

An Electrical Connector

Field of technology

5 [001] This description relates to electrical contacts and electrical connectors, and more particularly to board to board electrical connectors.

Background

10 [002] Over the last two decades, the trend towards compact designs in consumer electronics equipment such as portable communications devices and laptops have led to the development of various low-profile board-to-board connectors that enable circuitry on different circuit boards to be placed in close proximity. Early connectors generally did not have requirements for shielding or grounding contacts due to the absence of signal
15 integrity issues at low data transfer rates. The effects of phenomena such as noise, jitter, skew, near-end and far-end cross-talk and electromagnetic interference (EMI) were generally not significant in early connectors. However, as data communication rates increase from gigabit to terabit levels per second, high signal integrity becomes increasingly difficult to achieve as the effects of these phenomena become more
20 pronounced with increasing transmission frequency.

[003] In order to meet the requirements for high-speed transmission, connectors need to be designed to exhibit superior performance over gigahertz (GHz) ranges of frequencies. An important design requirement from a signal quality perspective is the
25 reduction of signal degrading phenomena in the connector to such a low level that signal quality is not adversely affected. At the same time, it is important that other design requirements are maintained, such as the mechanical strength of connector components to withstand normal use, sufficiently small size and height profile of the connector for incorporation into specified spaces, and so on.

[004] In view of the foregoing, it is desirable to provide a connector having improved signal integrity performance when operating at high data transfer rates over a wide range of frequencies, as well as improved mechanical qualities and design features to withstand mechanical stress.

Summary of invention

[005] In one aspect, an electrical contact for a socket connector comprises a first arm extending along a first direction from a joint to a terminal end for coupling to a contact on a board, the first arm having a straight inner edge and a constant thickness from the joint to the terminal end; and a resilient second arm extending along a second direction not parallel to the first direction from the joint to a contact end for electrical coupling with a mating electrical contact, the first arm and the resilient second arm each having a generally flat configuration disposed in a common plane, the resilient second arm being configured to flex substantially along the common plane when the electrical contact is coupled with a mating electrical contact, the resilient second arm having a straight inner edge and a constant thickness from the joint to the contact end, and an outer edge that tapers from the joint towards the contact end over at least a portion of the resilient second arm.

[006] In another aspect, an electrical contact for a plug connector comprises a first arm extending along a first direction from a joint to a terminal end for coupling to a contact on a board and an engaging portion extending along a different second direction for engaging an insulative body of a plug connector, the first arm having a straight inner edge and a constant thickness from the joint to the terminal end; and a second arm extending along a third direction not parallel to the first direction from the joint to a mounting end, the second arm having a constant thickness from the joint to the mounting end and a reclining outer edge, the joint having a constant width between the first and second arms.

[007] In further aspects, electrical connectors comprising electrical contacts as provided herein, connector assemblies comprising such electrical connectors, and systems comprising connector assemblies are described.

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[008] These and other aspects are described in the detailed description below. In no event should the above summary be construed as a limitation on the claimed subject matter, which is defined solely by the claims as set forth herein.

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Brief Description of the Drawings

[009] Throughout the specification, reference is made to the appended drawings, where like reference numerals designate like elements, wherein:

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[010] FIG. 1 is a cross-sectional view of an electrical contact for a socket connector.

[011] FIG. 2 is a cross-sectional view of an electrical contact for a plug connector.

[012] FIG. 3 is a perspective cross-sectional view of a socket connector.

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[013] FIG. 4 is a perspective view of a socket connector.

[014] FIG. 5 is a perspective cross-sectional view of a plug connector.

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[015] FIG. 6 is a perspective view of a plug connector.

[016] FIG. 7 is a perspective view of the scheme of engagement of a plug connector and a socket connector.

[017] FIG. 8 is a perspective cross-sectional view of the initial engagement of a plug connector and a socket connector.

[018] FIG. 9 is a perspective cross-sectional view of a plug connector fully engaged with a socket connector.

[019] FIG. 10 is a cross-sectional view of a plug connector fully engaged with a socket connector.

[020] FIG. 11 is a table tabulating computer stress analysis simulation results of various electrical contact configurations for socket connectors.

[021] The figures are not necessarily to scale. However, it will be understood that the use of a numeral to refer to a component in a given figure is not intended to limit the component in another figure labeled with the same number.

Detailed Description

[022] Referring to FIG. 1, there is shown an electrical contact 100 for a socket connector according to one embodiment. The electrical contact 100 comprises a first arm 103 and a second arm 118. First arm 103 extends along a first direction shown by arrow 106 from joint 109 to terminal end 112 and serves to electrically couple the electrical contact 100 to a circuit on a circuit board to which the socket connector is mounted. Protrusion 113 is located on the first arm 103 opposite the terminal end 112 and engages an insulative housing of the socket connector in order to secure the electrical contact in place. The first arm 103 has an inner edge 115 which faces the insulative housing. The inner edge 115 has a straight profile and constant thickness from the joint 109 to the terminal end 112.

[023] Resilient second arm 118 extends from joint 109 to a contact end 121 along a second direction shown by arrow 124, and is configured to flex when contact end 121 is coupled with a mating electrical contact. The resilient second arm 118 has an inner edge 130 and an outer edge 133. Inner edge 130 has a straight profile and constant thickness from the joint 109 to the contact end 121. Contact end 121 serves to physically contact, and thus electrically couple, with a mating electrical contact. It may have any suitable shape for enabling slidable contact with the mating electrical contact. In one embodiment, the contact end comprises a round-ended protrusion extending away from the second direction 124. Second direction 124 is not parallel to the first direction 106, and may be set at any suitable angle, such as 60°, 70°, 80°, 90°, 100°, 110° or 120° for example. In this embodiment, second direction 124 is arranged orthogonally, i.e. at 90°, to the first direction 106.

[024] Both the first arm 103 and the resilient second arm 118 have a generally flat configuration and are disposed in a mutually common plane. When coupling with a mating electrical contact, initial insertion forces causes the resilient second arm 118 to deflect or flex as it is abutted against a mating electrical contact. The resilient second arm 118 is configured to flex substantially within the common plane, as shown by arrow 127. In other words, the resilient second arm 118 flexes within the same plane as the first arm 103. The in-plane flexing imposes mechanical stress on the electrical contact. Furthermore, in certain embodiments, the resilient second arm may have a length or profile height of 10 mm or less, or in some embodiments, 5mm or less. The thickness of each arm may be approximately 0.20 mm or less, or 0.15 mm or less, or in one embodiment, approximately 0.12 mm. The combination of short contact length and thinness leads to increased stress and strain on the electrical contact during the in-plane flexing, which in turn may lead to premature breakage of the electrical contact during use.

[025] To deal with the mechanical stress while maintaining design for good signal quality, outer edge 133 has a profile that tapers towards the contact end 121 over at least a portion of the resilient second arm 118, the outer edge 133 facing a mating electrical

connector. In one embodiment, outer edge 133 tapers at or near the joint end of the resilient second arm 118. In FIG. 1, outer edge 133 tapers from the joint 109 towards approximately the middle of the resilient second arm 118, the tapered portion as shown by arrows 135. In general, the outer edge 133 of the resilient second arm 118 may taper to any extent, such as between 10% to 90%, or 40% to 60% of the length of the resilient second arm 118 starting from the joint end 109, or it may taper over the entire length of the resilient second arm 118. The tapering profile may comprise a straight tapering profile or, in other embodiments, it may comprise a concave tapering profile. In other embodiments, it may adopt a combination of a concave tapering profile in combination with a straight tapering profile, as shown in FIG. 1. Other portions of the outer edge 133 that does not taper, as shown by arrow 136, may run parallel, and hence not tapering, relative to the inner edge 130.

[026] In some embodiments, the resilient second arm is configured to withstand mechanical stress exerted on it when it is flexed. In order that no permanent mechanical damage is caused to the electrical contact, various ways of strengthening the resilient second arm can be used. As shown in FIG. 1, the resilient second arm may comprise a reinforced base section 138 that connects to the joint 109. The reinforced base section may comprise a thickened portion of the resilient second arm 118 in which the width of reinforced base section 138 is broader than other parts of the resilient second arm. It may be possible that the electrical contact 100 is heat treated near the joint 109 to strengthen the resilient second arm 118, for example.

[027] Referring to FIG. 2, there is shown an electrical contact 200 for a plug connector according to one embodiment. Electrical contact 200 may be coupled with a corresponding electrical contact 100, for example. The electrical contact 200 comprises a first arm 203 and second arm 218. The first arm 203 extends along a first direction shown by arrow 206 from joint 209 to a terminal end 212. Terminal end 212 serves to couple to an electrical contact on a circuit board to which the plug connector is mounted or connected. First arm 203 includes an engaging portion 215 that extends along a different

second direction 221 from the first direction 206. Engaging portion 215 serves to physically engage an insulative housing of a plug connector in which the electrical contact 200 is arranged. The first arm has an inner edge 224 having a straight profile and constant thickness from the joint 209 to the terminal end 212.

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[028] The second arm 218 extends from the joint 209 to mounting end 227 along a third direction shown by arrow 230 that is not parallel to the first direction 206. The mounting end 227 engages a part of the insulative housing of the plug connector, securing the second arm 218 such that it is rendered immobile in the plug connector. The second arm 218 has constant thickness from the joint 209 to the mounting end 227. The joint 209 has a constant width between the first arm 203 and second arm 218.

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[029] Second arm 218 comprises a reclining outer edge 233. In general, the reclining outer edge 233 may extend over the entire length of the second arm 218, or it may extend over 10% , 20%, 30%, 40% or 50% or 60% or more of the length of the second arm 218 starting from the joint end 209. The reclining outer edge may be located towards the mounting end, or over a substantial portion of the second arm 218. It serves to couple with a mating electrical contact. The backward-sloping profile of the reclining outer edge reduces the initial insertion force that electrical contact 200 exerts on a mating electrical contact during initial engagement, as well as enables mechanical stress on the mating electrical contact to increase gradually during the course of moving the electrical contact 200 over the mating electrical contact. In one embodiment, the reclining outer edge is at an angle of at least 20°, or at least 10°, or approximately 5° or more relative to normal. In another embodiment, the mounting end extends in a fourth direction, the fourth direction being at an angle of at least 20°, or at least 10°, or approximately 5° or more relative to the third direction 230. The reclining outer edge 233 may adopt a straight profile or, in other embodiments, it may adopt a curved profile. In some embodiments, it may adopt a combination of a curved profile in combination with a straight profile. Other portions of the outer edge 235 of the second arm 218 may recline less than reclining outer edge 233, or may be approximately normal to inner edge 224.

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[030] In certain embodiments, the second arm 218 may have a length or profile height of 10 mm or less, or in some embodiments, 5mm or less. The thickness of the second arm 218 and/or the first arm 103 may be configured larger than the thickness of the mating electrical contact, to enable the reclining outer edge, being defined by the thickness of the second arm 218, to securely receive and contact the mating electrical contact for edge to edge coupling. In some embodiments, the thickness of the electrical contact 200 is approximately 0.3mm or less, or 0.2 mm or less, or in one embodiment, approximately 0.17 mm.

[031] FIG. 3 shows a cross section of a socket connector 300 comprising a plurality of electrical contacts 100. The socket connector comprises an insulative housing 303 for accommodating the plurality of electrical contacts 100. In general, the insulative housing 303 may comprise one or more walls configured to define a cavity, and a plurality of contact slots arranged along the at least one wall, and each contact slot accommodating one electrical contact arranged to face the cavity. Although shown as having a rectangular cross-section in the figure, the cavity 315 may have any suitable shape such as a triangle, square or circle cross-section.

[032] In general, the socket connector 300 may comprise 1, 2, 3, or 4 rows of electrical contacts 100. For example, the socket connector may have first row 324 situated along the first wall 306 without the second row 327, or alternatively it may have four rows of electrical contacts situated along, respectively the first wall 306, second wall 309 and the sidewalls 312. In the embodiment shown in FIG. 3, socket connector 300 is provided in which the insulative housing 303 comprises a first wall 306 and a second wall 309 arranged in opposing orientation, and are connected by sidewalls 312 (opposing sidewall not shown in cross-section view). The arrangement of the walls and sidewalls defines a cavity 315 for receiving a plug connector. Base block 317 abuts a plug connector when fully engaged. Two opposing rows of contacts are provided in this embodiment in which each electrical contact in the first row 324 is spaced apart and opposing a respective

electrical contact in the second row 327. The electrical contacts 100 are arranged in a first row 324 within contact slots 318 along the first wall 306, and in a second row 327 within contact slots 321 along the second wall 309. Contact ends 121 may protrude out of contact slots 318, 321 into the cavity 315 for edge coupling with a mating electrical contact in this embodiment. The electrical contacts may be configured for single ended or differential signals, and may be arranged in a ground-signal-signal-ground configuration.

[033] Each contact slot 318, 321 may be adapted to permit the resilient second arm 118 of each electrical contact 100 to be flexed. The portion of the insulative housing 303 defining each contact slot may comprise a reclining wall 330 that faces straight inner edge 130 of each electrical contact 100. When the socket connector is not coupled to a plug connector, a gap exists between the reclining wall 330 and the straight inner edge 130 of each electrical contact 100. When coupled, the gap provides allowance for the resilient second arm 118 to flex backwards towards the reclining wall 330, so that the contact end 121 is recessed within the contact slot 318, 321 once the socket connector 300 is fully engaged with a plug connector. Ribs 325 separate the contact slots 318, 321.

[034] To enable partial shielding, an external shield 333 surrounding the first wall, second wall and sidewalls may be provided. The external shield 333 provides shielding of the electrical contacts from various signal-degrading phenomena such as noise or EMI. FIG. 4 shows a perspective view of the connector 300 having an external shield 333 having solder tabs 336, 339 for securing the socket connector to a circuit board. Releasable latches 342, 345 help to secure the external shield 333 to the insulative housing 303 of socket connector 300.

[035] FIG. 5 shows a cross section of a plug connector 400 comprising a plurality of electrical contacts 200. Plug connector 400 may be coupled with a corresponding socket connector 300. The socket connector comprises an insulative housing 403 for accommodating the plurality of electrical contacts 200. The insulative housing comprises main block 404 and lateral block 405. The main block 404 is configured to be receivable

within the cavity 315 of socket connector 300. Although shown as having a rectangular cross-section in the figure, main block 404 may have any shape corresponding to that of cavity 315. Main block 404 has a first side 406 and a second side 409 located on opposing sides. Each electrical contact in the first side 406 is spaced apart and opposing a respective electrical contact in the second side 409. The number of rows of electrical contacts present corresponds to that present in the mating socket connector. For example, the socket connector may comprise 1, 2, 3, or 4 rows of electrical contacts 200. Main block 404 abuts base block 317 of a socket connector 300 when fully engaged to facilitate precise positioning of socket connector 300 relative to plug connector 400. Engaging portion 215 of the electrical contacts 200 engages the lateral block 405. The mounting end 227 engages a part of the main block 404, securing the second arm 218 such that it is rendered immobile in the plug connector 400. In one embodiment, the mounting end 227 is inclined away from the direction of insertion of the plug connector 400 into a mating socket connector. In the plug connector, the electrical contacts 200 may be configured for single ended or differential signals, and may be arranged in a ground-signal-signal-ground configuration.

[036] In one embodiment, one or more sides of the main block 404 comprises a plurality of guiding slots 412, 413 for guiding the electrical contacts of a mating electrical connector, such as electrical contacts 100 of socket connector 300, into alignment and mating engagement with the electrical contacts 200 of plug connector 400. Each guiding slot accommodates one electrical contact. The second arm 218 of each electrical contact 200 is recessed and exposed in each guiding slot so that the electrical contacts 100 of the socket connector 300 easily engages the electrical contacts 200 of the plug connector 400. Ribs 415 separate the guiding slots 412 and are configured to engage corresponding ribs 325 of the socket connector 300 to guide and align the initial insertion.

[037] To enable partial shielding, an internal shield 418 may be provided. Internal shield 418 is situated within main block 404 and separates first set of contacts 421 from second set of contacts 424 so as to shield each row of contacts from the other from various

signal-degrading phenomena such as noise or EMI generated by either row. FIG. 6 shows a perspective view of the connector 400 having an internal shield 418 having ground tab 427 that is connected to ground a. Main block 404 may comprise engagement features 430 to securely align plug connector 400 to socket connector 300 when fully engaged.

5 [038] FIG. 7 shows the general scheme of coupling of a socket connector 300 with a plug connector 400. Plug connector 400 is brought into initial contact with socket connector 200 along the direction of arrows 501 by placing main block 404 into the cavity 315 of the socket connector 200. When fully coupled, a mated electrical connector assembly 500 is achieved. FIG. 8 and FIG. 9 show the manner in which electrical contacts of the socket and plug connectors contact each other during the coupling process. FIG. 8 shows the initial position of the socket and plug connectors upon initial engagement. Contact end 121 of each the socket electrical contacts 510 (housing not shown) are received in a guiding slot 412 as the plug connector's main block 404 enters the socket connector's cavity 315. The resilient second arm 118 of each of the socket electrical contacts 510 initially contacts the reclining outer edge 233 of the second arm 218 of each of the plug electrical contacts 520. The contact end 121 is configured to abut and be biased against the reclining outer edge 233 in order to ensure firm physical contact, and hence consistent electrically coupling, between the socket electrical contacts 510 and the plug electrical contacts 520. As plug and socket connectors 300, 400 are pushed together, contact end 121 slides over the reclining outer edge 233. As second arm 218 is generally immobile due to mounting end 227 being secured to the insulative housing, resilient second arm 118 of the socket electrical contacts 510 is flexed backward while sliding over the reclining outer edge 233. Resilient second arm 118 experiences maximum flexing when plug 400 and socket 300 connectors are fully engaged as shown in FIG. 9 and FIG. 10. By providing the resilient second arm 118 with an outer edge that tapers from the joint towards the contact end, the maximum mechanical stress exerted on the resilient second arm due to the flexing is reduced. Further, by providing a reclining profile to the reclining outer edge 233, mechanical force exerted on the resilient second arm increases gradually to a maximum over the course of the sliding engagement, as opposed to being

flexed to a maximum upon initial engagement, which would occur if the outer edge of the second arm 218 does not have a reclining outer edge 233.

[039] FIG. 11 shows computer simulation results of mechanical stress that is exerted on various configurations of an electrical contact for a socket connector. Example 1 shows an electrical connector with a straight outer edge, and a notch incorporated at the portion between the resilient second arm and the joint. Example 2 shows an electrical connector with a straight outer edge without incorporation of a notch. Examples 3 to 5 show an electrical connector with an outer edge that tapers to varying extents. Maximum stress and strain are less in Examples 3 to 5 as compared to examples 1 and 2. The maximum tolerable insertion force and normal force in Examples 3 to 5 are higher than in Examples 1 and 2. Stress tolerance increased with the tapering occurring over a larger length of the resilient second arm. The best stress tolerance was observed for Example 5 in which the outer edge tapers from the joint to about half the length of the resilient second arm in this simulation.

[040] In a further aspect, an electrical connector assembly is provided comprising an electrical socket connector as described herein, the electrical socket connector adapted to receive an electrical plug connector as described herein. In some embodiments, the height of the electrical connector assembly is approximately between 4 mm to 15 mm when the first electrical connector and the second electrical connector are mated together. The electrical contacts in either the socket connector or the plug connector may be spaced less than 1 mm apart, or less than 0.8 mm apart, or less than 0.5 mm apart, depending on the desired pitch required for an application. Pin counts may be at any suitable number required for an application. In various embodiments, each connector may comprise 60, 120, 180 or 240 pins, for example. The electrical connector assembly may further comprise a first shielding device coupled to the electrical socket connector, and a second shielding device coupled to the electrical plug connector. Examples of the shielding devices are row and column shields. Other examples are internal shields 418 and external shields 333 as described in reference to the figures.

[041] The signal integrity performance of the electrical connector assembly was simulated and tested. In order to enable the electrical connector assembly connector to work at high frequency, it was sought to match the impedance of the electrical connector assembly when mated. Because of the small form factor, impedance matching of close to 100 Ohm presented considerable difficulty. In general, with thicker contacts, the design is more capacitive, which would not be usable for high frequency operation. In order to increase the impedance of the electrical connector assembly, contact thickness was reduced for both plug and socket contacts to increase the impedance. In one embodiment, contact thickness was approximately set at 0.12mm for the socket connector, and approximately set at 0.17mm for the plug connector. When tested, the electrical connector assembly was able to provide impedance characteristics of between about 85 Ω and about 115 Ω , at a risetime of 35 ps (20%-80%). The electrical connector assembly was able to achieve crosstalk of less than about -35 dB for frequencies up to about 10 GHz. Due to the thinner contact thickness and straight contact design, the alignment of the socket and plug connectors and the stress level of the socket electrical contact would have presented issues if not for the features of the embodiments provided herein. The thinner contacts used did not present problems of alignment or stress breakage of the electrical contacts in the electrical connector assembly.

[042] In one embodiment, the electrical connector assembly is comprised in a solid state data storage drive system. It will be apparent to the skilled person that the electrical contacts, connectors, and connector assemblies described herein may be used in any other type of hard disk drive systems, or any other small form factor electronic system requiring use of high speed, low profile interconnects.

[043] Although the present invention has been described with particular reference to preferred embodiments illustrated herein, it will be understood by those skilled in the art that variations and modifications thereof can be effected and will fall within the scope of this invention as defined by the claims thereto now set forth hereinbelow.

What is claimed is:

1. An electrical connector assembly comprising an electrical socket connector adapted to receive an electrical plug connector,

the electrical socket connector comprising a plurality of electrical contacts, each contact comprising:

a first arm extending along a first direction from a joint to a terminal end for coupling to a contact on a board, the first arm having a straight inner edge and a constant thickness from the joint to the terminal end; and

a resilient second arm extending along a second direction not parallel to the first direction from the joint to a contact end for electrical coupling with a mating electrical contact, the first arm and the resilient second arm each having a generally flat configuration disposed in a common plane, the resilient second arm being configured to flex substantially along the common plane when the electrical contact is coupled with the mating electrical contact, the resilient second arm having a straight inner edge and a constant thickness from the joint to the contact end, and an outer edge that tapers from the joint towards the contact end over at least a portion of the resilient second arm; and

the electrical plug connector comprising a plurality of electrical contacts, each contact serving as a mating electrical contact for each of the plurality of electrical contacts of the electrical socket connector and comprising a first arm and a second arm, the second arm comprising a reclining outer edge,

the resilient second arm of each of the socket electrical contacts initially contacting the reclining outer edge of the second arm of each of the plug electrical contacts when the plug connector is brought into initial contact with the socket connector.

2. The electrical connector assembly of Claim 1, wherein the outer edge of the resilient second arm has a straight tapering profile.
3. The electrical connector assembly of Claim 2, wherein the outer edge of the resilient second arm tapers at the joint end of the second arm.

4. The electrical connector assembly of Claim 3, wherein the resilient second arm has a reinforced base section that connects to the joint.
5. The electrical connector assembly of Claim 4, wherein the reinforced base section is broader than other parts of the resilient second arm.
6. The electrical connector assembly of Claim 1, wherein the contact end comprises a round-ended protrusion extending away from the second direction.

7. The electrical connector assembly of Claim 1, wherein the resilient second arm has a length of less than 5 mm.
8. The electrical connector assembly of Claim 1, wherein the electrical contact has a thickness of approximately 0.12 mm.
9. The electrical connector assembly of Claim 1, wherein the second arm is arranged orthogonally to the first arm.
10. The electrical connector assembly of Claim 1, comprising a plurality of electrical socket connector electrical contacts wherein each electrical contact in a first row is spaced apart and opposing a respective electrical contact in a second row.
11. The electrical connector assembly of Claim 10, wherein the electrical socket connector further comprises an insulative housing for accommodating the plurality of electrical contacts, the insulative housing comprising at least one wall configured to define a cavity for receiving a mating electrical connector, a plurality of contact slots arranged along the at least one wall to face the cavity, and each contact slot accommodating one electrical contact.
12. The electrical connector assembly of Claim 11, wherein the insulative housing comprises a first wall and a second wall arranged in opposing orientation, said walls being connected by sidewalls to define a cavity for receiving a mating electrical connector, the first wall and the second wall each having a plurality of contact slots facing the cavity, each contact slot accommodating one electrical contact
13. The electrical connector assembly of Claim 12, wherein the electrical contacts are arranged in a first row along the first wall and in a second row along the second wall, each electrical contact in the first row being spaced apart and opposing a respective electrical contact in the second row.

14. The electrical connector assembly of Claim 12, wherein each contact slot is adapted to permit the resilient second arm of each electrical contact to be flexed within the contact slot.
15. The electrical connector assembly of Claim 11, wherein the contact end of each electrical contact protrudes into the cavity for edge coupling with a mating electrical contact.
16. The electrical connector assembly of Claim 11, further comprising an external shield surrounding the first wall, second wall and sidewalls.
17. An electrical connector assembly comprising an electrical socket connector adapted to receive an electrical plug connector, the electrical plug connector comprising a plurality of electrical contacts, each contact comprising:
- a first arm extending along a first direction from a joint to a terminal end for coupling to a contact on a board and an engaging portion extending along a different second direction for engaging an insulative body of a plug connector, the first arm having a straight inner edge and a constant thickness from the joint to the terminal end; and
 - a second arm extending along a third direction not parallel to the first direction from the joint to a mounting end, the second arm having a constant thickness from the joint to the mounting end and a reclining outer edge, the joint having a constant width between the first and second arms
- and
- the electrical socket connector comprising a plurality of electrical contacts, each contact comprising a first arm and a resilient second arm, the resilient second arm comprising an outer edge that tapers over at least a portion of the resilient second arm,
 - the resilient second arm of each of the socket electrical contacts initially contacting the reclining outer edge of the second arm of each of the plug electrical contacts when the plug connector is brought into initial contact with the socket connector.
18. The electrical connector assembly of Claim 17, wherein the reclining outer edge is located towards the mounting end of the second arm.

19. The electrical connector assembly of Claim 17, wherein the reclining outer edge is at an incline of 5° or more relative to normal.
20. The electrical connector assembly of Claim 17, wherein the mounting end extends in a fourth direction, said fourth direction being at an incline of 5° or more relative to the third direction.

21. The electrical connector assembly of Claim 17, wherein the second arm has a length of less than 5 mm.
22. The electrical connector assembly of Claim 17, wherein the electrical contact has a thickness of approximately equal to 0.17 mm.
23. The electrical connector assembly of Claim 17, comprising a plurality of electrical plug connector electrical contacts wherein each electrical contact in a first side is spaced apart and opposing a respective electrical contact in a second side.
24. The electrical connector assembly of Claim 23, further comprising an insulative block having a first side and a second side located on opposing surfaces of the insulative block, the electrical contacts being arranged in a first row and a second row on, respectively, the first side and the second side of the insulative block.
25. The electrical connector assembly of Claim 23, wherein the insulative block comprises a plurality of guiding slots for guiding the electrical connector into mating engagement with a mating electrical connector .
26. The electrical connector assembly Claim 23, wherein each guiding slot accommodates one electrical contact, the second arm of the electrical contact being exposed in each guiding slot for edge coupling with a mating electrical contact.
27. The electrical connector assembly of Claim 23, wherein the mounting end of the second arm is inclined away from the direction of insertion of the plug connector into a mating socket connector.
28. The electrical connector assembly comprising an electrical socket connector as defined in any of Claims 10 to 16, adapted to receive an electrical plug connector as defined in any of Claims 23 to 27.

29. The electrical connector assembly of Claim 28, wherein the electrical contacts are spaced at or less than 0.5 mm apart.
30. The electrical connector assembly of Claim 29, wherein the height of the electrical connector assembly is approximately between 4 mm to 15 mm when the first electrical connector and the second electrical connector are mated together.
31. The electrical connector assembly of Claim 28, further comprising a first shielding device coupled to the first electrical connector, and a second shielding device coupled to the second electrical connector, each shielding device comprising row and column shields.
32. The electrical connector assembly of Claim 28, wherein the electrical contacts are configured such that impedance is between about 85 Ω and about 115 Ω at a risetime of 35 ps.
33. The electrical connector assembly of Claim 28, wherein the electrical contacts are configured such that crosstalk is less than about -35 dB for frequencies up to about 10 GHz.
34. A solid state data storage drive system comprising the electrical connector assembly of Claim 28.

An Electrical Connector

Abstract

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An electrical contact comprises a first arm extending along a first direction from a joint to a terminal end, the first arm having a straight inner edge and a constant thickness from the joint to the terminal end; and a resilient second arm extending along a second direction not parallel
10 to the first direction from the joint to a contact end for electrical coupling with a mating electrical contact, the first arm and the resilient second arm each having a flat configuration disposed in a common plane, the resilient second arm being configured to flex along the common plane when the electrical contact is coupled with a mating electrical contact, the resilient second arm having a straight inner edge and a constant thickness from the joint to the
15 contact end, and an outer edge that tapers from the joint towards the contact end.

FIG. 10

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