

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 1 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the PCI Express card-edge connector.

2.0 Scope

This specification is applicable to the termination characteristics of PCI Express Card Electromechanical Specification and certain customer specifications not covered by the PCI-SIG document.

3.0 Ratings

- 3.1 Operating Voltage Rating = 29.9 Vdc
- 3.2 Operating Current Rating =1.1 Amperes per contact
- 3.3 Operating Temperature Range = -55 to +105 °C

4.0 Applicable Documents

- 4.1 AFCI Specifications
 - 4.1.1 PCIe Groups of Connectors (SMT, TH and PF)
- 4.2 National or International Standards
 - 4.2.1 Flammability: UL94V-0
 - 4.2.2 EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications.

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.

 - Signal Contacts –Copper alloy
 - Housing – Class filled, High temperature resin
- 5.3 Finish

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

 - Contact area: Au over Nickel under-plating
 - Solder tails area: Matte Tin over Nickel under-plating

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 2 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

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.

5.5 Workmanship includes freedom from blistering, cracks, discoloration, etc.

NUMBER	GS-12-1406	TYPE	PRODUCT SPECIFICATION	Amphenol FCI	
TITLE				PAGE	REVISION
PCI Express Gen 4, 5 & 6 Connector				3 of 11	C
				AUTHORIZED BY	DATE
				Matthew Cheong	2023-05-08
				CLASSIFICATION	UNRESTRICTED

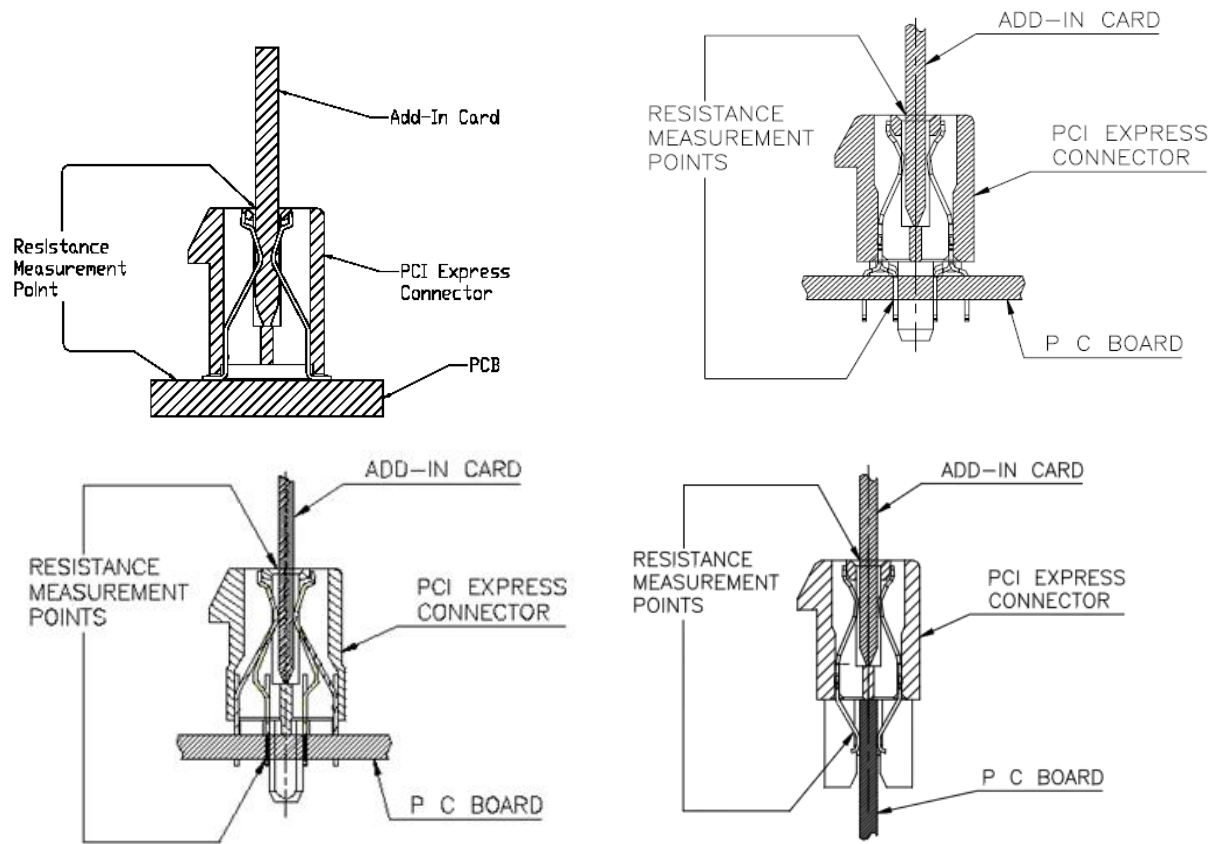
6.0 Electrical Characteristics

6.1 Contact Resistance, Low Level (LLCR)

The low level contact resistance shall not exceed 30 milliohms initially. The low level contact resistance shall also not exceed 10 milliohms change in resistance (from the initial measurement) 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 maximum open circuit voltage.
- b. Test Current - 100 milli-amperes maximum.
- c. The contact resistance measurement points shall include the solder tail and the contact-mating interface, as illustrated in Figure 1.



Contact Resistance Test Setup
Figure 1

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 4 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

6.2 Insulation Resistance

The insulation resistance of unmated connectors shall not be less than 1000 Megohms initially and after environmental exposure.

Measurements shall be in accordance with EIA 364-21.

The following details shall apply:

- Test Voltage – 500+/-10% volts DC.
- Electrification Time - 2 minutes
- Points of Measurement - Between adjacent contacts

6.3 Dielectric Withstanding Voltage

There shall be no evidence of arc-over, insulation breakdown when unmated connectors are tested in accordance with EIA 364-20.

The following details shall apply:

- Test Voltage - 500 Volts, AC RMS, 60HZ.
- Test Duration - 60 seconds.
- Points of Measurement - Between adjacent contacts

6.4 Current Rating

Wire the eight power pins(B1,B2,B3,A2,A3,B8,A9,and A10) and the eight nearest ground pins(A4,B4,B7,A12,B13,A15,B16,and B18) in a series circuit, the temperature rise above ambient shall not exceed 30 deg C at any point in the system when contacts are powered at 1.1 ampere.

The following details shall apply:

- Reference - EIA 364-70 method 2

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 5 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

7.0 Mechanical Characteristics

7.1 Mating/Unmating Force

The force to mate a receptacle connector and card shall not exceed 1.15 Newtons per contact pair using a steel gauge 1.70 mm thick with a tolerance + 0.00/-0.01 mm.

The unmating force shall not be less than 0.15 Newtons per contact pair using a steel gauge 1.44 mm thick with a tolerance +0.01/ - 0.00 mm.

The following details shall apply:

- Cross Head Speed – 25.4 mm per minute Max.
- Utilize free floating fixtures.
- EIA 364-13, Method A

7.2 Durability (preconditioning)

The connector pairs shall be capable of withstanding 50 mating/ unmating cycles. When used for pre-conditioning treatment, 20 mating/ unmating cycles shall be applied prior to mechanical/environmental exposure.

- Cycling Rate - 127 mm per minute maximum
- EIA 364-09

7.3 Durability - EIA 364-09

- Number Cycles - 50 cycles
- Cycling Rate -127 mm per minute by using maximum thickness gauge.
- Use free floating fixtures

7.4 Mechanical Shock –EIA 364-27

- Condition - A (50G, 11 millisecond, half-sine pulses type)
- Shocks - 3 shocks in both directions along each of three orthogonal axes (18 shocks total)
- Mounting - Rigidly mount assemblies
- No discontinuities greater than 1.0 micro second

7.5 Random Vibration – EIA 364-28

- Test Condition - test condition VII, test condition letter D.
- Duration – 1 hour in each of three mutually perpendicular directions
- Mounting - Rigidly mount assemblies
- No discontinuities greater than 1.0 micro seconds

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 6 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

7.6 Contact Retention

Straddle Mount: Individual upper and lower contacts shall withstand an axial retention load of 90 Grams minimum.

Surface Mount: Contacts shall withstand an axial retention load of 500 Grams minimum.

Plated Through Hole: Contacts shall withstand an axial retention load of 500 Grams minimum.

Press fit: Contacts shall withstand an axial retention load of 300 Grams minimum.

- Rate of 1.27mm per minute without dislodging from the housing cavity.
- Test 10 contacts per contacts of 20 positions.

7.7 Reseating

The connector pair needs to undergo 3 manual plug/unplug cycles.

- Sample Size – Dependent upon current test group, refer to specific sample sizes.
- Failure Criteria - No evidence of physical damage.

7.8 Solderability

Surface Mount and Plated Through Hole: Per J-STD-002D.

- Bake for 4 hours at 155°C
- 220°C for 5 sec (Tin/Lead plating); Method A/A1. 245°C for 5 sec for (Tin and Tin/Lead plating)
- Method S1 for Surface Mount or Straddle Mound Connector
- Contact areas evaluated, shall meet 95% minimum coverage.

7.9 Compliant Pin Insertion Force (For Press-fit type connector only)

Perform in accordance with EIA 364-05. The following details shall apply:

- The force to insert a compliant pin into PCB hole at a rate of 25.4 ± 1 mm/minute shall not exceed 40 N.
- Measure and record the test board's finished hole sizes prior to performing test.

7.10 Compliant Pin Retention Force (For Press-fit type connector only)

Perform in accordance with EIA 364-05. The following details shall apply:

- The force to remove a compliant pin from PCB hole at a rate of 25.4 ± 1 mm/minute shall not be less than 6 N.
- Measure and record the test board's finished hole sizes prior to performing test.

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 7 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

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

- Number of Cycles –Method A, Test condition I , 10 cycles.
- Temperature Range – Between: -55 and +85 °C
- Time at extreme Temperature - 30 minutes minimum
- Transfer Time - 5 minutes maximum

8.2 Cycling Temperature & Humidity –EIA 364-31, method IV, condition D

- Relative Humidity and temperature - between 25°C± 3°C at 90% RH and 65°C± 3°C at 98%RH
- Duration – 24 cycles (Ramp times should be 0.5 hour and dwell times should be 1.0 hour. Dwell times start when the temperature and humidity have stabilized within the specified levels)

8.3 High Temperature Life –EIA 364-17, Method A.

- Test Temperature - 105 deg C
- Test Duration - 168 hours

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

- Class - IIA
- Duration - 10days
- ½ of samples mated for 240 hours, ½ of samples unmated for 160 hours, then mated for final 80 hours.

8.5 Thermal disturbance-EIA 364-110

- The test specimens shall be mated during the test.
- Temperature Range – +15 ±3 °C to +85 ±3 °C
- Thermal Ramp – minimum of 2 °C per minute.
- Dwell time to ensuring that the contacts reach the temperature extremes for a minimum of 5 minutes.
- Number of cycles – 10.

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 8 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

8.6 RESISTANCE TO SOLDERING HEAT

Straddle Mount and Surface Mount: EIA-364-56 procedure 6, level 6
Plated Through Hole: EIA-364-56 procedure 3, test condition H.
Refer to EIA-364-56 for more details.

- a. Test Condition – Refer to test conditions specified in EIA-364-56
- b. There shall be no evidence of physical or mechanical damage

8.7 High Temperature Life(preconditioning) –EIA 364-17, Method A.

- a. Test Temperature - 105°C
- b. Test Duration - 92 hours

NUMBER GS-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 9 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		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 ISO 9000.

9.2 Inspection Conditions

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

- Temperature: 25 +/- 5 °C
- Relative Humidity: 30% to 60%
- Barometric Pressure: Local ambient

9.3 Sample Quantity and Description

The sample size and description for each test is listed in table 1

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.

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 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.
- A significant change is made to the manufacturing process which impacts the product form, fit or function.
- 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-12-1406	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE PCI Express Gen 4, 5 & 6 Connector		PAGE 10 of 11	REVISION C
		AUTHORIZED BY Matthew Cheong	DATE 2023-05-08
		CLASSIFICATION UNRESTRICTED	

9.7 Qualification Test Table 1

Test Sequence Table 1

Test Items	Section	1	2a	2b	3	4	5	6	7	8	9	10
Examination of Product	5.5	1 8	1 7	1 11	1 10	1 14	1 9	1 3	1 3	1 3	1 3	1 4
Contact Resistance Low Level	6.1	2 5,7		2, 4, 6,8, 10	2, 5,7 9	2,5, 7,9 11, 13	3,6					
Insulation Resistance	6.2		2,4, 6,									
Dielectric Withstanding Voltage	6.3						4,7					
Current Rating	6.4									2		
Mating/Unmating Force	7.1						2,8					
Durability (Preconditioning)	7.2	3		3	3	3						
Durability	7.3						5					
Mechanical Shock	7.4				6							
Random Vibration	7.5				8							
Contact Retention	7.6								2			
Reseating	7.7	6		9		12						
Solderability	7.8										2	
Thermal Shock	8.1		3	5								
Cycling Temperature and Humidity	8.2		5	7								
Temperature Life	8.3	4										
Mixed Flowing Gas(unmated)	8.4					6						
Mixed Flowing Gas(mated)	8.4					8						
Thermal disturbance	8.5					10						
Resistance to solder heat	8.6							2				
Temperature Life (preconditioning)	8.7				4	4						
Compliant Pin insertion												2
Compliant Pin retention												3

NUMBER	GS-12-1406	TYPE	PRODUCT SPECIFICATION		Amphenol FCI			
TITLE					PAGE	11 of 11	REVISION	C
					AUTHORIZED BY		DATE	
					Matthew Cheong		2023-05-08	
					CLASSIFICATION			
					UNRESTRICTED			

Samples quantity		5pcs	5pcs	5pcs	5pc s	5pc s	5pc s	5pc s	5pc s	5pc s	5pc s	5pc s
------------------	--	------	------	------	----------	----------	----------	----------	----------	----------	----------	----------

REVISION RECORD

Rev	Page	Description	EC#	Date
A	ALL	INITIAL RELEASE	S17-0019	2017-12-08
B	6, 10	Add clause 7.9 & 7.10 and group 10 in Table 1	ELX-S-30020	2018-05-11
C	ALL	Updates Title to PCIe 4, 5 & 6	ELX-S-48152	2023-05-08