

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br><b>GS-12-658</b>                      | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>1 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

## 1.0 OBJECTIVE

This specification defines the performance, test, quality, and reliability requirement of the PwrBlade+™ Connector System.

## 2.0 SCOPE

This specification is applicable to the termination characteristic of separable right angle and vertical plugs when mated to the right angle and vertical receptacles.

## 3.0 GENERAL

| Paragraph | Title                          | Page |
|-----------|--------------------------------|------|
| 1.0       | OBJECTIVES                     | 1    |
| 2.0       | SCOPE                          | 1    |
| 3.0       | GENERAL                        | 1    |
| 4.0       | APPLICABLE DOCUMENTS           | 1    |
| 5.0       | REQUIREMENTS                   | 2    |
| 6.0       | ELECTRICAL CHARACTERISTICS     | 3    |
| 7.0       | MECHANICAL CHARACTERISTICS     | 5    |
| 8.0       | ENVIRONMENT CONDITIONS         | 6    |
| 9.0       | QUALITY ASSURANCE PROVISIONS   | 7    |
| TABLE 4   | QUALIFICATION TESTING SEQUENCE | 9    |
| RECORD    | REVISION RECORD                | 10   |

## 4.0 APPLICABLE DOCUMENTS

### 4.1 Other Standard and Specification

- 4.1.1 UL-94 : Flammability
- 4.1.2 EIA-364: Electrical Connector/Socket Test Procedure Including Environmental Classifications
- 4.1.3 MIL-STD-1344A: Federal Specifications, Test Methods for Electrical Connectors.

### 4.2 FCI Specifications

- 4.2.1 BUS-03-601 Current Rating
- 4.2.2 GS-14 -1502 Package Specification
- 4.2.3 GS-20-141 Application Specification

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>2 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

## 5.0 REQUIREMENTS

### 5.1 Qualification

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein.

### 5.2 Material

The material for each component shall be as specified herein or equivalent.

High/Low Power Contacts - High Conductivity Copper alloy.

Signal contacts - Copper alloy.

Housing Resin– Glass filled, Nylon, or other high performance resin rated flame retardant 94V-0 in accordance with UL-94.

### 5.3 Finish

Standard PwrBlade+ contact plating refer to FCI 10116351.

### 5.4 Design and Construction

Connectors shall be of the design, construction and physical dimensions specified on the applicable product drawings.

5.5 Workmanship includes freedom from blistering, cracks, discoloration, etc.

5.6 Operating temperature range: -40°C~125°C

5.7 Examination of product-EIA-364-18, visual and dimensions inspection per product drawing, meet requirements of product drawing.

## 6.0 ELECTRICAL CHARACTERISTICS

6.1 Low Level Contact Resistance (LLCR) – The low level contact resistance shall not exceed  
High Power contacts: 10 milliohm initially and 20milliohm final  
Low Power contacts: 15 milliohm initially and 20milliohm final  
Signal contacts: 20milliohm final  
after environmental exposure when measured in accordance with EIA-364-23 .The following details shall apply,

- a) Test Voltage – 20 millivolts DC max open circuit volatge.
- b) Test Current – Not to exceed 100 milliamps.

6.2 Contact resistance at rated current– The contact resistance at rated current shall not exceed 0.7 milliohm for high power contact and 1.5 milliohm for low power contact initially or after mating cycles and environmental exposure when measured in accordance with EIA 364 TP06. Test

|                                                 |                               |                                                                                     |                           |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|---------------------------|
| NUMBER<br><b>GS-12-658</b>                      | TYPE<br>Product Specification |  |                           |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br><b>3 of 11</b>                                                              | REVISION<br><b>J</b>      |
|                                                 |                               | AUTHORIZED BY<br><b>RAINBOW ZHAN</b>                                                | DATE<br><b>23 FEB, 17</b> |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                           |

current is 30A for 12 high power contacts at 6.35mm pitch, 16A for 8 low power contacts show in Table 1A.

- 6.3 **Insulation Resistance** – The insulation resistance of mated connectors shall not be less than 1,000 megohms for power contacts and 500 megohms for signal initially and after environmental exposure when measured in accordance with EIA 364 TP21.
- a) Test Voltage 500 volts DC.
  - b) Electrification time – 2 minutes.
  - c) Points of Measurement – Between adjacent contacts.
- 6.4 **Dielectric Withstanding Voltage** – There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (>1 Milliampere) when mated connectors are tested in accordance with EIA-364-20. The following details apply.
- a) Test Voltage – 1000 volts, DC for signal and low power contacts.
  - b) Test Voltage – 2500 volts, DC for high power contacts.
  - c) Test Duration – 60 seconds.
  - d) Test Condition – 760 Torr - sea level.
  - e) Points of Measurement – Between adjacent contacts.

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>4 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

6.5 **Current Rating** – Refer to table 1, the temperature rise above ambient shall not exceed 30°C at any point in the system at specified amperes (Table 1A&1B) when mated connectors are tested in accordance with EIA-364-70, method 1. The following detail shall apply:

- a) Ambient Conditions – Still air at 25°C
- b) Stabilize at a single current level until 3 readings at 5 minutes intervals are within 1°C.
- c) Test with single energized contact and with all adjacent power contacts energized.

Table 1A: Rated current table (amperes),

Note: Connectors are applied to test boards with 2 layers X 2 ounce copper power plane

| Types              | Pitch<br>(mm) | Single<br>Contact | 4 adjacent<br>Contacts | 8 adjacent<br>Contacts | 12 adjacent<br>Contacts |
|--------------------|---------------|-------------------|------------------------|------------------------|-------------------------|
| High Power Contact | 7.62          | 50                | 42                     | N.A.                   | N.A.                    |
| High Power Contact | 6.35          | 50                | 38                     | 33                     | 30                      |
| High Power Contact | 5.08          | 50                | 36                     | 31                     | 28                      |
| Low Power Contact  | 2.92          | 30.               | 19                     | 16                     | N.A.                    |

NOTE: Schematic of 2 layer PCB

Top and bottom layers are commoned.

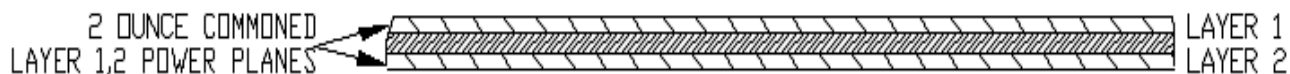


Table 1B: Rated current table (amperes)

Note: Connectors are applied to test boards with 10 layers X 2 ounce copper power plane

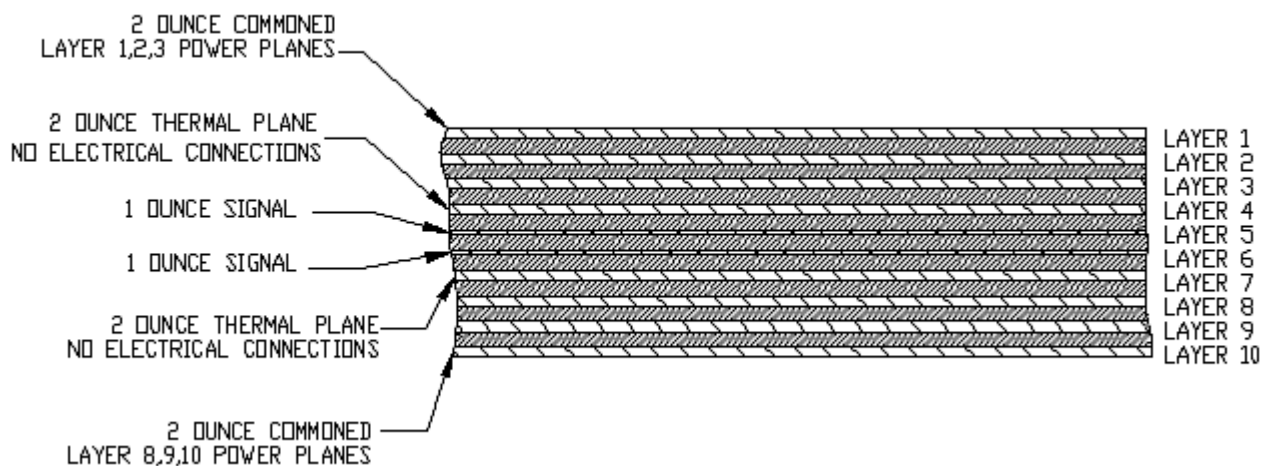
| Types              | Pitch<br>(mm) | Single<br>Contact | 4 adjacent<br>Contacts | 8 adjacent<br>Contacts | 12 adjacent<br>Contacts |
|--------------------|---------------|-------------------|------------------------|------------------------|-------------------------|
| High Power Contact | 7.62          | 75                | 67                     | N.A.                   | N.A.                    |
| High Power Contact | 6.35          | 75                | 63                     | 48                     | 45                      |
| High Power Contact | 5.08          | 75                | 58                     | 45                     | 43                      |
| Low Power Contact  | 2.92          | 49                | 28                     | 27                     | N.A.                    |

| Types          | Pitch<br>(mm) | Single<br>Contact | 24 adjacent<br>Contacts | 48 adjacent<br>Contacts |
|----------------|---------------|-------------------|-------------------------|-------------------------|
| Signal Contact | 2.54          | 3                 | 1.5                     | 1                       |

|                                                 |                               |                                       |                    |
|-------------------------------------------------|-------------------------------|---------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification | FCI                                   |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>5 of 11                       | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN         | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b> |                    |

NOTE: Schematic of 10 layer PCB

Layer 1,2,3 and 8,9,10 aren't commoned.



|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>6 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

## 6.6 **Voltage Rating** – see table 2

Table 2: Rated voltage table

| Table 2                | PwrBlade+ Maximum Working Voltage Vs. Minimum Creep Distance<br>(Reference UL 60950-1 Second Edition Table 2N) |                                       |                                    |          |                                  |                                      |
|------------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------|------------------------------------|----------|----------------------------------|--------------------------------------|
| Type                   | Contact Pitch                                                                                                  | Pollution Degree (office Environment) | Material Group (Base on UL Rating) | MCD (mm) | Maximum Working Voltage (AC RMS) | Maximum Working Voltage (DC/AC Peak) |
| Signal                 | 2.54 [.100"]                                                                                                   | 2                                     | II                                 | 0.94     | 88                               | 124                                  |
| Signal – High Power    | 3.81 [.150"]                                                                                                   |                                       |                                    | 1.98     | 281                              | 397                                  |
|                        | 4.45 [.175"]                                                                                                   |                                       |                                    | 2.62     | 376                              | 531                                  |
|                        | 5.08 [.200"]                                                                                                   |                                       |                                    | 3.25     | 456                              | 644                                  |
|                        | 5.72 [.225"]                                                                                                   |                                       |                                    | 3.89     | 541                              | 764                                  |
|                        | 6.35 [.250"]                                                                                                   |                                       |                                    | 4.52     | 633                              | 895                                  |
| Signal – Low Power     | 2.73 [.107"]                                                                                                   |                                       |                                    | 2.22     | 322                              | 455                                  |
|                        | 3.37 [.132"]                                                                                                   |                                       |                                    | 2.86     | 407                              | 575                                  |
|                        | 4.00 [.157"]                                                                                                   |                                       |                                    | 3.49     | 486                              | 687                                  |
|                        | 4.64 [.182"]                                                                                                   |                                       |                                    | 4.13     | 576                              | 814                                  |
|                        | 5.27 [.207"]                                                                                                   |                                       |                                    | 4.76     | 670                              | 947                                  |
| High Power             | 5.08 [.200"]                                                                                                   |                                       |                                    | 2.06     | 295                              | 417                                  |
|                        | 6.35 [.250"]                                                                                                   |                                       |                                    | 3.33     | 466                              | 659                                  |
|                        | 7.62 [.300"]                                                                                                   |                                       |                                    | 4.60     | 645                              | 912                                  |
| High Power – Low Power | 4.00 [.157"]                                                                                                   |                                       |                                    | 2.28     | 330                              | 467                                  |
|                        | 4.64 [.182"]                                                                                                   |                                       |                                    | 2.92     | 415                              | 586                                  |
|                        | 5.27 [.207"]                                                                                                   |                                       |                                    | 3.55     | 493                              | 697                                  |
|                        | 5.91 [.232"]                                                                                                   |                                       |                                    | 4.19     | 585                              | 827                                  |
|                        | 6.54 [.257"]                                                                                                   |                                       |                                    | 4.82     | 679                              | 960                                  |
| Low Power              | 2.92 [.115"]                                                                                                   |                                       |                                    | 2.52     | 363                              | 513                                  |

## 7.0 **MECHANICAL CHARACTERISTICS**

### 7.1 **Mating/Unmating Force** – The force to mate/unmate a receptacle and compatible plug.

Table 3: Mating/unmating force

|                       | Per High power Contact | Per Low power contacts | Per Signal contacts |
|-----------------------|------------------------|------------------------|---------------------|
| Mating force (Max.)   | 5N [18 ounce]          | 1N [3.6ounce]          | 1N [3.6ounce]       |
| Unmating force (Min.) | 2.2N [8 ounce]         | 0.5N [1.8 ounce]       | 0.2N [0.64 ounces]  |

The following details shall apply:

7.1.1) Cross head speed – 12.7mm [0.5 in] per minute

7.1.2) Lubrication – None

7.1.3) Utilize free floating fixtures.

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>7 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

7.1.4) Reference EIA 364-13

7.2 **Compliant Pin Insertion**

| Contact types                       | Insertion force per compliant pin |
|-------------------------------------|-----------------------------------|
| Plug/ receptacle high power contact | 111.2N[25lbf] maximum             |
| Plug/receptacle low power contact   | 111.2N[25lbf] maximum             |
| Plug signal contact                 | 93.4N[21lbf] maximum              |
| Receptacle signal contact           | 27N[ 6 lbf] maximum               |

7.2.1 Per EIA-364-5

7.2.2 Measure force necessary to correctly apply a specimen to a printed circuit board at a maximum rate of 12.7mm per minute.

7.3 **Radial hole distortion** – 0.070mm [.00276 in] maximum radial distortion. 0.008mm [.00032 in] minimum copper hole wall remaining. The following details shall apply:

7.3.1 Per EIA-364-96

7.3.2 Measure at 0.2 to 0.5mm [.008 to .020 in] depth.

7.4 **Compliant Pin Retention**

| Contact types                       | Retention force per compliant pin |
|-------------------------------------|-----------------------------------|
| Plug/ receptacle high power contact | 6.7N[1.5lbf] minimum              |
| Plug/receptacle low power contact   | 6.7N[1.5lbf] minimum              |
| Plug signal contact                 | 6.7N[1.5lbf] minimum              |
| Receptacle signal contact           | 6.7N[1.5lbf] minimum              |

7.4.1 Per EIA-364-5

7.4.2 Measure force necessary to remove a correctly applied specimen from its printed circuit board at a maximum rate of 12.7mm per minute.

7.5 **Component heat resistance to wave soldering**– Shall meet visual requirements, show no physical damage, and meet requirements of additional tests as specified in the TABLE 4: QUALIFICATION TESTING SEQUENCE.

7.6 **Solderability dip test**– EIA-364-52, solderable area shall have a minimum of 95% solder coverage.

7.7 **Vibration, random** – EIA-364-28

7.7.1) Test procedure – VII, test condition letter E.

7.7.2) Subject mated specimens to 4.90G's rms between 20-500Hz.

7.7.3) Mounting – To eliminate relative motion, both mating halves should be rigidly fixed.

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>8 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

7.7.4) Duration – 15 minutes in each of 3 mutually perpendicular planes.

7.7.5) No evidence of physical damage, No interruptions > 1.0 microsecond.

7.8 **Mechanical Shock** – EIA 364-27

7.8.1) Condition A (50G, 11 millisecond half sine wave )

7.8.2) Shocks – 3 shocks in both directions along each of three orthogonal axes. (18 total)

7.8.3) Mounting – Rigidly mount assemblies.

7.8.4) No discontinuities of greater than 1.0 microsecond.

7.9 **Durability** – Standard laboratory procedure as applicable to the specific product EIA-364-09

7.9.1) Number of cycles – 500.

7.9.2) Maximum cycling rate – 500 cycles per hour.

8.0 **ENVIRONMENTAL CONDITIONS**

After exposure to the following environmental conditions in accordance with the specified test procedure and/or details, the product shall show no physical damage and shall meet the applicable electrical and mechanical requirements of paragraph 6.0 and 7.0 as detailed in Table 4 test sequences. Unless otherwise specified, assemblies shall be mated during exposure.

8.1 **Thermal Shock** – EIA-364-32

8.1.1) Subject mated specimens to 36 cycles.

8.1.2) Temperature Range – 40 to 125°C.

8.1.3) Time at each temperature – 30 minutes minimum.

8.1.4) Transfer time – 5 minutes, maximum.

8.2 **Humidity-temperature cycling**– EIA-364-31, Method III.

8.2.1) Subject mated specimens to 10 cycles(10 days)

8.2.2) Relative Humidity – 80~100%

8.2.3) Temperature +25°C~+40°C

8.3 **Temperature Life** – EIA-364-17, Method A.

8.3.1) Test condition 5.

8.3.2) Test duration – 504 Hours.

8.3.3) Temperature 125°C.

8.4 **Mixed Flowing Gas (MFG)** – EIA 364-65

8.4.1) Class – IIA

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>9 of 11                                                                     | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

8.4.2) Duration – 14 days. (7 days mated, 7 days unmated)

## 9.0 QUALITY ASSURANCE PROVISIONS

### 9.1 Equipment Calibration

All test equipment and inspection facilities used in the performance of any test shall be maintained in a calibration system in accordance with QS9000.

### 9.2 Inspection Conditions

Unless otherwise specified, all inspections shall be performed under the following conditions:

- a) Temperature: 25+/- 5°C
- b) Relative Humidity: 30% to 60%
- c) Barometric Pressure: Local ambient

### 9.3 Acceptance

9.3.1 Electrical and Mechanical requirements shall be as indicated in Paragraphs 6.0 and 7.0 using test data and appropriate statistical techniques.

9.3.2 Failures attributed to equipment, test setup or operator error shall not disqualify the product.

### 9.4 Qualification Testing

9.4.1 Specimen selection  
Specimens shall be prepared in accordance with applicable instruction sheets and shall be selected at random from current production.

9.4.2 Test Sequence-as specified in Table 4.

### 9.5 Re-qualification Testing

If any of the following conditions occur, the responsible product engineer shall initiate re-qualification testing consisting of the applicable parts of the test matrix, Table 4.

- d) A significant design change is made to the existing product that impacts the product form, fit or function. Example of significant changes shall include, but not be limited to, changes in the plating material composition or thickness, contact force or contact surface geometry, insulator design, contact base material or contact lubrication requirements.
- e) A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.
- f) A significant change is made to the manufacturing process that impacts the product form, fit or function.

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br>GS-12-658                             | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>10 of 11                                                                    | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

**TABLE 4: QUALIFICATION TESTING SEQUENCE**

| TEST                                                              | PARA | Test Group (a)      |     |     |     |             |     |     |     |
|-------------------------------------------------------------------|------|---------------------|-----|-----|-----|-------------|-----|-----|-----|
|                                                                   |      | 1                   | 2   | 3   | 4   | 5           | 6   | 7   | 8   |
|                                                                   |      | Test Sequence ( c ) |     |     |     |             |     |     |     |
| Examination of Product                                            | 5.7  | 1,6                 | 1,9 | 1,8 | 1,5 | 1,13        | 1,4 | 1,4 | 1,5 |
| Low level contact resistance, Signal, high/low power contacts     | 6.1  | 2,5                 | 3,7 |     | 2,4 |             |     |     |     |
| Low level contact resistance, High/low Power contacts only        | 6.1  |                     |     |     |     | 2,6<br>8,10 |     |     |     |
| Contact Resistance at rated current, High/low power contacts only | 6.2  |                     |     |     |     | 12          |     |     |     |
| Insulation resistance                                             | 6.3  |                     |     | 2,6 |     |             |     |     |     |
| Dielectric Withstanding Voltage                                   | 6.4  |                     |     | 3,7 |     |             |     |     |     |
| Current Rating (Temperature rise vs current)                      | 6.5  |                     |     |     |     | 4,11        |     |     |     |
| Vibration, Random                                                 | 7.7  |                     | 5   |     |     | 9(d)        |     |     |     |
| Mechanical Shock                                                  | 7.8  |                     | 6   |     |     |             |     |     |     |
| Durability                                                        | 7.9  | 3(e)                | 4   |     |     | 3(f)        |     |     |     |
| Mating Force                                                      | 7.1  |                     | 2   |     |     |             |     |     |     |
| Un-Mating Force                                                   | 7.1  |                     | 8   |     |     |             |     |     |     |
| Compliant pin insertion                                           | 7.2  |                     |     |     |     |             |     | 2   | 2   |
| Radial hole distortion                                            | 7.3  |                     |     |     |     |             |     | 3   |     |
| Compliant pin retention                                           | 7.4  |                     |     |     |     |             |     |     | 4   |
| Component heat resistance to wave soldering                       | 7.5  |                     |     |     |     |             | 2   |     |     |
| Solderability dip test                                            | 7.6  |                     |     |     |     |             | 3   |     |     |
| Thermal Shock                                                     | 8.1  |                     |     | 4   |     |             |     |     |     |
| Humidity-temperature cycling                                      | 8.2  |                     |     | 5   |     |             |     |     |     |
| Temperature Life                                                  | 8.3  |                     |     |     | 3   | 7           |     |     | 3   |
| Mixed Flowing Gas                                                 | 8.4  | 4                   |     |     |     | 5           |     |     |     |

**NOTE:**

- (a) See paragraph 9.4.
- (b) Split into subgroups as needed for on and off board tests.
- (c) Numbers indicate sequence in which tests are performed.
- (d) Energize at current for 18°C temperature rise.
- (e) Precondition specimens with 5 durability cycles.
- (f) Precondition specimens with 25 durability cycles.

|                                                 |                               |                                                                                     |                    |
|-------------------------------------------------|-------------------------------|-------------------------------------------------------------------------------------|--------------------|
| NUMBER<br><b>GS-12-658</b>                      | TYPE<br>Product Specification |  |                    |
| TITLE<br><br><b>PwrBlade+™ Connector System</b> |                               | PAGE<br>11 of 11                                                                    | REVISION<br>J      |
|                                                 |                               | AUTHORIZED BY<br>RAINBOW ZHAN                                                       | DATE<br>23 FEB, 17 |
|                                                 |                               | CLASSIFICATION<br><b>UNRESTRICTED</b>                                               |                    |

### REVISION RECORD

| REV | PAGE | DESCRIPTION                                                                                                        | ECN#             | DATE                      |
|-----|------|--------------------------------------------------------------------------------------------------------------------|------------------|---------------------------|
| A   | All  | Initial Release                                                                                                    | DG10-0140        | Mar 3 <sup>rd</sup> , 10  |
| B   | All  | Remove 4.3,<br>Update 4.2, 5.2, 5.3, 6.2, 7.2, 7.4, Table 1, Table 4                                               | ECR-ELX-T-004389 | Jul 8 <sup>th</sup> , 11  |
| C   | 2    | Remove Signal Contact LLCR initial 15 milliohm                                                                     | ECR-ELX-T-005060 | Aug 15 <sup>th</sup> , 11 |
| D   | 2,4  | Updated 6.1, 6.2, 6.5                                                                                              | ECR-ELX-T007381  | Oct 26 <sup>th</sup> , 11 |
| E   | 5    | Update 6.6, 7.1                                                                                                    | ECR-ELX-T008000  | Nov 22 <sup>nd</sup> , 11 |
| F   | 1    | Change section 4.2.1 from GES-03-601 to BUS-03-601                                                                 | ELX-DG-011380-1  | May 8 <sup>th</sup> , 12  |
| G   | All  | Change unrestriction to unrestricted, page 1, change TALBE to TABLE, add 4.2.3 GS-20-141 Application Specification | ELX-DG-14063-1   | Feb 15 <sup>th</sup> , 13 |
| H   | All  | Change name description from "header" to "plug".                                                                   | ELX-DG20876-1    | May 13 <sup>th</sup> , 15 |
| J   | 4,5  | Add the description for the PCB layers                                                                             | ELX-DG-26147-1   | Feb 13 <sup>th</sup> , 17 |

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| <a href="#"><u>10106125-4006002LF</u></a> | <a href="#"><u>10106126-8006002LF</u></a> | <a href="#"><u>10106127-C812002LF</u></a> | <a href="#"><u>10106124-4006003LF</u></a> | <a href="#"><u>10106117-5005001LF</u></a> |
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| <a href="#"><u>10106265-B006006LF</u></a> | <a href="#"><u>10106131-4006003LF</u></a> | <a href="#"><u>10106124-C004001LF</u></a> | <a href="#"><u>10106265-B006003LF</u></a> | <a href="#"><u>10106125-6002001LF</u></a> |
| <a href="#"><u>10106262-5203001LF</u></a> | <a href="#"><u>10106263-2003001LF</u></a> |                                           |                                           |                                           |