



(43) International Publication Date
29 January 2015 (29.01.2015)

- (51) International Patent Classification:
H05K 1/18 (2006.01)
- (21) International Application Number:
PCT/US2013/051515
- (22) International Filing Date:
22 July 2013 (22.07.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (71) Applicant: **HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.** [US/US]; 11445 Compaq Center Drive W., Houston, Texas 77070 (US).
- (72) Inventor: **NORTON, John**; 11445 Compaq Center Drive W, Houston, Texas 77070 (US).
- (74) Agents: **MCDOWELL, Robert** et al.; Hewlett-Packard Company, Intellectual Property Administration, Mail Stop 35, 3404 E. Harmony Road, Fort Collins, Colorado 80528 (US).
- (81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,

DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

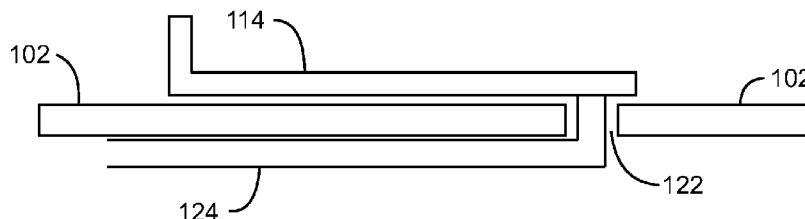
Declarations under Rule 4.17:

- *as to the identity of the inventor (Rule 4.17(i))*
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

- *with international search report (Art. 21(3))*

(54) Title: MOTHERBOARD WITH A HOLE



100
FIG. 2

(57) Abstract: A printed circuit board (PCB) can include a central processing unit (CPU) installed on a first surface of the PCB. The PCB can also include a cable routed on a second surface of the PCB parallel to the first surface. The PCB can further include a hole extending through a thickness of the PCB to connect the first surface and the second surface. The cable can extend through the hole to be coupled to the CPU.

MOTHERBOARD WITH A HOLE

BACKGROUND

[0001] A motherboard is a printed circuit board (PCB) to which main components of a computing device are coupled. Examples of main components include a central processing unit (CPU) and memory. The motherboard can also include connectors for peripheral devices (e.g., I/O devices).

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] Certain exemplary embodiments are described in the following detailed description and in reference to the drawings, in which:

[0003] Fig. 1a is a top view illustration of an example of a motherboard;

[0004] Fig. 1b is a bottom view illustration of an example of a motherboard;

[0005] Fig. 2 is a side view illustration of an example of a motherboard;

[0006] Fig. 3 is another side view illustration of an example of a motherboard;

[0007] Fig. 4 is a further side view illustration of an example of a motherboard; and

[0008] Fig. 5 is a process flow diagram of an example of a method of installing a central processing unit.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0009] Embodiments disclosed herein provide techniques for installing CPUs in a motherboard. As data transfer rates increase and push the limits of achievable speeds in standard PCBs, the ability to connect high-speed cables directly to central processing units (CPUs) becomes increasingly important as connecting cables directly to CPUs enables routing of high speed signals without suffering the signal losses incurred when first routing through a PCB.

[0010] Currently, cables are routed on top surfaces of motherboards, along with the other components of the motherboards. However, cables on densely packed motherboards can interfere with daughter cards and components. In addition, with the decreasing size of motherboards to meet the demands of

-2-

increasingly smaller computing devices, cables routed on top of a motherboard consume valuable space on the motherboard. Further, routing the cables after connecting the cables to CPUs, and other components, can cause damage to the delicate components.

[0011] However, by adding holes extending through the motherboard, these cables can be routed on the bottom side of the motherboards and extended through the holes to the top surface for connecting to components. By routing the cables on the bottom surface of the motherboard, the additional space becomes available on the top surface of the motherboard. This space can be occupied by additional components, or the overall size of the motherboard can be decrease. Further, the cables can be pre-routed on the bottom surface of the motherboard before installation of the components, reducing the risk of damage to the components caused by routing the cables.

[0012] Fig. 1a is a top view illustration of an example of a motherboard 100 and Fig. 1b is a bottom view illustration of an example of the motherboard 100. The motherboard 100 can include a printed circuit board (PCB) 102. A plurality of components can be electrically coupled to the PCB 102. Examples of components include a BIOS chip 104, a backup battery 106, peripheral connectors 108, such as universal serial buses (USBs), serial ports, parallel ports, audio ports, ethernet ports, etc., memory 110, and a graphics processor 112, among others. The motherboard can also include a central processing unit 114. The central processing unit 114 can include a single processor or a plurality of processors. The processor(s) can include any suitable type of processor.

[0013] The PCB can include a first surface 116 and a second surface 118 joined by a thickness 120 of the motherboard 100. A hole 122 can extend between the first surface 116 and the second surface 118 through the thickness 120 of the motherboard. While only a single hole 122 is shown in Figs. 1a and 1b, the motherboard 100 can include any number of holes 122. For example, the motherboard 100 can include a number of holes 122 suitable to allow coupling of each of the components 104-114 of the motherboard 100. The hole 122 can be formed in the PCB 102 through any suitable means. For example,

the hole can be formed in the PCB 102 through drilling or through molding. The hole 122 can be any suitable size and shape. For example, the hole 122 can be sized to allow a cable to pass through. In another example, the hole can be sized to allow a connector to pass through.

[0014] A cable 124 can be routed on the second surface 118 of the motherboard 100. In an example, the cable can be installed on the second surface 118 of the PCB 102 before the components 104-114 are installed on the first surface 116 of the PCB 102. The cable 124 can extend into the hole 122 to be coupled to the CPU 114. The cable 124 can be coupled to the CPU in any suitable manner, such as through soldering or via a connector. In another example, an adapter coupled to the CPU 114 can extend through the hole 122 to be received in a socket coupled to the cable 124. While a single cable is shown here, the motherboard 100 can include any suitable number of cables 124.

[0015] It is to be understood that the illustrations of Figs. 1a and 1b are not intended to indicate that the motherboard 100 is to include all of the components shown in Figs. 1a and 1b in every case. Further, any number of additional components can be included within the motherboard 100, depending on the details of the specific implementation.

[0016] Fig. 2 is a side view illustration of an example of a motherboard 100. The motherboard 100 includes a PCB 102. The CPU 114 can be installed on the first surface of the PCB 102. The CPU 114 can be coupled to a cable 124. The cable 124 can couple the CPU 114 to another component not shown here. The cable 124 can be installed on the PCB 102 before the CPU 114 is installed. Further, the cable 124 can be installed before any of components 104-112 are installed. The cable 124 can be routed on the second surface of the PCB 102. The hole 122 can extend through the PCB 102. The cable 124 can extend through the hole 122 to be coupled to the CPU 114. The cable 124 can be coupled to the CPU 114 through any suitable means.

[0017] It is to be understood that the illustration of Fig. 2 is not intended to indicate that the motherboard 200 is to include all of the components shown in Fig. 2 in every case. Further, any number of additional components can be included within motherboard 200, depending on the details of the specific

implementation.

[0018] Fig. 3 is a side view illustration of an example of a motherboard 100. The motherboard 100 includes a PCB 102. The CPU 114 can be installed on the first surface of the PCB 102. The cable 124 can be routed on the second surface of the PCB 102. The cable 124 can include a conductor 302, or a plurality of conductors, and a housing 304 to insulate the conductor(s) from the power and ground planes of the motherboard 100. The cable 124 can be installed on the PCB 102 before the CPU 114 is installed. Further, the cable 124 can be installed before any of components 104-112 are installed.

[0019] The hole 122 can extend through the PCB 122 and can include a lining 306 of an insulating material. The lining 306 can include any suitable type of insulating material. For example, the lining 306 can include an insulating material to insulate the conductor 302 from the power and ground planes of the motherboard 100. A portion of the housing 304 can be removed from the conductor 302. The conductor 302, without the housing 304, can extend through the hole 122 to be coupled to the CPU 114. The conductor 302 can be coupled to the CPU 114 through any suitable means.

[0020] It is to be understood that the illustration of Fig. 3 is not intended to indicate that the motherboard 300 is to include all of the components shown in Fig. 3 in every case. Further, any number of additional components can be included within motherboard 300, depending on the details of the specific implementation.

[0021] Fig. 4 is a side view illustration of an example of a motherboard 100. The motherboard 100 includes a PCB 102. The CPU 114 can be installed on the first surface of the PCB 102. The cable 124 can be routed on the second surface of the PCB 102. The cable 124 can be installed on the PCB 102 before the CPU 114 is installed. Further, the cable 124 can be installed before any of components 104-112 are installed.

[0022] A socket 402 can be coupled to the cable 124. The socket 402 can be coupled to the cable 124 through any suitable means, such as soldering or by compression. A single socket 402 or multiple sockets 402 can be coupled to the cable 124. For example, the cable 124 can include two ends and a socket

402 can be coupled to each end of the cable 124. The socket 402 can be coupled to the cable 124 before installation of the cable 124 on the PCB 102. In another example, the socket 402 can be coupled to the cable 124 after installation of the cable 124 on the PCB 102.

[0023] The socket 402 can be designed to receive an adapter 404 of any suitable type. For example, the socket 402 can be a vertical connector, as illustrated in Fig. 4. The adapter 404 can be coupled to the CPU 114 by any suitable means, such as by soldering. The adapter 404 can be coupled to the CPU 114 before installation of the CPU on the PCB 102. The adapter 404 can be designed to be received in the socket 402. For example, the adapter 404 can be a right-angled adapter, as illustrated in Fig. 4. During installation of the CPU 114 on the PCB 102, the adapter 404 can be inserted in the socket 402. The adapter 404 and the socket 402 can create a direct connection between the CPU 114 and the cable 124.

[0024] In another example, the socket 402 can include a plurality of compression pins, such as a land grid array (LGA) of compression pins. The socket 402 can include any suitable number of compression pins and the compression pins can be arranged in any suitable pattern. The adapter 404 can be designed to be received in the socket 402. For example, the adapter 404 can include a plurality of pads. The adapter 404 includes a number of pads equal to the number of compression pins included in the socket 402 and the pads can be arranged in a pattern corresponding to the pattern of the compression pins 204.

[0025] The adapter 404 can be coupled to the CPU 114 by any suitable means. In an example, the adapter 404 can include the compression pads and can be coupled to the CPU 114, such as by soldering. In another example, the adapter 404 can include the compression pads directly connected to a surface of the CPU 114. The adapter 404 can be coupled to the CPU 114 before installation of the CPU 114 on the PCB 102.

[0026] In an example, the socket 402 can be coupled to the cable and located at the bottom of the hole 122, on the second surface of the PCB 102, to receive the adapter 404. The adapter 404 can extend through the hole 122 to be

received in the socket 402 during installation of the CPU.

[0027] It is to be understood that the illustration of Fig. 4 is not intended to indicate that the motherboard 400 is to include all of the components shown in Fig. 4 in every case. Further, any number of additional components can be included within motherboard 400, depending on the details of the specific implementation.

[0028] Fig. 5 is a process flow diagram of an example of a method of installing a CPU. The method can begin at block 502 with installing a central processing unit (CPU) on a first surface of a motherboard. The CPU can be installed with any suitable method.

[0029] At block 504, a cable can be routed on a second surface of the motherboard parallel to the first surface. The cable can be designed to connect to the CPU and can connect the CPU to another component. For example, the cable can connect the CPU to another CPU. In another example, the cable can connect the CPU to an input/output (I/O) device. The cable can be any type of cable designed to connect to the CPU, such as a flexible printed copper cable or a discrete wire. In an example, the cable can be a high-speed cable. The cable can include a housing, to insulate the conductors of the cable from the power and ground planes in the motherboard.

[0030] At block 506, the cable can be routed through a hole extending between the first surface and the second surface through the thickness of the motherboard. In an example, the entire cable can be routed through the hole. In another example, a portion of the cable housing can be removed and the conductors of the cable can be routed through the hole. In this example, the hole can be lined with an insulator to insulate the conductors of the cable from the power and ground planes of the motherboard.

[0031] In a further example, a socket can be coupled to the cable. The socket can be installed on the second surface side of the hole, without routing the cable through the hole. In another example, the cable can be routed through the hole and the socket can be coupled to the cable after the cable is routed through the hole, such that the socket is installed on the first side of the motherboard.

[0032] The socket can be coupled to the cable by any suitable method, such as by soldering or compression. In an example, the socket can be coupled to the cable before installation of the cable in the motherboard. The socket can be any type of socket. For example, the socket can be a vertical connector. In another example, the socket can be a land grid array (LGA) of compression pins. The cable can include more than one socket. For example, the cable can include two ends and two sockets, one socket coupled to each end of the cable. Further, the socket can include more than one type of socket. For example, in a cable with a socket coupled to each end of the cable, a first socket can be a first type of socket, such as a vertical connector, and a second socket can be a second type of socket, such as an array of compression pins.

[0033] At block 508, the cable and the CPU can be coupled. The cable and CPU can be coupled through any suitable method, such as soldering or compression. In an example, the CPU can include a coupled adapter. The adapter is designed to be received in the socket during installation of the CPU in the motherboard. For example, the adapter can be a right-angled adapter received in a vertical connector socket. In another example, the adapter can be an array of pads arranged in a pattern corresponding to the land grid array (LGA) of compression pins of the socket. In an example, the adapter can be inserted through the hole to be received in the socket positioned on the second side of the motherboard during installation of the CPU. In another example, the adapter can be received in a socket that is positioned on the first side of the motherboard and coupled to a cable routed through the hole.

[0034] It is to be understood that the process flow diagram of Fig. 5 is not intended to indicate that the method 500 is to include all of the blocks shown in Fig. 5 in every case. Further, any number of additional blocks can be included within the method 500, depending on the details of the specific implementation. In addition, it is to be understood that the process flow diagram of Fig. 5 is not intended to indicate that the method 500 is only to proceed in the order indicated by the blocks shown in Fig. 5 in every case. For example, block 504 can be rearranged to occur before block 502.

[0035] While the present techniques may be susceptible to various modifications and alternative forms, the exemplary examples discussed above have been shown only by way of example. It is to be understood that the technique is not intended to be limited to the particular examples disclosed herein. Indeed, the present techniques include all alternatives, modifications, and equivalents falling within the true spirit and scope of the appended claims.

CLAIMS

What is claimed is:

1. A printed circuit board (PCB), comprising:
a central processing unit (CPU) installed on a first surface of the PCB;
a cable routed on a second surface of the PCB parallel to the first surface; and
a hole extending through a thickness of the PCB to connect the first surface and the second surface,
wherein the cable extends through the hole to be coupled to the CPU.
2. The PCB of claim 1, wherein the hole comprises an insulating lining and wherein a conductor of the cable extends through the hole, without a cable housing, to be coupled to the CPU.
3. The PCB of claim 1, wherein the cable comprises a socket coupled to the cable and the CPU comprises an adapter coupled to the CPU, and wherein the adapter extends through the hole to be received in the socket upon installation of the CPU on the motherboard.
4. The PCB of claim 3, wherein the socket comprises a land grid array (LGA) of compression pins and the adapter comprises pads arranged in a land grid array (LGA) corresponding to the LGA of compression pins.
5. The PCB of claim 3, wherein the socket comprises a vertical connector and the adapter comprises a right-angled adapter that is received in the vertical connector.
6. A motherboard, comprising:
a first surface and a second surface parallel to the first surface;

-10-

a hole extending through a thickness of the motherboard to connect the first surface and the second surface;
a central processing unit (CPU) installed on the first surface; and
a cable routed on the second surface,
wherein the cable is routed through the hole to be coupled to the CPU.

7. The motherboard of claim 6, wherein the hole comprises an insulating lining and wherein a conductor of the cable extends through the hole, without a cable housing, to be coupled to the CPU.

8. The motherboard of claim 6, wherein the cable comprises a socket coupled to the cable and the CPU comprises an adapter coupled to the CPU, and wherein the adapter extends through the hole to be received in the socket upon installation of the CPU on the motherboard.

9. The motherboard of claim 8, wherein the socket comprises a land grid array (LGA) of compression pins and the adapter comprises pads arranged in a land grid array (LGA) corresponding to the LGA of compression pins.

10. The motherboard of claim 8, wherein the socket comprises a vertical connector and the adapter comprises a right-angled adapter that is received in the vertical connector.

11. A method, comprising:
installing a central processing unit (CPU) on a first surface of a motherboard;
routing a cable on a second surface of the motherboard parallel to the first surface;
routing the cable through a hole extending between the first surface and the second surface through a thickness of the motherboard; and

-11-

coupling the cable and the CPU.

12. The method of claim 11, further comprising removing a portion of cable housing and routing a cable conductor through the hole to couple the cable to the CPU.

13. The method of claim 12, wherein the hole comprises an insulating lining.

14. The method of claim 11, wherein the cable comprises a socket coupled to the cable and the CPU comprises an adapter coupled to the CPU and wherein coupling the cable and the CPU comprises installing the CPU on the motherboard such that the adapter extends through the hole to be received in the socket.

15. The method of claim 14, wherein the socket comprises a vertical connector and the adapter comprises a right-angled adapter that is received in the vertical connector.

1/5

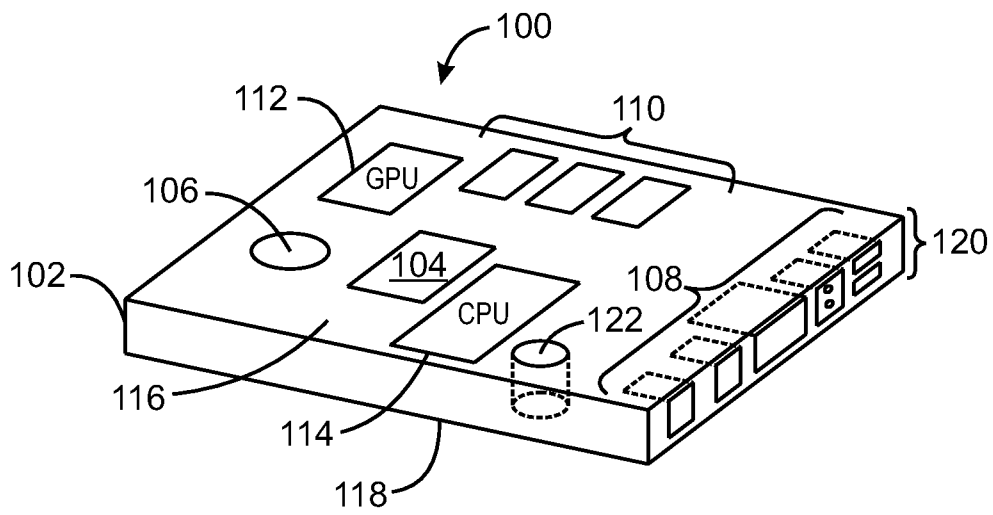


FIG. 1a

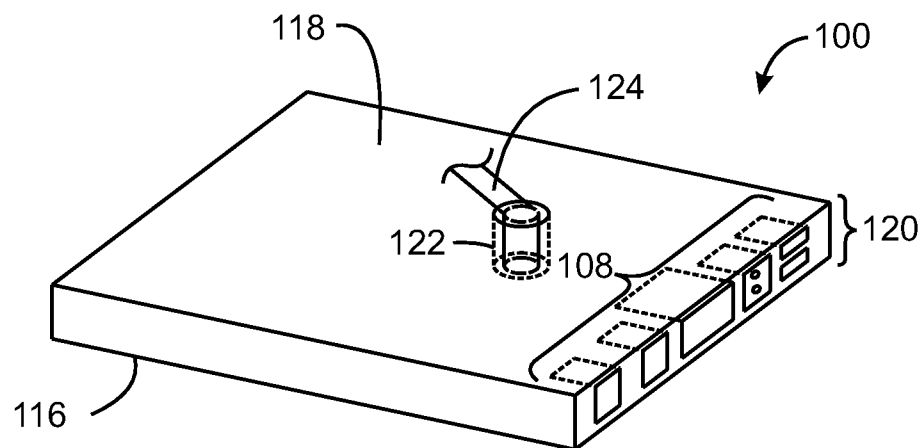
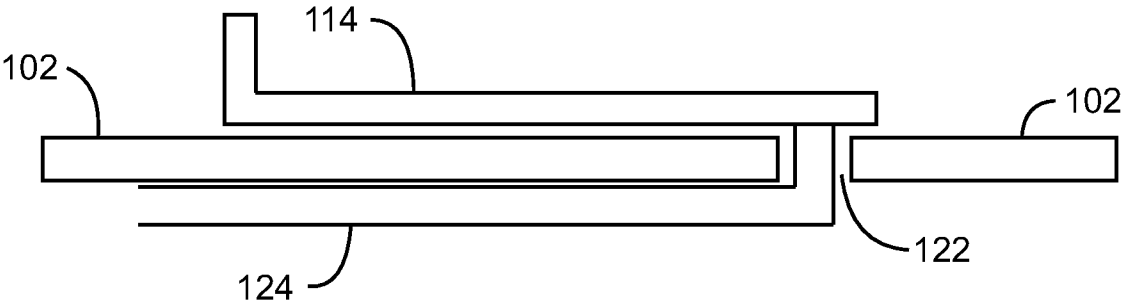


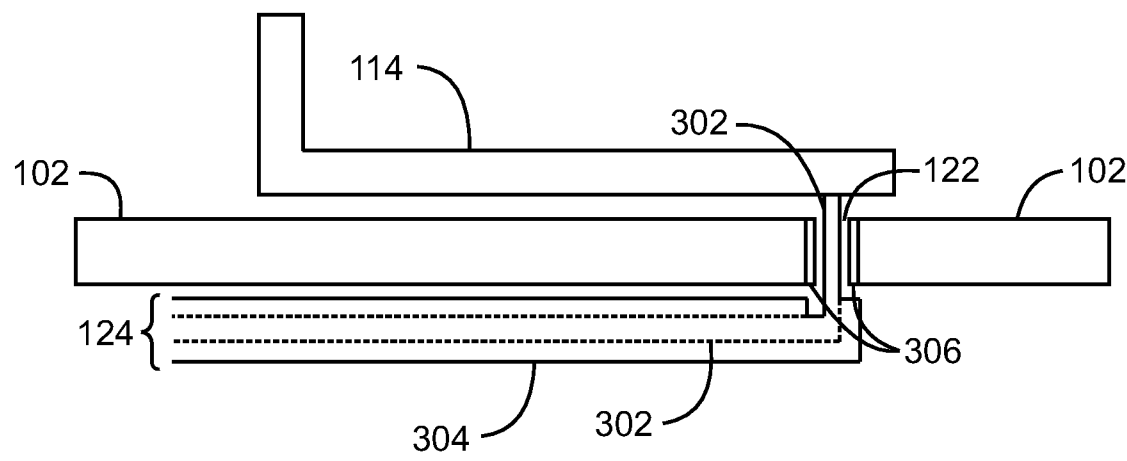
FIG. 1b

2/5



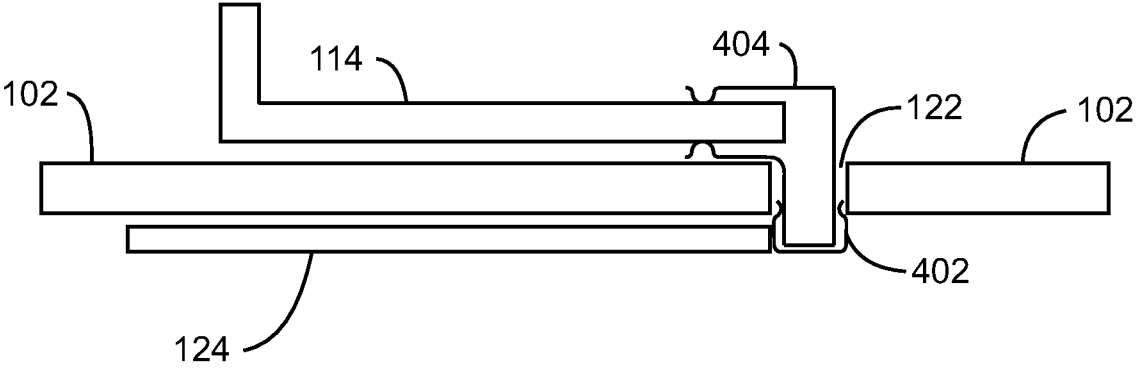
100
FIG. 2

3/5



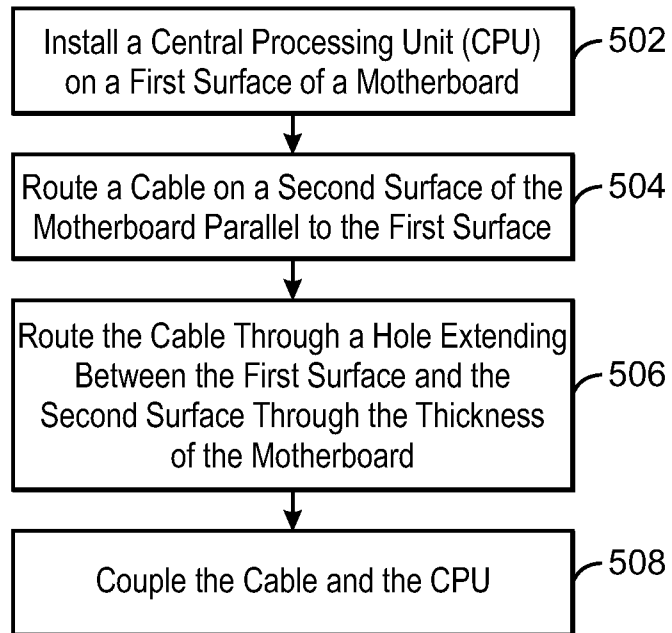
100
FIG. 3

4/5



100
FIG. 4

5/5



500
FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/051515**A. CLASSIFICATION OF SUBJECT MATTER****H05K 1/18(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
H05K 1/18; H01L 21/60; H05K 3/34; H05K 3/30; B32B 31/00; H05K 1/00; H05K 1/02Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: printed circuit board, CPU, cable, hole, adapter, socket, motherboard**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6651322 B1 (THOMAS P. CURRIE) 25 November 2003 See column 5, line 1 - column 6, line 24, and figures 1-3.	1,3-6,8-12,14-15
Y		2,7,13
Y	US 2002-0059721 A1 (ALAN HARRIS CRUDO et al.) 23 May 2002 See paragraphs [0035]-[0042], and figures 1-3C.	2,7,13
A	US 2003-0196749 A1 (ROBERT, M. JAPP et al.) 23 October 2003 See abstract, paragraphs [0043]-[0060], and figures 1-4.	1-15
A	KR 10-2008-0082365 A (SAMSUNG ELECTRONICS CO., LTD.) 11 September 2008 See abstract, pages 4-6, and figures 1A-2B.	1-15
A	US 2009-0288874 A1 (DUDNIKOV, JR. GEORGE et al.) 26 November 2009 See abstract, paragraphs [0032]-[0050], and figures 3-9.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

18 March 2014 (18.03.2014)

Date of mailing of the international search report

19 March 2014 (19.03.2014)

Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

JEONG, So Yeon

Telephone No. +82-42-481-5656



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2013/051515

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6651322 B1	25/11/2003	None	
US 2002-0059721 A1	23/05/2002	JP 03925821 B2 JP 10-051109 A US 05809641 A US 06018866 A US 06115912 A US 6295724 B1 US 6437254 B1	06/06/2007 20/02/1998 22/09/1998 01/02/2000 12/09/2000 02/10/2001 20/08/2002
US 2003-0196749 A1	23/10/2003	AT 233466 T AU 2000-34436 A1 CN 1226904 C0 CN 1272038 A0 CZ 20013829 A3 CZ 301187 B6 DE 60001500 D1 DE 60001500 T2 EP 1190608 A1 EP 1190608 B1 HK 1028701 A1 HU 0200876 A2 HU 225075 B1 IL 145852 A IL 145852 D0 JP 03495315 B2 JP 2000-323840 A PL 196239 B1 PL 351138 A1 US 6613413 B1 US 6944946 B2 WO 00-65889 A1	15/03/2003 10/11/2000 09/11/2005 01/11/2000 17/12/2003 02/12/2009 03/04/2003 27/11/2003 27/03/2002 26/02/2003 10/02/2006 29/07/2002 28/06/2006 10/04/2006 25/07/2002 09/02/2004 24/11/2000 31/12/2007 24/03/2003 02/09/2003 20/09/2005 02/11/2000
KR 10-2008-0082365 A	11/09/2008	None	
US 2009-0288874 A1	26/11/2009	CN 100587921 C CN 101133478 A EP 1856723 A2 EP 1856723 A4 EP 1856723 B1 JP 05179883 B2 JP 2008-532326 A TW I389205B US 2006-0199390 A1 US 2008-296057 A1 US 2008-301934 A1 US 8222537 B2 WO 2006-094307 A2 WO 2006-094307 A3	03/02/2010 27/02/2008 21/11/2007 04/08/2010 01/05/2013 10/04/2013 14/08/2008 11/03/2013 07/09/2006 04/12/2008 11/12/2008 17/07/2012 08/09/2006 30/08/2007