

ENGAGEMENT APPARATUS, SYSTEM AND METHOD

TECHNICAL FIELD

The present invention relates to a device and in particular to a device for securing one electrical connector to another.

5 BACKGROUND

Hard disk drives (HDDs) are used to store digital data content for laptops, desktop computers, servers and other electronic devices in use today.

Every HDD interface communicates with the rest of the computer via the computer input/output (I/O) bus. The interface is the communication channel
10 over which the data flows as the data is read from or written to the HDD. There are many types of HDD interfaces and they include Integrated Drive Electronics (IDE), Advanced Technology Attachment (ATA), Small Computer System Interface (SCSI), Serial ATA (SATA), Serial Attached SCSI (SAS), and Fibre Channel. The list of HDD interfaces described in this section is not exhaustive
15 and is constantly increasing to keep pace with the ever changing demands of the electronic devices which dictate the specifications of the HDDs and their interfaces.

The SATA interface and the SAS interface are the two most commonly adopted interfaces in the HDD industry today. The SATA headers are often used
20 on HDDs that are fitted with laptops and desktop computers while the SAS headers are used on HDDs fitted with enterprise server systems.

Available in the market today are specialised production test equipment used for testing the HDDs' reliability before the HDDs are released for sale. However, most of these test equipments are designed specifically for HDDs with
25 a specific type of interface.

Also, the repeated mating and un-mating of the header on the HDD with the socket on the HDD production test equipment wears out the socket on the HDD production test equipment after a pre-defined number of cycles dependent on the specification of the socket on the HDD production test equipment. The
5 replacement of the socket on the HDD production test equipment is often tedious and time-consuming resulting in HDD production downtime.

To solve the two problems cited, an intermediate connector (henceforth referred to as sacrificial connector) is used to couple the header on the HDD to the socket on the HDD production test equipment by mating the header on the
10 HDD to the socket end of the sacrificial connector and mating the socket on the HDD production test equipment to the header end of the sacrificial connector. Since the connection and disconnection of the HDD to the HDD production test equipment is now via the sacrificial connector, any wear and tear due to repeated mating and un-mating action will happen on the sacrificial connector instead of
15 the socket on the HDD production test equipment.

Along with this solution comes the need to secure the sacrificial connector to the socket on the HDD production test equipment during the mating and un-mating of the HDD to/from the HDD production test equipment via the sacrificial connector.

20 It would be desirable to provide a device that can be used to secure one connector to another connector easily.

SUMMARY

In accordance with one embodiment of the invention, there is provided a device for securing a first electrical connector to a second electrical connector, comprising a bracket body which at least partially envelops the first electrical
5 connector; and at least one engaging portion extending from the bracket body to the second electrical connector and coupling to a portion of the second electrical connector.

In accordance with another embodiment of the invention, there is provided a device for securing an intermediate electrical connector to an electrical
10 connector on a printed circuit board, comprising a bracket body which at least partially envelops the intermediate electrical connector; and at least one engaging portion extending from the bracket body to the electrical connector on the printed circuit board and coupling to a portion of the electrical connector on the printed circuit board.

15 In accordance with another embodiment of the invention, there is provided a method of securing one electrical connector to another electrical connector, the method comprising coupling a first electrical connector to a second connector; and using a device to secure the first electrical connector to the second electrical connector wherein the device comprises a bracket body and at least one engaging
20 portion extending from the bracket body such that when the device is fitted with the first connector, the bracket body at least partially envelops the first connector and the engaging portion extends to the second electrical connector and couples to a portion of the second electrical connector.

In accordance with another embodiment of the invention, there is provided an
25 interconnect system comprising a first connector, a second connector, a third connector and an engaging device, wherein the first connector mates with the second connector at a first end of the second connector and the third connector

mates with the second connector at a second end of the second connector and the engaging device secures the second connector to the third connector; and wherein the engaging device further comprises a bracket body and at least one engaging portion extending from the bracket body such that when the engaging device is
5 fitted with the second connector, the bracket body at least partially envelops the second connector and the engaging portion extends to the third connector and couples to a portion of the third connector.

The invention may further be said to consist in any alternative combination of parts or features mentioned herein or shown in the accompanying
10 drawings. Known equivalents of these parts or features which are not expressly set out are nevertheless deemed to be included.

BRIEF DESCRIPTION OF THE DRAWINGS

An exemplary form of the present invention will now be described with reference to the accompanying drawings in which:

15 **Figure 1** shows a sacrificial connector in relation to a first complementary connector that is intended to be coupled to a backplane printed circuit board (PCB) of a hard disk drive (HDD) production test equipment and to a second complementary connector that is intended to be coupled to another printed circuit board (PCB) which is further coupled to a HDD;

20 **Figure 2** shows the sacrificial connector in relation to the first complementary connector;

Figure 3 shows another sacrificial connector in relation to another first complementary connector;

Figure 4 shows a close-up view of a vertical cross-section of a housing protrusion with the sacrificial connector and the first complementary connector in an engaged position;

Figure 5 is a perspective view of an exemplary engagement device of the present invention in position before engagement with the first complementary connector mated with the sacrificial connector;

Figure 6A shows a close-up side view of a vertical cross-section of the housing protrusion with the engagement device of the present invention, the sacrificial connector and the first complementary connector in an engaged position;

Figure 6B shows a close-up top view of a horizontal cross-section of the housing protrusion with the engagement device of the present invention, the sacrificial connector and the first complementary connector in an engaged position;

Figure 7A is a perspective view of another exemplary engagement device of the present invention in position before engagement with another first complementary connector coupled to the printed circuit board (PCB) mated with the sacrificial connector;

Figure 7B shows the engagement device engaged with the sacrificial connector and the first complementary connector;

Figure 7C shows the engagement device engaged with the sacrificial connector and the first complementary connector further secured with a plurality of securing devices;

Figure 8A is a perspective view of another exemplary engagement device of the present invention in position before engagement with another first

complementary connector coupled to the printed circuit board (PCB) mated with the sacrificial connector; and

Figure 8B shows the engagement device engaged with the sacrificial connector and the first complementary connector.

5 **DETAILED DESCRIPTION**

Figure 1 shows a sacrificial connector **10** in relation to a first complementary connector **20** that is intended to be coupled to a backplane printed circuit board (PCB) **40** of a hard disk drive (HDD) production test equipment (not shown) and to a second complementary connector **30** that is
10 intended to be coupled to a PCB **45** which is further coupled to a HDD (not shown). This is disclosed in the Singapore Application Serial No.200701728-8, 'Connector Apparatus', now incorporated herein by reference. Figure 2 shows the sacrificial connector **10** in relation to the first complementary connector **20**. For illustration purposes, in both Figures 1 and 2, the first complementary
15 connector **20** is represented as a socket and the second complementary connector **30** is represented as a header.

In absence of the sacrificial connector **10**, the second complementary connector **30** which is coupled to a HDD via the PCB **45** has to be plugged directly into the first complementary connector **20** which is coupled to the HDD
20 production test equipment via the PCB **40** before any test sequences on the HDD production test equipment can be executed on the connected HDD. The second complementary connector **30** is then unplugged from the first complementary connector **20** when the test sequences are completed. Each plugging and unplugging of the second complementary connector **30** to and from the first
25 complementary connector **20** is known as a mating cycle.

The performance of the first complementary connector **20** on the PCB **40** drops with increased mating cycles. The first complementary connector **20** on the

PCB 40 is replaced as soon as the number of mating cycles reaches the number specified by the manufacturer of the first complementary connector 20. To replace the first complementary connector 20 on the PCB 40, one has to de-solder the first complementary connector 20 from the PCB 40 and then re-solder
5 a new connector to the PCB 40 before a HDD can be coupled to the HDD production test equipment for testing. This is time consuming and repeated de-soldering and re-soldering of the first complementary connector 20 from and to the PCB 40 may damage the PCB 40.

The sacrificial connector 10 prolongs the useful life of the first
10 complementary connector 20 by being the interface between the first complementary connector 20 and the second complementary connector 30. Since the mating and un-mating of the second complementary connector 30 is now with the sacrificial connector 10, any wear and tear due to repeated mating and un-mating action will happen on the sacrificial connector instead of the first
15 complementary connector 20 on the PCB 40 of the HDD production test equipment. Along with this solution comes the need to secure the sacrificial connector 10 to the first complementary connector 20 on the PCB 40 of the HDD production test equipment so as to prevent any disengagement of the sacrificial connector 10 from the first complementary connector 20 during the mating and
20 un-mating of the second complementary connector 30 with the sacrificial connector 10. Preferably, the sacrificial connector 10 can be secured to the first complementary connector 20 to the extent of withstanding a disengagement force of at least 4 Newtons(N). Here, the disengagement force refers to the force required to disengage the sacrificial connector 10 from the first complementary
25 connector 20.

For illustration purposes, the sacrificial connector 10 as illustrated in Figure 2 comprises an elongated insulative housing 2 with a longitudinal base 4 and a plurality of contacts received in the housing 2. The housing 2 forms a first mating surface 6 and a second mating surface 8. Since the first complementary

connector **20** is a socket at its mating surface and the second complementary connector **30** is a header at its mating surfaces, the sacrificial connector **10** has a header at the first mating surface **6** and a socket at the second mating surface **8**.

At each end of the sacrificial connector **10** is a bonding device **14**. The
5 bonding device **14** may be any device that is able to temporarily hold the sacrificial connector **10** in place with respect to the first complementary connector **20** at the first mating surface **6** as the second complementary connector **30** is plugged and unplugged to and from the sacrificial connector **10** at the second mating surface **8** during each mating cycle.

10 The bonding device **14** as illustrated in Figure 2 is a latching device with a latch release **12**, a latch member **16** extending in the direction of the first mating surface **6** and a hole **18** in the latch member **16**. As the sacrificial connector **10** engages with the first complementary connector **20** at the first mating surface **6**, a protrusion **22** coupled to an end wall on the first complementary connector **20**
15 pushes the latch member **16** outwards away from the end wall of the first complementary connector **20** as the latch member **16** rides over the slope of protrusion **22**. As the latch member **16** passes the ridge of the protrusion **22**, the hole **18** in the latch member **16** engages with the protrusion **22** of the first complementary connector **20** causing the latch member **16** to fall back to its
20 original horizontal position. This is the locked position of the latching device and the sacrificial connector **10** is engaged to the first complementary connector **20**. To disengage the sacrificial connector **10** from the first complementary connector **20**, the latch release **12** is depressed inwards towards the housing **2** of the sacrificial connector **10**. In doing so, the hole **18** in the latch member **16**
25 disengages with the protrusion **22** on the first complementary connector **20**, and the two connectors **10**, **20** can be easily disengaged by pulling the sacrificial connector **10** in a direction away from the first complementary connector **20**.

In cases where there is no bonding device **14** coupled to the sacrificial connector **10** and/or in cases where there is no corresponding device on the first complementary connector **20** to engage with the bonding device **14** on the sacrificial connector **10** such as to secure the sacrificial connector **10** to the first complementary connector **20** during the un-mating of the second complementary connector **30** from the sacrificial connector **10**, there is a need to have a separate engagement device to secure the sacrificial connector **10** to the first complementary connector **20**.

Figure 3 shows another sacrificial connector **100** in relation to another first complementary connector **200**. The sacrificial connector **100** comprises an elongated insulative housing **110** with a longitudinal base **103** and a plurality of contacts received in the housing **110**. The housing **110** forms a first mating surface **106** and a second mating surface **108**.

At one end of the housing **110** of the sacrificial connector **100** is a housing extension **120** which further comprises a hook **123** at one end of the housing extension **120** furthest from the second mating surface **108**. Preferably, there is one housing extension **120** at each end of the housing **110** of the sacrificial connector **100**.

The first complementary connector **200** comprises a housing **210** wherein at one end of the housing **210** is a housing protrusion **220**. Preferably, there is one housing protrusion **220** at each end of the housing **210** of the first complementary connector **200**. The housing protrusion **220** further comprises a horizontal through-hole **240** which is in alignment with the housing extension **120** of the sacrificial connector **100** and a vertical tunnel **230**. It is preferred but not mandatory that the tunnel **230** be made perpendicular to the through-hole **240**. Preferably the tunnel **230** extends from a first surface **231** of the housing protrusion **220** to a second surface **232** of the housing protrusion **220**.

Figure 4 shows a close-up view of a vertical cross-section of the housing protrusion 220 with the sacrificial connector 100 and the first complementary connector 200 in an engaged position. While there is frictional resistance at the areas of contact between the housing extension 120 of the sacrificial connector 100 and the through-hole 240 of the housing protrusion 220 of the first complementary connector 200, the frictional resistance may not be sufficient to prevent the disengagement of the sacrificial connector 100 from the first complementary connector 200 during the un-mating of the second complementary connector (not shown) from the sacrificial connector 100, especially when the disengagement force is greater than 4 Newtons(N). Here, the disengagement force refers to the force required to disengage the sacrificial connector 100 from the first complementary connector 200.

Figure 5 is a perspective view of an exemplary engagement device 300 of the present invention in position before engagement with the first complementary connector 200 that is engaged with the sacrificial connector 100. The engagement device 300 comprises a bracket body 310 which at least will partially envelop the sacrificial connector 100 once it is engaged and at least one engaging portion 320 extending from the bracket body 310 to the first complementary connector 200 and coupling to a portion of the first complementary connector 200.

Figure 6A shows a close-up side view of a vertical cross-section of the housing protrusion 220 with the engagement device 300, the sacrificial connector 100 and the first complementary connector 200 in an engaged position. Figure 6B shows a close-up top view of a horizontal cross-section of the housing protrusion 220 with the engagement device 300, the sacrificial connector 100 and the first complementary connector 200 in an engaged position. When in an engaged position, the engaging portion 320 of the engagement device 300 fits into the tunnel 230 of the housing protrusion 220 as illustrated by Figure 6A. Without the engagement device 300, during the un-mating of the second complementary connector (not shown) from the sacrificial connector 100, the

disengagement force, typically greater than 4 Newtons(N), may be exerted on the sacrificial connector 100 causing the sacrificial connector 100 to be disengaged from the first complementary connector 200. However, when the engaging device 300 is engaged with the sacrificial connector 100 and the first
5 complementary connector 200, the engaging portion 320 of the engagement device 300 will obstruct the movement of the hook 123 thereby preventing the movement of the housing extension 120 of the sacrificial connector 100 and thus, preventing the sacrificial connector 100 from disengaging with the first complementary connector 200.

10 Figure 7A is a perspective view of another exemplary engagement device 400 of the present invention in position before engagement with the sacrificial connector 10 which is engaged to another first complementary connector 250 that is coupled to the printed circuit board (PCB) 40. As illustrated in Figure 7A, the sacrificial connector 10 has a bonding device 14 coupled to each end of the
15 sacrificial connector 10. The first complementary connector 250 comprises a housing 255, a housing protrusion 260 coupled to both ends of the housing 255 and at least one knob 270 extending from the housing 255. As there is no corresponding device on the first complementary connector 250 to engage with the bonding device 14 on the sacrificial connector 10, the sacrificial connector 10
20 may disengage from the first complementary connector 250 during the un-mating of the second complementary connector (not shown) from the sacrificial connector 10.

The engagement device 400 as shown in Figure 7A comprises a bracket body 410 which at least will partially envelop the sacrificial connector 10 once it
25 is engaged and at least one engaging portion 420 extending from the bracket body 410 to the first complementary connector 250. The engagement device 400 further comprises at least one hole 425 on the engaging portion 420 which is positioned according to and will couple to at least one knob 270 on the housing 255 of the first complementary connector 250 when the engagement device 400

is engaged with the sacrificial connector **10** and the first complementary connector **250**. Preferably, there is more than one knob **270** extending from the housing **255** and more than one hole **425** on the engaging portion **420** of the engagement device **400**. Figure 7B shows the engagement device **400** engaged
5 with the sacrificial connector **10** and the first complementary connector **250**. Figure 7C shows the engagement device **400** further secured to the first complementary connector **250** by at least one securing device **275** such as but not limited to screws. While it is shown in Figures 7A, 7B and 7C that there is a bonding device **14** coupled to the two ends of the sacrificial connector **10**, it is
10 possible to do away with the bonding device **14** in this case since there is no corresponding device on the first complementary connector **250** to engage with the bonding device **14**.

Figure 8A is a perspective view of another exemplary engagement device **500** of the present invention in position before engagement with the sacrificial
15 connector **10** engaged to another first complementary connector **280** coupled to the printed circuit board (PCB) **40**. The engagement device **500** comprises a bracket body **510** which at least will partially envelop the sacrificial connector **10** once it is engaged and at least one engaging portion **520** extending from the bracket body **510** to the first complementary connector **280**. The engagement
20 device **500** further comprises at least one engagement lip **530** at the end of the engaging portion **520** which will hook over at least one portion on the first complementary connector **280** when the engagement device **500** is engaged with the sacrificial connector **10** and the first complementary connector **280**. Figure
8B shows the engagement device **500** engaged with the sacrificial connector **10**
25 and the first complementary connector **280**. While it is shown in Figures 8A and 8B that there is a bonding device **14** coupled to the two ends of the sacrificial connector **10**, it is possible to do away with the bonding device **14** in this case since there is no corresponding device on the first complementary connector **280** to engage with the bonding device **14**.

The foregoing description of the preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed, since many modifications or variations thereof are possible in light of the above
5 teaching. All such modifications and variations are within the scope of the invention. The embodiments described herein were chosen and described in order best to explain the principles of the invention and its practical application, thereby to enable others skilled in the art to utilise the invention in various embodiments and with various modifications as are suited to the particular use
10 contemplated thereof. It is intended that the scope of the invention be defined by the claims appended hereto, when interpreted in accordance with the full breadth to which they are legally and equitably suited.

CLAIMS

1. A sacrificial testing device for securing a first electrical connector to a second electrical connector, comprising: a bracket body which at least partially envelops the first electrical connector; at least one engaging portion extending from the bracket body to the second electrical connector and coupling to a portion of the second electrical connector; and a retaining feature adapted to hold the sacrificial testing device to the first electrical connector and or to the second electrical connector.
2. The device of claim 1 wherein the bracket body has two or more engaging portions extending from two locations of the bracket body and coupling to two or more portions of the second electrical connector.
3. A device for securing an intermediate sacrificial electrical connector to an electrical connector on a printed circuit board, comprising:
 - a bracket body which at least partially envelops the intermediate sacrificial electrical connector; and
 - at least one engaging portion extending from the bracket body to the electrical connector on the printed circuit board and coupling to a portion of the electrical connector on the printed circuit board.
4. The device of claim 3 wherein the bracket body has two or more engaging portions extending from two locations of the bracket body and coupling to two or more portions of the electrical connector on the printed circuit board.
5. A method of securing one electrical connector to another electrical connector, the method comprising: coupling a first electrical connector to a second electrical connector; and using a device to secure the first electrical connector to the second electrical connector wherein the device comprises a bracket body, a retention feature, and at least one engaging portion extending from the bracket body such that when the device is fitted with the first connector, the bracket body at least partially envelops the first connector and the engaging portion extends to the second electrical connector and couples to a portion of the second

electrical connector, and wherein the retaining feature is adapted to hold the device to the first electrical connector and or to the second electrical connector.

6. An interconnect system comprising a first connector, a second connector, a third
5 connector and an engaging device, wherein the first connector mates with the second
connector at a first end of the second connector and the third connector mates with the
second connector at a second end of the second connector and the engaging device secures
the second connector to the third connector; and wherein the engaging device further
comprises a bracket body, a retaining feature adapted to hold the device to the first
10 connector and or to the second connector, and at least one engaging portion extending
from the bracket body such that when the engaging device is fitted with the second
connector, the bracket body at least partially envelops the second connector and the
engaging portion extends to the third connector and couples to a portion of the third
connector.

15 7. The interconnect system of claim 6 wherein the third connector further comprises
at least one protrusion on at least one surface of the third connector, the engaging portion
of the engaging device further comprises at least one through-hole, and the protrusion on
the third connector couples with the through-hole of the engaging portion of the engaging
20 device when the engaging device is in the position that secures the second connector to the
third connector.

8. The interconnect system of claim 6 wherein the second connector is bonded to the
third connector by a bonding device and the engaging portion of the engaging device
25 couples to the third connector at the location where the second connector is bonded to the
third connector.

9. The interconnect system of claim 8 wherein the bonding device is a latching device,
the engaging portion of the engaging device is a protrusion and at the location of the third
30 connector where the engaging portion couples to the third connector is a through-hole; and
wherein the protrusion fits into the through-hole and engages with the latching device
when the engaging device is in the position that secures the second connector to the third
connector.