

[54] **INTERCHANGEABLE ADAPTER MODULE FOR ELECTRONIC DEVICES**

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[\*] **Notice:** The portion of the term of this patent subsequent to Jun. 26, 2007 has been disclaimed.

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**Related U.S. Application Data**

[63] Continuation of Ser. No. 286,311, Dec. 19, 1988, Pat. No. 4,936,785.

[51] **Int. Cl.<sup>5</sup>** ..... **H01R 9/09**

[52] **U.S. Cl.** ..... **439/75; 439/76; 439/620**

[58] **Field of Search** ..... **439/59-62, 439/76, 65, 74, 75, 620; 361/394, 395, 396, 399, 412, 413, 414, 415, 401, 402**

[56] **References Cited**

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[57] **ABSTRACT**

An interchangeable adapter module allows a circuit board, tape cartridge system, or other add-on device to be readily interfaced with any of a variety of different computer systems. A number of pins extend perpendicularly outward from the device circuit board. An adapter circuit board having a pin connector attached thereto engages these pins to removably secure the adapter module in a plane parallel to the device circuit board. One or more external connectors attached to the adapter circuit board are then plugged into corresponding connectors of the external electronic system. Electrical interface circuitry on the adapter circuit board provides electrical interconnections between a predetermined set of the pins attached to the device, and a predetermined set of the electrical contacts of the external connectors.

**17 Claims, 3 Drawing Sheets**

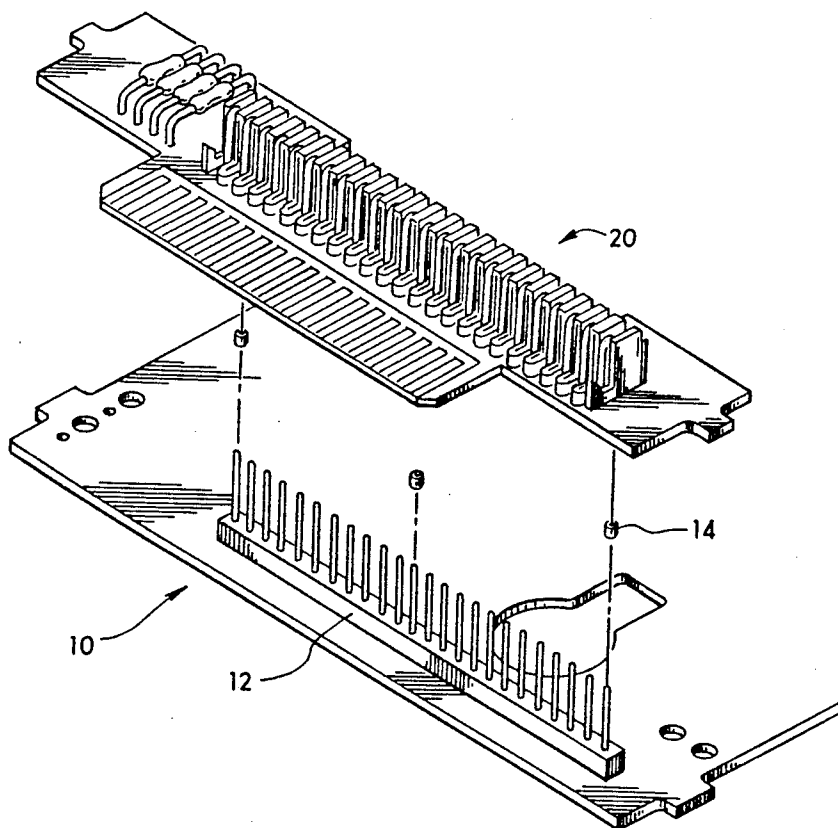


Fig. 1

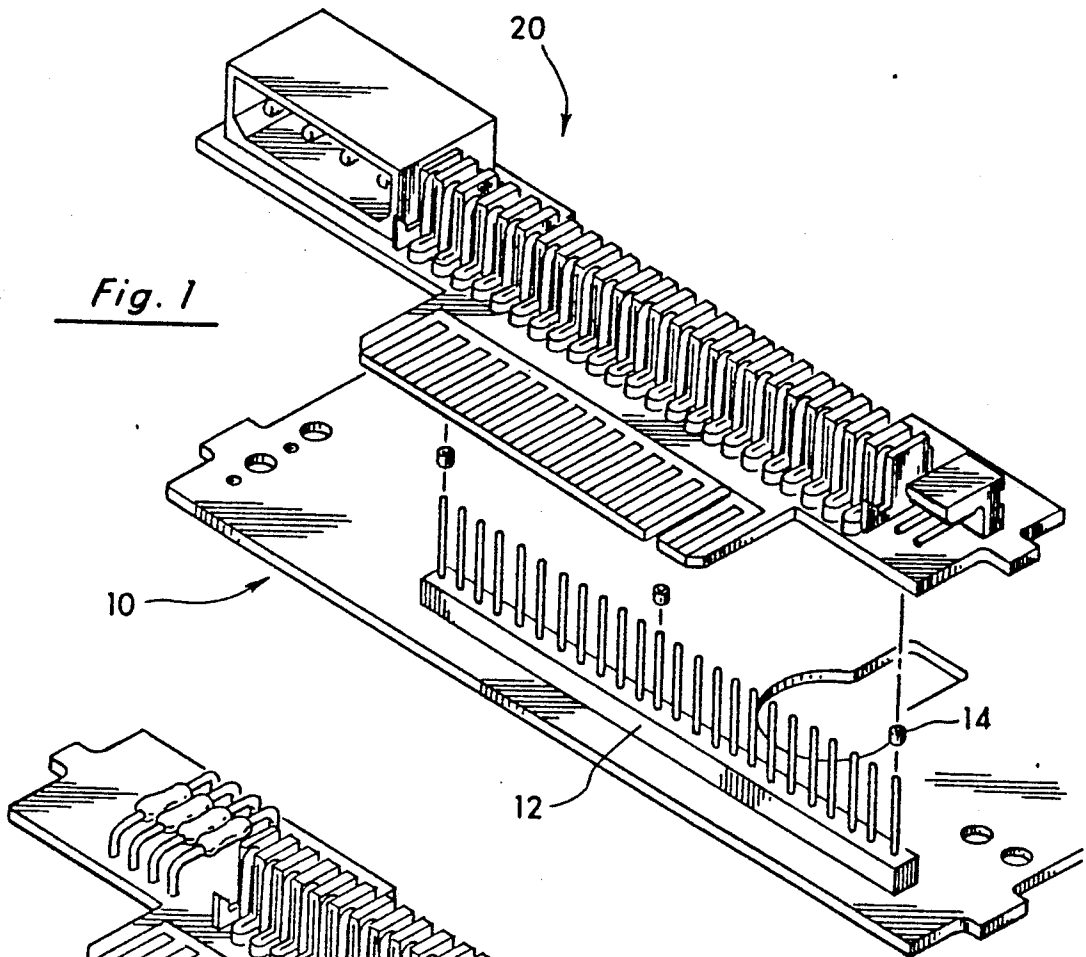
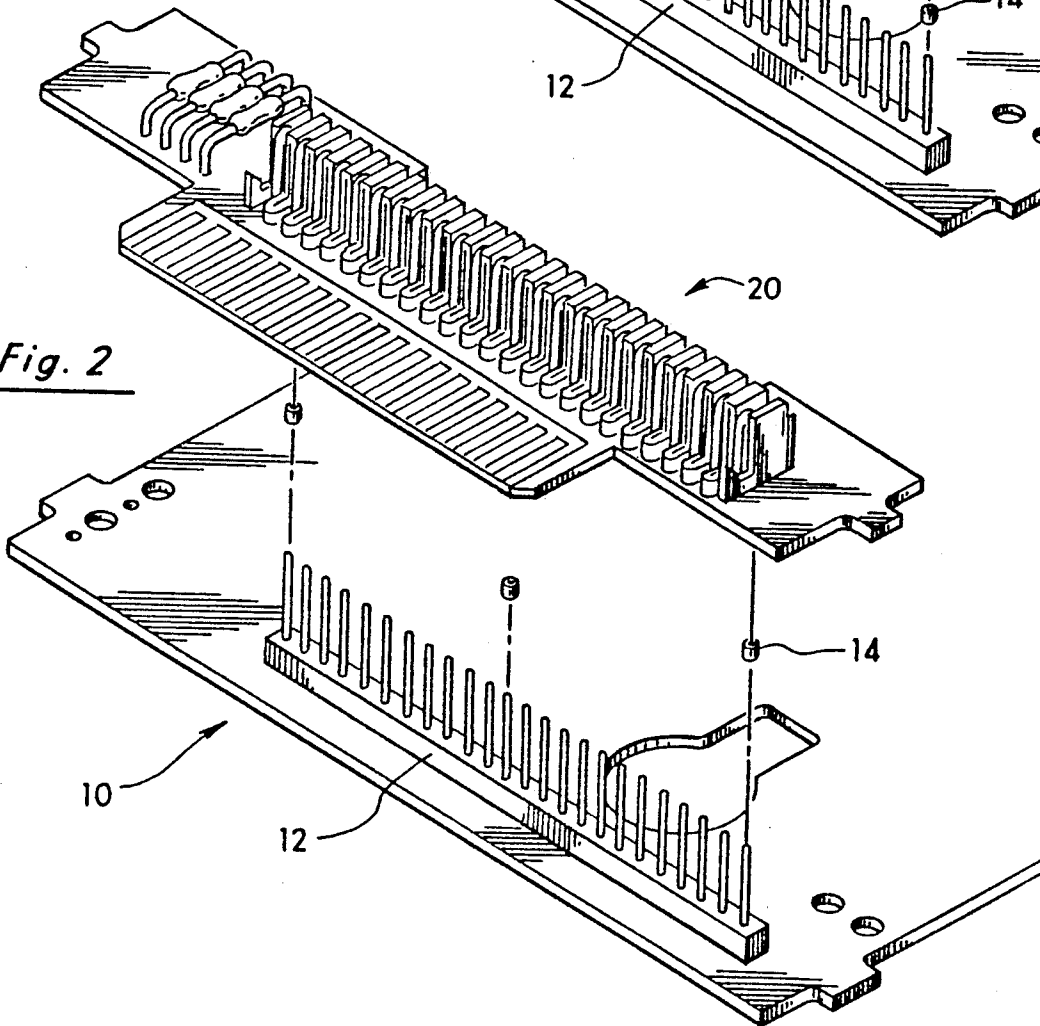
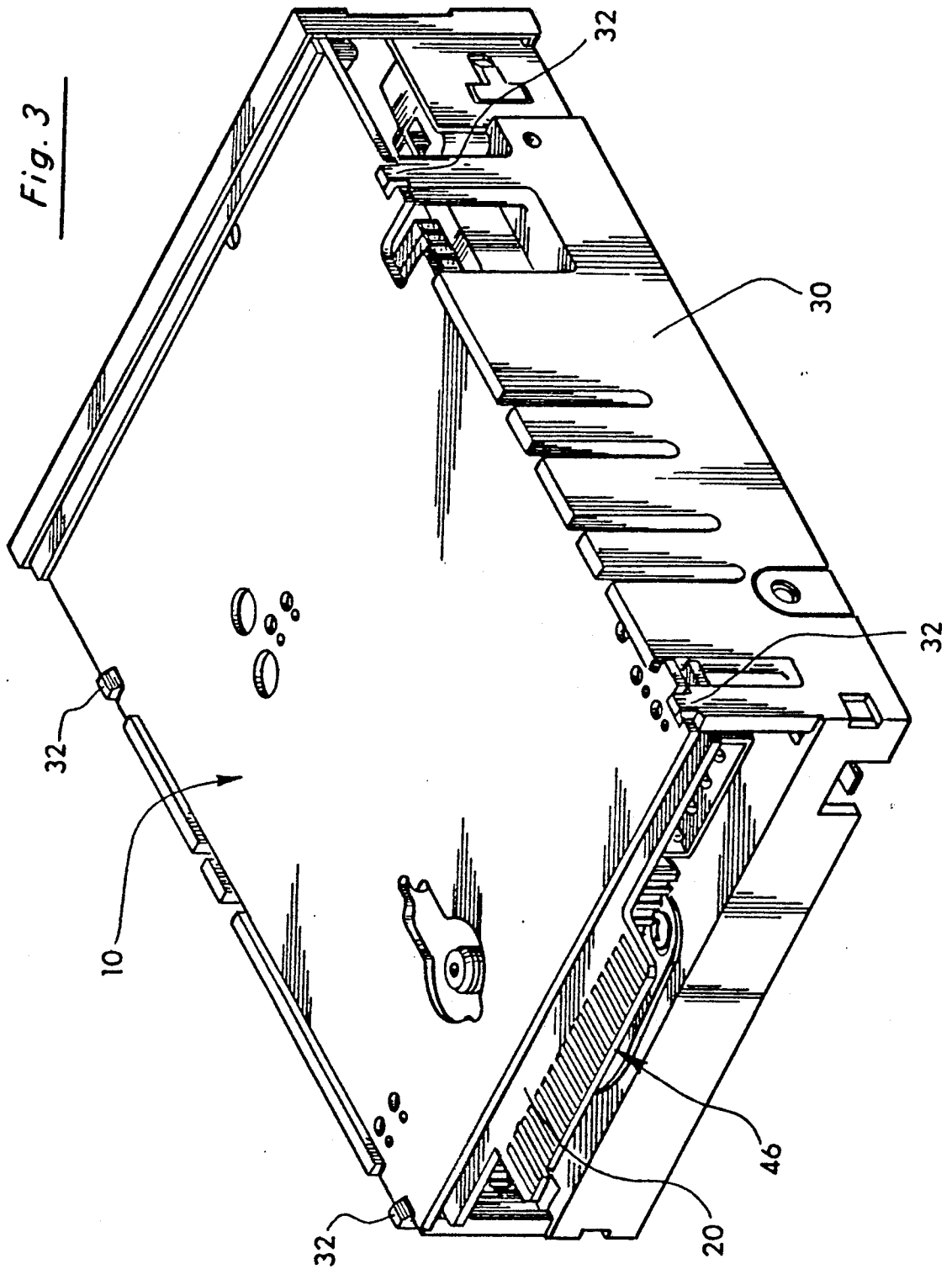
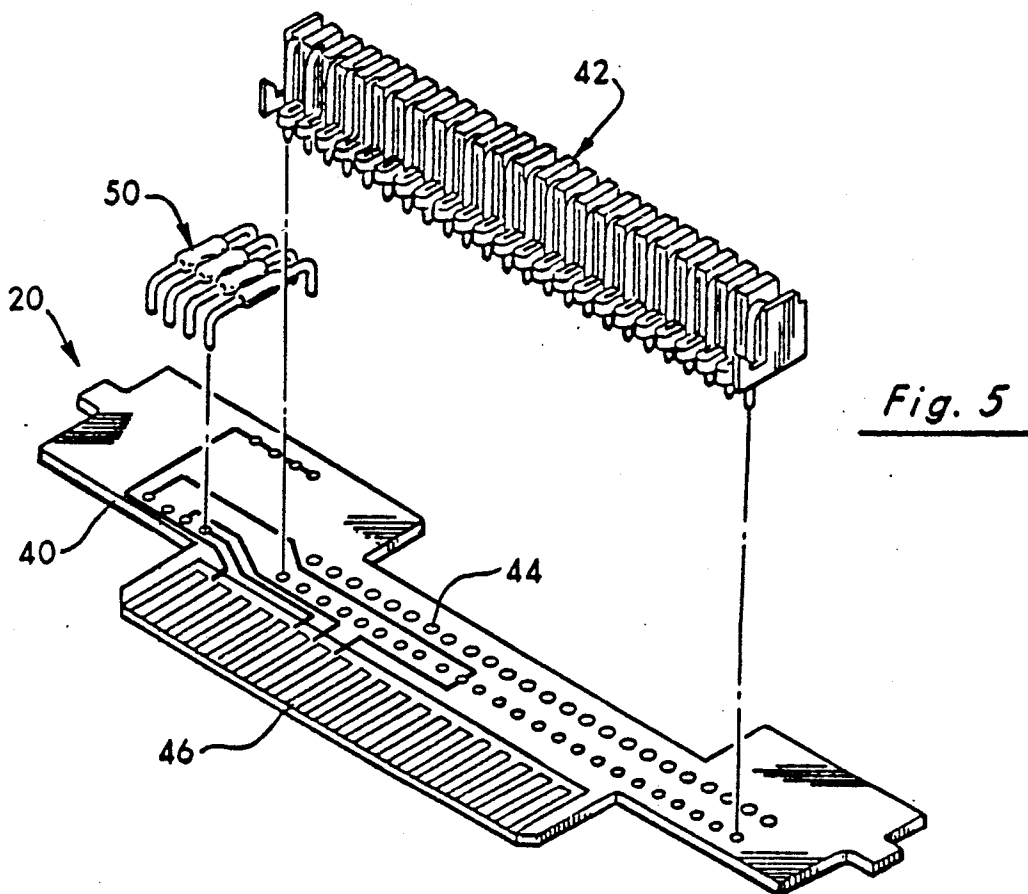
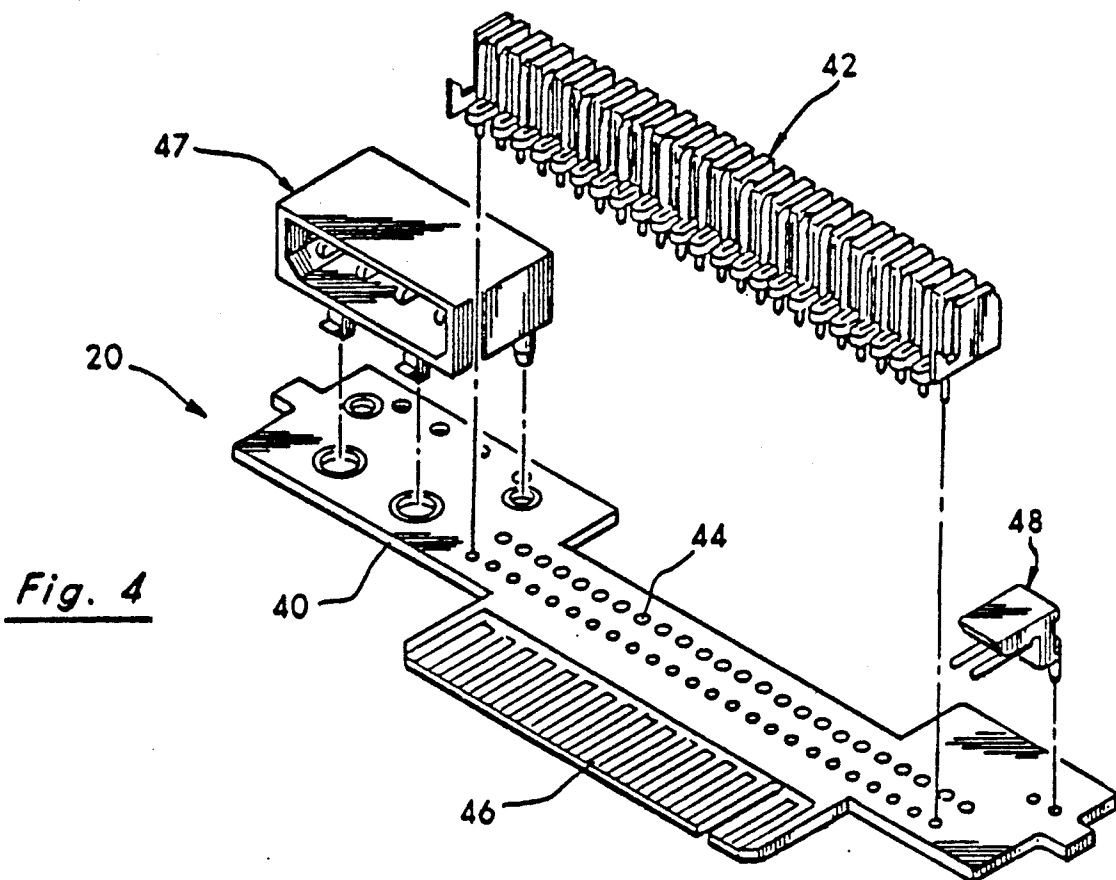


Fig. 2







## INTERCHANGEABLE ADAPTER MODULE FOR ELECTRONIC DEVICES

### RELATED APPLICATION

The present application is a continuation of co-pending U.S. patent application Ser. No. 07/286,311, entitled "Interchangeable Adapter Module for Electronic Devices", filed on Dec. 19, 1988 now U.S. Pat. No. 4,936,785.

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates generally to the field of electrical connectors and interface adapters for electronic devices, and in particular to interchangeable adapter modules that can be used to provide an electrical interface for a circuit board, tape cartridge system, or other add-on devices in any of a variety of different computer systems.

#### 2. Statement of the Problem

In the computer industry, a substantial "add-on" market has developed for devices and circuit boards manufactured by third parties that can be added to existing computer systems. For example, a number of manufacturers produce memory boards, disk drives, and tape backup systems that can be added to personal computers. Virtually all computer systems make provision, to some degree, for these add-on devices. Most personal computers have a number of expansion slots for this purpose, each of which have appropriate electrical connectors to interface the expansion board with the system bus and power supply. In addition, most personal computers provide a number of slots or openings in the front of the unit to house floppy disk drives, hard disk drives, or other mass storage devices such as a tape cartridge system. Each of these slots is also provided with appropriate electrical connectors to interface with the system bus and power supply. In order to function properly as part of a given computer system, an add-on device must be both physically and electrically compatible with the electrical connectors provided by the host computer system.

A problem arises due to the fact that the types of physical connectors and electrical interfaces used by various computer manufacturers for these add-on devices are different. Some computer systems use a different number of signal lines to communicate, while others use different types of connectors. For example, interfaces used in IBM personal computers are different from those used in Apple or Commodore computers. The numerous companies producing clones of IBM personal computers generally use the same interfaces as IBM to ensure complete compatibility. However, even within the IBM family of personal computers, different interfaces are used for different models. The interfaces for an IBM PS/2 computer are different from those for an IBM PC-AT, which in turn are different from those for an IBM PC or PC-XT.

Heretofore, the usual solution to this problem has been for manufacturers of add-on devices to produce a separate product customized for each type of computer system. In particular, the main circuit board of the add-on device is changed to accommodate whatever differences exist in the interface. This approach has the disadvantage of requiring a separate inventory of products and spare parts for each type of computer system, thereby resulting in higher costs for manufacturing and

distributing the products. In addition, the resulting smaller volume of each product greatly reduces or eliminates any economies of scale that might otherwise be available in the manufacturing process.

#### 3. Solution to the Problem

The present invention overcomes this problem by using a small inexpensive adapter circuit board to provide an interface for the larger, more expensive, main circuit board of the device. Given a number of these interchangeable adapters, it becomes possible to easily install the same device (including the same main circuit board) in any of a variety of different computer interface configurations.

### SUMMARY OF THE INVENTION

This invention provides an interchangeable adapter module that allows a circuit board, tape cartridge system, or other add-on device to be readily interfaced with any of a variety of different computer systems.

A number of pins extend perpendicularly outward from the device circuit board. An adapter circuit board having a pin connector attached thereto engages these pins to secure the adapter module in a plane parallel to the device circuit board. One or more external connectors attached to the adapter circuit board are then plugged into corresponding connectors of the external electronic system. Electrical interface circuitry on the adapter circuit board provides electrical interconnections between a predetermined set of the pins attached to the device, and a predetermined set of the electrical contacts of the external connectors.

A primary object of the present invention is to provide a small, inexpensive, interchangeable adapter module that allows such add-on devices to be interfaced to any of a number of different computer systems, without having to change the large, expensive main circuit board of the device for each type of computer system. This allows the device to be manufactured in larger batches to allow economies of scale. In addition, the user can more easily adapt the add-on device to interface with any new configuration of computer system that may be acquired in the future.

These and other advantages, features, and objects of the present invention will be more readily understood in view of the following detailed description and the drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention can be more readily understood in conjunction with the accompanying drawings, in which:

FIG. 1 is an exploded perspective view showing the adapter module and the series of pins used to attach the adapter module to the main circuit board of the device.

FIG. 2 is an exploded perspective view showing an alternative embodiment of the adapter module for use in association with a different type of computer system.

FIG. 3 is a rear perspective view showing the adapter module incorporated into a tape cartridge system.

FIG. 4 is an exploded perspective view showing the adapter circuit board, pin connector, and three external connectors. This view corresponds to the adapter module shown in FIG. 1.

FIG. 5 is an exploded perspective view showing an alternative embodiment of the adapter circuit board with a pin connector, one external connector, and four

terminating resistors. This view corresponds to the adapter module shown in FIG. 2.

### DETAILED DESCRIPTION OF THE INVENTION

Turning to FIG. 1, an exploded perspective view is shown of one end of the main circuit board 10 of the add-on device, and the adapter module 20. A number of pins 12 extend perpendicularly upward from the main circuit board 10. These pins are generally arranged in a row, or series of rows, adjacent to one edge of the main circuit board. Each pin is in electrical contact with one of the input or output electrical signals of the device necessary to allow the device to function and provide an effective interface between the device and the host computer system.

FIG. 2 shows an alternative embodiment of the adapter module 20 shown in FIG. 1. This is to demonstrate the readily interchangeable nature of the adapter modules 20. The main circuit board 10 and pins 12 remain the same, regardless of which adapter module is used. The adapter module 20 is installed simply by sliding it over the pins 12 extending upward from the main circuit board 10.

FIGS. 4 and 5 are exploded perspective views of two embodiments of the adapter modules 20, corresponding respectively to FIGS. 1 and 2. The key element in both embodiments is the adapter circuit board 40 which holds all of the remaining components of the adapter module 20. This adapter circuit board 40 has a number of holes 44 arranged to match the pins 12 attached to the device circuit board 10.

A pin connector 42 is mounted to adapter circuit board 40 in alignment with the holes 44. When the adapter module 20 is attached to the device circuit board 10, the pins 12 pass through the holes 44 and are removably secured by the pin connector 42. Both the pins and pin connector are of conventional design. For example, a conventional back entry pin connector of the type available from Molex of 2222 Wellington Court, Lisle, Ill. 60532 has been found to be suitable. The back entry pin connector has a series of spring-loaded contacts that firmly hold the pins 12. The adapter circuit board 40 is thereby held in an orientation parallel to the plane of the device circuit board 10. The minimum spacing between these two circuit boards is determined by the height of the base of the pins 12. Additional spacing can be provided by including a number of spacers 14 between the circuit boards, as shown in FIGS. 1 and 2.

As shown in FIGS. 4 and 5, a number of external electrical connectors 46, 47 and 48 are attached to the adapter circuit board 40. The number and type of these external connectors for a given adapter module will be determined by the interface requirements of the host computer system. For example, the external connector 46 in FIG. 4 is one type of conventional edge connector commonly used to interface with the bus of the host computer system. An edge connector of this type generally extends outward from the adapter circuit board 40 in the plane of said adapter circuit board, with a number of electrical contacts on the upper and/or lower surfaces of the connector. The second external connector 47 is a 4-pin socket connector that can be connected to the power system of the host computer system. The third external connector 48 is a 2-pin fan connector. An alternate adapter module 20 is shown in FIG. 5 for use with IBM PS/2 personal computers in which all of the

necessary electrical interface is provided by a single edge connector 46.

Electrical interface circuitry on the adapter circuit board 40 provides electrical interconnection between a predetermined set of the pins 12 and a predetermined set of the electrical contacts of external connectors 46, 47, and 48. Beyond providing simple interconnections, the interface circuitry can also provide signal processing. FIG. 5 shows four resistors 50 intended to allow signal levels from the device to match the interface signal levels required by an IBM PS/2 computer. The interface circuitry can also provide a termination resistance to pins that are not otherwise used by the host computer's interface.

FIG. 3 is a perspective rear view showing the adapter module 20 as assembled as part of a typical add-on device 30, such as a tape cartridge system for a personal computer. The device circuit board 10 forms the top surface of the device 30, and is held in place by a number of clips 32. This example is typical of many applications of the present invention. One edge of the device circuit board 10 extends along the back edge of the device. The pins 12 extend in a row along the back edge of the device circuit board 10 as shown in FIGS. 1 and 2. The adapter circuit board 40 is removably secured to the pins, such that the back edge of the adapter circuit board 40 is substantially in alignment with the back edge of the device circuit board. The edge connector 46 then extends beyond the back edge of the device circuit board 10. As mentioned previously, the vertical alignment of the edge connector 46 with respect to the top or bottom of the device can be fixed by inserting spacers 14 of appropriate thickness between the adapter circuit board 40 and the base of the pins 12. This configuration is particularly advantageous where the device is to be installed in one of the disk drive slots in the front of a personal computer. The device is simply inserted through the opening in the front of the computer, and the external connectors of the device are then easily connected by hand to the corresponding connectors of the computer system. In the case of an IBM PS/2 computer, the external edge connector 46 of the adapter module will automatically mate with the corresponding female edge connector of the computer as the device is inserted through the front of the computer.

The above disclosure sets forth a number of embodiments of the present invention. Other arrangements or embodiments, not precisely set forth, could be practiced under the teachings of the present invention and as set forth in the following claims.

We claim:

1. In an electronic device having general application in association with a number of different computer systems, an adapter module to provide a specific interface between said electronic device and one of said computer systems having an opening adapted to receive said electronic device by insertion along an axis and further having a number of connectors embodying a predetermined mechanical and electrical protocol for connection with said electronic device; said electronic device having an end located adjacent to said computer system connector after installation of said electronic device, and at least one circuit board with an edge adjacent to said end, said adapter module comprising:

(a) a plurality of electrical conductors attached to said circuit board adjacent to said edge, extending perpendicular to said circuit board; each of said

conductors in electrical contact with one of a predetermined set of electrical signals of said device;

(b) an adapter circuit board;

(c) a first electrical connector attached to said adapter circuit board suitable for removable engagement with said electrical conductors, such that said adapter circuit board can be removably secured to said device circuit board in a plane substantially parallel to the plane of the device circuit board adjacent to said edge;

(d) a number of external electrical connectors attached to said adapter circuit board, said external electrical connectors having a plurality of electrical contacts adapted to mate with said electrical connectors of said computer system, at least one of said external electrical connectors being an edge connector formed as an integral part of said adapter circuit board extending for a predetermined distance beyond said edge of said device circuit board;

(e) electrical interface circuitry on said adapter circuit board, providing electrical interconnection between a predetermined set of said electrical conductors of said device and said electrical contacts of said external electrical connectors in accordance with said protocol of said computer system.

2. The adapter module of claim 1, wherein said electrical conductors attached to said device circuit board comprise a number of metallic pins.

3. The adapter module of claim 2, wherein said first electrical connector comprises a back entry pin connector.

4. The adapter module of claim 2, further comprising a number of spacer elements adjacent to said pins to determine the minimum spacing between said adapter circuit board and said device circuit board.

5. The adapter module of claim 1, wherein said interface circuitry also provides signal processing for a number of the electrical signals interconnected through said interface circuitry between said first electrical connector and said external connectors.

6. The adapter module of claim 1, wherein said interface circuitry also provides a predetermined termination resistance to a number of said electrical conductor of said first electrical connector that are not interconnected through said interface circuitry to said external connectors.

7. In an electronic device having general application in association with a number of different computer systems, an adapter module to provide a specific interface between said electronic device and one of said computer systems having an opening adapted to receive said electronic device by insertion along an axis and further having a number of connectors embodying a predetermined mechanical and electrical protocol for connection with said electronic device; said electronic device having an end located adjacent to said computer system connector after installation of said electronic device, and at least one circuit board with an edge adjacent to said end, said adapter module comprising:

(a) a plurality of pins attached to said circuit board of said electronic device, extending perpendicularly outward from said circuit board in a number of rows adjacent to said edge of said circuit board; each of said pins in electrical contact with one of a predetermined set of electrical signals of said device;

(b) an adapter circuit board having a number of holes adapted to permit said pins to pass through said adapter circuit board;

(c) a pin connector attached to said adapter circuit board, having spring-loaded electrical contacts that removably engage with said pins, such that said adapter circuit board can be removably secured to said device circuit board in a plane substantially parallel to the plane of the device circuit board, with a predetermined spacing separating said adapter circuit board and said device circuit board;

(d) an edge connector extending outward from said edge of said adapter circuit board for a predetermined distance beyond said end of said electronic device, said edge connector having a plurality of electrical contacts suitable for electrical connection with at least one of the connectors of said computer system;

(e) electrical interface circuitry on said adapter circuit board, providing electrical interconnection between a predetermined set of the electrical contacts of said pin connector and a predetermined set of the electrical contacts of said edge connector.

8. The adapter module of claim 7, wherein said pin connector is a back entry pin connector.

9. The adapter module of claim 7, further comprising a number of spacer elements adjacent to said pins to determine the minimum spacing between said adapter circuit board and said device circuit board.

10. The adapter module of claim 7, wherein said interface circuitry also provides signal processing for a number of the electrical signals interconnected through said interface circuitry between said pins and said edge connector.

11. The adapter module of claim 7, wherein said interface circuitry also provides a predetermined termination resistance to a number of said pins that are not interconnected through said interface circuitry to said edge connector.

12. In an electronic device having general application in association with a number of different computer systems, an adapter module to provide a specific interface between said electronic device and one of said computer systems having an opening adapted to receive said electronic device by insertion along a predetermined axis and further having a number of connectors, including at least one edge connector, within said opening embodying a predetermined mechanical and electrical protocol for connection with said electronic device; said electronic device having at least one circuit board with an edge adjacent to said computer system edge connector after insertion of said electronic device into said opening, and further having a plurality of electrical conductors adjacent to said edge, extending substantially perpendicular to said circuit board, with each of said conductors in electrical contact with one of a predetermined set of electrical signals of said electronic device; said adapter module comprising:

(a) an adapter circuit board;

(b) a number of external electrical connectors attached to said adapter circuit board, said external electrical connectors having a plurality of electrical contacts adapted to mate with said electrical connectors of said computer system; at least one of said external electrical connectors being an edge connector extending for a predetermined distance

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beyond said edge of said device circuit board parallel to said axis of insertion and being adapted to mate with said computer system edge connector during insertion of said electronic device into said opening;

(c) an adapter electrical connector attached to said adapter circuit board suitable for removable engagement with said electrical conductors of said electronic device, adapted to removably secured said adapter circuit board to said electronic device circuit board in a predetermined position adjacent to said edge such that said adapter edge connector is aligned to mate with said computer system edge connector during insertion of said electronic device into said opening; and

(d) electrical interface circuitry on said adapter circuit board providing electrical interconnection between a predetermined set of said electrical conductors of said electronic device and said electrical contacts of said external electrical connectors in accordance with said protocol of said computer system.

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13. The adapter module of claim 12, wherein said electrical conductors attached to said electronic device circuit board comprise a number of metallic pins.

14. The adapter module of claim 13, wherein said adapter electrical connector comprises a back entry pin connector adapted to receive said pins.

15. The adapter module of claim 13, further comprising a number of spacer elements adjacent to said pins to provide a predetermined spacing between said adapter circuit board and said device circuit board.

16. The adapter module of claim 12, wherein said interface circuitry also provides signal processing for a number of the electrical signals interconnected through said interface circuitry between said first electrical connector and said external connectors.

17. The adapter module of claim 12, wherein said interface circuitry also provides a predetermined termination resistance to a number of said electrical conductor of said first electrical connector that are not interconnected through said interface circuitry to said external connectors.

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