
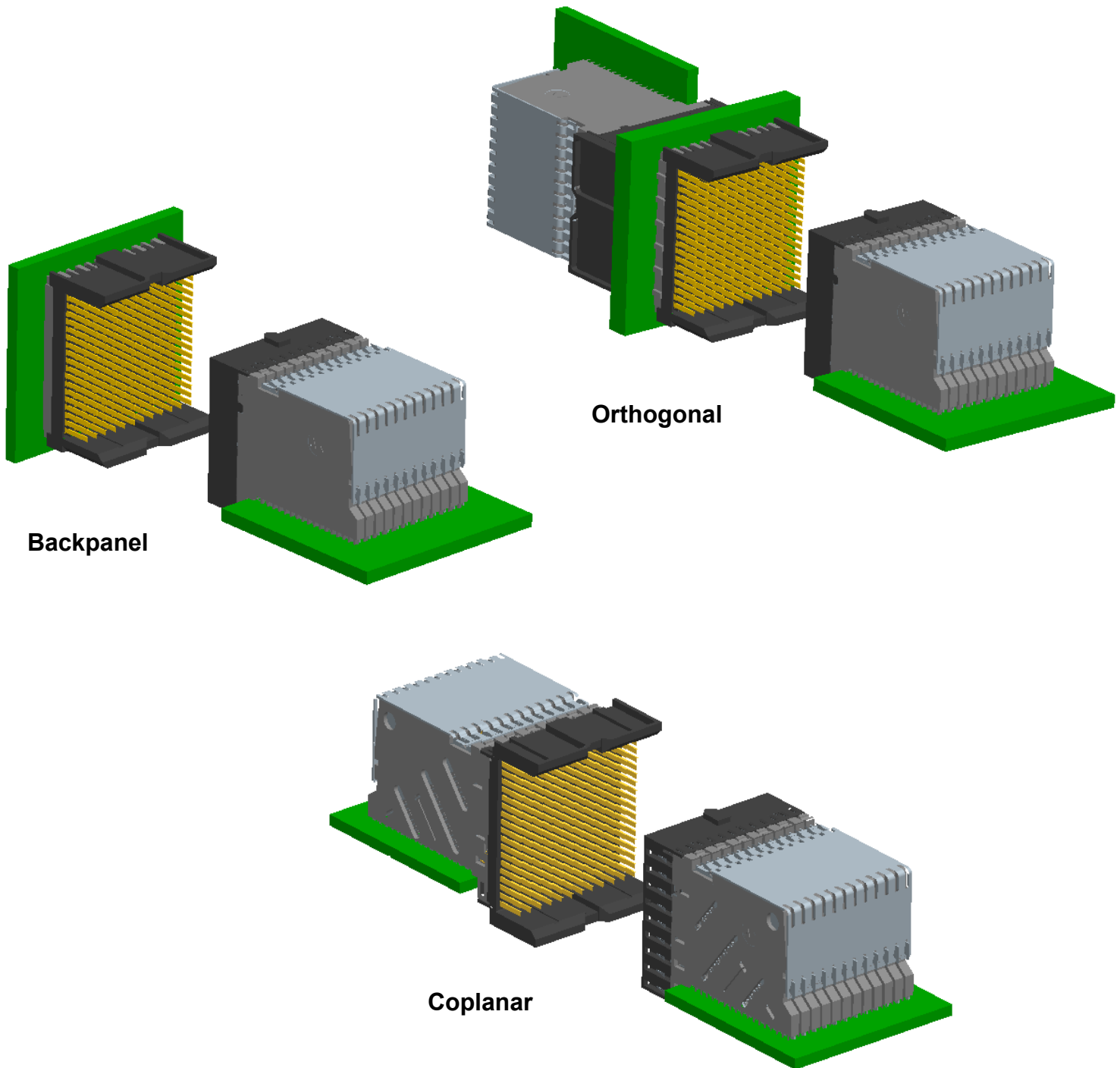



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## ZipLine™ Connector System



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## 1.0 OBJECTIVE

This specification defines the quality and reliability, performance, and test requirements of the ZipLine™ connector system. This specification applies to all press-fit versions including standard backpanel, orthogonal, coplanar, and power configurations. The test sequences defined in this specification meet the intent of Telcordia GR-1217-CORE requirements.

## 2.0 SCOPE

This specification is applicable to the press-fit ZipLine™ connector system which provides a high speed differential board-to-board interconnect.

## 3.0 APPLICABLE DOCUMENTS

### 3.1 FCI Specifications

- Applicable FCI product customer drawings
- FCI Application Specification GS-20-094 (ZipLine™ Connector System)

### 3.2 Other Standards and Specifications

- UL94V-O: Test for Flammability of Plastic Materials in Devices and Appliances
- EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications
- GR-1217-CORE, Issue 2, December 2008: Telcordia Specification "Generic Requirements for Separable Electrical Connectors"

### 3.3 FCI Product Qualification Test reports

- EL 2009-02-002A: ZipLine™ Connector System, backpanel and orthogonal signal products
- EL 2008-08-029: ZipLine™ Connector System, power products
- EL 2009-08-032: ZipLine™ Connector System, coplanar products

### 3.4 Safety Agency Approvals

- UL File Number: E66906

## 4.0 REQUIREMENTS


### 4.1 Materials

The material for each component shall be as specified herein or equivalent.

- Contacts: copper alloy
- Plating:
  - Contact Areas: Performance-based plating, qualified to meet the requirements of this specification, including the Telcordia GR-1217-CORE Central Office test sequence.
  - Press-fit Tails: Tin or tin-lead over nickel
- Housings: high temperature thermoplastic; UL 94V-0 compliant

### 4.2 Visual Examination of Product

Visual examinations shall be performed using 10x magnification. Parts should be free from blistering, cracks, discoloration, etc.

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## 5.0 ELECTRICAL CHARACTERISTICS

### 5.1 Contact Resistance

#### 5.1.1 Low Level (LLCR)

Measurements shall be performed using a four-wire method per EIA 364-23. The maximum initial contact resistance is 150 mΩ for backpanel and orthogonal configurations, and 255 mΩ for coplanar configurations. The increase in resistance for any position shall not exceed 10 mΩ.

**Make sure metal organizer has been removed for all signal contact measurements because several positions are shorted together by the organizer.** The following details apply:

- a. Test voltage: 20 mV maximum open circuit
- b. Test current: 100 mA maximum
- c. Number of readings: 500 minimum

#### 5.1.2 At Specified Current (power contacts only)

The contact resistance at a specified current shall not exceed 5.00mΩ initially or after mating cycles and environmental exposure when measured in accordance with EIA 364-06. The test current is as follows:

1 Column Fully Powered	6.00A
2 Adjacent Columns Fully Powered	4.50A
All Columns Fully Powered	2.25A

**The metal organizer is to remain assembled for power contact evaluation. There is no shorting between power contacts and the metal organizer.**

### 5.2 Insulation Resistance


The insulation resistance of mated connectors shall not be less than 1000 MΩ after environmental exposure when measured in accordance with EIA 364-21. **Make sure metal organizer has been removed for all signal contact measurements because several positions are shorted together by the organizer.** The following details shall apply:

- a. Test voltage: 500 VDC
- b. Electrification time: 60 seconds
- c. Points of measurement: between closest adjacent contacts
- d. Number of readings: 30 (10 readings per loose-piece connector set)

### 5.3 Dielectric Withstanding Voltage

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current (> 0.5 mA) when the mated connectors are tested in accordance with EIA 364-20. **Make sure metal organizer has been removed for all signal contact measurements because several positions are shorted together by the organizer.** The following details shall apply:

- a. Test voltage: 500 VAC, 60Hz
- b. Test duration: 60 seconds
- c. Voltage application rate: 500 V per second
- d. Points of Measurement: between closest adjacent contacts
- e. Number of readings: 30 (10 readings per loose-piece connector set)

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#### 5.4 Current Rating (signal and power IMLA's to be tested separately)

##### 5.4.1 General Criteria

- Test Specification: EIA 364-70
- Ambient Temperature: 25°C
- Airflow: None (still-air)

##### 5.4.2 Signal Contacts


- **The metal organizer must be removed for all signal contact measurements because several positions are shorted together by the metal organizer.**
- Measure temperature versus applied current
- All contacts powered
- Thermocouple attachment: Mechanically attached to the base of the receptacle mating beams.
- Thermocouple location: One thermocouple on a central position on each of the two middle columns (two thermocouples per tested assembly)
- Copper trace weight: 1oz on one external layer, connector side.
- The temperature-rise above ambient shall not exceed 30°C at 0.25A per contact for backpanel and orthogonal configurations, and 0.20A per contact for coplanar configurations.

##### 5.4.3 Power Contacts

- **The metal organizer is to remain assembled for power contact evaluation. There is no shorting between power contacts and the metal organizer.**
- Measure temperature versus applied current
- Powered contact configurations to be qualified are represented in the supporting table.
- Thermocouple attachment: Mechanically attached to the base of the receptacle mating beams.
- Thermocouple location: One thermocouple on a central position of each column tested. Columns with thermocouples are noted in the supporting table
- Copper trace weight: 2oz on one external layer, opposite connector side.
- The temperature-rise above ambient shall not exceed 30°C at the current levels noted in the supporting table. Actual output curves shall be plotted up to 50°C T-rise.

TEST CONFIGURATIONS		Total number of columns in test sample: 12 Number of power contacts within each column: 6	
IMLA Columns Fully Powered	Columns with Thermocouples	Current Rating Per Contact	Current Rating Per Column
#1	#1	6.00A	36.0A
#1, #2	#1, #2	4.50A	27.0A
All	#6, #7	2.25A	13.5A

*Current-rating per column drops as the number of adjacent powered columns increases. This is due to the cumulative heating effect of multiple columns powered in still-air test conditions.*

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## 6.0 MECHANICAL CHARACTERISTICS

### 6.1 Mating / Un-mating Force

Perform in accordance with EIA 364-13. The force to mate a receptacle connector and compatible header shall not exceed 0.40 N per contact for signal contacts, and 1.65 N per contact for power contacts (Each power contact consisting of 3 mating interfaces). The un-mating force shall not be less than 0.10 N per contact for signal contacts, and 0.30 N per contact for power contacts. The following details shall apply:

- a. Cross head speed: 1 inch per minute
- b. Lubrication: None
- c. Utilize free-floating fixtures
- d. Number of mate/un-mate cycles: 3
- e. Number of mated connector pairs to be tested: per test matrix tables

### 6.2 Compliant pin insertion force

*The common compliant pin design was qualified during the AirMax VS® qualification testing. Please refer to test report EL-2004-03-008D. The requirements are restated here for reference.*

Perform in accordance with EIA 364-05. Fully populated connectors shall be applied to test boards with minimum, maximum, and nominal size plated through holes (as defined in Table 2) using an electric application press and FCI recommended application tooling. The following details shall apply:

- a. Insertion force per press-fit tail: 25 N maximum
- b. Number of readings: 1 per connector assembly tested
- c. Number of connectors to be tested: 13 sets (3 sets in minimum holes; 5 sets in nominal holes; 5 sets in maximum holes)

### 6.3 Compliant pin retention force

*The common compliant pin design was qualified during AirMax VS® qualification testing. Please refer to test report EL-2004-03-008D. The requirements are restated here for reference.*

Perform in accordance with EIA 364-05. Fully populated connectors shall be removed from test boards with minimum, maximum, or nominal size plated through holes (as defined in Table 2) using an electric application press and FCI recommended removal tooling. The following details shall apply:


- a. Retention force per press-fit tail: 3 N minimum
- b. Number of connectors to be tested: 13 sets (3 sets in minimum holes; 5 sets in nominal holes; 5 sets in maximum holes)

### 6.4 PCB Hole Deformation Radius

Perform in accordance with Telcordia GR-1217-CORE, section 5.1.7. Use test boards with nominal diameter plated through holes. Make cross-sections 0.25mm (0.010 inch) from the top board surface and near the center of the press-fit section. Photograph and measure the minimum copper thickness remaining between the compliant pin and the printed wiring board laminate and the hole deformation radius. The minimum average copper thickness remaining between the compliant pin and the printed wiring board laminate shall not be less than 7.5 µm (0.0003"). The maximum average hole deformation radius shall be no greater than 37.5 µm (0.0015"). The maximum hole deformation radius reading must not exceed 50 µm (0.0020"). Test 15 holes.

### 6.5 PCB Hole Wall Damage

Perform in accordance with Telcordia GR-1217-CORE, section 5.1.7. Use test boards with nominal diameter plated through holes. Cross-section perpendicular to the board surface and through the compliant section wear track. There shall be no copper cracks, separations between conductive interfaces, or laminate-to-copper separations. Test 15 pins.

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## 7.0 ENVIRONMENTAL CONDITIONS

After exposure to the following environmental conditions in accordance with “Table 1 – Qualification Test Matrix”, the product shall show no physical damage and shall meet the electrical and mechanical requirements in sections 6 and 7. Unless specified otherwise the products shall be mated during exposure.

### 7.1 Thermal Shock:

Perform in accordance with EIA 364-32. The following details shall apply:

- a. Number of cycles: 5
- b. Temperature range: -55 to + 85°C
- c. Time at each temperature: 30 minutes minimum
- d. Transfer time: 30 seconds maximum

### 7.2 Cyclical Humidity and Temperature:

Samples are to be exposed to cyclical humidity and temperature in accordance with EIA 364-31. Samples are to be subjected to 50 cycles of 10-hour duration for a total of 500 hours.

A cycle consists of the following steps.

- a. 2 hour ramp from 25°C at 80%-98% RH to 65°C at 90%-98% RH
- b. 4 hour dwell at 65°C at 90%-98% RH
- c. 2 hour ramp down to 25°C at 80%-98% RH
- d. 2 hour dwell at 25°C at 80%-98% RH

### 7.3 Temperature Life:

Perform in accordance with EIA 364-17. Headers and receptacles shall remain mated without any electrical load. The following details shall apply:

- a. Temperature: 85°C
- b. Duration: 500 hours

### 7.4 Industrial Mixed Flowing Gas (Class IIA, 4-gas):


Expose samples to gas mixture per Telcordia GR-1217-CORE, section 9.1.3. Details are as follows:

- a. Temperature: 30°C
- b. Relative humidity: 70%
- c. Mandatory readings after the 10<sup>th</sup> and 20<sup>th</sup> days
- d. Gas compositions, per **Central Office** requirements:

<u>Gas Type</u>	<u>Gas Concentration</u>
NO <sub>2</sub>	200 ppb
Cl <sub>2</sub>	10 ppb
H <sub>2</sub> S	10 ppb
SO <sub>2</sub>	100 ppb

Un-mated backpanel connectors are to be exposed to gas mixture for 10 days, then mated and exposed for an additional 10 days.



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**7.5 Vibration**

Perform in accordance with Telcordia GR-1217-CORE, sections 6.3.5 and 9.1.2.1. The following details shall apply:

- a. Vibration amplitude: 1.5 mm (0.06 inch) double amplitude or 10G acceleration
- b. Frequency range: 10 to 500 to 10 Hz
- c. Sweep time: 15 minutes per cycle
- d. Duration: 8 hours along each of three orthogonal axes (24 hours total)
- e. Mounting: rigidly mounted assemblies
- f. No discontinuities greater than 1 micro-second (requirement of signal connectors only)

**7.6 Mechanical Shock**

Perform in accordance with Telcordia GR-1217-CORE, sections 6.3.5 and 9.1.2.1. The following details shall apply:

- a. Amplitude: half sine 30G
- b. Duration: 11 milliseconds
- c. Number of shocks: 3 shocks in each direction along each of three orthogonal axis (18 total)
- d. Mounting: rigidly mounted assemblies
- e. Take resistance measurements after shock in each axis
- f. No discontinuities greater than 1 micro-second (required of signal connectors only)

**7.7 Durability**

Perform in accordance with EIA 364-09C. Use standard laboratory procedure as applicable to the specific product. The following details shall apply:

- a. Number of cycles: See Table 1 (200 total mating cycles)
- b. Cycling rate: 12.5 cm (5 inches) per minute

**7.8 Dust Contamination**


Perform in accordance with Telcordia GR-1217-CORE, section 9.1.1.1 & Table 9-1. Samples shall be subjected to a one-hour dust exposure using a benign dust composition as specified in Table 9-1 of Telcordia GR-1217-CORE, November 1995.

Un-mated backpanel connectors alone shall be subjected to dust exposure.

**7.9 Disturb**

Perform in accordance with Telcordia GR-1217-CORE, section 9.1.3.3 paragraph 7. The mated connectors shall be subjected to an interface disturbance that consists of slightly unmating the sample approximately 0.10 mm (0.004 inch). The sample is then resealed and measurements are made.



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## 8.0 QUALITY ASSURANCE PROVISIONS

### 8.1 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.

### 8.2 Inspection Conditions

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

- a. Temperature: 25 ± 5°C
- b. Relative humidity: 20% to 80%
- c. Barometric pressure: Local ambient

### 8.3 Sample Quantity and Description

The sample descriptions and quantities are shown in Tables 3 and 4. The number of readings is specified in the description for each test.

### 8.4 Acceptance

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

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


### 8.5 Qualification Testing

Qualification testing shall be performed on sample units with equipment and procedures normally used in production. The test sequences are shown in Tables 1 and 2.

### 8.6 Re-Qualification Testing

If any of the following conditions occur, the responsible product engineer shall initiate re-qualification testing consisting of all applicable parts of the qualification test program as shown in Tables 1 and 2.

- 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, pin/contact surface geometry, insulator or housing design, pin/contact base material or pin/contact lubrication.
- 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.


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**Table 1: Qualification Test Matrix, Signal Connectors**

TEST GROUP ID▶		P	1	2	3a	3b	4 <sup>(1)</sup>	5	6
TEST DESCRIPTION	SECTION	Design verification for product extension	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	PCB Hole Deform	Current Rating
VISUAL EXAMINATION OF PRODUCT	4.3	1,5	1,13	1,5	1,10	1,12	1,11	1	1,3
<b>ELECTRICAL:</b>									
CONTACT RESISTANCE, LOW LEVEL	5.1	2,4	2,4,6,8,10,12	2,4		2,4,6,8,10,11	2,4,6,8,10		
INSULATION RESISTANCE	5.2				2,5,8				
DIELECTRIC WITHSTANDING VOLTAGE	5.3				3,6,9				
CURRENT RATING	5.4								2
<b>MECHANICAL:</b>									
MATING/UN-MATING FORCE	6.1	See note 3	See note 3			See note 3	See note 3		
COMPLIANT PIN INSERTION FORCE	6.2							See note 2	
COMPLIANT PIN RETENTION FORCE	6.3							See note 2	
PCB HOLE DEFORMATION RADIUS	6.4							2 <sup>(4)</sup>	
PCB HOLE WALL DAMAGE	6.5							3 <sup>(4)</sup>	
<b>ENVIRONMENTAL:</b>									
THERMAL SHOCK	7.1				4	3			
CYCLICAL HUMIDITY & TEMPERATURE	7.2				7	9			
TEMPERATURE LIFE	7.3			3					
MFG, UNMATED, 10-DAYS	7.4		5						
MFG, MATED, 10-DAYS	7.4		7						
VIBRATION	7.5						7 <sup>(1)</sup>		
MECHANICAL SHOCK	7.6						9 <sup>(1)</sup>		
DURABILITY, 100 CYCLES <sup>(3)</sup>	7.7	3	3, 11			5	3		
DUST CONTAMINATION	7.8					7	5		
DISTURB	7.9		9						

**TEST SEQUENCE NOTES:**

1. Discontinuity is measured only on the set of connectors that are not being monitored for LLCR (Test Group 4)
2. ZipLine products use exactly the same 0.2mm thick press-fit tail as the qualified AirMax VS Connector System. Therefore, only PCB hole deformation radius and PCB hole wall damage tests were performed in nominal PCB holes to verify press-fit performance.
3. Record mating and un-mating forces on first three cycles of durability.
4. PCB hole deformation evaluation to be carried out after three repair cycles.


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**Table 2: Qualification Test Matrix, Power IMLAs**

TEST GROUP ID▶		P	1 <sup>(1)</sup>	2 <sup>(1)</sup>	3 <sup>(1)</sup>	4 <sup>(1)</sup>	5	6 <sup>(2)</sup>
TEST DESCRIPTION	SECTION	Design verification for product extension	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Vibration & Mech. Shock <sup>(5)</sup>	PCB Hole Deform	Current Rating
VISUAL EXAMINATION OF PRODUCT	4.3	1,7	1,14	1,6	1,12	1,12	1	1,4
<b>ELECTRICAL:</b>								
CONTACT RESISTANCE, AT SPECIFIED CURRENT	5.1	3,6	2,4,6,8,10,12	2,4	2,4,6,8,10	2,4,6,8,10		3
INSULATION RESISTANCE	5.2							
DIELECTRIC WITHSTANDING VOLTAGE	5.3							
CURRENT RATING	5.4	2,5	13	5	11	11		2
<b>MECHANICAL:</b>								
MATING/UN-MATING FORCE	6.1	See note 3	See note 3		See note 3	See note 3		
COMPLIANT PIN INSERTION FORCE	6.2							
COMPLIANT PIN RETENTION FORCE	6.3							
PCB HOLE DEFORMATION RADIUS	6.4						2 <sup>(4)</sup>	
PCB HOLE WALL DAMAGE	6.5						3 <sup>(4)</sup>	
<b>ENVIRONMENTAL:</b>								
THERMAL SHOCK	7.1				3			
CYCLICAL HUMIDITY & TEMPERATURE	7.2				9			
TEMPERATURE LIFE	7.3			3				
MFG, UNMATED, 10-DAYS	7.4		5					
MFG, MATED, 10-DAYS	7.4		7					
VIBRATION	7.5					7		
MECHANICAL SHOCK	7.6					9		
DURABILITY, 100 CYCLES <sup>(3)</sup>	7.7	4	3,11		5	3		
DUST CONTAMINATION	7.8				7	5		
DISTURB	7.9		9					

**TEST SEQUENCE NOTES:**

1. The assembled power configuration to be tested is "all IMLAs powered".
2. The assembled power configurations tested for the noted sequences are 1 end-IMLA powered, and ALL IMLAs powered.
3. Record mating and un-mating forces on first three cycles of durability.
4. PCB hole deformation evaluation to be carried out after three repair cycles.
5. Continuity monitoring is only required for signal connector test sequence.

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**Table 3: Qualification Sample Requirements, Signal Connectors**

TEST GROUP ID▶	P	1	2	3a	3b	4	5	6
SAMPLE DESCRIPTION <sup>(1)</sup>	Design verification for product extension <sup>(1)</sup>	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	PCB Hole Deform	Current Rating
<b>Product and test samples required (all 6 pair, 12 IMLA connectors<sup>(1)</sup>):</b>								
HEADER SAMPLES	4	3	4	3	4	4	9	3
RECEPTACLE SAMPLES	4	3	4	3	4	4		3
LLCR TEST BOARD SETS	4	3	4		4	3		
CONTINUITY BOARDS SETS						1		
CURRENT RATING TEST BOARD SETS (Signal)								3
NOMINAL HOLE MECHANICAL TEST BOARDS							3	

**SAMPLE REQUIREMENT NOTES:**


- The largest version of each product configuration is exposed to the entire qualification program (test groups 1-6). Product extensions using the same design, but fewer rows or different column spacing are to be exposed to test group P only for design verification.

**Table 4: Qualification Sample Requirements, Power IMLA Connectors**

TEST GROUP ID▶	P	1 <sup>(2)</sup>	2 <sup>(2)</sup>	3 <sup>(2)</sup>	4 <sup>(2)</sup>	5 <sup>(2)</sup>	6 <sup>(3)</sup>
SAMPLE DESCRIPTION	Design verification for product extension <sup>(2)</sup>	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Vibration & Mech. Shock	PCB Hole Deform	Current Rating
<b>Product and test samples required (all 6 pair, 12 IMLA connectors<sup>(1)</sup>):</b>							
HEADER SAMPLES	4	3	4	4	3	6	6 <sup>(3)</sup>
RECEPTACLE SAMPLES	4	3	4	4	3		6 <sup>(3)</sup>
CURRENT RATING TEST BOARD SETS (Power)	4	3	4	4	3		6 <sup>(3)</sup>
NOMINAL HOLE MECHANICAL TEST BOARDS						2	

**SAMPLE REQUIREMENT NOTES:**

- The largest version of each product configuration is exposed to the entire qualification program (test groups 1-6). Product extensions using the same design, but fewer rows or different column spacing are to be exposed to test group P only for design verification.
- All connector samples in this group fully loaded with power IMLAs unless otherwise noted.
- Three versions tested, 3 data-sets each: 1) one end IMLA powered 2) two end adjacent IMLAs powered 3) all IMLAs powered.

NUMBER <b>GS-12-452</b>	TYPE <b>PRODUCT SPECIFICATION</b>		
TITLE  ZipLine™ Connector System		PAGE 13 of 13	REVISION C
		AUTHORIZED BY M. Gray	DATE 2009-10-05
CLASSIFICATION <b>UNRESTRICTED</b>			

## 9.0 REVISION RECORD

REV	PAGE	DESCRIPTION	EC #	DATE
A	All	Initial Release	V09-0145	2009-04-01
B	All	See ECR V09-0381 for the full list of changes.	V09-0381	2009-09-04
C	All	Modified entire document to add Coplanar information and requirements. See ECR V09-0484 for the full list of changes.	V09-0484	2009-10-05