

NUMBER GS-12-1176	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PwrBlade ULTRA® Connector System		PAGE 1 of 10	REVISION B
		AUTHORIZED BY Kaka Zhang	DATE 04/13/2017
		CLASSIFICATION UNRESTRICTED	

1.0 Objective

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

2.0 Scope

This specification is applicable to the termination characteristics of the PwrBlade ULTRA® family of products which provides separable right angle plugs that mate to right angle and vertical receptacles.

3.0 Ratings

- 3.1 Operating Voltage Rating = 182V_{AC}/5.00mm Pitch-407V_{AC}/7.25mm Pitch
(Refer to section 6.6, Table 2)
- 3.2 Operating Current Rating = 85A/Single Power Contact – 58A/10 Power Contacts
(Refer to section 6.5, Table 1a & Table 1b)
- 3.3 Operating Temperature Range = -40°C ~ 125°C

4.0 Applicable Documents

- 4.1 AFCI Specifications
 - 4.1.1 Applicable AFCI PwrBlade ULTRA® product drawing
 - 4.1.2 GS-14-2354 Packaging Specification
 - 4.1.3 GS-20-0389 Application specification
- 4.2 National or International Standards
 - 4.2.1 UL94: Flammability
 - 4.2.2 EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications.
 - 4.2.3 MIL-STD-1344A: Federal Specifications, Test Methods for Electrical Connectors.
 - 4.2.4 J-STD-002: Solderability Tests for Component Leads, Terminations, Lugs, Terminals and Wires.
- 4.3 AFCI Laboratory Reports - Supporting Data
 - 4.3.1 EL-2015-04-022
 - 4.3.2 DG-2015-05-025

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

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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.

5.3 Finish

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

Standard PwrBlade ULTRA® 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.

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)

For Signal Contacts, the low level contact resistance shall also not exceed 20 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 millivolts DC max open circuit.
- b. Test Current - Not to exceed 100 milliamperes.

6.2 Contact Resistance, Specified Current

The High Power Contact resistance at rated current shall not exceed the specified mOhms in table initially and after any treatment and/or environmental exposure.

The Low Power Contact resistance at rated current shall not exceed the specified mOhms in table initially and after any treatment and/or environmental exposure.

Type	Initial Contact Resistance Max. (mOhms)	Post Environmental Contact Resistance Max. (mOhms)
High Power	0.3	0.4
Low Power	0.6	1.2

Measurements shall be in accordance with EIA 364-06.

The following details shall apply:

- a. Test Current – Shown in Tables 1a and 1b.

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6.3 Insulation Resistance

The insulation resistance of mated connectors shall not be less than 1,000 megohms initially and 1,000 megohms after environmental exposure for power contacts. The insulation resistance of mated connectors shall not be less than 500 megohms initially and 500 megohms after environmental exposure for signal contacts.

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 all adjacent power contacts and 5 adjacent signal 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.
- c. Test Duration - 60 seconds.
- d. Test Condition - 760 Torr - sea level.
- e. Points of Measurement - Between all adjacent power contacts and 5 adjacent signal contacts.

6.5 Current Rating

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

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. Test with single energized contact and with all adjacent contacts energized.
- d. Reference - EIA 364-70, method 1.

Table 1a: Rated current table (amperes),

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

Type	Pitch (mm)	Single Contact	4 adjacent Contacts	8 adjacent Contacts	10 adjacent Contacts
High Power	7.00	85	N/A	N/A	N/A
High Power	5.00	85	75	63	58
Low Power	3.50	51	45	38	35

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Types	Pitch (mm)	Single Contact	24 adjacent Contacts	48 adjacent Contacts
Signal Contact	2.54	3	1.5	1

NOTE: Schematic of 10 layer PCB

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

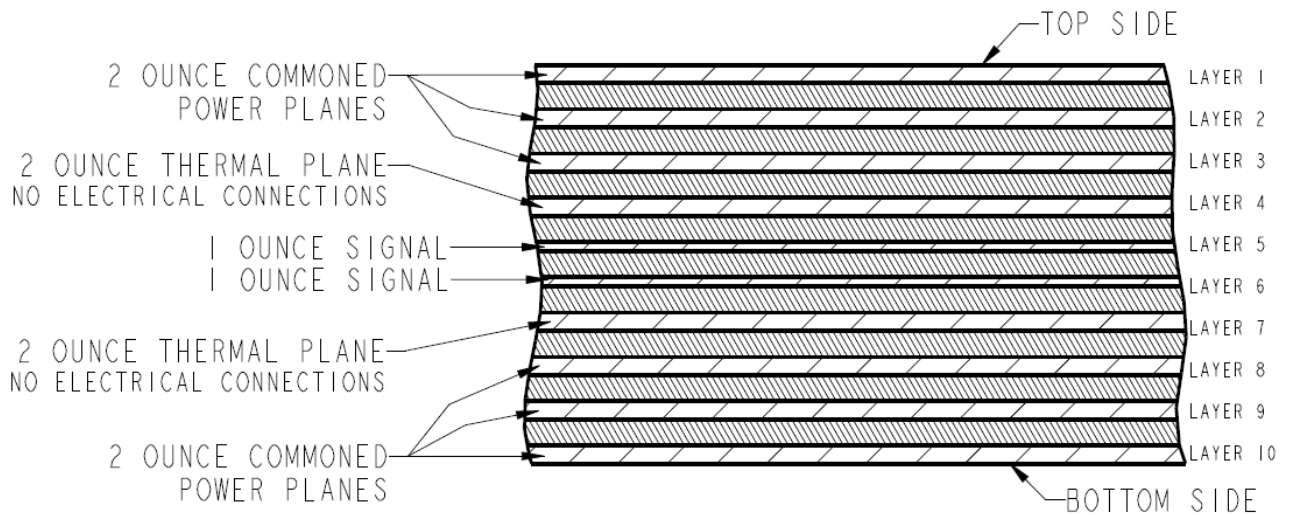


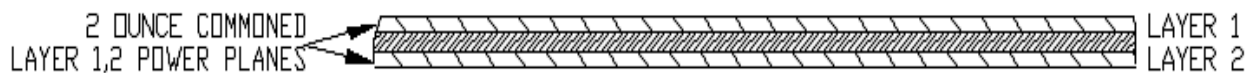
Table 1b: Rated current table (amperes),

Note: Connectors are applied to test boards with 2 layers x 2 ounce copper power planes

Type	Pitch (mm)	Single Contact	4 adjacent Contacts	8 adjacent Contacts	10 adjacent Contacts
High Power	7.00	52	N/A	N/A	N/A
High Power	5.00	52	43	36	33
Low Power	3.50	31	26	22	20

NOTE: Schematic of 2 layer PCB

Top and bottom layers are commonded.



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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 2: Rated voltage table,

Note: MCD determined using Ø1.02mm finished hole with 0.24mm annular ring (nominal). Resulting in a Ø1.50mm Pad (nominal).

Table 2	PwrBlade ULTRA® 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	2.54 [.100"]	2	II	1.04	120	170		
High Power	5.00 [.197"]			1.82	253	358		
	7.00 [.276"]			3.82	531	751		
	7.25 [.285"]			4.07	567	802		
Low Power	3.50 [.138"]			2.00	285	403		
	5.50 [.217"]			4.00	557	788		
Signal	2.54 [.100"]			2	IIIb	1.04	39	55
High Power	5.00 [.197"]					1.82	182	257
	7.00 [.276"]	3.82	382			540		
	7.25 [.285"]	4.07	407			575		
Low Power	3.50 [.138"]	2.00	200			282		
	5.50 [.217"]	4.00	400			565		

7.0 Mechanical Characteristics

7.1 Mating/Unmating Force

The force to mate/unmate a receptacle connector and compatible plug.

Contact types	Mating force	Unmating Force
Per High Power Contacts	7N [25 ounce] Maximum	2.2N [8 ounce] Minimum
Per Low Power Contacts	3.5N [12.5 ounce] Maximum	1.1N [4 ounce] Minimum
Per Signal Contacts	1N [3.6 ounce] Maximum	0.2N [0.7 ounce] Minimum

The following details shall apply:

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

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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	93.4N[21lbs] maximum
Receptacle Signal Contacts	27N[6lbs] maximum

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

7.3 Radial Hole Distortion and PTH Wall Damage

0.070mm [0.00276in] maximum radial distortion.

0.008mm [0.00032in] minimum copper hole wall remaining.

There shall be no copper cracks, separation between conductive interfaces, or laminate to copper separations.

The following details shall apply:

- a. Measure at 0.2 to 0.5mm [0.008 to 0.020in] depth.
- b. Reference – EIA 364-96.

7.4 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.

7.5 Component Heat Resistance to Wave Soldering

Shall meet visual requirements, show no physical damage, and meet requirements of additional test as specified in Table 3.

The following details shall apply:

- a) Reference – EIA 364-56, Procedure 3, Test Condition H
- b) Samples are to be loose piece connectors (not mounted to PCB)

7.6 Solderability Dip Test

Solderable area shall have a minimum of 95% solder coverage.

The following details shall apply:

- a. Reference – J-STD-002.

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- 7.7 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.
 - d. Duration – 15 minutes in each of 3 mutually perpendicular planes.
 - e. No evidence of physical damage.
 - f. No discontinuities greater than 1microsecond.
- 7.8 Mechanical Shock – EIA 364-27
 - a. Condition - A (50G, 11millisecond, 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 1.0microseconds.
- 7.9 Durability - EIA 364-09
 - a. Number Cycles - 200 cycles
 - b. Cycling Rate – 500 cycles/hour max.

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 3 test sequences. Unless specified otherwise, assemblies shall be mated during exposure.

- 8.1 Thermal Shock – EIA 364-32.
 - a. Number of Cycles – 36 mated
 - 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 III (cyclic temperature)
 - a. Relative Humidity – 80%~100%
 - b. Temperature – 25°C~40°C
 - c. Duration – 10 cycles, 10 days, omit step 7b
- 8.3 High Temperature Life – EIA 364-17, Method A.
 - a. Test Condition - 5
 - b. Test Temperature - 105°C
 - c. Test Duration - 504 hours

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- 8.4 Mixed Flowing Gas corrosion (MFG) – EIA 364-65
 - a. Class - IIA
 - b. Duration - 14 days
 - c. 1st 7 days unmated (both halves), 2nd 7 days mated

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 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 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.
- 9.3.2 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.

9.4 Qualification Testing

- 9.4.1 Qualification testing shall be performed on randomly selected sample units produced with equipment and procedures normally used in production.
- 9.4.2 Test Sequence – as specified in Table 3.

9.5 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, Table 3.

- a. 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.
- 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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Table 3: Qualification Test Table

TEST	PARA	Test Group (a,b)									
		1	2	3a	3b	4	5	6	7	8	P(g)
		Test Sequence (c)									
Examination of Product	5.6	1,8	1,15	1,8	1,10	1,7	1,13	1,4	1,4	1,5	1,9
Low level contact resistance, Signal Contacts only	6.1	2,6	3,6,9,12		2,5,8	2,5					
Contact Resistance at rated current, High/Low Power Contacts only	6.2	3,7	4,7,10,13		3,6,9	3,6	2,5,7,9,11				6,8
Insulation resistance	6.3			2,6							
Dielectric Withstanding Voltage	6.4			3,7							
Current Rating	6.5						4,12				5
Vibration, Random	7.7		8				10(d)				
Mechanical Shock	7.8		11								
Durability	7.9	4(e)	5				3(f)				2(f), 7(h)
Mating Force	7.1		2								3
Un-Mating Force	7.1		14								4
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	4						
Humidity-temperature cycling	8.2			5	7						
Temperature Life	8.3					4	8			3	
Mixed Flowing Gas	8.4	5					6				

NOTE:

- (a) See paragraph 9.4.
- (b) 3 mated pair per test group (Groups 1, 2, 3b, 4, 5 and Group P).
Need un-mounted samples (Groups 3a and 6)
Need a minimum of 10 loose piece contacts with a minimum of 20 Press-Fit EONs (Group 7).
Need a minimum of 10 loose piece contacts (Group 8).
- (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.
- (g) Group P is for preliminary testing and process verification.
- (h) Perform remaining durability cycles to meet the paragraph 7.9 requirement.

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REVISION RECORD

Rev	Page	Description	EC#	Date
A	All	Initial Release	-	06/17/2016
B	4	Add multilayer PCB schematic	ELX-DG-26654-1	04/13/2017