

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
27 October 2005 (27.10.2005)

PCT

(10) International Publication Number
WO 2005/099397 A2

(51) International Patent Classification: **Not classified**

(21) International Application Number:
PCT/US2005/011870

(22) International Filing Date: 8 April 2005 (08.04.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10/822,015 9 April 2004 (09.04.2004) US
10/879,877 28 June 2004 (28.06.2004) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

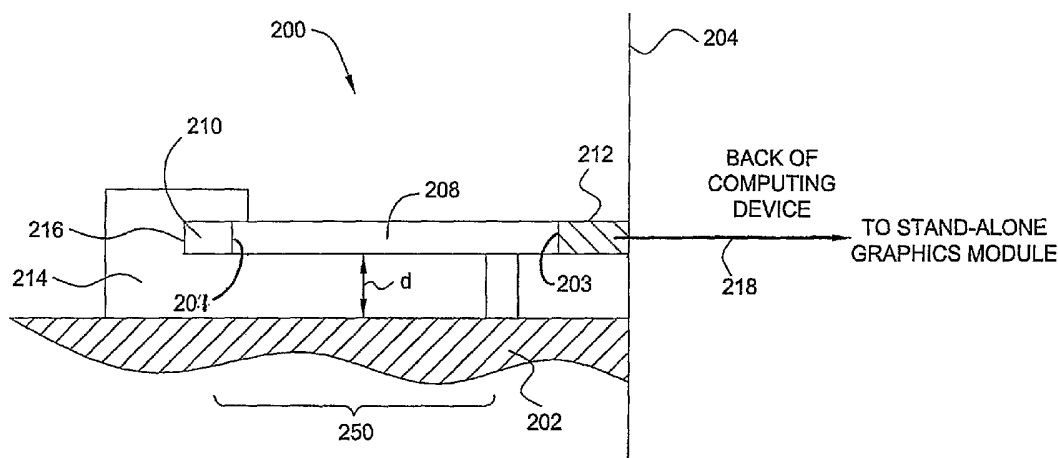
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— without international search report and to be republished upon receipt of that report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR ROUTING GRAPHICS PROCESSING SIGNALS TO A STAND-ALONE MODULE



(57) Abstract: One embodiment of a connector for a stand-alone graphics module is adapted for coupling a computing device to the stand-alone graphics module, which is external to the computing device. The connector is adapted for receiving a PCI express signal from the computing device and for delivering the PCI express signal to the stand-alone graphics module. The connector is further adapted for receiving display output signals from the stand-alone graphics module and delivering the display output signals to the computing system, e.g., for use in accordance with one or more output display panels coupled to said computing device.

METHOD AND APPARATUS FOR ROUTING GRAPHICS PROCESSING SIGNALS TO A STAND-ALONE MODULE

CROSS REFERENCE TO RELATED APPLICATIONS

- 5 [0001] This application is a continuation-in-part of United States Patent Application Serial No. 10/822,015, filed April 9, 2004 by Diamond et al. (entitled "Field Changeable Rendering System for a Computing Device"), which is herein incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

10 **Field of the Invention**

[0002] This invention relates generally to computer hardware and relates more particularly to a connector for coupling a stand-alone graphics module to a computing device.

Description of the Background Art

- 15 [0003] Contemporary computing devices typically incorporate a graphics card that enables a computing device to rapidly process graphics related data for graphics intensive applications, such as gaming applications. A graphics card generally comprises a printed circuit board (PCB) upon which a plurality of circuit components (such as memory chips and the like) and a graphics processing unit (GPU) are
20 mounted. In "closed platform" computing devices such as laptop computers, cellular telephones and personal digital assistants (PDAs) (*i.e.*, devices that use processors and are not easily changed by a user), the graphics card is mounted directly and permanently to the motherboard of the computing device.

- [0004] One drawback to mounting the graphics card directly to the motherboard is that
25 this fixed configuration impedes a user's ability to upgrade the computing device's graphics system. Specifically, in order to take advantage of an improved graphics system, the user typically must purchase an entirely new computing device, which is much more costly than a simple replacement of the graphics system in the existing computing device.

[0005] A second drawback is that the pace of graphics innovations that can be conveniently delivered to computing device users is hindered, because the implementation of on-board devices is typically limited by a design cycle of approximately nine to twelve months and because of the form factor power delivery, thermal management and physical size.

[0006] Thus, there is a need in the art for a method and apparatus for routing graphics processing signals to a stand-alone module.

SUMMARY OF THE INVENTION

[0007] One embodiment of a connector for a stand-alone graphics module is adapted for coupling a computing device to the stand-alone graphics module, which is external to the computing device. The connector is adapted for receiving PCI express signal from the computing device and for delivering the PCI express signal to the stand-alone graphics module. The connector is further adapted for receiving display output signals from the stand-alone graphics module and delivering the display output signals to the computing system, e.g., for use in accordance with one or more output display panels coupled to said computing device.

[0008] One embodiment of a method for routing graphics processing signals from a computing device to an external, stand-alone module includes detecting a connection between the computing device and the stand-alone module and outputting a PCI express signal from the computing device to the stand-alone module, e.g., via the connector described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 is a schematic diagram illustrating a computing system incorporating stand-alone graphics, according to one embodiment of the present invention;

[0010] FIG. 2 is a side view of one embodiment of a connector interfaced to a portion of a computing device's motherboard; and

[0011] FIG 3. is a flow diagram of one embodiment of a method for routing graphics signals from a computing device to an external, stand-alone graphics module.

DETAILED DESCRIPTION OF THE INVENTION

[0012] FIG. 1 is a schematic diagram illustrating an exemplary computing system 100 incorporating stand-alone graphics, according to one embodiment of the present invention. As illustrated, the computing system 100 comprises a computing device 102 and a stand-alone graphics module 104 coupled by a connector 106. Stand-alone graphics module 104 is adaptable for use with any type of computing device, including, without limitation, a desktop computer, server, laptop computer, palm-sized computer, personal digital assistant, tablet computer, game console, cellular telephone, computer-based simulator and the like.

[0013] The configuration of computing device 102 is thus an exemplary system, and is not intended to in any way imply a limitation as to the types of computing devices that may be used to advantage with embodiments of the present invention. As illustrated, computing device 102 generally comprises a plurality of internal components, including, without limitation, a central processing unit (CPU) 110, memory 116, one or more input/output (I/O) devices 118, a Northbridge chip set 112, a Southbridge chip set 114, a standard integrated graphics processor (IGP) 108 that is a sub-component of the Northbridge chip set 112, and a discrete, fixed rendering including a graphics processing unit (GPU) 120. Typically, Northbridge chip set 112 outputs a PCI express signal to IGP 108, which in turn generates a plurality of display output signals for various output display panels (not shown), such as video graphics array (VGA), television (TV), low voltage differential signaling (LVDS) and digital video interface (DVI) signals.

[0014] Stand-alone graphics module 104 is an external (e.g., external to computing device 102) device configured to be coupled to computing device 102 in order to provide graphics processing power to computing device 102. In one embodiment, stand-alone graphics module 104 is positioned a user-defined distance away from computing device 102 and has its own power supply, thermal budget and mechanical budget. Generally, stand-alone graphics module 104 is configured to exchangeably receive one or more graphics cards (not shown) for external interface to computing

device 102. In one embodiment, stand-alone graphics module 104 is adapted to receive one or more field-changeable graphics cards.

[0015] One advantage of system 100 is that it enables a user to maximize the graphics capabilities of an existing computing device (e.g., computing device 102), regardless of the computing device's inherent thermal, form factor or other power limitations. Thus, system 100 thus allows a user to upgrade the graphics processing power of computing device 102 with little or no modification to the fixed architecture of computing device 102. A user may simply purchase one or more individual graphics cards, connect stand-alone graphics module 104 to computing device 102 (e.g., via connector 106), and insert the graphics cards into stand-alone graphics module 104, thereby externally interfacing computing device 102 to the graphics cards. Moreover, graphics cards are easily removed from stand-alone graphics module 104; further graphics system upgrades are therefore simply a matter of purchasing a new graphics card for use in addition to or in place of an existing graphics card.

[0016] FIG. 2 is a side view of one embodiment of a connector 200 interfaced to a portion of a computing device's motherboard 202. Similar to connector 106 illustrated in FIG. 1, connector 200 is adapted to couple computing device 204 to a stand-alone graphics module. Specifically, connector 200 is adapted to receive a PCI Express signal from a computing device (e.g., from a Northbridge chip set) and deliver the PCI Express signal to a stand-alone graphics module for the generation of one or more display output signals, as described in further detail below. Connector 200 therefore functions as a bridge or bus from computing device 102 to stand-alone graphics module 104.

[0017] In one embodiment, connector 200 is a removable, card-shaped connector having physical and mechanical dimensions that are compatible with the computing device's internal mechanical constraints. In one embodiment, connector 200 has dimensions similar to any of the field-changeable graphics cards described in co-pending, commonly assign United States Patent Application No. xx/xxx,xxx, filed xx/xx/xxxx (Attorney Docket No. NVDA/P001196), which is herein incorporated by reference.

[0018] Connector 200 generally comprises a printed circuit board (PCB) 208 (having a plurality of circuit components disposed thereon), a card connector 210 (e.g., comprising a plurality of plated contacts) and an external interface 212. Card connector 210 is disposed along a first edge 201 of PCB 208 and is adapted to interface with an edge connector mounted to the computing device's motherboard 202, as described in further detail below. External interface 212 is disposed along another edge of PCB 208 (e.g., in one embodiment a second edge 203 opposite first edge 201) and is adapted for coupling to, for example, a serial cable 218 that connects connector 200 to a stand-alone graphics module. In other embodiments, other means of connection including, but not limited to, an FR4 strip connector or a connector-to-connector docking station, may be used to connect connector 200 to a stand-alone graphics module.

[0019] In one embodiment, edge connector 214 is configured in a manner similar to the edge connector described in United States Patent Application No. 10/822,015. Edge connector 214 includes a slot 216 that is adapted to receive card connector 210 of connector 200. In one embodiment, slot 216 includes a plurality of connector pins (not shown) that directly contact card connector 210, including at least one connector pin that is configured to detect the presence of connector 200. In one embodiment, if connector 200 is not detected, computing device 204 operates in a standard IGP or on-board discrete graphics mode as described above. Once connector 200 is detected (e.g., at start-up or with a hot-plug), stand-alone graphics module 104 is mapped into the system 100 and graphics sub-system, bypassing the IGP or on-board discrete graphics system.

[0020] FIG 3. is a flow diagram of one embodiment of a method 300 for routing graphics signals from a computing device (e.g., computing device 204) to an external, stand-alone graphics module. The method 300 is initialized at step 302 and proceeds to step 304, where the method 300 detects a connection to a stand-alone graphics module. In one embodiment, the connection is indicated when the at least one connector pin on edge connector 214 detects the presence of connector 200.

[0021] Once a connection has been detected, the method 300 proceeds to step 306

and outputs PCI express signals to connector 200. In one embodiment, this is accomplished by sending a signal, via edge connector 214, to the Northbridge chip set (e.g., Northbridge chip set 112 of FIG. 1) indicating that connector 200 is present in computing device 204. Consequently, the Northbridge chip set outputs PCI express signals to connector 200 (e.g., rather than to an IGP or other fixed rendering device), in one embodiment connecting the PCI express signals through one or more connector pins on edge connector 114. Connector 200 completes the circuit paths between the PCI express signals and the stand-alone graphics module, e.g., over serial cabling. The method 300 terminates in step 308. Thus, connector 200, in conjunction with edge connector 214, enables a computing device user to implement an alternative (e.g., non-fixed) graphics system without the need to replace computing device 204.

[0022] Although the connector 200 has been described in the context of a standardized, field changeable card, the present invention may be deployed in other form factors such as credit card polymer substrates with embedded chips, and postage stamp-sized, self-contained devices, among others.

[0023] In one embodiment, display output signals (e.g., TV, VGA, LVDS, DVI signals and the like) may be sent from the stand-alone graphics module back to the computing device, in order to use integrated display options, e.g., in accordance with Application No. 10/822,015.

[0024] In another embodiment, a connector for coupling a computing device to an external, stand-alone graphics module according to the present invention is a fixed external port built into the computing device. The port functions in substantially the same way as the removable connector 200, e.g., in accordance with method 300. In one embodiment, the port detects a connection to a stand-alone graphics module over a connection via a serial cable, an FR4 connector strip, a connector-to-connector docking station, bundled wire cable, flexible Mylar® substrates printed with metal (e.g., copper) traces, shielding and protective plastic coating or other serial coupling means connected to the port.

[0025] Although a computing device has been described as being coupled to a stand-

alone graphics module via a serial cable, those skilled in the art will appreciate that any other connection means having the bandwidth necessary to transmit PCI express signals from the computing device to the stand-alone graphics module may be deployed, including FR4 strip connections, bundled wire cable and flexible Mylar® substrates printed with metal (*e.g.*, copper) traces, shielding and protective plastic coating. In one embodiment, the connection means is a standard sixteen-lane connection. In another embodiment, the length and dimensions of the connection means is adjusted in accordance with power optimization concerns for the particular computing device platform (*e.g.*, laptop computer, desktop computer, etc.) being coupled to the stand-alone graphics module.

[0026] A connector according to the present invention may thus be configured to enable a computing device user to upgrade or maximize an existing device's graphics system with minimal expense and minimal modification to the existing device's architecture (*e.g.*, regardless of the existing device's inherent thermal, form factor or other power limitations). Because the connector is adapted to couple the computing device to an external, stand-alone graphics module (*e.g.*, comprising one or more field-changeable graphics cards), the user is not forced to purchase an entirely new computing device in order to take advantage of graphics innovations. This advantage is particularly significant for users of portable computing devices, such as laptop computers and PDAs, in which graphics systems are frequently difficult or impossible to alter.

[0027] A further advantage of the disclosed edge connector is that it enables graphics innovations to be delivered to end-users at a much faster pace. Rather than wait for graphics innovations to be incorporated into next-generation computing platforms (the commercial availability of which may not reflect the pace of innovation, *e.g.*, an approximately nine to twelve month design cycle for on-board implementations is typical), suppliers of graphics innovations can commercially release products as they are developed, and users can incorporate these products into existing platforms as described above. The present invention also enables the build-to-order, stock-to-order and field repair of any of the systems disclosed, which is a significant advancement for a global economy having needs for just-in-time manufacturing and inventory

management.

[0028] Moreover, though the present invention has been described in terms of graphics cards, those skilled in the art will appreciate that the invention may be adapted for use with other devices that are typically hardwired to a motherboard, such as audio chips and the like.

[0029] Those skilled in the art will appreciate that although the present invention has been described in the context of closed platform computing devices such as laptop computers, cellular telephones and PDAs, the present invention may be adapted for use with any device that uses a processor and is not easily changed by a user, such as automotive navigation systems, entertainment systems, all-in-one personal computers, printers and the like.

[0030] Although the invention has been described above with reference to specific embodiments, persons skilled in the art will understand that various modifications and changes may be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. The foregoing description and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

Claims:

1. A connector for coupling a computing device to a stand-alone module containing one or more graphics cards, said connector comprising:
 - 5 means for receiving a PCI express signal; and
 - an interface adapted for delivering said PCI express signal from said computing device to said stand-alone module, wherein said stand-alone module is external to and a user-defined distance away from said computing device.
- 10 2. The connector of claim 1, further comprising a serial cable adapted for coupling said interface to said stand-alone module.
3. The connector of claim 1, further comprising an FR4 strip connector adapted for coupling said interface to said stand-alone module.
- 15 4. The connector of claim 1, wherein said interface is coupled to said stand-alone module by a sixteen-lane connection.
5. The connector of claim 1, wherein said connector is an external port built into
20 said computing device.
6. The connector of claim 1, wherein said connector is a removable card-shaped connector having physical dimensions compatible with said computing device's internal mechanical constraints.
- 25 7. The connector of claim 6, wherein said means for receiving a PCI express signal is a plurality of plated contacts disposed on said connector and adapted to engage an edge connector fixed to a motherboard of said computing device.
- 30 8. The connector of claim 7, wherein said edge connector is adapted for routing said PCI express signal from a Northbridge chip set to said connector.

9. The connector of claim 1, further comprising means for indicating the presence of a connection between said computing device and said stand-alone module via said connector.

5 10. The connector of claim 1, wherein said connector is further configured to route one or more display output signals from said stand-alone graphics module to said computing device.

11. A method for routing graphics processing signals from a computing device to a stand-alone module external to said computing device, the method comprising the steps of:

detecting a connection between said computing device and said stand-alone module; and

15 outputting a PCI express signal from said computing device to said stand-alone module.

12. The method of claim 11, wherein said detecting step comprises:

detecting the a connection over a serial cable from said stand-alone module to an external port built into said computing device.

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13. The method of claim 11, wherein said detecting step comprises:

detecting the a connection over an FR4 strip connector from said stand-alone module to an external port built into said computing device.

25 14. The method of claim 11, wherein said detecting step comprises:

detecting the engagement of a card-shaped connector with said computing device.

15. The method of claim 14, wherein said detecting step is performed by an edge connector mounted to a motherboard of said computing device and comprising a plurality of connector pins adapted for engaging said card-shaped connector.

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16. The method of claim 15, wherein said outputting step comprises:
routing said PCI express signal from a Northbridge chip set in said computing device to said card-shaped connector via said edge connector.

5 17. The method of claim 11, further comprising the step of:
outputting one or more display output signals from said stand-alone module to said computing device.

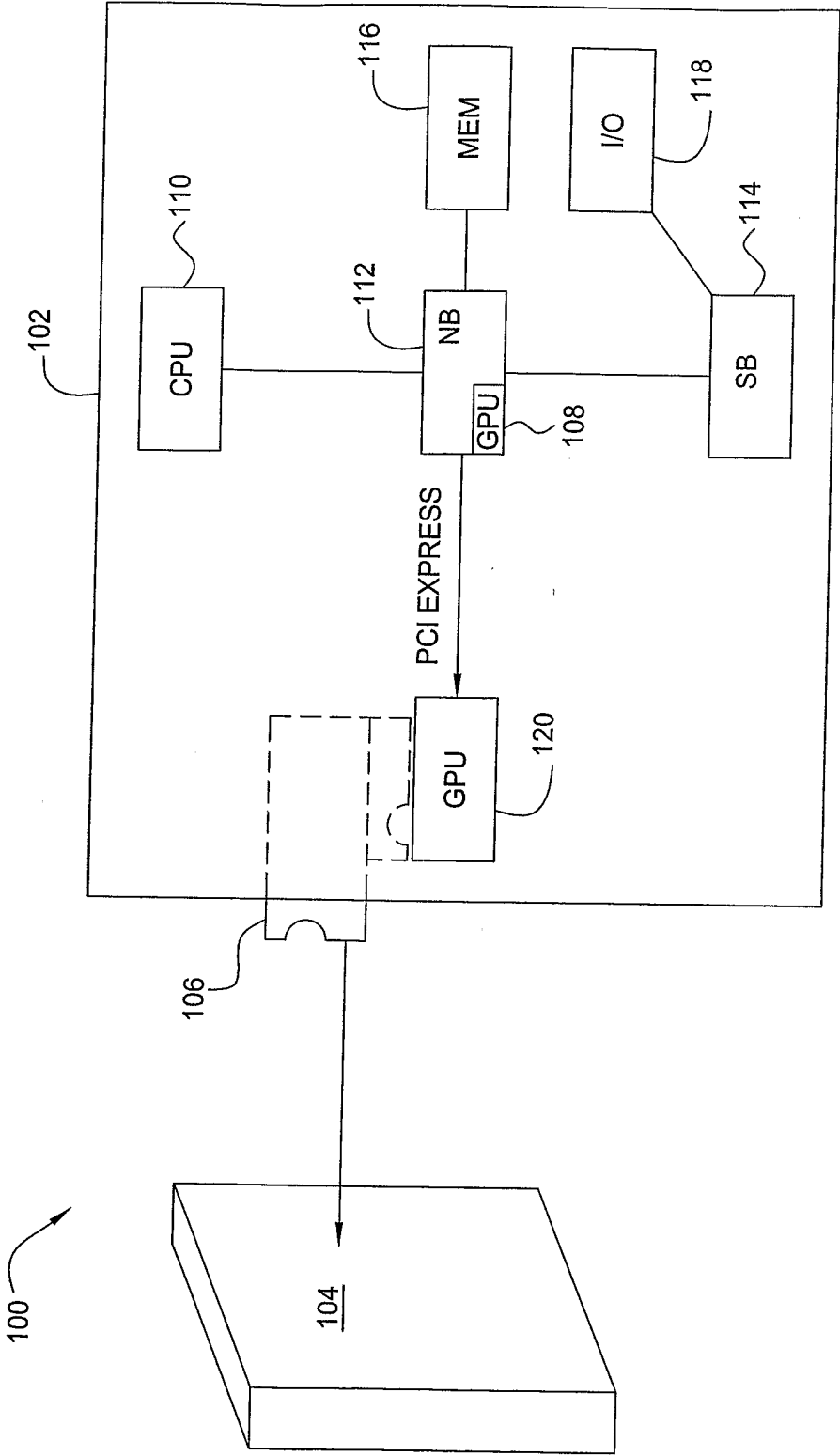


FIG. 1

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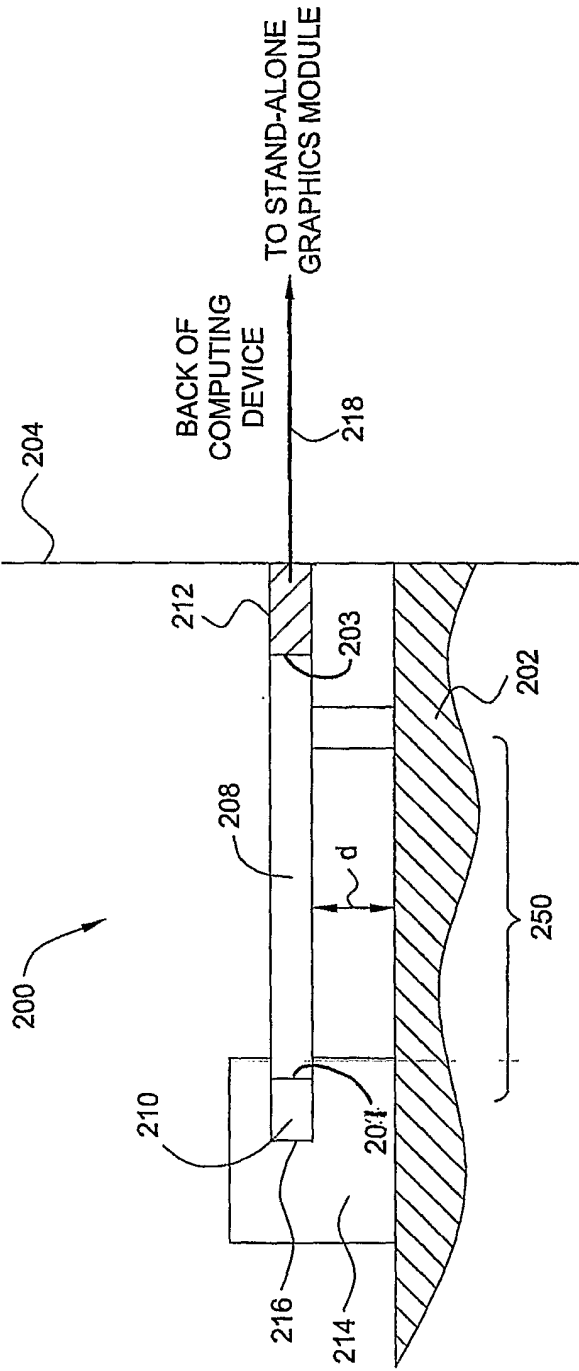


FIG. 2

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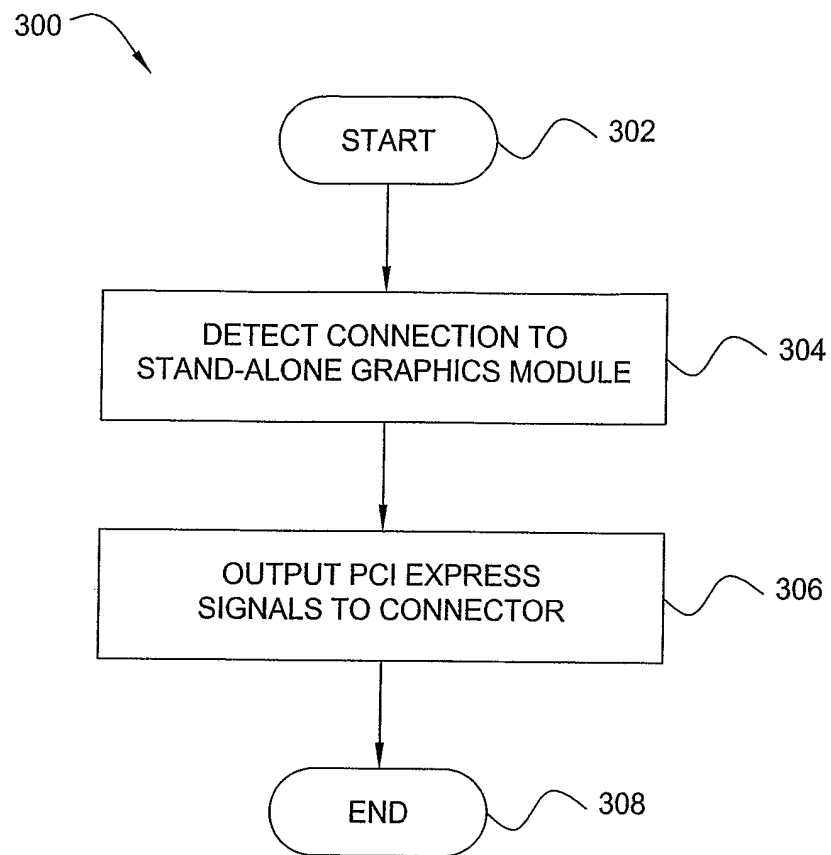


FIG. 3