

ELECTRICAL CONNECTOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an electrical connector, and more particularly, to an electrical connector configured for receiving paired
5 devices.

2. Description of the Related Art

U.S. Patent No. 6,250,966 B1 discloses an electrical connector designed to connect a flexible circuit board at one side and a mating
10 connector at an opposite side. The electrical connector includes an integrally formed insulating housing having a cavity for receiving a corresponding contact. The contact has a base section, wider than two opposite female contact sections, configured to intersect the cavity in the vertical direction. The contacts are pressed into a predetermined position
15 through one opening of the insulating housing and secured in the housing by barbs on the contacts interference fitting the insulating housing.

The insulating housing of an electrical connector adapted to connect two devices in line is usually complex. This is particularly true when the electrical connector connects two devices having significantly different
20 configurations. It is not easy to maintain the manufacture quality of a complex insulating housing.

Further, the contacts used in a one-piece insulating housing are usually secured in the insulating housing via interference-fitting barbs formed on the contacts. After the contacts are assembled, the barbs anchor on the
25 surface of the insulating housing, holding the contacts in place. The contacts are held mainly by the force of the interference fit between the tip of the barbs and the surface of the insulating housing. Generally, such a force is not sufficiently large, and the contacts might be moved away from their predetermined position when the contacts are pushed or pulled.

SUMMARY OF THE INVENTION

An objective of the present invention is to provide a connector that has a simple configuration and that can be easily manufactured.

Another objective of the present invention is to provide a connector,
5 the terminals of which can be firmly secured.

In order to achieve the above objectives, an electrical connector is provided. The electrical connector comprises upper and lower housings, a plurality of upper terminals, and a plurality of lower terminals. The upper and lower housings define a first receiving slot and a second receiving slot
10 opposite the first receiving slot. Each upper terminal includes a first contact portion extending within the first receiving slot, a second contact portion extending within the second receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the upper housing. Each lower terminal includes a first contact portion extending
15 within the first receiving slot, a second contact portion extending within the second receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the lower housing.

The present invention is embodied as an electrical connector, which includes a lower housing, a middle housing, an upper housing, a plurality of
20 first lower terminals, a plurality of second lower terminals, a plurality of first upper terminals, and a plurality of second upper terminals. The middle housing is disposed on the lower housing and combines with the lower housing to define a first lower receiving slot and a second lower receiving slot. The upper housing is disposed on the middle housing and combines
25 with the middle housing to define a first upper receiving slot and a second upper receiving slot. Each first lower terminal includes a first contact portion extending within the first lower receiving slot, a second contact portion extending within the second lower receiving slot, and a retaining portion disposed between the first and second contact portions and held
30 inside the lower housing. Each second lower terminal includes a first

contact portion extending within the first lower receiving slot, a second contact portion extending within the second lower receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the middle housing. Each first upper terminal includes a first
5 contact portion extending within the first upper receiving slot, a second contact portion extending within the second upper receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the middle housing. Each second upper terminal includes a first
10 contact portion extending within the first upper receiving slot, a second contact portion extending within the second upper receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the upper housing.

Other objects, advantages and novel features of the invention will become apparent from the following detailed description when read in
15 conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described according to the appended drawings in which:

FIG. 1 is a perspective view showing an electrical connector according
20 to one embodiment of the present invention;

FIG. 2 is a perspective exploded view of the electrical connector of FIG. 1;

FIG. 3 is another perspective exploded view of the electrical connector of FIG. 1;

25 FIG. 4 is a top view of the electrical connector of FIG. 1;

FIG. 5 is a cross-sectional view along line 5-5 of FIG. 4;

FIG. 6 is a cross-sectional view along line 6-6 of FIG. 4;

FIG. 7 is a fragmentary perspective view showing the upper terminal, the lower terminal, and the interlocking member of an electrical connector according to one embodiment of the present invention;

5 FIG. 8 is a fragmentary perspective view showing the interlocking member of an upper housing and the interlocking member of a lower housing according to one embodiment of the present invention;

FIG. 9 is a perspective view showing the arrangement of the interlocking members of the upper and lower housing according to one embodiment of the present invention;

10 FIG. 10 is a view showing the configuration of the interlocking member and the arranged relationship between the interlocking members of the upper housing and the interlocking members of the lower housing according to one embodiment of the present invention;

15 FIG. 11 is a perspective view showing interlocking elements according to one embodiment of the present invention;

FIG. 12 is a cross-sectional view showing the engagement between the interlocking element and the cavity according to one embodiment of the present invention;

20 FIG. 13 is a perspective showing an electrical connector according to another embodiment of the present invention;

FIG. 14 is a perspective exploded view of the electrical connector of FIG. 13;

FIG. 15 is another perspective exploded view of the electrical connector of FIG. 13;

25 FIG. 16 is a cross-sectional view showing the arrangement of the first and second lower terminals and the arrangement of the first and second upper terminals in the upper, middle, and lower housings according to one embodiment of the present invention;

FIGS. 17 and 18 are fragmentary perspective views showing the interlocking members of the upper housing, the first and second interlocking members of the middle housing, and the interlocking members of the lower housing according to one embodiment of the present invention;
5 and

FIG. 19 is a cross-sectional view showing the interlocking elements of the upper housing and the middle housing engaging with the cavities according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

10 Hereinafter, embodiments of the present invention are described in detail with reference to the attached drawings.

FIG. 1 is a perspective view showing an electrical connector 1 according to one embodiment of the present invention. Referring to FIG. 1, the embodied electrical connector 1 is configured to oppositely receive two
15 electronic devices 2 and 3, in which one electronic device 2 may be a daughter card or a card edge module such as a memory module, and another electronic device 3 may be a flexible flat cable, flexible printed circuit board, or mother board.

FIG. 2 is a perspective exploded view of the electrical connector 1 of FIG. 1, and FIG. 3 is another perspective exploded view of the electrical connector 1 of FIG. 1. Referring to FIGS. 1 to 3, the electrical connector 1 comprises separately built, elongated upper and lower housings 11 and 12, between which a plurality of upper terminals 13 and a plurality of lower terminals 14 are arranged along a longitudinal direction of the upper
20 housing 11 or the lower housing 12. The stacked upper and lower housings 11 and 12 can be secured using an upper bracket member 15, a lower bracket member 16, and a plurality of fasteners 17 such as screws or rivets. The upper housing 11 and the lower housing 12 are formed with a plurality of holes 111 and 121 as shown in FIG. 3, and the upper and lower bracket
25 members 15 and 16 are separately formed with holes 152 and 162. The
30

plurality of fasteners 17 are inserted respectively through the holes 111 and 121 of the upper and lower housings 11 and 12 and the holes 152 and 162 of the upper and lower bracket members 15 and 16 so as to screw or rivet the upper bracket member 15 and the lower bracket member 16 and to
5 secure the upper housing 11 and the lower housing 12.

As shown in FIG. 2, the upper bracket member 15 and the lower bracket member 16 can extend in such a manner that their two opposite end portions 151 and 161 are adjacent to the two opposite ends 112 or 122 of the upper housing 11 or the lower housing 12 so that the entire upper
10 housing 11 and lower housing 12 can be secured. The upper bracket member 15 and the lower bracket member 16 can be fastened together, in one embodiment, at the two opposite end portions 151 and 161, and at a location between the two polarized ribs 123 and 128.

As shown in FIG. 2, in one embodiment, the upper housing 11 may
15 include an indentation 113 configured to receive the upper bracket member 15. The indentation 113 can be configured to make the assembled upper housing 11 and upper bracket member 15 constitute a flat top surface. Similarly, referring to FIG. 3, the lower housing 12 may include an indentation 124, which can be configured to completely receive the lower
20 bracket member 16 and to make the assembled lower housing 12 and lower bracket member 16 constitute a flat top surface to have a flat bottom surface.

As shown in FIGS. 2 and 3, the upper and lower bracket members 15 and 16 can be components distinct from the upper and lower housings 11 and 12. The separated upper bracket member 15, lower bracket member 16,
25 upper housing 11, and lower housing 12 can be easily manufactured. Alternatively, the upper bracket member 15 and the upper housing 11 can be formed integrally by an insert-molding process, and the lower bracket member 16 and the lower housing 12 can be formed integrally by an insert-molding process. As such, fewer components of the electrical connector 1
30 are needed, simplifying the manufacturing and assembling processes.

In one embodiment, the upper and lower bracket members 15 and 16 can be metal. The metal upper and lower bracket members 15 and 16 can have sufficient strength to prevent the stressed upper and lower housings 11 and 12 from deflection.

5 FIG. 4 is a top view of the electrical connector 1 of FIG. 1. FIG. 5 is a cross-sectional view along line 5-5 of FIG. 4, and FIG. 6 is a cross-sectional view along line 6-6 of FIG. 4. Referring to FIGS. 4 to 6, the upper and lower housings 11 and 12 define, in combination, a first receiving slot 18 configured for receiving the mated edge portion of an electronic device 2 and a second receiving slot 19 disposed opposite the first receiving slot 18,
10 configured for receiving the mated edge portion of an electronic device 3. Each upper terminal 13 includes a first contact portion 131, a second contact portion 132 extending substantially opposite to the first contact portion 131, and a retaining portion 133 disposed between the first and second contact portions 131 and 132. As shown in FIG. 5, the first contact portion 131 extends within the first receiving slot 18 for electrical engagement with the electronic device 2. The second contact portion 132 extends within the second receiving slot 19 for electrical engagement with the electronic device 3. The retaining portion 133 extends transverse to the
15 insertion direction of the electronic device 2 or 3 and is held inside the upper housing 11 so that the upper terminal 13 can be firmly held in position, and cannot be moved even if a large push or pull force, caused by the insertion or removal of an electronic device 2 or 3, is applied on the upper terminal 13.
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25 In one embodiment, the first or second contact portion 131 or 132 is configured to deform elastically when the electronic device 2 or 3 is inserted into the electrical connector 1 such that clamping force can be generated to secure the inserted electronic device 2 or 3.

Referring to FIG. 6, in a similar manner, each lower terminal 14
30 includes a first contact portion 141, a second contact portion 142 extending substantially opposite to the first contact portion 141, and a retaining

portion 143 disposed between the first and second contact portions 131 and 132. The first contact portion 141 extends within the first receiving slot 18 for electrical engagement with the electronic device 2, and the second contact portion 142 extends within the second receiving slot 19 for electrical engagement with the electronic device 3. The retaining portion 143 extends transverse to the insertion direction of the electronic device 2 or 3 and is held inside the lower housing 12 so that the lower terminal 14 will not be moved even if a large push or pull force, caused by the insertion or removal of an electronic device 2 or 3, is applied on the lower terminal 14.

In particular, in one embodiment, the retaining portion 133 or 143 may be a plate element. In the present embodiment, each terminal 13 or 14 may include two retaining portions 133 or 143. Correspondingly, the upper and lower housings 11 and 12 may respectively include a plurality of cavities 115 and 125. The retaining portions 133 and 143 of the upper and lower terminals 13 and 14 are configured to interference fit the respective cavities 115 and 125 using, for example, laterally projecting barbs for firmly securing the upper and lower terminals 13 and 14.

Referring to FIG. 5, each upper terminal 13 may include a body portion 134 extending between and connecting the first contact portion 131 and the second contact portion 132, and the retaining portion 133 projects from the body portion 134 in a direction transverse to the extension direction of the body portion 134. Similarly, as shown in FIG. 6, each lower terminal 14 may include a body portion 144 extending between and connecting the first contact portion 141 and the second contact portion 142, and the retaining portion 143 projects from the body portion 144 in a direction transverse to the extension direction of the body portion 144.

Such arrangement of retaining portions 133 and 143 of upper and lower terminals 13 and 14, extended transverse to the electronic device insertion direction, does not allow easy assembly into an integrally formed housing. The design of two-piece housings, the upper housing 11 and the lower

housing 12, can avoid designing and manufacturing a complex single housing for holding the upper and lower terminals 13 and 14. The retaining portions 133 and 143 of the upper and lower terminals 13 and 14 are respectively inserted into the cavities 115 and 125 of the upper and lower housings 11 and 12. The upper and lower housing 11 and 12 installed with the upper and lower terminals 13 and 14 are then assembled, and the assembly of housings and the terminals are easily completed.

Referring to FIGS. 5 to 7, to firmly secure an electronic device 2 or 3, the first contact portions 131 and 141 or the second contact portions 132 and 142 shall sufficiently deflect to generate sufficient clamping force. To generate sufficient clamping force to secure a thin electronic device 3, the plurality of lower terminals 14 are arrayed in a staggered manner along the elongation direction of the upper housing 11 or the lower housing 12, and the contact tips 1321 of the second contact portions 132 and the contact tips 1421 of the second contact portions 142 are juxtaposed with each other in an alternating manner.

FIG. 8 is a fragmentary perspective view showing the interlocking member of an upper housing and the interlocking member of a lower housing according to one embodiment of the present invention. Referring to FIG. 8, the upper housing 11 includes a first interlocking member 114 and the lower housing 12 includes a companion second interlocking member 126, wherein the first interlocking member 114 of the upper housing 11 and the second interlocking member 126 of the lower housing 12 establishes interlocking connection when the upper and lower housings 11 and 12 are assembled so as to prevent the upper and lower housings 11 and 12 from the deflection caused by the force from compressed upper terminals 13 and lower terminals 14 while an electronic device 2 or 3 is inserted.

In one embodiment, the upper housing 11 includes a first interlocking member 114 formed on the side of the upper housing 11 facing the lower housing 12 when the upper and lower housings 11 and 12 are assembled. The first interlocking member 114 includes the interlocking portion 1141

configured for interlocking engagement. The interlocking portion 1141 is configured to extend toward the portion of the upper housing 11 defining the first receiving slot 18 as shown in FIG. 6. Similarly, the lower housing 12 includes a second interlocking member 126 formed on the side of the lower housing 12 facing the upper housing 11 when the upper and lower housings 11 and 12 are assembled. The second interlocking member 126 includes an interlocking portion 1261 configured for engaging the interlocking portion 1141 of the first interlocking member 114. The interlocking portion 1261 can, in one embodiment, extend toward the portion of the lower housing 12 defining the second receiving slot 19 as shown in FIG. 6.

In particular, the interlocking portion 1141 of the first interlocking member 114 and the interlocking portion 1261 of the second interlocking member 126 extend in opposite directions. The upper and lower housings 11 and 12 are stacked in a direction. The interlocking portion 1141 of the first interlocking member 114 comes into a hooked engagement with the interlocking portion 1261 of the second interlocking member 126 in the direction when the upper and lower housings 11 and 12 are assembled. Under such an arrangement, the interlocking portion 1141 and the interlocking portion 1261 can establish interlocking connection so as to securely interlock the assembled upper and lower housings 11 and 12.

In one embodiment, as shown in FIGS. 7 to 9, the upper housing 11 may comprise a plurality of interlocking members 114 arranged between the first and second receiving slots 18 and 19, along the elongation direction of the upper housing 11, and spaced apart from each other. Correspondingly, the lower housing 12 may comprise a plurality of interlocking members 126 between the first and second receiving slots 18 and 19, arranged along the elongation direction of the lower housing 12, and spaced apart from each other. The plurality of interlocking members 114 and the plurality of interlocking members 126 interlock together so as to prevent the upper and lower housings 11 and 12 from being deflected in direction along the

elongation direction of the upper or lower housings 11 or 12.

As shown in FIG. 10, the plurality of interlocking members 114 and the plurality of interlocking members 126 can be staggered relative to each other. In particular, the plurality of interlocking members 114 or 126 can be spaced apart with a pitch P. Each of the plurality of interlocking members 114 or 126 can have a width W, preferably, greater than one half of the pitch P. As such, the interlocking engagement between the plurality of interlocking members 114 and the plurality of interlocking members 126 can be ensured.

As shown in FIGS. 11 and 12, the vertically stacked upper housing 11 and lower housing 12 can be further secured by interlocking elements 116. The upper housing 11 may include two interlocking elements 116 disposed adjacent to the two opposite ends 112 of the upper housing 11. In a corresponding manner, the lower housing 12 may include two cavities 127. The interlocking elements 116 and the cavities 127 respectively cooperate to prevent the upper housing 11 and the lower housing 12 from separating vertically. In one embodiment, as shown in FIG. 11, the interlocking element 116 extends downward and has an interlocking portion 1161 extending in a direction parallel to the extending direction of the interlocking portion 1141 of the first interlocking member 114, and the cavities 127 face opposite to the extending direction of the interlocking portion 1161. After the upper and lower housings 11 and 12 are assembled, the interlocking portion 1161 enters the respective cavity 127.

FIG. 13 is a perspective showing an electrical connector 5 according to another embodiment of the present invention. FIG. 14 is a perspective exploded view of the electrical connector 5 of FIG. 13. Referring to FIGS. 13 and 14, the electrical connector 5 comprises a lower housing 51, a middle housing 52 disposed on the lower housing 51, and an upper housing 53 disposed on the middle housing 52. As shown in FIG. 15, the lower housing 51 and the middle housing 52, in combination, define a first lower receiving slot 54 (as shown in FIG. 16) for receiving an electronic device 58

and a second lower receiving slot 55 (as shown in FIG. 16) for receiving an electronic device 59 opposite the electronic device 58. The upper housing 53 and the middle housing 52, in combination, define a first upper receiving slot 56 for receiving an electronic device 60 and a second upper receiving slot 57 for receiving an electronic device 61. In one embodiment, the electronic devices 58 and 60 can be a card edge module or a daughter card, and the electronic devices 59 and 61 can be a flexible flat cable, flexible printed circuit board, or mother card.

In the same manner, the assembled lower housing 51, middle housing 52, and upper housing 53 can be secured using an upper bracket member 15 and a lower bracket member 16 secured by a plurality of fasteners 17 such as screws or rivets penetrating through the assembled lower housing 51, middle housing 52, and upper housing 53. The upper bracket member 15 can be physically distinct from the upper housing 53, or alternatively can be formed integrally with the upper housing 53 by an insert-molding process. If the upper bracket member 15 is a distinct component, the upper housing 53 may include an indentation 531 configured to completely receive the upper bracket member 15 and to allow the upper housing 53 and the upper bracket member 15 to commonly constitute a flat upper surface of the electrical connector 5. As shown in FIG. 16, the lower bracket member 16 can be physically distinct from the lower housing 51, or alternatively can be formed integrally with the lower housing 51 by an insert-molding process. If the lower bracket member 16 is a distinct component, the lower housing 51 can also have an indentation 511 configured to completely receive the lower bracket member 16 and to allow the lower housing 51 and the lower bracket member 16 to commonly form a lower flat surface of the electrical connector 5.

Referring to FIGS. 15 and 16, the electrical connector 5 comprises a plurality of first lower terminals 62 fixed at the lower housing 51, a plurality of second lower terminals 63 fixed at the side of the middle housing 52 facing the lower housing 51, a plurality of first upper terminals

64 fixed at the side of the middle housing 52 facing the upper housing 53, and a plurality of second upper terminals 65 fixed at the upper housing 53.

As shown in FIG. 16, each first lower terminal 62 includes a first contact portion 621 extending within the first lower receiving slot 54 for electrically engaging an inserted electronic device 58, a second contact portion 622 extending within the second lower receiving slot 55 for electrically engaging an inserted electronic device 59, and a retaining portion 623 disposed between the first and the second contact portions 621 and 622, configured to be held inside a corresponding cavity 512. Each second lower terminal 63 includes a first contact portion 631 extending within the first lower receiving slot 54 for electrically engaging an inserted electronic device 58, a second contact portion 632 for electrically engaging an inserted electronic device 59, and a retaining portion 633 disposed between the first and second contact portions 631 and 632, configured to be held inside a corresponding cavity 521 of the middle housing 52 facing the lower housing 51. Each first upper terminal 64 includes a first contact portion 641 extending within the first upper receiving slot 56 for electrically engaging an inserted electronic device 60, a second contact portion 642 for electrically engaging an inserted electronic device 61, and a retaining portion 643 disposed between the first and second contact portions 641 and 642, configured to be held inside a corresponding cavity 522 of the middle housing 52 facing the upper housing 53. Each second upper terminal 65 includes a first contact portion 651 extending within the first upper receiving slot 56 for electrically engaging an inserted electronic device 60, a second contact portion 652 for electrically engaging an inserted electronic device 61, and a retaining portion 653 disposed between the first and second contact portions 651 and 652, configured to be held inside a corresponding cavity 523 of the upper housing 53.

In particular, the retaining portion 623, 633, 643, or 653 of the terminal 62, 63, 64, or 65 extends transverse to the insertion direction of the electronic device 58, 59, 60, or 61 and is held inside the respective one of

the lower, middle, and upper housings 51, 52, and 53 such that the terminal 62, 63, 64, or 65 can be firmly held in position, and will not be moved if a large push or pull force is applied on the terminal 62, 63, 64, or 65. In one embodiment, the retaining portion 623, 633, 643, or 653 of the terminal 62, 63, 64, or 65 can be a plate element. In one embodiment, each of the terminals 62, 63, 64, and 65 may include a plurality of retaining portions 623, 633, 643, or 653 so that the terminals 62, 63, 64, and 65 will not incline at different angles after the terminals 62, 63, 64, and 65 are installed.

Each of the terminals 62, 63, 64, and 65 may include a body portion 624, 634, 644, or 654, which extends between and connects the corresponding first contact portion 621, 631, 641, or 651 and the corresponding second contact portion 622, 632, 642, or 651. The retaining portion 623, 633, 643, or 653 of each of the terminals 62, 63, 64, and 65 projects from the body portion 624, 634, 644, or 654 in a direction transverse to the extension direction of the body portion 624, 634, 644, or 654.

FIGS. 17 and 18 are fragmentary perspective views showing the interlocking members of the upper housing, the first and second interlocking members of the middle housing, and the interlocking members of the lower housing according to one embodiment of the present invention. Referring to FIGS. 17 and 18, the lower housing 51 and the middle housing 52 can be interlocked along the longitudinal direction of the lower housing 51 or the middle housing 52 after the lower housing 51 and the middle housing 52 are assembled so that the deflection of the lower and middle housings 51 and 52 can be prevented even if the first and second lower terminals 62 and 63 are elastically deformed by an inserted electronic device 58. The lower housing 51, the middle housing 52, and the upper housing 53 are stacked in a direction. The lower housing 51 can include a plurality of the interlocking members 513 each having an interlocking portion 5131 configured for interlocking engagement, and the middle housing 52 can include a plurality of interlocking members 524 each having

an interlocking portion 5241 configured for interlocking engagement with at least a corresponding interlocking portion 5131 of the interlocking member 513. In one embodiment, the interlocking portions 5131 of the interlocking member 513 and the interlocking portions 5241 of the interlocking members 524 extend in opposite directions, and come into a hooked engagement with one another in the direction when the lower housing 51 and the middle housing 52 are assembled so that the interlocking members 513 and the interlocking members 524 can mutually interlock with each other as shown in FIG. 18.

10 In one embodiment, the interlocking members 513 and the interlocking members 524 can be arranged in a staggered manner as shown in FIG. 10.

Similarly, as shown in FIGS. 17 and 18, the middle housing 52 can include a plurality of the interlocking members 525 each having an interlocking portion 5251 configured for interlocking engagement, and the upper housing 53 can include a plurality of interlocking members 531 each having an interlocking portion 5311 configured for interlocking engagement with at least a corresponding interlocking portion 5251 of the interlocking member 525. In one embodiment, the interlocking portions 5251 of the interlocking members 525 and the interlocking portions 5311 of the interlocking members 531 extend in opposite directions, and come into a hooked engagement with one another in the direction when the middle housing 52 and the upper housing 53 are assembled so that the interlocking members 531 and the interlocking members 525 can mutually interlock with each other as shown in FIG. 18.

25 In one embodiment, the interlocking members 531 and the interlocking members 525 can be arranged in a staggered manner as shown in FIG. 10.

As illustrated in FIGS. 16 and 19, the vertically stacked upper housing 53, middle housing 52, and lower housing 51 can be secured by interlocking elements 527 and 532. The upper housing 53 may include two interlocking elements 532 disposed adjacent to the opposite ends of the upper housing

53. Each interlocking element 532 has a laterally projected interlocking portion 5321 configured to establish an interlocking connection with a cavity 526 formed on the middle housing 52 so as to interlock the upper housing 53 and the middle housing 52. Further, the middle housing 52 includes two interlocking elements 527 disposed adjacent to the opposite ends of the upper housing 53. Each interlocking element 527 has a laterally projected interlocking portion 5271 configured to establish an interlocking connection with a cavity 514 formed on the lower housing 51 so as to interlock the lower housing 51 and the middle housing 52.

10 As shown in FIGS. 13 and 14, the upper housing 53 may include two oppositely disposed latch arms 533 each having a latch portion 5331. The latch arms 533 are for latching an inserted electronic device 60 by the engagement between the latch portions 5331 of the latch arms 533 and the notches 601 on the opposite sides of the inserted electronic device 60. Each latch arm 533 further comprises a pressing portion 5332 configured to hold an electronic device 60 in an inserted position by engaging a top surface of the electronic device 60. In addition, the middle housing 52 may also include two latch arms 528 each having a latch portion 5281. The latch arms 528 are for latching an inserted device 58 with their latch portions 5281 entering into the respective notches 581 of the electronic device 58. Each latch arm 528 further comprises a pressing portion 5282 configured to hold an electronic device 58 in an inserted position by engaging a top surface of the electronic device 58 as shown in FIG. 13.

25 In summary, an embodied electrical connector of the present invention comprises two separated upper and lower housings, and a plurality of terminals each having a retaining portion configured to extend in a direction transverse to the insertion direction of an electronic device. The retaining portions of the terminals are held inside the two separated upper and lower housings such that the terminals can be firmly held in position, and cannot be moved even if a large push or pull force, caused by the insertion or removal of an electronic device, is applied on the terminals. In addition,

with the design of two separated upper and lower housings, the terminals having such retaining portions can be easily installed in the housings. Furthermore, the two upper and lower housings respectively include a plurality of interlocking members disposed along the elongation direction of the housing. The interlocking members of the upper housing and the interlocking members of the lower housing interlock together when the upper housing and the lower housing are assembled so that the upper and lower housings can be prevented from deflecting from the force from compressed terminals while an electronic device is inserted. In addition, the upper and lower housings can be secured using two bracket members fastened by screws or rivets. The bracket members can be respectively molded with the upper and lower housings. As such, the number of components can be reduced.

The above-described embodiments of the present invention are intended to be illustrative only. Numerous alternative embodiments may be devised by persons skilled in the art without departing from the scope of the following claims.

What is claimed is:

1. An electrical connector, comprising:

upper and lower housings defining a first receiving slot and a second receiving slot opposite the first receiving slot;

5 a plurality of upper terminals each including a first contact portion extending within the first receiving slot, a second contact portion extending within the second receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the upper housing; and

10 a plurality of lower terminals each including a first contact portion extending within the first receiving slot, a second contact portion extending within the second receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the lower housing.

2. The electrical connector of Claim 1, further comprising an upper bracket member and a lower bracket member between which the upper and lower housings are disposed.

3. The electrical connector of Claim 2, wherein the upper bracket member and the upper housing are integrally formed by an insert-molding process, and the lower bracket member and the lower housing are integrally formed by an insert-molding process.

20 4. The electrical connector of Claim 2, wherein the upper bracket member and the lower bracket member are screwed or riveted to each other.

5. The electrical connector of any one of Claims 1 to 4, wherein the upper housing and the lower housing are stacked in a direction, and the upper housing includes a plurality of first interlocking members each having an interlocking portion, and the lower housing includes a plurality of second interlocking members each having an interlocking portion, wherein the first and second interlocking members are arranged between the first and second receiving slots, and the interlocking portions of the first

interlocking members are in a hooked engagement with the interlocking portions of the second interlocking members in the direction.

6. The electrical connector of Claim 5, wherein the lower housing includes a cavity, and the upper housing includes an interlocking element disposed adjacent to an opposite end of the upper housing and having an interlocking portion entering into the cavity when the upper and lower housings are assembled.

7. The electrical connector of Claim 6, wherein the first receiving slot is configured to receive a card edge module or a daughter card, and the second receiving slot is configured to receive a flexible flat cable, flexible printed circuit board or a mother card.

8. A electrical connector, comprising:

a lower housing;

a middle housing disposed on the lower housing, combining with the lower housing to define a first lower receiving slot and a second lower receiving slot;

an upper housing disposed on the middle housing, combining with the middle housing to define a first upper receiving slot and a second upper receiving slot;

a plurality of first lower terminals each including a first contact portion extending within the first lower receiving slot, a second contact portion extending within the second lower receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the lower housing;

a plurality of second lower terminals each including a first contact portion extending within the first lower receiving slot, a second contact portion extending within the second lower receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the middle housing;

5 a plurality of first upper terminals each including a first contact portion extending within the first upper receiving slot, a second contact portion extending within the second upper receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the middle housing; and

10 a plurality of second upper terminals each including a first contact portion extending within the first upper receiving slot, a second contact portion extending within the second upper receiving slot, and a retaining portion disposed between the first and second contact portions and held inside the upper housing.

9. The electrical connector of Claim 8, further comprising an upper bracket member and a lower bracket member between which the upper, middle and lower housings are disposed.

15 10. The electrical connector of Claim 9, wherein the upper bracket member and the upper housing are integrally formed by an insert-molding process, and the lower bracket member and the lower housing are integrally formed by an insert-molding process.

11. The electrical connector of Claim 9, wherein the upper bracket member and the lower bracket member are screwed or riveted to each other.

20 12. The electrical connector of any one of Claims 8 to 11, wherein the lower housing, the middle housing, and the upper housing are stacked in a direction, and the lower housing includes a plurality of the interlocking members each having an interlocking portion and the middle housing includes a plurality of first interlocking members each having an
25 interlocking portion, wherein the interlocking members of the lower housing and the first interlocking members of the middle housing are arranged between the first and second lower receiving slots, and the interlocking portions of the interlocking members of the lower housing are in a hooked engagement with the interlocking portions of the first

interlocking members of the middle housing in the direction; the middle housing includes a plurality of second interlocking members each having an interlocking portion and the upper housing includes a plurality of the interlocking members each having an interlocking portion, wherein the
5 second interlocking members of the middle housing and the interlocking members of the upper housing are arranged between the first and second upper receiving slots, and the interlocking portions of the second interlocking members of the middle housing are in a hooked engagement with the interlocking portions of the interlocking members of the upper
10 housing in the direction.

13. The electrical connector of Claim 12, wherein the middle housing includes a first cavity, and the upper housing includes an interlocking element disposed adjacent to an opposite end of the upper housing and having an interlocking portion entering into the first cavity, and
15 the lower housing includes a second cavity and the middle housing includes an interlocking element disposed adjacent to an opposite end of the middle housing and having an interlocking portion entering into the second cavity.

14. The electrical connector of Claim 13, wherein the first upper and lower receiving slots are configured to receive a card edge module or a daughter card, and the second upper and lower receiving slots are
20 configured to receive a flexible flat cable, flexible printed circuit board or mother card.

15. The electrical connector of Claim 14, wherein each of the upper and middle housings includes two oppositely disposed latch arms each having a latch portion engaging a respective notch of the respective
25 card module or daughter board, and each latch arm includes a pressing portion configured to hold the respective card module or daughter board in an inserted position.