

NUMBER GS-12-1895	TYPE GENERAL PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PwrBlade® ULTRA HD+ BTB Connector		PAGE 1 of 13	REVISION A
		AUTHORIZED BY ZJ HE	DATE 7/18/2024
		CLASSIFICATION UNRESTRICTED	

1.0 Objective

This specification defines the performance, test, quality, and reliability requirements of the PwrBlade® ULTRA HD+ product.

2.0 Scope

This specification is applicable to the termination characteristics of the PwrBlade® ULTRA HD+ family of products which provides separable right angle headers that mate to right angle receptacles.

3.0 Ratings

3.1 Operating Voltage Rating = Refer to section 6.6

3.2 Operating Current Rating = Refer to section 6.5

3.3 Operating Temperature Range = -40°C ~ 125°C ¹

Operating temperature is tested in accordance with EIA-364-17 Method A for 504 hours at 125°C per EIA-364-1000 Table 8 to meet field temperature of 95°C for 10 years field life (95°C field temperature is based on the assumption that the contact spends 1/3 of its field life at that temperature and its remaining life at 40°C or less).

Note 1: includes the terminal temperature rise when powered

4.0 Applicable Documents

4.1 AFCI Specifications

4.1.1 Engineering drawings: 10169891 & 10169892

4.1.2 Application specification: GS-20-0849

4.2 National or International Standards

4.2.1 Flammability: UL94V-0 or similar applicable specification

4.2.2 EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications.

4.2.3 J-STD-002: Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires.

4.3 AFCI Laboratory Reports - Supporting Data

DG-2024-02-005-CR

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4.4 Safety Agency Approvals

UL/CSA File #: E66906-Vol1-Sec222

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, halogen free polyamide or other high performance resin rated flame retardant 94V-0 in accordance with UL-94.

Retention clip – Copper Alloy

5.3 Finish

The finish for applicable components shall be as specified herein or equivalent.

Standard PwrBlade® ULTRA HD+ contact plating refer to AFCI 10135186.

5.4 Design and Construction

Connectors shall be of the design, construction, and physical dimensions specified on the applicable product drawing. There shall be no cracks, burrs, or other physical defects that may impair performance.



Figure 1: Header connector
Configuration shown: 10LP+36S+10HP

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Figure 1: Header connector
Configuration shown: 10LP+36S+10HP

5.5 Workmanship

This includes freedom from blistering, cracks, discoloration, etc.

5.6 Examination

Visual and dimensional inspection per product drawings, must meet requirements of product drawing in accordance with EIA-364-18.

6.0 Electrical Characteristics

6.1 Contact Resistance, Low Level (LLCR)

The low level Signal Contact resistance shall not exceed 20 milliohms initially. The low level Signal Contact resistance shall also not exceed 10 milliohms increase in resistance (from the initial measurement) after any treatment and/or environmental exposure.

The low level High Power Contact resistance shall not exceed 0.3 milliohms initially. The low level High power Contact resistance shall also not exceed 0.6 milliohms after any treatment and/or environmental exposure.

The low level Low Power Contact resistance shall not exceed 0.6 milliohms initially. The low level High power Contact resistance shall also not exceed 1.2 milliohms after any treatment and/or environmental exposure.

Measurements shall be in accordance with EIA 364-23.

The following details shall apply:

- a. Test Voltage - 20 milli-volts DC max open circuit.
- b. Test Current - Not to exceed 100 milli-amperes.

6.2 Contact Resistance, Specified Current

The High Power Contact resistance at a specified current shall not exceed 0.3 milliohms initially.

The High Power Contact resistance at a specified current shall also not exceed 0.6 milliohms after any treatment and/or environmental exposure.

The Low Power Contact resistance at a specified current shall not exceed 0.6 milliohms initially.

The Low Power Contact resistance at a specified current shall also not exceed 1.2 milliohms after any treatment and/or environmental exposure.

Measurements shall be in accordance with EIA 364-06.

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The following details shall apply:

- a. Test Current – Shown in table 1a.

6.3 Insulation Resistance

The Power Contacts insulation resistance of mated connectors shall not be less than 1,000 megohms initially and 1,000 megohms after environmental exposure.

The Signal Contacts insulation resistance of mated connectors shall not be less than 500 megohms initially and 500 megohms after environmental exposure.

Measurements shall be in accordance with EIA 364-21.

The following details shall apply:

- a. Test Voltage - 500 volts DC.
- b. Electrification Time - 2 minutes, unless otherwise specified.
- 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 milliamperes when mated connectors are tested in accordance with EIA 364-20.

The following details shall apply:

- a. Test Voltage – 1000 volts DC for Signal Contacts.
- b. Test Voltage – 2500 volts DC for High/Low Power Contacts.
- b. Test Duration - 60 seconds.
- c. Test Condition – 1 (760 Torr - sea level) .
- d. Points of Measurement - Between adjacent Contacts.

6.5 Current Rating

The temperature rise above ambient shall not exceed 30 deg C at any point in the system when all contacts are powered at specified amperes in Table 1a.

The following details shall apply:

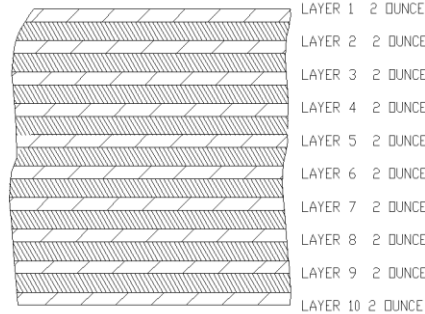
- a. Ambient Conditions – Still air at 25°C
- b. Stabilize at a single current level until 3 readings at 5 minute intervals are within 1°C.
- c. Reference - EIA 364-70, method 1.

Table 1a: Rated current table (amperes)

Type	Pitch (mm)	Single Contact	2 adjacent Contacts	4 adjacent Contacts	6 adjacent Contacts	8 adjacent Contacts	10 adjacent Contacts
High	5.00	140	110	100	90	85	80
Low	3.50	90	75	65	60	55	50

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Types	Pitch (mm)	Single Contact	36 adjacent Contacts
Signal Contact	2.00	3	1



Note: Connectors are applied to test boards with 10 layers x 2 ounces copper for power contact and 2 layers x 2 ounces copper for signal contact.

The 2layers x 2 ounces copper for signal contact is mixed with Top & Bottom layers of Power contact

6.6 Voltage Rating

The voltage ratings are based on the Minimum Creepage Distances when the connector is installed in the pc board. It's related to the real application.

Table 2a for Press-fit or wave soldering application, MCD for power contacts determined using Ø1.02mm finished hole with 0.24mm annular ring (nominal). Resulting in a Ø1.50mm Pad (nominal). MCD for signal contacts determined using Ø0.75mm finished hole with 0.25mm annular ring (nominal). Resulting in a Ø1.25mm Pad (nominal).

Table 2a: Voltage rating table

Table 2	PwrBlade® ULTRA HD+ Maximum Working Voltage Vs. Minimum Creep Distance (Reference UL 60950-1 Second Edition Table 2N)					
Type	Contact Pitch (mm / inch)	Pollution Degree (office Environment)	Material Group (Base on UL Rating)	MCD Of PCB (mm)	Maximum Working Voltage (AC RMS)	Maximum Working Voltage (DC/AC Peak)
Signal	2.00 [.079"]	2	II	0.75	38	54
High Power	5.00 [.197"]			1.74	242	342
	7.00 [.276"]			1.92	271	383
Low Power	3.50 [.138"]			1.92	271	383
Signal	2.00 [.079"]	2	IIIb	0.75	35	49
High Power	5.00 [.197"]			1.74	174	246
	7.00 [.276"]			1.92	192	271
Low Power	3.50 [.138"]			1.92	192	271

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Table 3a for PIP application, MCD for power contacts determined using Ø1.15mm finished hole with 0.25mm annular ring (nominal). Resulting in a Ø1.65mm Pad (nominal). MCD for signal contacts determined using Ø1.0mm finished hole with 0.25mm annular ring (nominal). Resulting in a Ø1.50mm Pad (nominal).

Table 3a: Voltage rating table

Table 2	PwrBlade® ULTRA HD+ Maximum Working Voltage Vs. Minimum Creep Distance (Reference UL 60950-1 Second Edition Table 2N)					
Type	Contact Pitch (mm / inch)	Pollution Degree (office Environment)	Material Group (Base on UL Rating)	MCD Of PCB (mm)	Maximum Working Voltage (AC RMS)	Maximum Working Voltage (DC/AC Peak)
Signal	2.00 [.079"]	2	II	0.50	25	35
High Power	5.00 [.197"]			1.59	223	315
	7.00 [.276"]			1.77	246	347
Low Power	3.50 [.138"]			1.77	246	347
Signal	2.00 [.079"]	2	IIIb	0.50	25	35
High Power	5.00 [.197"]			1.59	156	220
	7.00 [.276"]			1.77	177	250
Low Power	3.50 [.138"]			1.77	177	250

7.0 Mechanical Characteristics

7.1 Mating/Unmating Force

The force to mate a receptacle connector and compatible header.

Contact types	Mating force (Maximum)	Un-mating Force (Minimum)
Per High Power Contacts	12N	2.2N
Per Low Power Contacts	6N	1.1N
Per Signal Contacts	1N	0.2N

The following details shall apply:

- Cross Head Speed – 12.7mm [0.5in.] per minute.
- Utilize free floating fixtures.
- Reference – EIA 364-13.

7.2 Compliant Pin Insertion

The force necessary to correctly apply a specimen to a printed circuit board.

Contact types	Insertion force per compliant EON
Plug/Receptacle Power Contacts	90N[20.2lbs] maximum
Plug Signal Contacts	67N[15.0lbs] maximum
Receptacle Signal Contacts	30N[6.7lbs] maximum

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- a. Cross Head Speed – 12.7mm [0.5 in.] per minute max.
- b. Reference – EIA 364-5.

7.3 Retention force per compliant pin

The force necessary to remove a specimen from a printed circuit board.

Contact types	Retention force per compliant EON
Plug/Receptacle Power Contacts	10N[2.25lbs] minimum
Plug Signal Contacts	6.7N[1.5lbs] minimum
Receptacle Signal Contacts	6.7N[1.5lbs] minimum

- a. Cross Head Speed – 12.7mm [0.5 in.] per minute max.
- b. Reference – EIA 364-5.

7.4 Contact Retention

The force necessary to remove a power or signal contact from the connector housing.

Contact types	Retention force per contact
Plug Power Contacts	13.4N[3.0lbs] minimum
Plug IMLA	13.4N[3.0lbs] minimum
Receptacle Power Contacts	13.4N[3.0lbs] minimum
Receptacle IMLA	13.4N[3.0lbs] minimum

The following details shall apply:

- a. Reference – EIA 364-05.

7.5 PCB Hole Deformation Radius and Remaining Cu Plating Thickness (compliant pin)

Use PCB's with minimum diameter holes, tin/OSP plating, and 1.57mm overall thickness. Metallographic cross-sections shall be prepared parallel to the PCB surface (transverse section) to facilitate radial hole deformation measurement, photographs, and remaining Cu plating measurement.

Prior to cross-section preparation, perform 3 compliant pin insertions and 3 compliant pin withdrawals.

The measurements and photographs shall be performed at 0.3 mm, [+0.2 mm, -0.1 mm] (0.012", [+0.008", -0.004"]) from the connector side PCB laminate (not copper) surface and at the center of the compliant pin section on a minimum of 10 holes. The average (of 10 holes) hole deformation radius shall be no greater than 37.5 µm (0.0015") when measured from the drilled hole. The absolute maximum deformation radius shall not exceed 50 µm (0.002"). The minimum average (of 10 holes) copper thickness remaining between the compliant pin and the printed wiring board laminate shall not be less than 7.5 µm (300 µ"). Reference IEC 60352-5 or EIA-364-96. The force necessary to remove a power or signal contact from the connector housing.

7.6 PCB Hole Wall Damage

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Use PCB's with minimum diameter holes, tin/OSP plating, and 1.57mm overall thickness. Metallographic cross-sections shall be prepared perpendicular to the PCB surface (longitudinal section) and through the compliant section wear track to facilitate examination of the PTH.

Prior to cross-section preparation, perform 3 compliant pin insertions and 3 compliant pin withdrawals.

There shall be no copper cracks, separations between conductive interfaces, or laminate-to-copper separations. Test 10 pins/holes. Reference IEC 60352-5 or EIA-364-96.

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 electrical and mechanical requirements per paragraphs 6.0 and 7.0 as specified in the Table 1 test sequences. Unless specified otherwise, assemblies shall be mated during exposure.

8.1 Thermal Shock – EIA 364-32

- a. Number of Cycles – 10 cycles.
- b. Temperature Range - Between -40°C and 125°C
- c. Time at Each Temperature - 30 minutes minimum
- d. Transfer Time - 5 minutes, maximum

8.2 Humidity – EIA 364-31 method IV (cyclic temperature)

- a. Relative Humidity - 94%
- b. Temperature – 25°C ~ 65°C
- c. Duration – 10 cycles (24 hours each), 10 days
- d. With step 7a
- e. Step 7a – -10°C

8.3 High Temperature Life – EIA 364-17

- a. Test Temperature – 125°C
- b. Test Duration - 504 hours

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

- a. Class - IIA
- b. Duration - 20 days
- c. 1st 10days unmated (both halves), 2nd 10days mated.

8.5 Vibration (Random) – EIA 364-28

- a. Test Condition – VII, test condition E.
- b. Subject mated specimens to 4.90G's rms between 20~500Hz.
- c. Mounting – To eliminate relative motion, both mating halves should be rigidly fixed.

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- d. Duration – 15 minutes in each of 3 mutually perpendicular planes.
- e. No evidence of physical damage.
- f. No discontinuities greater than 1microsecond.

8.6 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 shocks total)
- c. Mounting - Rigidly mount assemblies.
- d. No discontinuities greater than 1.0 microseconds.

8.7 Durability - EIA 364-09

- a. Number Cycles - 200 cycles
- b. Cycling Rate – 500 cycles/hour Max.
- c. Latches disabled (If applicable)
- d. Use free floating fixtures

8.8 Solderability – J-STD-002

- a. Test Condition A1
- b. Minimum solder coverage: 95 %

8.9 Resistance to Solder Heat – EIA 364-56

- a. Test Condition – H, Procedure 3
- b. There shall be no evidence of physical or mechanical damage

8.10 Disturb (thermal) - EIA 364-110

- a. Test Condition A
- b. Test Specimens – Mated connectors mounted to PCBs
- c. 10 Temperature Cycles between 15±3°C and 85±3°C
- d. Ramp Time – >2°C per minute
- e. Dwell Time – 5 minutes min.
- f. Humidity not controlled

8.11 Dust - EIA 364-91

- a. Dust Composition - #1 (benign)
- b. Duration – 1hour (±15 minutes)
- c. Both halves to be placed in the chamber
- d. Specify connector orientation in the chamber.

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8.12 Re-Seating - Manually unplug and plug the connector for 3 cycles

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 ANSI Z-540 and ISO 9000.

9.2 Inspection Conditions

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

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

9.3 Sample Quantity And Description

3 mated pair of test samples mounted on test PCBs are needed for test groups 1, 2, 4, 5, 7.

3 mated pair of test samples not mounted on test PCBs are needed for test groups 3 and 8.

A minimum of 10 loose piece contacts with a minimum of 60 Press-Fit EONS are needed for test group 6.

9.4 Acceptance

9.4.1 Electrical and mechanical requirements placed on test samples as indicated in paragraphs 6.0 and 7.0 shall be established from test data using appropriate statistical techniques or shall otherwise be customer specified, and all samples tested in accordance with this product specification shall meet the stated requirements.

9.4.2 Failures attributed to equipment, test setup, or operator error shall not disqualify the product. If product failure occurs, corrective action shall be taken, and samples resubmitted for qualification.

9.5 Qualification Testing

Qualification testing shall be performed on sample units produced with equipment and procedures normally used in production. The test sequences shall be as shown in the qualification test table. Data shall be provided with the samples noting production history: production lot codes for components and assemblies, components and assemblies produced to print revision ___, verification of plating composition and thickness, etc.

9.6 Re-Qualification Testing

If any of the following conditions occur, the responsible product engineer shall initiate requalification testing consisting of all applicable parts of the qualification test matrix.

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- a. A significant design change is made to the existing product which 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, contact surface geometry, insulator design, contact base material, or contact lubrication requirements.
- b. A significant change is made to the manufacturing process which impacts the product form, fit or function.
- c. A significant event occurs during production or end use requiring corrective action to be taken relative to the product design or manufacturing process.

9.7 Qualification Test Table

TEST	PARA	Test Group								
		1	2	3	4	5	6a	6b	7	8
		Temp. Life	Thermal Shock/ Humidity	Dielectric	Vibration & Mech. Shock	MFG	Compliant Pin Repair (a)	Compliant Pin Repair (a)	Current Rating	Contact Retention & Solderability
Test Sequence (b)										
Examination of Product	5.6	1,11	1,15	1,10	1,15	1,17	1,10	1,9	1,4	1
Low level contact resistance,	6.1	2,6, 8,10	2,6,8,12 ,14		2,4,8, 10,12, 14	2,6,8, 10,12, 14,16				
Contact Resist.at rated current, High/Low Power Contacts only	6.2								3	
Insulation resistance	6.3			2,5,8						
Dielectric Withstanding Voltage	6.4			3,6,9						
Current Rating	6.5								2	
Mating/Un-Mating Force	7.1	3,5	3,5		5,7	3,5				
Compliant Pin Insertion	7.2						2,4,6	2,4,6		
Compliant pin retention	7.3						3,5,7	3,5		
Contact Retention	7.4									2
PCB Hole Deformation	7.5							7		
PCB Hole Wall Damage	7.6							8		
Thermal Shock	8.1		7	4						
Humidity	8.2		11	7						
High Temperature Life	8.3	7			3(c)	7(c)				
Mixed Flowing Gas (MFG)	8.4					9,11				
Vibration	8.5				11					
Mechanical Shock	8.6				13					
Durability	8.7	4(d)	4(d)		6	4(d)				
Solderability	8.8									3
Resistance to Solder Heat	8.9									4
Disturb (Thermal)	8.10					13				
Dust	8.11		9		9					
Re-Seating	8.12	9	13			15				

NOTE:

- (a) See paragraph 9.4.
- (b) Numbers indicate sequence in which tests are performed.
- (c) Precondition (Temp. Life) specimens per EIA-364-17. Refer to EIA-364-1000 Table 9 for test parameters.

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- (d) Precondition (Durability) specimens with 25 durability cycles per EIA-364-09.
- (e) Perform remaining durability cycles to meet the paragraph 8.7 requirement.
- (f) Test Groups:
 - Group 1 – Temp. Life
 - Group 2 – Thermal Shock/Humidity
 - Group 3 – Dielectric
 - Group 4 – Vibration and Mechanical Shock
 - Group 5 – MFG
 - Group 6 – Compliant Pin Repair
 - Group 7 – Current Rating
 - Group 8 – Contact Retention and Solderability
- (g) Samples quantity: Each test group with 3 sets of samples

REVISION RECORD

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A	All	New released	NA	2024/7/18