in the art, although specific steps are disclosed in FIG. **6**, FIG. **7** and FIG. **8**, such steps are examples. That is, the present invention is well suited to perform various other steps or variations of the steps recited in FIG. **6**, FIG. **7** and FIG. **8**.
[0096] Furthermore, the data transmission apparatus **310** includes different kinds of working states when the memory card **104** is decoupled, for example, the first working state: the host device **102** shows transmission chip and device driver when the data transmission apparatus **310** stands in a no-load condition; the second working state: the PCIE path is disconnected, i.e., the root complex in the host device **102** disconnects with the control module **304** and the memory card **104**; the third working state: the data transmission apparatus **310** stays in the working state before the memory card **104** is decoupled. That is, the data transmission apparatus **310** stays in the first transmission mode if the memory card which is decoupled satisfies a first condition, while the root complex in the host device **102** maintains connection with the control module **304**. Otherwise, the root complex in the host device **102** keeps connecting with the port B and the port B is turned on if the memory card which is decoupled satisfies a second condition, and the data transmission apparatus **310** works in the second transmission mode. The working states above mentioned have the shortcoming of time-consuming, and the data transmission apparatus **310** cannot show device driver in condition of hot-insertion and removal.
[0097] FIG. **9** shows a flowchart of an example of a method for switching signal path **900**, in accordance with an embodiment of the present invention. FIG. **9** shows a flowchart of switching signal path when the data transmission apparatus **310** stands in no-load condition. FIG. **9** is described in combination with FIG. **4**-FIG. **8**. As shown in FIG. **9**, after decoupling the memory card **104**, the method for switching signal path includes steps **901**-**909**.
[0098] At step **901**: the memory card **104** is decoupled.
[0099] At step **903**: the data transmission apparatus **310** determines the working state of the data transmission apparatus **310** before the memory card **104** is decoupled, and detects if the data transmission apparatus **310** works in a first transmission mode, if it is, performs step **909**; if not, performs step **905**.
[0100] At step **905**: port B in an analog signal switch module **3021** and an analog signal switch module **3022** keeps turning on.
[0101] At step **907**: wait a period a time before the root complex in the host device **102** disconnect with the port B.
[0102] At step **909**: the root complex in the host device **102** connects with the control module **304**, and the analog signal switch module **3021** and the analog signal switch module **3022** turn on the port A.
[0103] The data transmission apparatus **310** saves time of installing and/or uninstalling time of drive software for the memory card **104** when the data transmission apparatus **310** is triggered by insertion of the memory card **104**, in accordance with an embodiment of the present invention.
[0104] While the foregoing description and drawings represent embodiments of the present invention, it will be understood that various additions, modifications and substitutions may be made therein without departing from the spirit and scope of the principles of the present invention as defined in the accompanying claims. One skilled in the art will appreciate that the invention may

be used with many modifications of form, structure, arrangement, proportions, materials, elements, and components and otherwise, used in the practice of the invention, which is particularly adapted to specific environments and operative requirements without departing from the principles of the present invention. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims and their legal equivalents, and not limited to the foregoing description.
[0105] Unless otherwise expressly indicated herein, all numerical values indicating mechanical/thermal properties, compositional percentages, dimensions and/or tolerances, or other characteristics are to be understood as modified by the word “about” or “approximately” in describing the scope of the present disclosure. This modification is desired for various reasons including industrial practice, material, manufacturing, and assembly tolerances, and testing capability.
[0106] As used herein, the phrase at least one of A, B, and C should be construed to mean a logical (A OR B OR C), using a non-exclusive logical OR, and should not be construed to mean “at least one of A, at least one of B, and at least one of C.”
[0107] In this application, the term “controller” and/or “module” may refer to, be part of, or include: an Application Specific Integrated Circuit (ASIC); a digital, analog, or mixed analog/digital discrete circuit; a digital, analog, or mixed analog/digital integrated circuit; a combinational logic circuit; a field programmable gate array (FPGA); a processor circuit (shared, dedicated, or group) that executes code; a memory circuit (shared, dedicated, or group) that stores code executed by the processor circuit; other suitable hardware components (e.g., op amp circuit integrator as part of the heat flux data module) that provide the described functionality; or a combination of some or all of the above, such as in a system-on-chip.
[0108] The term memory is a subset of the term computer-readable medium. The term computer-readable medium, as used herein, does not encompass transitory electrical or electromagnetic signals propagating through a medium (such as on a carrier wave); the term computer-readable medium may therefore be considered tangible and non-transitory. Non-limiting examples of a non-transitory, tangible computer-readable medium are nonvolatile memory circuits (such as a flash memory circuit, an erasable programmable read-only memory circuit, or a mask read-only circuit), volatile memory circuits (such as a static random access memory circuit or a dynamic random access memory circuit), magnetic storage media (such as an analog or digital magnetic tape or a hard disk drive), and optical storage media (such as a CD, a DVD, or a Blu-ray Disc).
[0109] The apparatuses and methods described in this application may be partially or fully implemented by a special purpose computer created by configuring a general-purpose computer to execute one or more particular functions embodied in computer programs. The functional blocks, flowchart components, and other elements described above serve as software specifications, which can be translated into the computer programs by the routine work of a skilled technician or programmer.
[0110] The description of the disclosure is merely exemplary in nature and, thus, variations that do not depart from the substance of the disclosure are intended to be within the scope of the disclosure. Such variations are not to be regarded as a departure from the spirit and scope of the disclosure.

## Claims

**1**. A data transmission apparatus for providing communication between a memory card and a host device, said data transmission apparatus comprising: a first analog signal switch module comprising: a first port coupled to a control module that is coupled to a card signal selecting module via a first signal path; and a second port coupled to said card signal selecting module via a second signal path; and a mode selection and switch module, coupled to said first analog signal

switch module, and configured to control said first and second ports and said first and second signal paths according to a condition said memory card satisfies, wherein when said memory card satisfies a first condition, said data transmission apparatus works in a first transmission mode, wherein in said first transmission mode, said mode selection and switch module selects said first port to be turned on and selects said first signal path to transmit signals, said first signal path implements signal transmission between said control module and said card signal selecting module, and said data transmission apparatus connects said host device and said memory card via said first port and said first signal path, wherein when said memory card satisfies a second condition, said data transmission apparatus works in a second transmission mode, and wherein in said second transmission mode, said mode selection and switch module selects said second port to be turned on and selects said second signal path to transmit signals, said second signal path implements signal transmission from said host device to said card signal selecting module, and said data transmission apparatus connects said host device and said memory card via said second port and said second signal path.

**2**. The data transmission apparatus of claim 1, wherein said mode selection and switch module comprises: a switch control unit configured to generate a first control signal to control said first and second ports and generate a second control signal to control said first and second signal paths; a voltage control unit configured to output a common mode voltage according to a type of said memory card; a state machine configured to receive signals transmitted in said data transmission apparatus; and a mode detection unit configured to detect said type of said memory card.

**3**. The data transmission apparatus of claim 1, wherein said control module is configured to determine a type of said memory card by determining whether said memory card satisfies said first condition or said second condition according to a response signal provided from said memory card to said control module.

**4**. The data transmission apparatus of claim 3, wherein prior to determining said type of said memory card, said control module is further configured to receive a card detection signal sent from said memory card and detects insertion of said memory card.

**5**. The data transmission apparatus of claim 1, wherein said memory card satisfies said first condition if said memory card is a type of memory card selected from the group consisting of SD3.X, SD4.X, SD5.X and SD6.X, and wherein said memory card satisfies said second condition if the type of said memory card is SD7.X.

**6**. The data transmission apparatus of claim 1, wherein said card signal selecting module connects with said memory card via a third signal path, wherein in said first transmission mode, said first signal path connects to said third signal path to transmit at least one signal of data signals, a reset signal, and a reference clock signal, and wherein in said second transmission mode, said second signal path connects to said third signal path to transmit a reference clock signal and a clock request signal.

**7**. The data transmission apparatus of claim 1, further comprising: a second analog signal switch module comprising a first port coupled to said control module via a third signal path, and comprising a second port coupled to said second port of said first analog signal switch module via a fourth signal path.

**8**. The data transmission apparatus of claim 7, wherein in said first transmission mode, said first port of said first analog signal switch module transmits signals between said host device and said control module; and wherein in said second transmission mode, said host device transmits, to said memory card, a first part of signals between said host device and said memory card via said second signal path, and a second part of said signals between said host device and said memory card via said fourth signal path, wherein said second part comprises a TX signal and an RX signal.

**9**. The data transmission apparatus of claim 7, wherein said first transmission mode comprises a UHSII mode and a UHSI mode, wherein if said memory card supports said UHSII mode, said control module transmits data signals to said memory card via said third signal path and transmits a

reference clock signal to said memory card via said first signal path, and wherein if said memory card supports said UHSI mode, said control module transmits data signals to said memory card via said first signal path.

**10**. A method for providing communication between a host device and a memory card, comprising: determining a condition said memory card satisfies using a data transmission apparatus coupled between said host device and said memory card, wherein in said data transmission apparatus, a first analog signal switch module comprises a first port coupled to a control module that is coupled to a card signal selecting module via a first signal path, and comprises a second port coupled to said card signal selecting module via a second signal path; and controlling said first and second ports and said first and second signal paths according to said condition said memory card satisfies, wherein said controlling comprises: in response to said memory card satisfying a first condition, controlling said data transmission apparatus to work in a first transmission mode; in said first transmission mode, selecting said first port to be turned on, selecting said first signal path to transmit signals, implementing signal transmission between said control module and said card signal selecting module using said first signal path, and connecting said host device and said memory card via said first port and said first signal path; in response to said memory card satisfying a second condition, controlling said data transmission apparatus to work in a second transmission mode; and in said second transmission mode, selecting said second port to be turned on, selecting said second signal path to transmit signals, implementing signal transmission from said host device to said card signal selecting module, and connecting said host device and said memory card via said second port and said second signal path.

**11**. The method of claim 10, further comprising: receiving, by said control module, a response signal from said memory card; and determining whether said memory card satisfies said first condition or said second condition according to said response signal thereby determining a type of said memory card.

**12**. The method of claim 10, wherein said memory card satisfies said first condition if said memory card is a type of memory card selected from the group consisting of SD3.X, SD4.X, SD5.X and SD6.X, and wherein said memory card satisfies said second condition if the type of said memory card is SD7.X.

**13**. The method of claim 10, wherein said card signal selecting module connects with said memory card via a third signal path, and wherein said method further comprises: in said first transmission mode, transmitting, by said data transmission apparatus, at least one signal of data signals, a reset signal, and a reference clock signal to said memory card via said first signal path and said third signal path; in said second transmission mode, transmitting, by said host device, a reference clock signal and a clock request signal to said memory card via said second signal path and said third signal; and in said second transmission mode, transmitting, by said host device, a TX signal and an RX signal to said memory card via a fourth signal path, wherein said fourth signal path belongs to a peripheral component interconnect express (PCIE) bus.

**14**. The method of claim 10, wherein said data transmission apparatus comprises: a second analog signal switch module comprising a first port coupled to said control module via a third signal path, and comprising a second port coupled to said second port of said first analog signal switch module via a fourth signal path.

**15**. The method of claim 14, further comprising: in said first transmission mode, transmitting signals between said host device and said control module via said first port; in said second transmission mode, transmitting a first part of signals between said host device and said memory card via said second signal path; and in said second transmission mode, transmitting a second part of said signals between said host device and said memory card via fourth third signal path, wherein said second part comprises a TX signal and an RX signal.

**16**. The method of claim 14, wherein said first transmission mode comprises a UHSII mode and a UHSI mode, and wherein said method further comprises: if said memory card supports said UHSII

mode, transmitting data signals from said control module to said memory card via said third signal path and transmitting a reference clock signal to said memory card via said first signal path; and if said memory card supports said UHSI mode, transmitting data signals from said control module to said memory card via said first signal path.

**17**. A data transmission system comprising: a host device; and a data transmission apparatus coupled to said host device, and configured to provide communication between said host device and a memory card, wherein said data transmission apparatus comprises: an analog signal switch module comprising a first port and a second port, wherein said first port is coupled to a control module that is coupled to a card signal selecting module via a first signal path, and wherein said second port is coupled to said card signal selecting module via a second signal path; and a mode selection and switch module, coupled to said analog signal switch module, and configured to control said first and second ports and said first and signal paths according to a condition said memory card satisfies, wherein when said memory card satisfies a first condition, said data transmission apparatus works in a first transmission mode, wherein in said first transmission mode, said mode selection and switch module selects said first port to be turned on and selects said first signal path to transmit signals, said first signal path implements signal transmission between said control module and said card signal selecting module, and said data transmission apparatus connects said host device and said memory card via said first port and said first signal path, wherein when said memory card satisfies a second condition, said data transmission apparatus works in a second transmission mode, and wherein in said second transmission mode, said mode selection and switch module selects said second port to be turned on and selects said second signal path to transmit signals, said second signal path implements signal transmission from said host device to said card signal selecting module, and said data transmission apparatus connects said host device and said memory card via said second port and said second signal path.

**18**. The data transmission system of claim 17, wherein said card signal selecting module connects with said memory card via a third signal path, wherein in said first transmission mode, said data transmission apparatus transmits at least one signal of data signals, a reset signal, and a reference clock signal to said memory card via said first signal path and said third signal path, wherein in said second transmission mode, said host device transmits a reference clock signal and a clock request signal to said memory card via said second signal path and said third path, and wherein in said second transmission mode, said host device transmits a TX signal and an RX signal to said memory card via a fourth signal path, wherein said third signal path belongs to a peripheral component interconnect express (PCIE) bus.

**19**. The data transmission system of claim 17, wherein in said first transmission mode, said first port is configured to transmit signals between said host device and said control module, wherein in said second transmission mode, said host device transmits, to said memory card, a first part of signals between said host device and said memory card via said second signal path, and transmits, to said memory card, a second part of said signals between said host device and said memory card via a third signal path, and wherein said second part comprises a TX signal and an RX signal.

**20**. The data transmission system of claim 17, wherein said first transmission mode comprises a UHSII mode and a UHSI mode, wherein if said memory card supports said UHSII mode, said control module transmits data signals to said memory card via a third signal path and transmits a reference clock signal to said memory card via said first signal path, and wherein if said memory card supports said UHSI mode, said control module transmits data signals to said memory card via said first signal path.