

COMPUTER SYSTEM HAVING CUSTOMIZABLE PRINTED CIRCUIT BOARDS

This application claims priority from US provisional patent application number 60/774,788 filed on 17 February 2006, entitled "Customizable Printed Circuit Board", which is hereby incorporated by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention relates to computer systems. In particular, it relates to computer systems having customizable printed circuit boards.

BACKGROUND OF THE INVENTION

Printed Circuit Boards (PCBs) are widely used in electronics devices such as computer systems. Presently, main boards or motherboards used in computer systems all have the electronic components, such as the CPU and other integrated circuit chips, connectors as well as external Input / Output (I/O) interfaces, such as communications ports, Audio In/Out ports fixedly formed thereon.

External Input / Output (I/O) interfaces arranged in this matter, however, make it less flexible to customize or modify the design and configuration of the external I/O interfaces. In the event that newly developed external I/O interfaces are to be used, which has been taking place more and more often, the entire main board will have to be re-designed and re-fabricated. This will incur unnecessary costs and time.

Further, in the event that additional external I/O interfaces, for example additional communication ports or Universal Serial Bus (USB) ports are required, I/O expansion cards must be provided to connect the additional external I/O interface cards to the main board via Peripheral Component Interconnect (PCI) extension cards connected to the PCI slots. However, since all the PCI slots of

present main boards are fixed at locations away from the I/O ports, connection cables become necessary to provide electrical connections between the PCI extension cards and the additional external I/O interface I/O cards. However, use of connection cables is costly and may give rise to reliability issues in the computer systems.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide effective and convenient solutions for reconfiguration, upgrading, addition and/or removal of external I/O ports in computer systems without redesigning and/or replacing the whole motherboard. Only the parts of the printed circuit board(s) with the I/O ports fixed thereon are to be changed or replaced. The other parts of the print circuit board(s) on which the CPU and other components are fixed, are not affected by the redesigning or replacement of the external I/O ports. Design and fabrication periods for customizing the I/O ports are much shortened, and unnecessary redesign and re-fabrication work on the other parts of the computer system, e.g. the main board, is generally avoided.

In one embodiment, a computer system includes a first circuit board and a second circuit board which is detachably coupled to the first circuit board. In the event that the first circuit board or the second circuit board needs to be modified, the two circuit boards can be detached from each other and after the modification, the two circuit boards can be coupled together again to resume the functions of the computer system.

The first circuit board may be a main board, and the second circuit board may be an I/O card. When coupled together, the main board and the I/O card are positioned within a same plane. By positioning the two circuit boards in a same plane, a computer system is configured with easy customizable printed circuit boards without substantially increase of the overall physical dimension of the computer system. Advantages offered by embodiments of the present invention are apparent in that, for example, the casing and chassis of the computer system can remain unchanged, hence a high level of compatibility to the industrial standard can be achieved.

In another embodiment, a computer system includes a main board and an I/O card which is detachably coupled to the main board. When the I/O card is

coupled to the main board, an edge of the I/O card faces an edge of the main board.

BRIEF DESCRIPTION OF THE DRAWINGS

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These and other aspects and advantages of the present invention will be described in detail with reference to the accompanying drawings, in which:

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Fig. 1 is a perspective view of a computer PCB assembly according to one embodiment of the present invention;

Fig. 2 is an exploded view of Fig. 1;

Fig. 3 is a top view of Fig. 1;

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Fig. 4A is a perspective view of a computer PCB assembly according to another embodiment of the present invention;

Fig. 4B is an exploded view of Fig. 4A;

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Fig. 5 is a system block diagram showing an embodiment of the present invention;

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Figs. 6A, 6B and 6C are schematic diagrams showing top, side and front views of a computer PCB assembly according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention provide designers, manufacturers of electronic devices, for example computer systems, with solutions to reduce design and manufacturing costs and shorten the turn-around time required to change, modify and/or customize the external I/O interfaces or addition / removal of I/O ports without the need of redesigning and/or replacing the whole main board.

Embodiments of the present invention are configured with a customizable external I/O interface. A base I/O card is provided to couple to a main board, via a base I/O connector. The base I/O connector may be fixed to the main board, and the base I/O card is formed with printed circuits connection terminals. The base I/O connector further has a socket for receiving the base I/O card via the printed circuits connection terminals. Alternatively, the base I/O connector may be fixed to the base I/O card, and the main board is formed with printed circuits connection terminals. By virtue of the above-illustrated configuration, the base I/O card is able to detachably couple to the main board via the base I/O connector.

Embodiments of the present invention provide highly customizable circuit boards for electronics devices, such as computer systems. The circuit boards are configured in such a manner that multiple I/O cards which provide different external interfaces can be interchangeably connected to the main board. The I/O modules are fabricated on separate PCBs, which can be detachably connected to main board via the base I/O connector, or an I/O riser connector assembly.

It can be appreciated that, in the event that there is a need to modify or reconfigure the external interface, it no longer requires to redesign and re-fabricate the entire main board. Instead, the base I/O card may be disconnected from the main board, by unplugging the base I/O card from the main board. Any modification, redesign or customization will be carried out on the base I/O card only. The main board where the central processing unit (CPU) and other components / circuits are located, can be left untouched. The present invention

therefore enhances the efficiency of designing, producing and customizing the computer systems.

Reference is now made to Figs. 1, 2 and 3. A computer system PCB assembly 100 according to one embodiment of the present invention includes a first circuit board, such as a main board 110 and a base I/O card 120. Main board 110 has formed thereon first set of printed circuits 112, which provides all necessary Input/Output (I/O) electrical connections to the base I/O card 120. Base I/O card 120 has connecting circuits 122 connected to various External I/O ports 124, such as PS2 ports, serial ports, RJ45 ports and/or speaker In/Out ports.

A base I/O connector 115 is provided. Base I/O connector 115 may be fixed to base I/O card 120, as shown in Fig. 2. Under this configuration, main board 110 is formed with base I/O circuitries 112 terminated at a main board edge 114. When base I/O card 120 is to be connected to main board 110, base I/O connector 115 is brought into engagement to main board edge 114 of. Base I/O card 120 is therefore physically fixed to main board 110, with I/O card edge 116 facing against main board edge 114 and in the meantime, base I/O circuitries 112 are electrically connected to connecting circuits 122 which is in turn electrically connected to external I/O ports 124, as shown in Fig. 1. An example of pin definitions assigned to a base I/O connector 115 is set out in Table 1 below:

Table 1 – Pin Definition of a Base I/O Connector

Signal Name	Pin	Pin	Signal Name
GND	61B1	1A1	GND
DCD2#	62B2	2A2	DCD1#
DSR2#	63B3	3A3	DSR1#
RX2	64B4	4A4	RX1
RTS2#	65 B5	5 A5	RTS1#
TX2	66B6	6A6	TX1

CTS2#	67B7	7A7	CTS1#
DTR2#	68B8	8A8	DTR1#
RI2#	69B9	9A9	RI1#
GND	70B10	10A10	GND
+5V	71 B11	11A11	+5V
GND	72B12	12A12	GND
OC0	73B13	13A13	STB#
GND	74B14	14A14	AFD#
USBD1-	75B15	15A15	PD0
USBD1+	76B16	16A16	EER#
GND	77B17	17A17	PD1
USBD0-	78B18	18A18	INIT#
USBD0+	79B19	19A19	PD2
GND	80B20	20A20	SLIN#
+5VSB	81B21	21A21	PD3
GND	82B22	22A22	PD4
RXAVDD	83B23	23A23	PD5
LED_LINK	84B24	24A24	PD6
LED_ACT	85 B25	25A25	PD7
GND	86B26	26A26	ACK#
TD+	87B27	27A27	BUSY
TD-	88B28	28A28	PE
GND	89B29	29A29	SLCT
RD+	90B30	30A30	GND
RD-	91 B31	31A31	+5V
GND	92B32	32A32	GND
+5V	93B33	33A33	TX2N
GND	94B34	34A34	TX2P
DVI-R	95B35	35A35	GND
DVI-G	96B36	36A36	TX1N
DVI-B	97B37	37A37	TX1P

GND	98B38	38A38	GND
DVI_HSY	99B39	39A39	TX0N
DVI_VSY	100B40	40A40	TX0P
GND	101B41	41A41	GND
DDC_SDA	102B42	42A42	TXCN
GND	103B43	43A43	TXCP
DDC_SCL	104B44	44A44	GND
GND	105B45	45A45	DVIDDCCLK
+5V	106B46	46A46	GND
+5V	107B47	47A47	DVIDDCDAT
GND	108B48	48A48	GND
+5VSB	109B49	49A49	EDGE
CON KEY			CON KEY
CON KEY			CON KEY
BVCC	110B50	50A50	LOUTL
GND	111B51	51A51	LOUTR
KBDA	112B52	52A52	LINL
MSDA	113B53	53A53	LINR
GND	114B54	54A54	GND
KBCL	115B55	55A55	MIC
GND	116B56	56A56	GND
MSCL	117B57	57A57	VREF0
GND	118B58	58A58	GND
+5VSB	119B59	59A59	+12V
+5VSB	120B60	60A60	+12V

No connecting cable is required to provide electrical connections between main board 110 and base I/O card 120. Reliability issues caused by connecting cables are therefore avoided.

Depending on the design requirement, base I/O card 120 and main board 110 may be disposed with various relative positional relationships. In one

example, when coupled together, base I/O card 120 and main board 110 are disposed within a same plane, represented by dash lines 102 intersecting base I/O card 120 and main board 110, as shown in Figs. 1 and 3.

5 When there is a need to modify and/or redesign the external I/O ports 124, base I/O card 120 can be conveniently detached from main board 110, by unplugging the base I/O connector 115 from the main board 110. After being detached, the base I/O card 120 can be modified, reconfigured or redesigned, without affecting the main board 110. After the completion of the modification or
10 reconfiguration, the base I/O card 120 may be reconnected to main board 110, by plugging the base I/O connector to the main board edge 114, to resume the functions of the computer system.

 Figs. 4A and 4B are perspective views of a computer system PCB
15 assembly 200 according to another embodiment of the present invention. PCB assembly 200 has a main board 210 and a base I/O card 220. Main board 210 has formed thereon first set of printed circuits 212, which provides base Input/Output (I/O) electrical connections. Base I/O card 220 has connecting
20 circuits 222 connected to External I/O ports 224, such as PS2 ports, serial ports, RJ45 ports and/or speaker In/Out ports fixed on the base I/O card 220.

 In the present embodiment, main board 210 further has an I/O riser connector 230 formed thereon. An I/O riser card 240 is provided, which can be coupled to main board 210 via I/O riser connector 230. Additional I/O cards 250
25 may be interchangeably connected to I/O riser card 240. Additional I/O cards 250 together with base I/O card 220 therefore provide users with a wide variety of choices to customize the I/O port configurations. Embodiments of the present invention therefore enables customization, modification or redesigning of the external I/O ports or modules of electronics devices, such as computer systems,
30 in a convenient way, at low cost and with a shortened turn-around time.

In one embodiment, I/O riser connector 230 includes a main connector 230a and two edge connectors 230b and 230c. An example of pin definitions of the main connector is set out in Table 2 below. Necessary printed circuits 216 are formed on main board 210 to provide electrical connections from PCI slot 218 to main connector 230a, edge connectors 230b and / or 230c of I/O riser connector 230. The electrical connections provided by printed circuits 216 serve the same purpose of those provided by connection cables used in conventional computer systems, to connect the PCI slots to I/O riser connector 230. As such, connection cables are eliminated in computer systems according to embodiments of the present invention, in supporting additional I/O cards. Examples of pin definitions of the edge connectors are set out in Tables 3 and 4 below.

Table 2 – Pin Definition of a main Connector of an I/O riser connector

Signal Name	Pin	Pin	Signal Name
-12V	61B1	1A1	NC
CLK2	62B2	2A2	+12V
GND	63B3	3A3	TMS
TD0	64B4	4A4	TDI
+5V	65 B5	5 A5	+5V
+5V	66B6	6A6	INTA#
INTB#	67B7	7A7	INTC#
INTD#	68B8	8A8	+5V
PRSNT#1	69B9	9A9	RESERVED
RESERVED	70B10	10A10	+5V
PRSNT#2	71 B11	11A11	RESERVED
GND	72B12	12A12	GND
GND	73B13	13A13	GND
RESERVED	74B14	14A14	RESERVED
GND	75B15	15A15	RST#
CLK1	76B16	16A16	+5V

GND	77B17	17A17	GNT
REQ#	78B18	18A18	GND
+5V	79B19	19A19	PME
AD31	80B20	20A20	AD30
AD29	81B21	21A21	+3.3V
GND	82B22	22A22	AD28
AD27	83B23	23A23	AD26
AD25	84B24	24A24	GND
+3.3V	85 B25	25A25	AD24
C_BE#3	86B26	26A26	IDSEL
AD23	87B27	27A27	+3.3V
GND	88B28	28A28	AD22
AD21	89B29	29A29	AD20
AD19	90B30	30A30	GND
+3.3V	91 B31	31A31	AD18
AD17	92B32	32A32	AD16
C_BE#2	93B33	33A33	+3.3V
GND	94B34	34A34	FRAME#
IRDY#	95B35	35A35	GND
+3.3V	96B36	36A36	TRDY
DEVSEL#	97B37	37A37	GND
GND	98B38	38A38	STOP
LOCK#	99B39	39A39	+3.3V
PERR#	100B40	40A40	SDONE
+3.3V	101B41	41A41	SBO
SERR#	102B42	42A42	GND
+3.3V	103B43	43A43	PAR
C_BE#1	104B44	44A44	AD15
AD14	105B45	45A45	+3.3V
GND	106B46	46A46	AD13
AD12	107B47	47A47	AD11

AD10	108B48	48A48	GND
GND	109B49	49A49	AD9
CON KEY			CON KEY
CON KEY			CON KEY
AD8	110B50	50A50	C_BE#0
AD7	111B51	51A51	3.3V
+3.3V	112B52	52A52	AD6
AD5	113B53	53A53	AD4
AD3	114B54	54A54	GND21
GND	115B55	55A55	AD2
AD1	116B56	56A56	AD0
+5V	117B57	57A57	+5V
ACK64#	118B58	58A58	REQ64#
+5V	119B59	59A59	+5V
+5V	120B60	60A60	+5V

Table 3 – Pin Definition of first edge Connector of an I/O riser connector

Signal Name	Pin	Pin	Signal Name
DCD3#	12B1	1A1	DSR3#
RX3	13B2	2A2	RTS3#
TX3	14B3	3A3	CTS3#
DTR3#	15B4	4A4	RI3#
GND	16B5	5A5	GND
DCD4#	17B6	6A6	DSR4#
RX4	18B7	7A7	RTS4#
TX4	19B8	8A8	CTS4#
DTR4#	20B9	9A9	RI4#
GND	21B10	10A10	GND
GPIO43	22B11	11A11	GPIO42

Table 4 – Pin Definition of a second edge Connector of an I/O riser connector

Signal Name	Pin	Pin	Signal Name
LPC_AD3	12B1	1A1	LPC_AD1
LPC_AD2	13B2	2A2	LPC_AD0
LPC_FRAME#	14B3	3A3	LPC_DRQ0#
GND	15B4	4A4	GND
USB2-	16B5	5A5	USB2-
USB2+	17B6	6A6	USB2+
GND	18B7	7A7	GND
OC2	19B8	8A8	GPIO41
GND	20B9	9A9	GPIO40
GPIO39	21B10	10A10	GPIO37
GPIO38	22B11	11A11	GPIO23

Fig. 5 is a block diagram showing a computer system 500 according to an embodiment of the present invention. Base I/O circuitries or connections 512 are formed on the main board 510, and terminated at a main board edge 514, to provide electrical connections to a base I/O card 520. Additional I/O circuitries or connections 516 are also formed on the main board 510, to connect to an I/O riser slot 530 which is configured to receive three additional I/O cards 550,.

Base I/O card 520 and additional I/O cards 550 are all detachably coupled to main board 510, via main board edge 514 and I/O riser slot 530, respectively.

Figs. 6A, 6B and 6C are schematic diagrams showing a computer system PCB assembly 600 according to a further embodiment of the present invention. According to this embodiment, a base I/O card 620, two additional interchangeable I/O cards 650 are detachably connected to a main board 610.

Although embodiments of the present invention have been illustrated in conjunction with the accompanying drawings and described in the foregoing detailed description, it should be appreciated that the invention is not limited to the embodiments disclosed, and is capable of numerous rearrangements, modifications, alternatives and substitutions without departing from the spirit of the invention as set forth and recited by the following claims.

CLAIMS

1. A computer system comprising:
 - a main board;
 - 5 a base I/O card detachably coupled to the main board;
 - wherein the main board and the base I/O card are within a same plane when coupled together.
2. The computer system of claim 1, wherein the main board having a set of
10 base I/O circuitries terminated at a main board edge, and wherein the base I/O card is detachably coupled to the main board at the main board edge.
3. The computer system of claim 2, wherein the base I/O card is detachably
15 coupled to the main board with an I/O card edge facing against a main board edge.
4. The computer system of claim 2, wherein the main board having a set of
20 additional I/O circuitries connected to a riser connector, wherein the computer system further comprises a plurality of additional I/O cards detachably coupled to the riser connector via a riser card.
5. The computer system of claim 4, wherein the plurality of additional I/O
cards are disposed parallel to the base I/O card.
- 25 6. The computer system of claim 4, wherein the plurality of additional I/O cards are interchangeably coupleable to the riser card.
7. A computer system comprising:
 - a main board;
 - 30 a base I/O card having a plurality of I/O ports fixed thereon for coupling to external I/O devices;

wherein the base I/O card is detachably coupled to the main board with an I/O card edge facing against a main board edge.

- 5 8. The computer system of claim 7, wherein the main board having a set of base I/O circuitries terminated at the main board edge for connecting to the base I/O card.
- 10 9. The computer system of claim 8, wherein the main board having a set of additional I/O circuitries connected to a riser connector, wherein the computer system further comprises a plurality of additional I/O cards detachably coupled to the riser connector via a riser card.
- 15 10. The computer system of claim 9, wherein the plurality of additional I/O cards are disposed parallel to the base I/O card.
11. The computer system of claim 9, wherein the plurality of additional I/O cards are interchangeably coupleable to the riser card.
- 20 12. A computer system comprising:
 - a first circuit board having a first set of I/O circuitries terminated at a first board edge;
 - a second circuit board having at least one I/O port coupled thereon and a second set of I/O circuitries terminated at a second board edge;
 - wherein the first and second circuit boards are detachably coupled to each other via an engagement of the first board edge and the
 - 25 second board edge.
- 30 13. The computer system of claim 12, wherein the main board further comprises a third set of I/O circuitries connected to a riser connector and a plurality of additional I/O cards detachably coupled to the main board via the riser connector.

14. The computer system of claim 13, wherein the plurality of additional I/O cards are disposed parallel to the base I/O card.
15. The computer system of claim 13, wherein the plurality of additional I/O cards are interchangeably coupleable to the riser card.