1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the PwrMAX® Orthogonal PCB/Busbar connector system.

2.0 Scope

This specification is applicable to the termination characteristics of the PwrMAX® Orthogonal family of products which provides a separable interface for power board to board and board to busbar applications.

3.0 Ratings

3.1 Operating Voltage Rating: 600V_{AC} for power contact.

3.2 Operating Current Rating: refer to values in the table in section 6.4.

3.3 Operating Temperature Range = -55℃ ~ +125℃[1]

Operating temperature is tested in accordance with EIA-364-17 Method A for 1000 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 are 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 Specifications

4.1.1 Engineering drawings: 10132640 and 10133407 etc.

4.1.2 Application specification: GS-20-0452

4.2 National or International Standards

4.2.1 Flammability: UL94V-0

4.2.2 EIA 364: Electrical connector/Socket test procedures include environmental classification.

4.2.3 EIA 364-1000: Environmental test methodology for assessing the performance of electrical connectors and sockets used in business office applications.

4.2.4 EIA 364-1004: Environmental test methodology for verifying the current rating of freestanding power contacts or electrical connectors and sockets.

4.3 Laboratory Reports - Supporting Data

DL-2016-09-036-CR

4.4 Safety Agency Approvals

UL/CSA File #: E66906 Vol. 1 Sec. 162

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 Receptacle Contacts: Copper alloy

Housings: High temperature thermoplastic, UL 94V-0 compliant

5.3 Finish

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

Contact Area : GCS®

Tails : Tin plated over Nickel

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.

6.0 Electrical Characteristics

6.1 Contact Resistance, Specified Current

The contact resistance at a specified current shall not exceed 0.3 mΩ initially or after any treatment and/or environmental exposure.

Measurements shall be in accordance with EIA 364-06.

The following details shall apply:

a. Test Current – refer to section 6.4.

6.2 Insulation Resistance

The insulation resistance of unmated connectors shall not be less than 10,000MΩ (mega ohms) initially or after any treatment and/or 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.

6.3 Dielectric Withstanding Voltage

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current > 1 mA when unmated connectors are tested in accordance with or EIA 364-20.

The following details shall apply:

a. Test Voltage - 2500 VDC .

b. Test Duration - 60 seconds.

c. Test Condition - 1 (760 Torr - sea level).

d. Points of Measurement - Between adjacent contacts.

6.4 Current Rating

The temperature rise above ambient shall not exceed 30℃ at any point in the system when all contacts are powered at specified current as below.

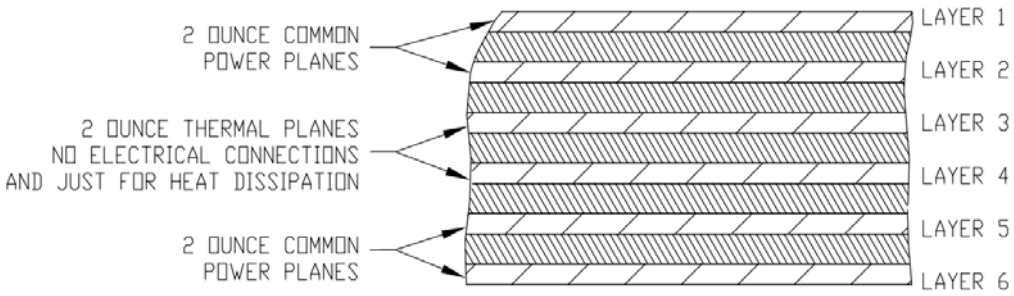
The following details shall apply:

a. Ambient Conditions – still air at lab room ambient;

b. Reference - EIA 364-70.

Application	Number of adjacent contacts (fully powered)	Test Board (Copper Pad)	Still Air	T-Rise (ºC)	Current Rating per power contact (Amp)
PwrMAX® Orthogonal (Board To Board)	2	6 layers*	Yes	30	100
PwrMAX® Orthogonal (Board to Busbar)	2	6 layers*			125

Note: * Regarding test PCB with 6 layers, the thickness of copper each layer please refer to the below:



7.0 Mechanical Characteristics

7.1 Mating/Unmating Force

The following details shall apply:

a. Cross Head Speed - 25.4mm per minute.

b. Utilize free floating fixtures.

c. Reference – EIA 364-13.

Configuration	Mating Force (N) (Max. Allowance)	Un-Mating Force (N) (Min. Allowance)
Per Power Contact	25	6.5

7.2 Contact retention

Test condition: Per EIA-364-29C, method C, a maximum rate of 25.4mm per minute

Requirement: individual power pin shall withstand an axial retention load of 35 N minimum

7.3 Reseating

Test condition: Manual plug/unplug the connector with module board.

Requirement: Perform 3 such cycles.

7.4 Compliant Pin Insertion Force

Receptacle - Individual compliant Pin

The force required to insert an individual compliant pin into a plated through hole in a tin/OSP printed circuit board at a rate of 5.08mm/minute shall not exceed 67 N.

RA plug - Individual compliant Pin

The force required to insert an individual compliant pin into a plated through hole in a tin/OSP printed circuit board at a rate of 5.08mm/minute shall not exceed 140 N.

7.5 Compliant Pin / Retention Force

Receptacle - Individual compliant Pin

The retention force in the axial direction opposite that of insertion at a rate of 5.08mm/minute shall not be less than 8 N per press-fit tail.

RA plug - Individual compliant Pin

The retention force in an axial direction opposite that of insertion at a rate of 5.08mm/minute shall not be less than 20 N.

7.6 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 EIA-364-96.

7.7 PCB Hole Wall Damage

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 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 - 5

b. Temperature Range - Between -65°C and +125°C

c. Time at Each Temperature - 30 minutes

d. Transfer Time - 5 minutes, maximum

8.2 Cyclic Temperature & Humidity – EIA 364-31 method III (cyclic temperature)

a. Relative Humidity - 80% to 98%

b. Temperature - 25℃~65℃

c. Duration - 500 hours

d. Omit step 7b (vibration) where applicable

8.3 High Temperature Life – EIA 364-17.

a. Test Temperature - 125± 2℃

b. Test Duration - 1000 hours

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

a. Class - IIA

b. Duration - 20 days

c. Un-mated condition for 10 days and followed by exposure of mated connectors for the remaining 10 days (See table 1B)

8.6 Vibration (Random) – EIA 364-28

a. Test Condition - method VII, letter E

b. Vibration Amplitude - 4.90 rms G

c. Duration – 15 minutes along each of three orthogonal axes

d. Mounting - Rigidly mount assemblies

e. No discontinuities greater than 1 microsecond

8.7 Mechanical Shock – EIA 364-27

a. Condition - Test condition A (50G, 11 millisecond, half-sine pulse type)

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 microsecond.

8.8 Durability - EIA 364-09

a. Number Cycles - 200 cycles

b. Cycling Rate - 127 mm/minute

c. Use free floating fixtures

8.9 Dust - EIA 364-91

a. Dust Composition #1 (benign)

b. Duration: 1.0 hour

c. Unmated connector to be placed in the chamber

8.10 Resistance to Solder Heat – EIA 364-56

a. Test Condition - Condition H, Procedure 3

b. There shall be no evidence of physical or mechanical damage

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°C

b. Relative Humidity: 30% to 60%

c. Barometric Pressure: Local ambient

9.3 Sample Quantity and Description

The sample size and description is listed for each test in the appropriate section of this document.

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.

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 GROUP ID:			1A	1B	2	3A	3B	4	5	6
TEST DESCRIPTION	**SECTION**	**Group P Testing (1)**	**Mixed Flowing Gas (Mated)**	**Mixed Flowing Gas (Un-Mated)**	**Temp Life**	**Thermal Shock & Humidity (Dielectric)**	**Thermal shock / Humidity**	**Vibration / Mech. Shock**	**Current Rating**	**Repair ability**
VISUAL EXAMINATION	5.5	1	1, 12	1,14	1,6	1,10	1,14	1,15	1,6	1, 10,
MATE HEADER & RECEPTACLE		2	2	2,8	2	2	2,10	3,9	2	
UNMATE HEADER & RECEPTACLE				6	7		8	7	5	
ELECTRICAL:										
CONTACT RESISTANCE AT LOW LEVEL	6.1	3								
CONTACT RESISTANCE AT SPECIFIED CURRENT	6.1	6,8,10	3,5,7,9,11	3,5,9,11,13	3,6		3,5,7,11, 13	4,6,10,12, 14	4	
INSULATION RESISTANCE	6.2					4,7				
DIELECTRIC WITHSTANDING VOLTAGE	6.3					5,8				
CURRENT RATING	6.4	5							3	
MECHANICAL:										
MATING / UNMATING FORCE	7.1							2		
CONTACT RETENTION	7.2					9				
COMPLIANT PIN INSERTION FORCE	7.3									2,4,6
COMPLIANT PIN RETENTION FORCE	7.4									3,5,7
PCB HOLE DEFORMATION RADIUS	7.5									8
PCB HOLE WALL DAMAGE	7.6									9
ENVIRONMENTAL:										
THERMAL SHOCK	8.1					3	4			
CYCLICAL HUMIDITY & TEMP.	8.2					6	12			
TEMPERATURE LIFE	8.3				4					
MFG – UNMATED, 10 Days	8.4			7						
MFG - MATED, 10 days	8.4		6,8	10						
VIBRATION	8.5							13		
MECHANICAL SHOCK	8.6							11		
DURABILITY, 100 CYCLES	8.7	9(3)					6	5		
DURABILITY, 25 CYCLES	8.7	4(2)	4	4						
DURABILITY, 75 CYCLES	8.7	7								
DUST CONT	8.10						9	8		
DISTURB	8.11		10	12						

Table 2: Qualification Sample Requirements

TEST GROUP ID ►	P(1)	1A	1B	2	3	4	5	6	7
COMPONENT DESCRIPTION	Design Verification for Product Extension	Mixed Flowing Gas	Mixed Flowing Gas (Un-mated)	Temp Life	Thermal Shock & Humidity (Dielectric)	Thermal Shock & Humidity	Vibration & Mech. Shock	Current Rating	Reparability
Number of RA Plug	3	3	3	3	3	3	3	3	9
Number of RA Receptacle	3	3	3	3	3	3	3	3	9
RA T-rise Board	3	3	3	3	3	3	3	3	3
RA Busbar	3	3	3	3	3	3	3	3	3

REVISION RECORD

Rev	Page	Description	EC#	Date
A	All	Preliminary	N/A	2018/May/21