

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 1 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the PwrMAX® board to board connector and board to board connector with cable configuration.

2.0 Scope

This specification is applicable to the termination characteristics of the PwrMAX® Connector System which provides a separable interface which provides separable right angle board plugs that mate to right angle board receptacles, vertical board receptacles, right angle board receptacles with cable configuration, vertical board receptacles with cable configuration.

3.0 Ratings

- 3.1 Operating Voltage Rating: 600V_{AC} for power contacts.
- 3.2 Operating Current Rating: refer to values in the table in section 6.6.
- 3.3 Operating Temperature Range = -55°C ~ +125°C¹

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 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 Specifications

- 4.1.1 Engineering drawings:
G2 version: 10141042, 10143473, 10143475, 10143481, 10143483 etc.
Legacy version: 10141036, 10141022 etc.
- 4.1.2 Application specification: GS-20-0447

4.2 National or International Standards

- 4.2.1 Flammability: UL94 V-0
- 4.2.2 EIA 364: Electrical connector/Socket test procedures include environmental classification.
- 4.2.3 SAE/USCAR 21: Performance specification for Cable-to-Terminal Electrical Crimps.
- 4.2.4 ANSI-J-STD-002: Solderability Tests for Component Leads, Termination, Lugs, Terminals and Wires.

4.3 Laboratory Reports - Supporting Data

DL-2017-04-003-CR

4.4 Safety Agency Approvals

UL/CSA File #: E66906 Vol. 1 Sec. 162
TUV certification # B170734414025

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 2 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

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:	Copper alloy
Signal Contacts:	Copper alloy
Plug and Receptacle Housings:	High temperature thermoplastic, UL 94V-0 compliant.
Retention clip:	Copper alloy

5.3 Finish

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

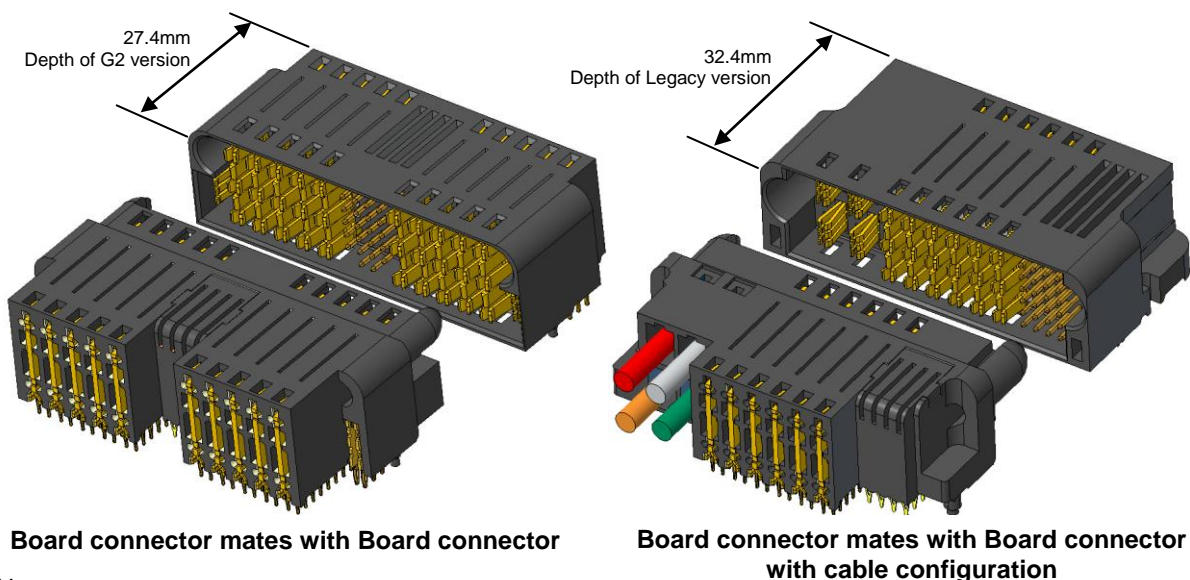
Contact Area (power & signal): GCS® for Power contact, GXT® for Signal contact

Tails (power & signal): Tin plated over Nickel

Crimp Area (Cable I/O): 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.



Notes:

1. The depth of PwrMAX® Plug Connector in G2 version is 27.4mm, and 8 tails/column for G2 plug power contact. The depth of PwrMAX® Plug Connector in legacy version is 32.4mm, and 9 tails/column for legacy plug power contact.
2. Only PwrMAX® in legacy version has board connector with cable configuration.

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION		
TITLE PwrMAX® Connector System		PAGE 3 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

5.5 Examination of product – EIA 364-18, visual and dimensions inspection per product drawing, meets requirements of product drawing.

6.0 Electrical Characteristics

6.1 Contact Resistance, Low Level (Signal contact)

The low level contact resistance shall not exceed 30 milliohms initially. The low level contact resistance shall also not exceed 10 milliohms increase in resistance (from the initial measurement) after environmental expose. 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 (Power contact)

1) High power contacts

The contact resistance at a specified current shall not exceed 0.3 milliohms initially or after mating cycles and environmental exposure. Measurements shall be in accordance with EIA 364-06.

The following details shall apply:

- a. Test Current – Shown in the table in section 6.6.

2) Low power contacts

The contact resistance at a specified current shall not exceed 1.0 mΩ (milliohms) initially or after mating cycles and environmental exposure. Measurements shall be in accordance with EIA 364-06.

The following details shall apply:

- a. Test Current – Shown in the table in section 6.6

6.3 Contact Resistance, Low Level (Crimped Low power cable contact)

The low level contact resistance for Crimped Low power cable contact shall not exceed 1 milliohm initially or after 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

6.4 Insulation Resistance

The insulation resistance of mated connectors shall not be less than 1000 MΩ (megohms) for the Low Power and High Power contacts, and 500 MΩ for Signal initially and 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.

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 4 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

c. Points of Measurement - Between adjacent contacts.

6.5 Dielectric Withstanding Voltage

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current > 1 mA when mated connectors.

Measurements shall be in accordance with EIA 364-20

The following details shall apply:

- a. Test Voltage - 2500 volts DC (power), 1000 volts DC (signal).
- b. Test Duration - 60 seconds.
- c. Test Condition - 1 (760 Torr - sea level).
- d. Points of Measurement - Between adjacent contacts.

6.6 Current Rating

The temperature rise above ambient shall not exceed 30°C 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 25°C;
- b. Reference - EIA 364-70.

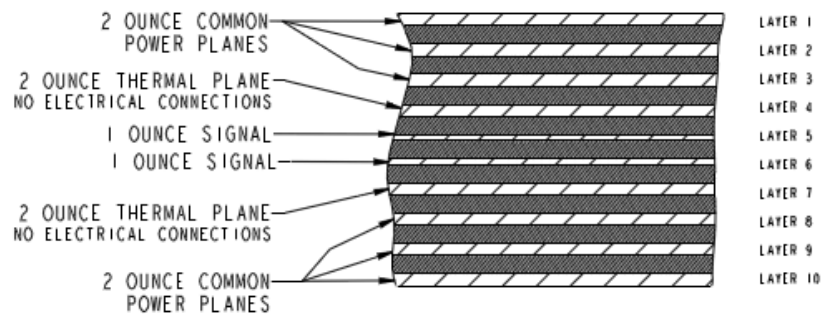
Application	Type of contact	Number of adjacent contacts (fully powered)	Information of Test PCB or cable	Still Air	T-Rise (°C)	Current Rating per contact (Amp)
PwrMAX® (Board connector mates with Board connector) Or (Board connector mates with Board connector with cable configuration)	High Power (4.50mm pitch)	1	10 layers (refer to figure 1)	Yes	30	130
		2				100
		4				92
		6				85
		8				83
		10				75
	Low Power (Board to board)	2	25			
	Signal (2.50mm pitch)	1	3			
		≥2	1			
	Low Power for cable contact (6.50mm pitch)	4 (2 columns x 2 low power contacts/column)	12 AWG			25
			8 AWG			37
			6 AWG			44

Notes:

1. Only PwrMAX® in legacy version has board connector with cable configuration.
2. In figure 1 as below, PCB layer 1,2,3 are not connected with layer 8,9,10

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 5 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

Figure 1 Test PC Board with 10 layers copper plane



7.0 Mechanical Characteristics

7.1 Mating/Un-mating Force

The following details shall apply:

- Cross Head Speed - 25.4mm per minute.
- Lubrication: Yes
- Utilize free floating fixtures.
- Reference – EIA 364-13.

	Mating Force (Maximum)	Un-mating Force (Minimum)
One pair of HP Contacts	25 N	6.5 N
One pair of LP Contacts	7 N	2.2 N
One pair of Signal Contact	1 N	0.2 N

7.2 Contact retention

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

Requirements:

- Signal Contact: individual signal contact shall withstand an axial retention load of 10 N minimum.
- High Power Contact: individual power pin shall withstand an axial retention load of 35 N minimum.
- Low Power Contact: individual power pin shall withstand an axial retention load of 15 N minimum.

7.3 Compliant Pin Insertion Force – EIA 364-05

High Power - 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.

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 6 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

Low Power - 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 90 N.

Signal 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 27 N.

Signal 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 93 N.

7.4 Compliant Pin Retention Force – EIA 364-05

High Power - 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 6.7 N per press-fit tail.

Low Power - 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 10 N per press-fit tail.

Signal - 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 6.7 N.

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"). Refer to EIA-364-96.

7.6 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. Refer to EIA-364-96.

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 7 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

7.7 Crimp Tensile Strength:

The force required to pull the properly crimped wire from the terminal shall not be less than the value specified in Table. If terminals are equipped with an insulation barrel, they should not be crimped to have an effect on this test. Reference – SAE/USCAR21 or UL 486A

Cable Size (AWG)	12	8	6
Crimping Pull Force (N) min.	240	350	445*

Notes:

1. The specification is applicable only for board connector with cable configuration
2. The specification for 6 AWG refer to UL 486A

7.8 Crimp Acceptance Criteria:

General Appearance as defined by SAE/USCAR21 section 4.2.5 and TA-681, TA-317, TA-211.

7.9 Cross Section Acceptance:

Cross section acceptance as defined by SAE/USCAR21 section 4.3.4 and 4.3.5.

7.10 Bending Radius:

The bending radius of cable shall be 8 times of its outer diameter without any cracking to the outer cable jacket or breaking of strands of copper wires.

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 test sequences in the qualification table. 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 IV (cyclic temperature).


- a. Relative Humidity - 80% to 98%
- b. Temperature - 25°C~65°C
- c. Duration – 10 cycles, 24h/cycle, 240 hours total

8.3 High Temperature Life – EIA 364-17.

- a. Test Temperature - 125± 2°C

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 8 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

- b. Test Duration - 1000 hours
- 8.4 Mixed Flowing Gas corrosion (MFG) – EIA 364-65.
 - a. Class - IIA
 - b. Duration - 20 days
 - c. Mated only
- 8.5 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
- 8.6 Mechanical Shock – EIA 364-27
 - a. Condition - Test condition A (50G, 11 milliseconds, 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.
- 8.7 Durability - EIA 364-09
 - a. Number Cycles - 200 cycles
 - b. Cycling Rate - 127 mm/minute
 - c. Use free floating fixtures
- 8.8 Solder ability –ANSI-J-STD-002, Test Condition A, Solder Dip
 - a. Preconditioning Category E
 - b. PCB termination area was evaluated and meets the requirements of ANSI-J-002
- 8.9 Resistance to Solder Heat – EIA 364-56
 - a. Condition E
 - b. There shall be no evidence of physical or mechanical damage
- 8.10 Dust - EIA 364-91
 - a. Dust Composition #1 (benign)
 - b. Duration: 1 hour
 - c. Unmated connector to be placed in the chamber
- 8.11 Disturb - (ref. GR-1217-CORE)
 - Back the fully seated plug from the receptacle approximately 0.10 mm (0.004 in) and reseal fully.

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION		
TITLE PwrMAX® Connector System		PAGE 9 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

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 are 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 1. 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.

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 10 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
CLASSIFICATION UNRESTRICTED			

9.7 Qualification Test – Table 1

TEST GROUP ID:		1	2	3	4	5	6	7	8	9	10	11
TEST DESCRIPTION	SECTION	MFG	Temp Life	IR & DWV	Thermal shock & Humidity	Vibration & Mech. Shock	Current Rating	Repair ability	ENV /Crimp	MECH /Crimp	Solder ability	Resistance to Solder Heat
VISUAL EXAMINATION	5.5	1, 23,	1,8	1,10	1,22	1,20	1,6	1, 10,	1,9	1,5	1,3	1,3
MATE HEADER & RECEPTACLE		2,	2	2	2,13	3,11	2					
UNMATE HEADER & RECEPTACLE					11	9						
ELECTRICAL:												
CONTACT RESISTANCE AT LOW LEVEL(LLCR)	6.1	3,6,9,12,1518,21	3,6		3,6,9,14,17,20	4,7,12,15,18						
CONTACT RESISTANCE AT SPECIFIED CURRENT	6.2	4,7,10,13,16,19,22	4,7		4,7,10,15,18,21	5,8,13,16,19						
Crimp Contact Resistance, Low Level	6.3								2,4,6,8			
IR	6.4			4,7								
DWV	6.5			5,8								
CURRENT RATING (Single Power contact)	6.6						3					
CURRENT RATING (Multiple Power Contacts)	6.6						4					
CURRENT RATING (Single & Multiple Signal Contacts)	6.6						5					
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				
Crimp Tensile Strength	7.7									4		
Crimp Acceptance Criteria	7.8									2		
Cross Section Acceptance	7.9									3		
ENVIRONMENTAL:												
THERMAL SHOCK	8.1			3	5				3			
CYCLICAL HUMIDITY & TEMP.	8.2			6	16				5			
TEMPERATURE LIFE	8.3		5						7			
MFG – MATED 5 DAYS, 10 days, 15 days, 20 days	8.4	8,11,14,17										
VIBRATION	8.5					14						
MECHANICAL SHOCK	8.6					17						
DURABILITY, 100 CYCLES	8.7				8,19	6						
DURABILITY, 25 CYCLES	8.7	5										
Solder ability	8.8										2	
Resistance to Solder Heat	8.9											2
DUST	8.10				12	10						
DISTURB	8.11	20										
Sample size (pcs)												
R/A Plug ASSEMBLIES		3	3	3	3	3	3				3	3
R/A RECEPTACLE ASSEMBLIES		3	3	3	3	3	3					
VERTICAL RECEPTACLE ASSEMBLIES						3	3					
CONTACT WITH PRESS-FIT TAILS (Power and signal)								35				
R/A RECEPTACLE CONNECTOR WITH CABLE CONFIGURATION									3	10		

NUMBER GS-12-1314	TYPE PRODUCT SPECIFICATION	Amphenol ICC	
TITLE PwrMAX® Connector System		PAGE 11 of 11	REVISION A
		AUTHORIZED BY Zhijun.He	DATE Dec 20, 2021
		CLASSIFICATION UNRESTRICTED	

REVISION RECORD

Rev	Page	Description	EC#	Date
1	A	Initial release	N/A	12/20/2021