

NUMBER <b>GS-12-149</b>	TYPE <b>PRODUCT SPECIFICATION</b>	<b>Amphenol FCi</b>	
TITLE PwrBlade <sup>®</sup> Product Specification		PAGE 1 of 13	REVISION AA
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		CLASSIFICATION <b>UNRESTRICTED</b>	

## 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

If there is conflict between the product drawings and specifications, the drawing takes precedence.

This document is composed of the following sections:

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Table 2	Qualification Testing Matrix

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#### 4.0 APPLICABLE DOCUMENTS

- 4.1 Specifications
  - 4.1.1 Applicable FCI power blade product drawings
- 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 BUS-03-601: Current Rating/30BUS-03-601: Current Rating/30°C Temperature Rise
  - 4.4.2 BUS-03-404: Normal Force Measurement
  - 4.4.3 BUS-12-090: HPC Product Specification
  - 4.4.4 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 – High Performance Copper Alloy  
Signal Header Contacts – Copper Alloy  
Signal Receptacle Contacts – Copper Alloy  
Receptacle and Plug Housings - Glass Filled HTN (High Temperature Nylon)

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5.3 Finish

Refer to plating specification 10064183.

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.

**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.

6.2 Power tested at Specified Current – The contact resistance at a specified current shall not exceed 0.7 milliohm end of life when measured in accordance with EIA 364 TP32. 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).

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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 1) 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 1: Rated current table (amperes)

Types	Pitch (mm)	Single Contact	2 adjacent Contacts*	4 adjacent Contacts	8 adjacent Contacts	12 adjacent Contacts
Power Contact	6.35	48	50*	36	31	30

\* 2 adjacent contacts test by wire, the wire size is 6AWG.

Types	Pitch (mm)	Single Contact	Multiple contact
Signal Contact	2.54	3	1

## 7.0 MECHANICAL CHARACTERISTICS

7.1 Mating/Unmating Force – The force to mate a receptacle connector and compatible header shall not exceed 6.94N [25 ounce] per power contact and 0.97N [3.5 ounce] per signal contact. The unmating force shall not be less than 2.23N [8 ounce] per power contact and 0.18N [0.64 ounce] per signal contact. The following details shall apply:

Table 2: Mating/Unmating Force

Force spec.	Power contact	Signal contact
Mating force Maximum	6.94N [25 ounce]	0.97N [3.5 ounce]
Unmating force Minimum	2.23N [8 ounce]	0.18N [0.64 ounce]

- a. Cross Head Speed – 25.4mm [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.

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- 7.3 Contact Retention – Individual power and signal contacts shall withstand an axial retention load of 13.4N [3 pound]. Individual signal receptacle contacts will withstand an axial load of 26.7N [6 pound] minimum to seat further into housing.
- Rate of 12.7mm [0.5 inch] per minute without dislodging from the housing cavity.
  - Test 30 contacts
  - 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 5.08mm [0.2 inch] per minute shall not exceed 26.6N [6 pound] for signal receptacle contacts, 93.4N [21 pound] for signal header pins and 111.2N [25 pound] per tail for power contacts. The retention force in the axial direction opposite that of insertion shall not be less than 6.7N [1.5 pound] for signal receptacle contacts, 13.4N [3 pound] for signal header pins and 22.3N [5 pound] per tail for power contacts.

Table 3: Individual Pin Insertion/Retention Force table

Force spec.	Pwr contact (per tail)	Signal contact	
		Rec Signal contact	Hdr Signal contact
Insertion force Maximum	111.2N [25lbs]	26.6N [6lbs]	93.4N [21lbs]
Retention force Minimum	22.3N [5lbs]	6.7N [1.5lbs]	13.4N [3lbs]

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 0.254mm [0.010"] 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 0.0381mm [0.0015"] when measured from the drilled hole. The absolute maximum deformation radius shall not exceed 0.0508mm [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 0.00762mm [0.0003"]. In addition there shall be no copper cracks, separations between conductive interfaces, or laminate-to-copper separations.

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- 7.7 Board Lock Retention to Housing- Individual board locks shall withstand an axial load of 13.4N [3 pound] minimum.
- Rate of 12.7mm [0.5 inch] per minute without dislodging from the housing cavity.
  - Test 30 board locks

## **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 – -55 to +125 °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
- 8.3 High Temperature Life, EIA 364 TP 17
- a. Test Duration – 21 Days
  - b. Temperature – +125 °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 -55 and +125 °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%

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c. Temperature – +40 ° C

Phase III – High Temperature Life, EIA 364-17

- a. Test Duration – 21days
- b. Temperature – +125 ° 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 – 1.524mm [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 A (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

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

- a. Number of Cycles – 200
- b. Cycling rate – 127mm [5 inch] 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.

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8.11 Operating temperature – -55 ° C to 125 ° 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 3**

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 T E D	2 6			2 6	I T 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 Phase I	8.4	5													
Phase II		8													
Phase III		16													
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			

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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	3 & 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
P	3	Remove Gold Flash plating option on tail area. (5.3)	DG08-0187	07/22/08
R	3	Remove GXT plating option on contact area for Signal contact. (5.3)	DG08-0226	08/19/08
S	2 & 3	Modify item 4.1 drawing number & 5.3 add plating spec. 10092675	DG08-0255	10/02/08
T	7	Change operating temperature range. (8.11)	DG10-0162	05/04/10
U	2 & 3	Remove PwrBlade Qualification Summary GS-29-149. (4.4.1) Re-describe raw materials of Power and Signal contacts. (5.2) Remove plating specification 10092675. (5.3) Tighten Contact Resistance spec. of Power contacts from 2.0 milliohm max. to 0.7 milliohm max..	DG10-0205	06/02/10
V	1, 4, 6,7,10	Add a new table for Individual Pin Insertion/Retention Force.(7.4) Change operation temperature range.(8.11)	DG-13984-1	03/27/13
W	ALL	Correct print error	DG-14425-1	04/07/13
X	3,5,6,7	Update operating temperature	DG-16432-1	03/04/14
Y	4	Update current rating (6.5)	DG-23359	02/25/16
	ALL	Update logo		
AA	4	Update current rating of signal contact (6.5)	DG-24556	07/29/16

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