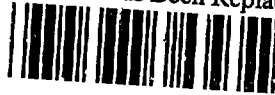


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## ELECTRICAL CONNECTOR

### FIELD OF THE INVENTION

The present invention relates to electrical connectors having a shape similar to that of a memory card and, in particular, to an electrical connector for connecting a data processing device, for example, a personal computer, to an external memory device, for example, a hard disk drive.

### BACKGROUND OF THE INVENTION

External memory mediums or devices electrically connectable to the personal computer, e.g., a memory card, a hard disk drive, etc. are used to increase the storage capacity of the personal computer. The storage capacity of these devices varies. The memory capacity of a memory card is determined and limited by the number of memory elements incorporated therein and the memory capacity of each individual memory element. As a consequence, when a memory card is used for application requiring a large memory capacity, the memory elements must each have a large memory capacity.

However, because memory cards are designed to be compact, the number and capacity of the memory elements incorporated therein is restricted. In view of the limited memory capacity of a memory card, in some applications, it may be desirable to use the hard disk drive as an external storage device due to its greater memory capacity. In addition to the limited capacity, memory cards are generally expensive due to the cost of the memory elements incorporated therein.

In the Japanese market, for example, a typical memory card, for example, a Static Random Access Memory ("SRAM") type



- 2 -

memory card with a 1 MB to 2 MB memory capacity costs about 20,000 to 30,000 yen. Further, a memory card with a 10 MB to 20 MB memory capacity (requiring memory elements of greater memory capacity, such as a flash memory) costs for about 5 200,000 to 300,000 yen. In contrast thereto, a hard disk drive costs about 80,000 yen for a memory capacity of 80 MB, about 100,000 yen for a memory capacity of 100 MB, and about 150,000 yen for a memory capacity of 200 MB.

Therefore, in view of the comparison between memory 10 capacity and price, it may be desirable to use the hard disk drive rather than a the memory card in certain applications because hard disk drives have a larger memory capacity than memory cards and are also less expensive.

Because the hard disk drive is larger than the memory 15 card, it is difficult to load it into a compact personal computer, in particular, into a notebook computer, for example. As a consequence, most compact computers are designed to have a memory card insertion slot or a connector for a memory card so that they may use a memory card as an external memory 20 medium. In order to connect a hard disk drive to a computer designed as described above, a new connector is needed.

#### SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide an electrical connector which can meet the above- 25 mentioned need. In particular, an object of the present invention is to provide an electrical connector which can be used to connect a data processing device designed to use a memory card as an external memory medium to other inexpensive external memory devices having large memory capacity.

30 According to one aspect of the present invention, an electrical connector is provided which can electrically connect a data processing device via a connection for a memory card to an external memory device via a cable adapted to interface the external memory device.

35 The electrical connector includes a frame having an outer dimension substantially the same as that of the memory



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- 3 -

and a plurality of connection elements located at one end  
and at another end in its longitudinal direction, the plurality  
of connection elements located at the one end being adapted to  
be electrically connectable to the data processing device via  
the connection for the memory card, and the plurality of  
connection elements located at the other end being adapted to  
be electrically connectable to the cable.

The electrical connector may further include a board  
held in the frame and having a circuit for electrically  
connecting the connection elements located at the one end of  
the frame to the connection elements located at the other end  
of the frame.

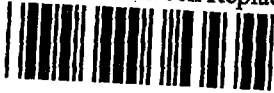
According to a further aspect of the present  
invention, an electrical connector is provided which includes  
a board having a plurality of connection elements at one end  
adapted to be electrically connectable to the data processing  
device via the connection for the memory card, having another  
end being electrically connectable to the cable, and having a  
circuit for electrically connecting the one end to the other  
end.

The electrical connector further includes a frame  
having an external dimension substantially the same as that of  
the memory card and holding the board therein.

Preferably, the data processing device to be connected  
to these electrical connectors has a space for receiving the  
memory card and the frame of the electrical connector is  
adapted to be inserted into the receiving space for the memory  
card.

According to a further aspect of the present  
invention, an electrical connector is provided which  
electrically connects a data processing device via a connection  
for a memory card to an external memory device via a cable  
adapted to interface the external memory device, the data  
processing device including a space for receiving the memory  
card and a hook for latching the memory card inserted in the  
memory card receiving space.

The electrical connector includes a board having a



- 4 -

plurality of connection elements at one end adapted to be electrically connectable to the data processing device via the connection for the memory card, having another end being electrically connectable to the cable, and having a circuit for electrically connecting the one end to the other end.

The electrical connector further includes a frame holding the board therein, including a first portion placed on a connection element side of the board and having an outer dimension substantially the same as that of the memory card so as to be insertable into the memory card receiving space of the data processing device, a second portion extending from the first portion and placed on a cable connection side of the board, and an engaging portion between the first portion and the second portion configured to be engagable with the hook of the data processing device for latching the memory card.

In this embodiment of the invention, the width of the second portion of the housing may be greater than the width of the first portion of the housing. In addition, the data processing device in this embodiment may have an electrical connector for forming an electrical connection with the memory card and the memory card receiving space and the engaging hook of the data processing device are provided in the electrical connector for the memory card.

In the above described electrical connector of the present invention, electronic circuit components may be mounted on the board.

According to another embodiment of the invention, an electrical connector is provided for electrically connecting a data processing device via a connection for a memory card to an external memory device.

The electrical connector includes a frame having an outer dimension substantially the same as that of the memory card and a flexible circuit board having a plurality of connection elements at its one end, a plurality of connection elements at the other end and a circuit for electrically connecting the one end to the other end, the one end being held in the frame, the connection elements at the one end being

- 5 -

5 device to be electrically connectable to the data processing device via the connection for the memory card, the other end extending from the frame, and the connection elements at the other end being adapted to be electrically connectable to the external memory device.

10 In the aforementioned electrical connectors, the frame desirably has a cover for covering the board held in the frame. In addition, in the aforementioned electrical connectors, at least one group of the connection elements at the one end and at least one group of the connection elements at the other end are male or female elements.

15 The data processing device and the external memory device being electrically connected by the electrical connector of the present invention are typically a personal computer and a hard disk drive, respectively. In addition, the term "personal computer" should be understood to cover a compact version of a personal computer, that is, a laptop, a notebook and a palmtop computer...

#### BRIEF DESCRIPTION OF THE DRAWINGS

20 Figure 1 is a perspective view of a card-type connector according to a first embodiment of the present invention.

Figure 2 is a perspective view of the card type connector of Figure 1 as well as a system having a personal computer and a hard disk drive both of which are to be connected to each other by the connector.

Figure 3 is a perspective view of the card type connector of Figure 1 with its housing partly broken away.

Figure 4 is a perspective view of a card type connector according to a second embodiment of the present invention.

Figure 5 is a perspective view of the card type connector of Figure 4 with its housing partly taken away.

Figure 6 is a perspective view of a card type connector according to a third embodiment of the present invention.

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- 6 -

Figure 7 is a perspective view of a card type connector according to a fourth embodiment of the present invention.

Figure 8 is a perspective view of a card type connector according to a fifth embodiment of the present invention.

Figure 9 is an exploded perspective view of the card type connector of Figure 8 as viewed from its bottom side.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figure 1, an electrical connector 2 of the present invention is shown. The housing 4 of the electrical connector or card-type connector 2 is designed to have substantially the same outer dimension as that of a standard memory card. For example, memory cards are standardized under Japan Electronic Industry Development Association ("JEIDA"). The housing 4 of the electrical connector 2 may be configured according to the standards set forth under JEIDA.

As a consequence, the housing 4 of the electrical connector 2 may fit into the connection for a memory card for a personal computer as shown in Figure 2. In particular, the housing 4 of the electrical connector 2 may be connected to the memory card insertion slot or a connector 22 provided in the personal computer 200.

The embodiment of the electrical connector 2 is discussed in more detail with reference to Figure 3. In particular, the housing 4 of the card-type connector 2 has female connector units or elements 6 and 8 at its front and rear ends. These two female connector units 6 and 8 are electrically connected to each other by a rigid printed circuit board 10 housed in the housing 4. In detail, a plurality of contact terminals 12 in the respective female connector units 6 and 8 are soldered to the circuit pattern 14 on the printed circuit board 10. The female connector units 6 and 8 are similar to connector units used in a well known memory cards, as a consequence, their structure is well known.

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- 7 -

connector unit 6 at the front end of card type connector 2 can be connected to a male connector unit, not shown, located in the memory card connector 22 in the personal computer 200. The female connector unit 8 at the rear end of the connector 2 can be connected to a male connector unit 32 of a well known harness 30 for connecting the card type connector 2 to a hard disk drive ("HDD") 210. The harness 30 includes the male connector unit 32, a female connector unit 34 to be connected to a male connector unit 26 of the HDD 210, and a cable 36 for electrically connecting the male connector unit 32 and the female connector unit 34.

As shown in Figure 2, the personal computer 200 can be connected to the HDD 210 by the card-type connector 2 and the harness 30 by inserting the housing 4 of the card-type connector 2 into the memory card connector 22 of the personal computer 200. As a result, data transmission and reception can be performed between the personal computer 200 and the HDD 210.

Referring to Figure 4, a card-type connector 2' according to a second embodiment of the present invention is shown. The connector 2' has a housing 4 and a printed circuit board 10 both of which are similar to those in the first embodiment. One major difference between the first embodiment and the second embodiment is in the system for connecting the card type connector 2' to the well known harness 30.

As shown in more detail in Figure 5, the card-type connector 2' of the second embodiment has no female connector unit 8 at its rear end (HDD side) and the cable 36 of the harness 30 has no male connector unit 32 (corresponding to the female connector unit 8 in the first embodiment of the invention). In this embodiment, portions of conductors on the PC-side end of the cable 36 of the harness are soldered directly to a circuit pattern 14 on the printed circuit board 10 in the housing 4 of the card-type connector 2'.

As a consequence, when the housing 4 of the card-type connector 2' is inserted into the memory card connector 22 (Figure 2) in the personal computer 200, the personal computer

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can be connected to the HDD 210 (Figure 2) (as in the case of the first embodiment) enabling data transmission and reception between the personal computer 200 and HDD 210 via the electrical connector 2' of the second embodiment of the invention.

Referring to Figure 6, a card-type connector 20 according to a third embodiment of the present invention is shown. The card type connector 20 is designed to be latched by memory card latching hooks (not shown) provided in the memory card connector 22 (Figure 2) of the personal computer 200. In the memory card connectors, latching hooks are well known which perform latching engagement with a rear end of the memory card inserted into the memory card connector to prevent the memory card from accidentally ejecting out from the memory card connector while the memory card transmits data to the personal computer or receives data therefrom. The card type connector 20 is configured to engage such well known latches so that the card 20 will not become dislodged upon insertion in the memory card connector 22 of the personal computer 200 according to the third embodiment of the invention.

In particular, the card type connector 20 has a housing 40, and the housing 40 is divided into a front portion 40a and a rear portion 40b by a pair of grooves 42 opposed in its width direction. Length L1 of the front portion 40a of the housing 40 is equal to that of the standardized memory card. The width  $W_1$  and  $W_2$  (here  $W_1 = W_2$ ) of the front and rear portions 40a and 40b of the housing 40 are equal to that of the standardized memory card. The grooves 42 are adapted to be engaged with the latching hooks of the above-mentioned memory card connector 22 so that the card 20 will become securably engaged to the memory card connector 22 upon insertion therein.

A printed circuit board (not shown) having a configuration corresponding to that of the housing 40 is housed in the housing 40. A plurality of contact terminals of a female connector unit 6 (as shown in the first embodiment) are soldered to a front end (PC side) of a circuit pattern on the printed circuit board. In the same manner as in the second



embodiment, conductors on the PC-side end of the cable 36 of the harness 30 are soldered to a rear end (HDD side) of the circuit pattern on the printed circuit board of the card connector 20.

5 When the front portion 40a of the housing 40 of the card type connector 20 is inserted into the memory card connector 22 of the personal computer 200, the card type connector 20 can connect the personal computer 200 to the HDD 210 (Figure 2) to enable the personal computer 200 to transmit  
10 data to the HDD 210 and to receive data from the HDD 210 in the same manner as in the first and second embodiments of the invention.

In addition, the engagement of the latch hooks of the memory card connector 22 with the grooves 42 of the card-type  
15 connector 20 enables the card-type connector 20 to be securely electrically connected to the memory card connector 22. As a consequence, the card type connector 20 prevents accidental disconnection from the personal computer 200 where an  
20 accidental disconnection may cause operation error when data transfer (transmission and reception) is being performed between the personal computer 200 and the HDD 210.

Referring to Figure 7, a card type connector 20 according to a fourth embodiment of the present invention is shown. A housing 40' has a front portion 40a' having the same  
25 shape and size as a standardized memory card. One difference between the fourth embodiment and the third embodiment of the connector of the present invention is the rear portion of the connector. In particular, the rear portion 40b' of the housing 40' of the fourth embodiment of the invention is designed to be  
30 connected to a cable 36' of a harness 30' having width  $W_3$  greater than the standard width of a memory card. The width  $W_2$  of a rear portion 40b' of the housing 40' is greater than the width  $W_1$  of the front portion 40a' ( $W_2 > W_1$ ) where the width  $W_1$  of the front portion 40a' is substantially equal to the  
35 standard width of a memory card. Similarly, the width of a rear end of a printed circuit board (not shown) in the housing 40' is greater than that of a front end of the printed circuit



as shown in Figure 6, if the width  $W_3$  of the cable is not substantially equal to  $W_1$ , the cable cannot be soldered to the printed circuit board 10. In contrast to this, in the fourth embodiment shown in Figure 7, it is possible to connect the cable 36' having a relatively larger width  $W_3$  to the printed circuit board 10 by setting the width  $W_2$  of the rear portion 40b' of the housing 40' to have the relationship  $W_2 > W_3 > W_1$ .

Referring to Figure 8, a card-type connector 20" according to a fifth embodiment of the present invention is shown. One difference between the fifth embodiment of the invention and the first embodiment of the invention is that a flexible printed circuit board 50 is used in place of the rigid printed circuit board 10. The printed circuit board 50 of this embodiment uses a three-layered board. Connector elements on each end of the board 50 are connected by a circuit pattern 52 formed on the circuit board 50. The frame 54 of the connector 20" is designed to have substantially the same outer shape and outer size as a standard memory card.

As shown in Figure 9, the frame 54 of the connector 20" has an opening 56 at its rear end. In this embodiment, one end 58 of the flexible printed circuit board 50 is inserted into the frame 54 through the opening 56 and is soldered to a female connector unit 60 equipped with a plurality of conductive female terminals or elements 62.

The female connector unit 60 has lugs 64 at its both ends. The female connector unit 60 is fitted in the frame 54 by inserting the lugs 64 into corresponding grooves 66 in the front end of the frame 54. The female connector unit 60 can be electrically connected to a personal computer 200 (not shown in Figure 9). In this embodiment of the invention, the other end of the flexible printed circuit board 50, extending out from the frame 54 through the opening 56, is soldered to a relatively small rigid board 68.

The rigid board 68 has a plurality of through holes 70 which are connectable to a connector (not shown in Figure 9)

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- 11 -

the HDD 210. When the frame 54 of the connector 20" is inserted into the memory card connector 22 of the personal computer 200, the personal computer is connected to the HDD 210 so that data transmission and reception can be performed between the personal computer and the HDD.

Finally, the frame 54, preferably, has covers (not shown) at its upper and lower surfaces to prevent the circuit pattern 52 from short circuiting.

The present invention is not limited to the above mentioned embodiments. Various changes and modifications of the present invention can be made without departing from the spirit and scope of the present invention. For example, in the first to fourth embodiments, if there is no risk of short circuit of the circuit pattern on the circuit board, the housings of these embodiments may be replaced with a frame which exposes the circuit board held therein as in the fifth embodiment.

Although, in the respective embodiments, the circuit board in the housing of the card type connector has only the circuit pattern, it may be possible to mount electronic circuit components on the circuit board.

Other standards for the design the housing of the card type connector may be used in addition to the standard for the memory card under the JEIDA. For example, the standard of the Personal Computer's Memory Card International Association ("PCMCIA") or other standards may be used.

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is claimed is:

1. An electrical connector for electrically connecting  
a data processing device via a connection for a memory card to  
an external memory device via a cable adapted to interface the  
5 external memory device, comprising:

a frame having an outer dimension substantially the  
same as that of the memory card and a plurality of connection  
elements located at one end and at another end in its  
longitudinal direction, the plurality of connection elements  
10 located at the one end being adapted to be electrically  
connectable to the data processing device via the connection  
for the memory card, and the plurality of connection elements  
located at the other end being adapted to be electrically  
connectable to the cable.

15 2. An electrical connector according to claim 1 further  
comprising a board held in the frame and having a circuit for  
electrically connecting the connection elements located at the  
one end of the frame to the connection elements located at the  
other end of the frame.

20 3. An electrical connector according to claim 2, wherein  
electronic circuit components are mounted on the board.

4. An electrical connector according to claim 1, wherein  
the data processing device has a space for receiving the memory  
card and the frame is adapted to be inserted into the receiving  
25 space for the memory card.

5. An electrical connector according to claim 2, wherein  
at least one group of the connection elements at the one end  
and at least one group of the connection elements at the other  
end are male elements.

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- 13 -

5        An electrical connector according to claim 2, wherein  
      least one group of the connection elements at the one end  
      and at least one group of the connection elements at the other  
      end are female elements.

7.        An electrical connector according to claim 2, wherein  
the frame has a cover for covering the board held in the frame.

8.        An electrical connector according to claim 2, wherein  
the data processing device is a personal computer.

9.        An electrical connector according to claim 2, wherein  
10 the external memory device is a hard disk drive.

10.       An electrical connector for electrically connecting  
a data processing device via a connection for a memory card to  
an external memory device via a cable adapted to interface the  
external memory device, comprising:

15        a board having a plurality of connection elements at  
one end adapted to be electrically connectable to the data  
processing device via the connection for the memory card,  
having another end being electrically connectable to the cable,  
and having a circuit for electrically connecting the one end to  
20 the other end; and

      a frame having an external dimension substantially the  
same as that of the memory card and holding the board therein.

11.       An electrical connector according to claim 10, wherein  
electronic circuit components are mounted on the board.

25 12.       An electrical connector according to claim 10, wherein  
the data processing device has a space for receiving the memory  
card and the frame is adapted to be insertable into the  
receiving space for the memory card.

13.       An electrical connector according to claim 10, wherein  
30 the connection elements at the one end are male elements.

This Sheet Has Been Replaced





- 14 -

An electrical connector according to claim 10, wherein connection elements at the one end are female elements.

15. An electrical connector according to claim 10, wherein the frame has a cover for covering the board held in the frame.

5 16. An electrical connector according to claim 10, wherein the data processing device is a personal computer.

17. An electrical connector according to claim 10, wherein the external memory device is a hard disk drive.

18. An electrical connector for electrically connecting a data processing device via a connection for a memory card to an external memory device via a cable adapted to interface the external memory device, the data processing device including a space for receiving the memory card and a hook for latching the memory card inserted in the memory card receiving space, the  
15 connector comprising:

a board having a plurality of connection elements at one end adapted to be electrically connectable to the data processing device via the connection for the memory card, having another end being electrically connectable to the cable,  
20 and having a circuit for electrically connecting the one end to the other end; and

a frame holding the board therein, including a first portion placed on a connection element side of the board and having an outer dimension substantially the same as that of the  
25 memory card so as to be insertable into the memory card receiving space of the data processing device, a second portion extending from the first portion and placed on a cable connection side of the board, and an engaging portion between the first portion and the second portion configured to be  
30 engagable with the hook of the data processing device for latching the memory card.

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- 16 -

An electrical connector for electrically connecting a data processing device via a connection for a memory card to an external memory device, comprising:

a frame having an outer dimension substantially the same as that of the memory card; and

a flexible circuit board having a plurality of connection elements at its one end, a plurality of connection elements at the other end and a circuit for electrically connecting the one end to the other end, the one end being held  
10 in the frame, the connection elements at the one end being adapted to be electrically connectable to the data processing device via the connection for the memory card, the other end extending from the frame, and the connection elements at the other end being adapted to be electrically connectable to the  
15 external memory device.

28. An electrical connector according to claim 27, wherein the data processing device has a space for receiving the memory card and the frame is adapted to be inserted into the receiving space for the memory card.

20 29. An electrical connector according to claim 27, wherein electronic circuit components are mounted on the circuit board.

30. An electrical connector according to claim 28, wherein at least one group of the connection elements at the one end and at least one group of the connection elements at the other  
25 end are male elements.

31. An electrical connector according to claim 28, wherein at least one group of the connection elements at the one end and at least one group of the connection elements at the other end are female elements.

30 32. An electrical connector according to claim 28, wherein the frame has a cover for covering the board held in the frame.

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- 17 -

An electrical connector according to claim 28, wherein  
data processing device is a personal computer.

34. An electrical connector according to claim 28, wherein  
the external memory device is a hard disk drive.

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