


NUMBER <b>GS-12-149</b>	TYPE <b>PRODUCT SPECIFICATION</b>		
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		AUTHORIZED BY Jerome Chen	DATE 21 Jan 08
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## 1.0 OBJECTIVE

This specification defines the performance, test, quality and reliability requirements of the PwrBlade Connector System.


## 2.0 SCOPE

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

## 3.0 GENERAL

This document is composed of the following sections:

<u>Paragraph</u>	<u>Title</u>
1.0	OBJECTIVE
2.0	SCOPE
3.0	GENERAL
4.0	APPLICABLE DOCUMENTS
5.0	REQUIREMENTS
5.1	Qualification
5.2	Material
5.3	Finish
5.4	Design and construction
5.5	Workmanship
6.0	ELECTRICAL CHARACTERISTICS
7.0	MECHANICAL CHARACTERISTICS
8.0	ENVIRONMENTAL CONDITIONS
9.0	QUALITY ASSURANCE PROVISIONS
9.1	Equipment Calibration
9.2	Inspection Conditions
9.3	Sample Quality and Description
9.4	Acceptance
9.5	Qualification Testing
9.6	Re-qualification Testing
10.0	Reference Documents
Table 1	Qualification Testing Matrix

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#### 4.0 **APPLICABLE DOCUMENTS**

##### 4.1 Specifications

4.1.1 Engineering Drawings 51700, 51720, 51740, 51760, 51866, 51939, 51940, 51897, 51921 etc.

##### 4.2 Federal Specifications

4.2.1 MIL-STD-1344A: Test Methods for Electrical Connectors

##### 4.3 Other Standards and Specifications

4.3.1 UL 94 V-0: Flammability

4.3.2 EIA 364: Test Procedures for Electrical Connectors, Sockets and Coaxial Contacts

##### 4.4 FCI Specifications:

4.4.1 GS-29-149: PwrBlade Qualification Summary

4.4.2 BUS-03-601: Current Rating/30°C Temperature Rise

4.4.3 BUS-03-404: Normal Force Measurement

4.4.4 BUS-12-090: HPC Product Specification

4.4.5 BUS-12-111: HPC Solderless (Press fit) Right Angle Receptacle

#### 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.

Power Contacts – Copper Base Alloy

Signal Pin Contact – Phos Bronze

Signal Receptacle Contacts – Beryllium Copper

Receptacle and Plug Housings - Glass Filled HTN (High Temperature Nylon)

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### 5.3 Finish (quoted from plating specification 10064183)

PowerBlade Type	Contact Type	P/N (NOTE 1) (See Print)	Contact Area	Tail Area			
Header	Solder To Board	Signal & Power Contact	Non Lead Free ++++-+++	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	100u"/2.54um SnPb PLATING OVER 50u"/1.27um Ni		
		Signal & Power Contact	Lead Free ++++-+++LF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	78u"/2.00um Sn PLATING OVER 50u"/1.27um Ni		
		Signal Contact Power Contact	Gold Flash ++++-+++GLF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	5u"/0.125um Au OVER 50u"/1.27um Ni		
	Press Fit	Signal Contact Power Contact	Non Lead Free ++++-+++	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	100u"/2.54um SnPb PLATING OVER 50u"/1.27um Ni 50u"/1.27um ~100u"/2.54um SnPb PLATING OVER 50u"/1.27um Ni		
			Lead Free ++++-+++LF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	78u"/2.00um Sn PLATING OVER 50u"/1.27um Ni 50u"/1.27um ~100u"/2.54um Sn PLATING OVER 50u"/1.27um Ni		
		Signal Contact Power Contact	Gold Flash ++++-+++GLF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	5u"/0.125um Au OVER 50u"/1.27um Ni		
		Receptacle	Solder To Board	Signal & Power Contact	Non Lead Free ++++-+++	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	100u"/2.54um SnPb PLATING OVER 50u"/1.27um Ni
				Signal & Power Contact	Lead Free ++++-+++LF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	78u"/2.00um Sn PLATING OVER 50u"/1.27um Ni
	Signal Contact Power Contact			Gold Flash ++++-+++GLF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	5u"/0.125um Au OVER 50u"/1.27um Ni	
	Press Fit		Signal Contact Power Contact	Non Lead Free ++++-+++	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	100u"/2.54um SnPb PLATING OVER 50u"/1.27um Ni 50u"/1.27um ~100u"/2.54um SnPb PLATING OVER 50u"/1.27um Ni	
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Signal Contact Power Contact			Gold Flash ++++-+++GLF	(30u"/0.76um Au) OR (3u"/0.076um Au + 27u"/0.68um PdNi) OVER 50u"/1.27um Ni	5u"/0.125um Au OVER 50u"/1.27um Ni		

### 5.4 Design and Construction

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


5.4.1 See drawing numbers 51700, 51720, 51740, 51760 and 51866 for test connector configurations.

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


## 6.0 ELECTRICAL CHARACTERISTICS

6.1 Signal tested at Low Level (LLCR) - The low level contact resistance shall not exceed 20 milliohm after environmental exposure when measured in accordance with EIA 364 TP 06. The following details shall apply:

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

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- 6.2 Power tested at Specified Current - The contact resistance at a specified current shall not exceed 2.0 milliohm initially or after mating cycles and environmental exposure when measured in accordance with EIA 364 TP06. Test Current 30 amperes DC
- 6.3 Insulation Resistance - the insulation resistance of mated connectors shall not be less than 10,000 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 TP 20. The following details apply:
- a. Test Voltage – 2500 volts DC (power), 1000 volts DC (signal)
  - b. Test Duration – 60 seconds.
  - c. Test Condition – (760 Torr – sea level).
  - d. Points of measurement – Between adjacent Contacts


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6.5 Current Rating - The temperature rise above ambient shall not exceed 30° C at any point in the system when all power contacts are powered with each contact being powered at 30 amperes or only one power contact is powered to 48 amperes. The temperature rise above ambient shall not exceed 30° C at any point in the system when all signal contacts are powered with each contact being powered at 1.0 amperes or only one signal contact is powered at 3.0 amperes. The following details shall apply:

- a. Ambient conditions - Still air at 25 °C
- b. Reference – FCI Test Specification BUS-03-601

## 7.0 MECHANICAL CHARACTERISTICS

- 7.1 Mating/Unmating Force - The force to mate a receptacle connector and compatible header shall not exceed 25 ounces per power contact and 3.5 ounces per signal contact. The unmating force shall not be less than 8 ounces per power contact and .64 ounces per signal contact. The following details shall apply:
- a. Cross Head Speed - 1 inch per minute
  - b. Lubrication - None
  - c. Utilize free floating fixtures
  - d. Reference EIA 364-13
- 7.2 Normal Force - The contact normal force shall not be less than 350 grams per beam for the power contacts and 50 grams (nor greater than 120 grams) per beam for the signal contacts when tested in accordance with FCI Test Specification BUS-03-404.
- 7.3 Contact Retention - Individual power and signal contacts shall withstand an axial retention load of 3 pounds. Individual signal receptacle contacts will withstand an axial load of 6 pounds minimum to seat further into housing.
- a. Rate of 0.5 inches/minute without dislodging from the housing cavity.
  - b. Test 30 contacts
  - c. As per MIL-STD-1344A, Method 2007.1.
- 7.4 Individual Pin Insertion/Retention Force - The force required to insert an individual compliant pin into a plated through hole in a printed circuit board at a rate of 0.2 inches/minute shall not exceed 6 pounds for signal receptacle contacts, 21 pounds for signal header pins and 25 pounds per tail for power contacts. The retention force in the axial direction opposite that of insertion shall not be less than 1.5 pounds for signal receptacle contacts, 3 pounds for signal header pins and 5 pounds per tail for power contacts.

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#### 7.5 PCB Hole Deformation Radius

Power Contacts - cross-section parallel to board surface. Photograph and measure the hole deformation (deformation on board material) radius at a point .010" from the surface, and the center of the compliant pin section. Include 10 holes. The average (of 10 holes) hole deformation radius shall be no greater than 0.0015" when measured from the drilled hole. The absolute maximum deformation radius shall not exceed 0.002".

#### Signal Contacts

Signal Receptacle Contacts – Reference FCI BUS-12-111 – HPC Solderless (Press Fit) Right Angle Receptacles


Signal Header Contacts – Same as the requirement for Power Contacts above

- 7.6 PCB Hole Wall Damage - Cross-section perpendicular to the board surface, and through the compliant section wear track. Photograph and measure the copper thickness remaining between the compliant section and the printed wiring board laminate. Include 10 holes. The minimum average (of 10 holes) copper thickness remaining between the compliant pin and the printed wiring board laminate shall not be less than 0.0003". In addition there shall be no copper cracks, separations between conductive interfaces, or laminate-to-copper separations.
- 7.7 Board Lock Retention to Housing- Individual board locks shall withstand an axial load of 3 pounds minimum.
- Rate of 0.5 inches/minute without dislodging from the housing cavity.
  - Test 30 board locks

### 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 paragraphs 6.0 and 7.0 as detailed in Table 1 test sequences. Unless otherwise specified, assemblies shall be mated during exposure.

- 8.1 Thermal Shock - EIA 364 TP 32
- a. Test condition - 36 cycles
  - b. Temperature Range - -20 to +80 ° C
  - c. Time at Each Temperature - To refer to EIA 364 TP 32 based on product mass
  - d. Transfer Time - 5 minutes, maximum
- 8.2 Humidity, Steady State - EIA 364 TP 31, Method II
- a. Relative Humidity - 95%
  - b. Temperature +40 ° C
  - c. Test Duration – 96 hours

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8.3 High Temperature Life, EIA 364 TP 17

- a. Test Duration - 21 Days
- b. Temperature 105 ° C
- c. Pre-condition - Perform number of durability cycles specified for product

8.4 Environmental Sequence:

Phase I - Thermal Shock, EIA 364-32

- a. Test Duration - 36 cycles
- b. Temperature Range - Between -20 and +80 ° C
- c. Time at Each Temperature – To refer to EIA 364-32 based on product mass
- d. Transfer Time - 5 minutes, maximum

Phase II - Humidity, EIA 364-31, Method II

- a. Test Duration - 10 days
- b. Relative Humidity - 95%
- c. Temperature - 40 deg C

Phase III - High Temperature Life, EIA 364-17

- a. Test Duration - 21days
- b. Temperature - 105 deg C
- c. Pre-condition - Perform number of durability cycles specified for product

8.5 Industrial Mixed Flowing Gas (IMFG) – EIA 364-65


- a. Class – IIA
- b. Duration – 20 days
- c. Mated
- d. Test contact resistance after 10 and 20 days

8.6 Vibration Sinusoidal - EIA 364 TP 28

- a. Condition - III
- b. Vibration Amplitude - 0.06" DA or ± 15G
- c. Frequency Range - 10 to 2000 to 10 Hz
- d. Sweep Time and Duration - 20 minutes per cycle, 4 hours along each of three orthogonal axes (12 hours total)
- e. Mounting - rigidly mount assemblies
- f. No Discontinuities of greater than 10 nano-seconds

8.7 Mechanical Shock - EIA 364-27

- a. Condition I (50G, 11 millisecond half sine wave)
- b. Shocks - 3 shocks in both directions along each of three orthogonal axes (18 total)
- c. Mounting - rigidly mount assemblies
- d. No discontinuities of greater than 10 nano-seconds

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8.8 Durability - Standard laboratory procedure as applicable to the specific product

- a. Number of Cycles - 200
- b. Cycling rate - 5 inches per minute

8.9 Solderability – ANSI-J-002, Test Condition A

- a. Steam aging - 4 hours
- b. Pcb termination area was evaluated and meets the requirements of ANSI-J-002.

8.10 Resistance to Solder Heat – EIA 364-56

- a. Test Condition - E
- b. There shall be no evidence of physical or mechanical damage.

8.11 Operating temperature – -5 ° C to 105 ° C

## 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 ISO 9000

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



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### 9.3 Sample Quality and Description

R/A Header P/N 51720, Vertical Receptacle P/N 51740 and R/A Receptacle P/N 51760

P/N For lead free test, use 517*0 - *****LF	Type	1	2	3	4	5	6	7	8	9	10	11	12	13	14
51720-11008410AA__	Ass'y	6	3	O	6	6	3	3	O	6	2	3	3	0	0
51740-11008410AA__	Ass'y	0	3	M	0	0	0	0	M	0	0	0	0	0	0
51740-11008410CC__	Ass'y	3	0	I	3	3	0	3	I	3	0	0	0	9	0
51760-11008410AA__	Ass'y	3	0	T	3	3	3	0	T	3	2	3	3	0	12
SK-44146-002	PCB	0	0	T	0	0	0	0	T	0	0	0	0	0	0
SK-44147-002	PCB	0	0	E	0	0	0	0	E	0	0	0	0	9	0
SK-44148-002	PCB	0	0	D	0	0	0	0	D	0	0	0	0	0	0
SK-44146-012	PCB	6	3		6	0	3	3		6	0	0	0	0	0
SK-44147-012	PCB	3	3		3	0	0	3		3	0	0	0	9	0
SK-44148-012	PCB	3	0		3	0	3	0		3	0	0	0	0	0

Vertical Header P/N 51700, R/A Receptacle Press Fit P/N 51866 and Vertical Receptacle P/N 51740 (mated to 51700 for qualification testing)

P/N For lead free test, use 517*0 - *****LF	Type	1	2	3	4	5	6	7	8	9	11	12	13	14
51546-001021__	contact			O		O			O			O		12
51700-11008410AA__	Ass'y		3	M		M	3		M	4		M	3	
51700-11008410CC__	Ass'y	3		I	3	I		6	I		4	I		
SK-44145-002 (2 oz)	PCB			T		T			T	2	2	T		
SK-44145-012 (5 oz)	PCB	3	3	E	3	E	3	6	E	2	2	E		1
51866-002__	Ass'y	3	3	D	3	D			D	4		D		
51740-1108410AA__	Ass'y						3	6			4			
SK-44148-002 (2 oz)	PCB									2				
SK-44148-012 (5 oz)	PCB	3	3							2				
SK-44147-002 (2 oz)	PCB										2			
SK-44147-012 (5 oz)	PCB						3	6			2			

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#### 9.4 Acceptance

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

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


#### 9.5 Qualification Testing

Qualification testing shall be performed on sample units predicted with equipment and procedures normally used in production. Test sequence is as shown in Table 1.

#### 9.6 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 1.

- a. A significant design change is made to the existing product that impacts the product form, fit or function. Examples 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.
- b. A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.
- c. A significant change is made to the manufacturing process that impacts the product form, fit or function.

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**Test Sequence Table 1**

Test	PAR	Test Group													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Examination of Product	5.5	1 20	1 12	O M	1 8	1 8	1 3	1 8	O M	1 3	1 3	1	1 3	1 13	1 3
Contact Resistance Low Level	6.1	3 6 9 14 17	3 6 10	I T E D	2 6			2 6	I T E D					3 6 9	
Contact Resistance At specified current	6.2	4 7 10 15 18	4 7 11		3 7			3 7							
Insulation Resistance	6.3				2 6										
Dielectric Withstanding Voltage	6.4				3 7										
Current Rating	6.5									2					
Mating/Unmating Force	7.1	2 11 13 19	2 8												
Normal Force	7.2					2									
Contact Insertion/ Retention	7.3											2			
Individual Pin Insertion (new pin for each insertion)	7.4													2 5 8	
Individual Pin Retention	7.4													4 7 10	
PCB Hole Deformation Radius	7.5													11	
PCB Hole Wall Damage	7.6													12	
Board Lock Retention	7.7														2
Thermal Shock	8.1				4										
Humidity, Steady State	8.2				5										
Hi Temperature Life	8.3						5								
Environmental Sequence	8.4	5													
Phase I		8													
Phase II		16													
Phase III															
Ind. Mixed Flowing Gas	8.5		9												
Vibration	8.6				4										
Mechanical Shock	8.7				5										
Durability	8.8	12	5					4							
Solderability	8.9									2					
Res. to Soldering Heat	8.10										2		2		

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### REVISION RECORD

<u>REV</u>	<u>PAGE</u>	<u>DESCRIPTION</u>	<u>EC#</u>	<u>DATE</u>
A	ALL	New release	V10892	02/22/01
B	2,12,14,16, 17	Update to include R/A Receptacle press fit Revise test groups and sequences to reflect actual test procedures	V11528	05/02/01
C	ALL	Update to include vertical header Remove test group 8	V12261	09/24/01
D	5 & 6	Correct test procedure numbering	V12530	11/14/01
E	1, 2, 4, 6, 7, 9	Added reference to HPC product specification Added/deleted referenced lab reports to make current Added vertical header signal contact press fit values Added vertical header and R/A receptacle press fit test sample table Corrected paragraph numbering in test sequence table; Added Areva log	V20869	05/2/02
F	2 3 4	Add HPC press fit specifications references Add P/N 51866 to paragraph 5.4.1 Include min. 6# to seat signal receptacle contacts further into housing. Revised Section 7.5 to include references to HPC specifications	V21237	8/05/02
G	7	Increase durability rating to 200 cycles	V21408	8/29/02
H	1 3 9 All	4.1.1 Add more typical P/N series: 51939, 51940, 51897, 51921 etc. 5.3 Update the finish for Powerblade all series 9.3 Add the test samples P/N for Lead Free parts, in the table" For lead free test, use 517*0 - *****LF" Change the "FCI" logo	DG06-0223	6/02/06
J	6 & 7 5 6	Update dwell time for 8.1 and phase 1 in 8.4 Update insertion / retention force for signal header pins (7.4) Update hole deformation radius for signal header pins (7.5)	DG06-0400	12/13/06
K	5	Update to clarify para. 6.5 by a clearer description	DG07-0002	1/4/07
L	2	Remove referenced FCI spec. GS-12-005: Split-Lif Compliant and FCI Lab Reports. (4.4.5 & 4.5)	DG07-0323	8/08/07

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M	5 & 8	Update to clarify the retention force of power pin by a clearer description. (7.4) Change operating temperature range. (8.11)	DG07-0420	10/23/07
N	3 & 8 & 11	Add GXT plating option on contact area. (5.3) Correct operating temperature range. (8.11) Correct the test sequence in test group 1.	DG08-0022	01/21/08