

Cross Talk Reduction For A High Speed Electrical Connector

FIELD OF INVENTION

The invention relates broadly to cross talk reduction for a high speed electrical connector.

- 5 In particular, the invention relates to cross talk reduction for a connector such as 12G SAS (12 Gbps Serial Attached SCSI) connector.

BACKGROUND

- 10 Electrical connectors are generally used to provide signal connections between various in electronic devices. Electrical connectors consist of contact pins for connecting electrical signals as well as ground.

- 15 The increase in complexity of design of electric circuits due to usage of micro-electronic devices has resulted in the need to use electrical connectors with closely positioned electrical contact pins. Close proximity may cause cross-talk between adjacent contact pins carrying signals. Cross-talk is an electrical phenomenon in signal transmission due to electrical signal interference between adjacent signal lines. Cross-talk in signal transmission leads to loss in signal integrity.

- 20 Cross-talk in high speed electrical connectors can cause insertion of unwanted spikes into signal lines resulting in loss of high frequency signals. Often, resonance occurs when there is a shift in frequency due to cross-talk, which leads signal degradation.

- 25 Conventionally (refer to Figure 1), in order to reduce cross-talk, a connector 100 is designed by separating adjacent signal pins 101 with ground pins 103. i.e. the connectors are designed to position the signal pins 101 in between ground pins 103 and separate ground coupling contacts 105 are provided to connect all the ground pins 103. The use of separate ground coupling contacts 105 is dependent on mechanical force of the ground coupling contacts 105, which deteriorates over time.

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There is thus a need to provide an electrical connector that seeks to address one or more of the above disadvantages.

SUMMARY

- 35 Embodiments of the present invention provide a high speed electrical connector (e.g. a 12G SAS connector) with reduced cross talk.

According to a first aspect of the present invention, there is provided an electrical connector comprising: a housing comprising one or more series of electrical pins, wherein each series of electrical pins comprises: a plurality of ground pins; and a plurality of signal pins; wherein the signal pins are positioned in between the ground pins, and wherein the plurality of ground pins are integrally connected to each other within the housing.

Each of the ground pins may further comprise: a contact portion for establishing contact between mating connectors; a terminal portion for connecting adjacent electric circuits; and a base portion connecting the contact portion and terminal portion.

The base portion may be substantially rectangular and comprise: a substantially upright wall; a podium; and an inclined wall, wherein the upright wall connects the contact portion and one end of the podium, while the inclined wall connects the other end of the podium and the terminal portion, and wherein the center of the podiums are integrally connected by a substantially flat bus bar.

The signal pins may be located in between two ground pins and beneath the bus bar.

The housing of mating connectors may be provided with a hollow channel for accommodating the bus bar of the ground pin.

The number of ground pins that are integrally connected may be preferably three. The number of signal pins in between two ground pins that are integrally connected may be preferably two. The connector may be a 12G SAS connector.

According to a second aspect, there is provided a method of fabricating an electrical connector comprising the steps of: providing a housing for holding one or more series of electrical pins; providing a plurality of ground pins and signal pins; and positioning the signal pins in between the ground pins, wherein the plurality of ground pins are integrally connected to each other within the housing.

According to a third aspect, there is provided an array of ground pins for an electrical connector, the array of ground pins configured to be received in a housing of the electrical connector with a plurality of signal pins positioned between the respective ground pins of the array, wherein the ground pins of the array are further configured for integral connection to each other within the housing.

According to a fourth aspect, there is provided a housing for an electrical connector, the housing configured to receive a plurality of ground pins and a plurality of signal pins positioned between the respective ground pins, wherein the housing is configured to accommodate an integral interconnection between the ground pins within the housing.

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BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

10 Figure 1 is a perspective view of a conventional electrical connector;

 Figure 2 is a perspective view of a bussed ground pin used in a plug of the electrical connector in accordance with an embodiment of the present invention;

 Figure 3 is perspective view of a bussed ground pin used in a receptacle of the electrical connector in accordance with an embodiment of the present invention;

15 Figure 4a is an exemplary perspective view showing electrical pins of a 12G SAS connector plug in accordance with an embodiment of the present invention

 Figure 4b is a partial inverted perspective view of Figure 4a;

 Figure 5a is an exemplary perspective view showing electrical pins of a 12G SAS connector receptacle in accordance with an embodiment of the present invention;

20 Figure 5b is a partial inverted perspective view of Figure 5a;

 Figure 6a is a partial perspective view of an housing for a conventional 12G SAS connector plug;

 Figure 6b is a partial perspective view of an housing for a 12G SAS connector plug in accordance with an embodiment of the present invention;

25 Figure 7a is a partial perspective view of an housing for conventional 12G SAS connector plug in accordance with an embodiment of the present invention;

 Figure 7b is a partial perspective view of an housing for a 12G SAS connector receptacle in accordance with an embodiment of the present invention; and

30 Figure 8 shows a flowchart illustrating a method of fabricating an electrical connector according to an example embodiment.

DETAILED DESCRIPTION

Figure 2 is a perspective view of a bussed ground pin 200 used in a plug of the electrical connector in accordance with an embodiment of the present invention. In the embodiment,
35 three ground pins 250 are shown to be integrally connected by a bus bar 205.

Each ground pin 250 consists of a linear contact portion 201 and a terminal portion 207 that are connected by a substantially rectangular base portion 203. The base portion 203 consists of a substantially upright wall 202 and a podium 204. The terminal portion 207 consists of an inclined portion 206 and an arcuate portion 209. The upright wall 202 connects the contact portion 201 and one end of the podium 204, while the inclined wall 206 connects the other end of the podium 204 and the arcuate portion 209. Substantially at the center, the podiums 204 are integrally connected by a substantially flat bus bar 205. As a result, the three ground pins 250 provide two channels 208 through which signal pins (refer Figures 4a) are provided. The bus bars 205 provide ground integrity between the ground pins 250.

Figure 3 is a perspective view of a bussed ground pin 300 used in a receptacle of the electrical connector in accordance with an embodiment of the present invention. In the embodiment, three ground pins 350 are shown to be integrally connected by a bus bar 305.

Each ground pin 350 consists of a contact portion 301 and a terminal portion 307 that are connected by a base portion 310. The terminal portion 307 consists of a substantially upright wall 302 and a horizontal portion 309. The base portion 310 consists of a podium 304 and an inclined wall 306. One end of the upright wall 302 terminates outside the receptacle, for mounting on a PCB, while the other end of the horizontal portion 309 is connected to one end of the podium 304. The inclined wall 306 connects the other end of the podium 304 and a linear portion 303, which in turn is connected to an arcuate contact portion 311. Substantially at the center, the podiums 304 are integrally connected by a flat bus bar 305. As a result, the three ground pins 350 provide two channels 308 through which signal pins (refer Figures 5a and 5b) are provided. The integrally connected bus bars 305 provide ground integrity between the ground pins 350.

Figure 4a is an exemplary perspective view showing electrical pins of a 12G SAS connector plug (without connector housing) in accordance with an embodiment of the present invention. The illustration shows three sets of the bussed ground pins 200 each connected integrally with bus bars 205. A pair of signal pins 401 is provided between two ground pins 250, in between the channel 208 formed and beneath the bus bars 205.

Figure 4b is a partial inverted perspective view of Figure 4a showing a set of the bussed ground pin 200 connected integrally with bus bars 205. A pair of signal pins 401 is shown between the two ground pins 250.

Figure 5a is an exemplary perspective view showing electrical pins of a 12G SAS connector receptacle (without connector housing) in accordance with an embodiment of the present invention. The illustration shows three sets of the bussed ground pins 300 each connected integrally with bus bars 305. A pair of signal pins 501 is provided between two ground pins 350, in between the channel 308 formed and beneath the bus bar 305.

Figure 5b is a partial inverted perspective view of Figure 5a showing a set of the bussed ground pin 300 connected integrally with bus bars 305. A pair of signal pins 501 is shown between the two ground pins 350.

Figure 6a is a partial perspective view of an housing 600 for a conventional 12G SAS connector plug. Along an elongate or lateral direction of the housing 600, the housing 600 comprises a plurality of series 605, 607 of hollow channels 601, 603. Each series 605, 607 comprises three hollow channels 601 for holding the ground pins (not shown) and four hollow channels 603 for holding the signal pins (not shown). The hollow channels 601, 603 are positioned in the direction parallel to a height of the housing 600. The channels 601 for holding the ground pins are positioned at extreme ends and the center of each series 605, 607 while a pair of channels 603 for holding the signal pins are positioned in between the channels 601 for holding the ground pins.

Figure 6b is a partial perspective view of an housing for a 12G SAS connector plug in accordance with an embodiment of the present invention. Along an elongate or lateral direction of the housing 650, the housing 650 comprises a plurality of series 606, 608 of hollow channels 610, 620. Each series 606, 608 comprises three hollow channels 610 for holding the ground pins 250 (refer Figure 2, Figures 4a and 4b) and four hollow channels 620 for holding the signal pins 401 (refer Figures 4a and 4b). The hollow channels 610, 620 are positioned in the direction parallel to a height of the housing 650. The channels 610 for holding the ground pins 250 are positioned at extreme ends and center of each series 606, 608 while a pair of channels 620 for holding the signal pins 401 are positioned in between the channels 610 for holding the ground pins 250.

Unlike the conventional housing 600, the channels 610 for holding the ground pins 250 are joined together by elongate hollow connection channels 630 extending between the two ends of the series of electrical pins 606, 608. The dimensions of the hollow channels 630 are appropriately chosen to accommodate and hold the bus bar 205 (refer Figure 2).

Figure 7a is a partial perspective view of an housing 700 for a conventional 12G SAS connector receptacle. Along an elongate or lateral direction of the housing 700, the housing 700 comprises a plurality of series 705, 707 of hollow channels 701, 703. Each series 705, 707 comprises three hollow channels 701 for holding the ground pins (not shown) and four hollow channels 703 for holding the signal pins (not shown). The hollow channels 701, 703 are positioned in the direction parallel to a height of the housing 700. The channels 701 for holding the ground pins are positioned at extreme ends and the center of each series 705, 707 while a pair of channels 703 for holding the signal pins are positioned in between the channels 701 for holding the ground pins.

Figure 7b is a partial perspective view of an housing for a 12G SAS connector receptacle in accordance with an embodiment of the present invention. Along an elongate or lateral direction of the housing 750, the housing 750 comprises a plurality of series 706, 708 of hollow channels 710, 720. Each series 706, 708 comprises three hollow channels 710 for holding the ground pins 350 (refer Figure 3, Figures 5a and 5b) and four hollow channels 720 for holding the signal pins 501 (refer Figures 5a and 5b). The hollow channels 710, 720 are positioned in the direction parallel to a height of the housing 750. The channels 710 for holding the ground pins 350 are positioned at extreme ends and the center of each series 706, 708 while a pair of channels 720 for holding the signal pins 501 are positioned in between the channels 710 for holding the ground pins 350.

Unlike the conventional housing 700, the channels 710 for holding the ground pins 350 are joined together by elongate hollow channels 730 extending between the two ends of the series of electrical pins 706, 708. The dimensions of the hollow connection channels 730 are appropriately chosen to accommodate and hold the bus bar 305 (refer Figure 3).

Figure 8 shows a flowchart illustrating a method of fabricating an electrical connector according to an example embodiment.

At step 801, a copper alloy strip, out of which the electrical pins 250, 350, 401, 501 are fabricated, is provided. At step 803, the copper alloy strip is subjected to a stamping process to obtain the basic configuration of electrical pins 250, 350, 401, 501. At step 805, a forming process is applied to obtain a desired shape required for each of the electrical pins 250, 350, 401, 501. These pins 250, 350, 401, 501 are subjected to a plating process at step 807 to obtain the final configuration of electrical pins 250, 350, 401, 501 at step 809.

At step 811, a high temperature thermoplastic resin is provided and subjected to a moulding process 813 to fabricate the housing 650, 750 of the electrical connector. At step 820, the electrical pins 250, 350, 401, 501, obtained at step 809, are assembled into respective channels 610, 620, 710, 720 provided in the housing 650, 750 of the electrical connector to obtain the electrical connector at step 830.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the specific embodiments without departing from the spirit or scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

The plug and receptacle of the electrical connector may consist of a series of electrical pins with a pitch of 0.8mm or 1.27 mm.

The electrical pins 250, 350, 401, 501 of the plug and receptacle of the electrical connector may be fabricated using e.g. copper alloy.

The electrical pins 250, 350, 401, 501 of the plug and receptacle of the electrical connector may be obtained by a stamping process (refer Figure 8).

The housing of the plug and receptacle of the electrical connector may be fabricated using a high temperature thermo plastic material by an injection moulding process.

Solder pegs (not shown) used in the receptacle of the electrical connector may be obtained using (e.g. a copper alloy) a stamping process.

CLAIMS

1. An electrical connector comprising:
a housing comprising one or more series of electrical pins, wherein each series of
5 electrical pins comprises:
a plurality of ground pins; and
a plurality of signal pins;
wherein the signal pins are positioned in between the ground pins, and
wherein the plurality of ground pins are integrally connected to each other
10 within the housing.
2. The electrical connector as claimed in claim 1, wherein each of the ground pins
comprises:
a contact portion for establishing contact between mating connectors;
15 a terminal portion for connecting adjacent electric circuits; and
a base portion connecting the contact portion and terminal portion.
3. The electrical connector as claimed in claim 2, wherein the base portion is
substantially rectangular and comprises:
20 a substantially upright wall;
a podium; and
an inclined wall,
wherein the upright wall connects the contact portion and one end of the podium,
while the inclined wall connects the other end of the podium and the terminal portion, and
25 wherein the center of the podiums are integrally connected by a substantially flat
bus bar.
4. The electrical connector as claimed in claim 3, wherein the signal pins are located
in between two ground pins and beneath the bus bar.
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5. The electrical connector as claimed in claim 3 or 4, wherein the housing of mating
connectors are provided with a hollow channel for accommodating the bus bar of the
ground pin.
- 35 6. The electrical connector as claimed in any one of the preceding claims, wherein the
number of ground pins that are integrally connected is preferably three.

7. The electrical connector as claimed in any one of the preceding claims, wherein the number of signal pins in between two ground pins that are integrally connected is preferably two.
- 5 8. The electrical connector as claimed in any one of the preceding claims, wherein the connector is a 12G SAS connector.
9. A method of fabricating an electrical connector comprising the steps of:
providing a housing for holding one or more series of electrical pins;
10 providing a plurality of ground pins and signal pins; and
positioning the signal pins in between the ground pins,
wherein the plurality of ground pins are integrally connected to each other
within the housing.
- 15 10. An array of ground pins for an electrical connector, the array of ground pins configured to be received in a housing of the electrical connector with a plurality of signal pins positioned between the respective ground pins of the array, wherein the ground pins of the array are further configured for integral connection to each other within the housing.
- 20 11. A housing for an electrical connector, the housing configured to receive a plurality of ground pins and a plurality of signal pins positioned between the respective ground pins, wherein the housing is configured to accommodate an integral interconnection between the ground pins within the housing.