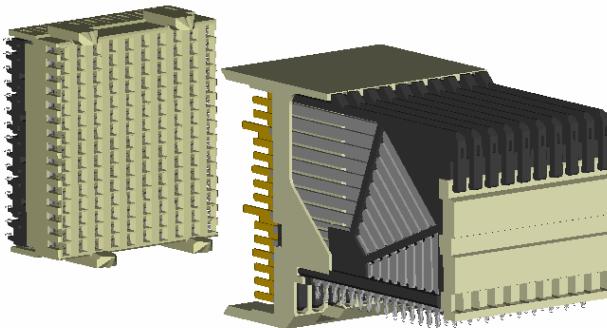


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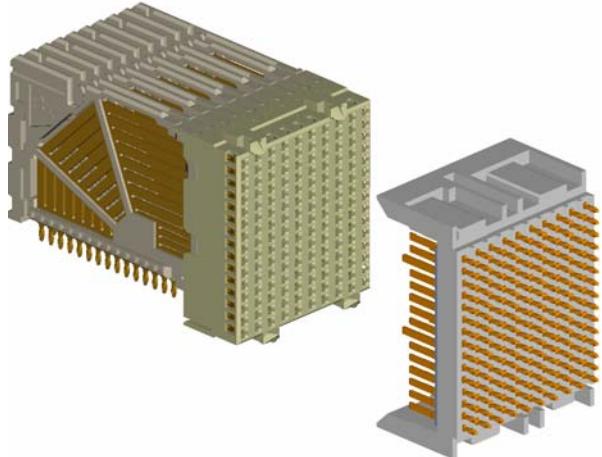
### **AirMax VS® Connector System**



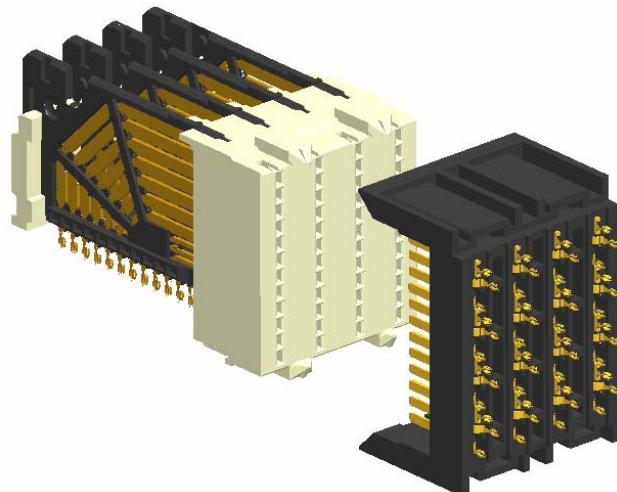
**Backpanel Receptacle**



**Coplanar**



**Backpanel Header**



**Orthogonal Header and Receptacle**

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## 1.0 OBJECTIVE

This specification defines the performance, test, and quality and reliability requirements of the press-fit AirMax VS® Connector System. This specification applies to all press-fit backpanel, coplanar and orthogonal receptacles and headers, including 5 pair, 4 pair, and 3 pair products on both 2mm and 3mm column pitch and 4 pair orthogonal receptacles and headers on 4.2mm column pitch. 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 termination characteristics of the press-fit AirMax VS® Connector System which provides a high speed board-to-board interconnect for differential pairs and single-ended lines.

## 3.0 APPLICABLE DOCUMENTS

### 3.1 FCI Specifications

- Applicable FCI product customer drawings
- FCI Application Specification GS-20-035 (AirMax VS® Connector System, press-fit products)

### 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: Telcordia Specification "Generic Requirements for Separable Electrical Connectors"

### 3.3 FCI Product Qualification Test reports

- EL 2004-03-008D: Press-fit AirMax VS® Backpanel Receptacle products
- EL 2006-04-004D: Press-fit AirMax VS® Backpanel Receptacle products, Performance-based Plating, GXT™ & Hard Gold contact cross-mating
- EL 2006-07-022A: Press-fit AirMax VS® Backpanel Header products
- EL 2008-08-017 : Press-fit AirMax VS® Orthogonal Header and Receptacle products

## 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 (November 1995) 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 Low Level Contact Resistance

Measurements shall be performed using a four-wire method per EIA 364-23B. The maximum initial signal contact resistance is 35 mΩ for backpanel and orthogonal (one mated interface) applications and 50 mΩ for coplanar applications. The increase in resistance for any position shall not exceed 10 mΩ. The following details apply:

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

## 5.2 Insulation Resistance

The insulation resistance of mated connectors shall not be less than  $1000\text{ M}\Omega$  after environmental exposure when measured in accordance with EIA 364-21C. 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 ( $> 0.5 \text{ mA}$ ) when the mated connectors are tested in accordance with EIA 364-20C. 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)

## 5.4 Current Rating

Perform in accordance with EIA 364-70A. Measure temperature vs. applied current for all contacts powered. The following details shall apply:

- a. Ambient conditions: still air at 25°C
- b. Thermocouple location: mechanically attached to the base of the header mating contacts
- c. Copper trace weight: 1 oz
- d. Quantity and location of thermocouples: 10 (5 on an interior column at positions A, C, E, G, and I; 5 on an outside column at positions A, C, E, F, G, and I)

The temperature rise above ambient shall not exceed 30 degrees C with all contacts powered at 0.5A.

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## 6.0 MECHANICAL CHARACTERISTICS

### 6.1 Mating / Un-mating Force

Perform in accordance with EIA 364-13B. The force to mate a receptacle connector and compatible header shall not exceed 0.45 N per contact (0.60 N per orthogonal contact). The un-mating force shall not be less than 0.15 N per contact. The following details shall apply:

- Cross head speed: 1 inch per minute
- Lubrication: None
- Utilize free-floating fixtures
- Number of mate/un-mate cycles: 3
- Number of mated connector pairs to be tested: 10

### 6.2 Compliant pin insertion force

Perform in accordance with EIA 364-05B. 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:

- Force to insert one straight or right angle header pin: 40 N maximum
- Force to insert one right angle receptacle pin: 40 N maximum
- Force to insert one straight receptacle or orthogonal header pin: 25 N maximum
- Number of readings: 1 per connector assembly tested
- 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

Perform in accordance with EIA 364-05B. 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:

- Force to remove one straight or right angle header pin: 7 N minimum
- Force to remove one right angle receptacle pin: 7 N minimum
- Force to remove one straight receptacle or orthogonal header pin: 3 N minimum
- 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, November 1995, Section 5.1.7. Use test boards with minimum 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  $\mu\text{m}$  (0.0003"). The maximum average hole deformation radius shall be no greater than 37.5  $\mu\text{m}$  (0.0015"). The maximum hole deformation radius reading must not exceed 50  $\mu\text{m}$  (0.0020"). Test 15 holes.

### 6.5 PCB Hole Wall Damage

Perform in accordance with Telcordia GR-1217-CORE, November 1995, Section 5.1.7. Use test boards with minimum 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 364-32C. 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:

Mated samples are to be exposed to cyclical humidity and temperature in accordance with EIA 364-31B. 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 364-17B. 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, November 1995, Section 9.1.3 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:

Gas Type	Gas Concentration
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

## Case 1: Backpanel and Orthogonal Applications

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

## Case 2: Coplanar Applications

Each connector gender is to be exposed to gas mixture in the unmated condition for 10 days, then mated to an unexposed connector for a 10 day additional gas exposure and the remainder of the test.

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## 7.5 Vibration

Perform in accordance with Telcordia GR-1217-CORE, November 1995, 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

## 7.6 Mechanical Shock

Perform in accordance with Telcordia GR-1217-CORE, November 1995, 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 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

## 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, November 1995, 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, and in accordance with the following:

## Case 1: Backpanel and Orthogonal Applications

---

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

## Case 2: Coplanar Applications

Each connector gender is to be subjected to dust exposure in the unmated condition, then mated to an unexposed connector for the remainder of the test sequence. Alternatively, in order to reduce the need for additional samples, the mating halves may be subjected to dust exposure and re-mated to each other for the remainder of the test sequence.

## 7.9 Disturb

Perform in accordance with Telcordia GR-1217-CORE, November 1995, 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 reseated 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:  $25 \pm 5^{\circ}\text{C}$
- b. Relative humidity: 20% to 80%
- c. Barometric pressure: Local ambient

### 8.3 Sample Quantity and Description

The test sequences for qualification testing and connector sample sizes for each are shown in Table 1. 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 Table 1.

### 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 Table 1.

- 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**

<b>TEST GROUP ID►</b>		<b>P</b>	<b>1</b>	<b>2</b>	<b>3a</b>	<b>3b</b>	<b>4<sup>(1)</sup></b>	<b>5</b>	<b>6</b>	<b>7</b>
<b>TEST DESCRIPTION</b>	<b>SECTION</b>	Design verification for product extension <sup>2</sup>	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	PCB Hole Deform	Press-fit Forces & Mating Force	Current Rating
VISUAL EXAMINATION OF PRODUCT	4.3	1,6	1,16	1,5	1,11	1,16	1,14	1	1	1,3
MATE HEADER AND RECEPTACLE			2,8		2	2,10	2,8			
UNMATE HEADER AND RECEPTACLE			6			8	6			
<b>ELECTRICAL:</b>										
LOW LEVEL CONTACT RESISTANCE	5.1	3,5	3,5,9,11 ,13,15	2,4		3,5,7,11, 13,15	3,5,9,11, 13			
INSULATION RESISTANCE	5.2				3,6,9					
DIELECTRIC WITHSTANDING VOLTAGE	5.3				4,7,10					
CURRENT RATING	5.4									2
<b>MECHANICAL:</b>										
MATING/UN-MATING FORCE	6.1	2								3
COMPLIANT PIN INSERTION FORCE	6.2							2,4,6	2	
COMPLIANT PIN RETENTION FORCE	6.3							3,5	4	
PCB HOLE DEFORMATION RADIUS	6.4							7		
PCB HOLE WALL DAMAGE	6.5							8		
<b>ENVIRONMENTAL:</b>										
THERMAL SHOCK	7.1				5	4				
CYCLICAL HUMIDITY & TEMPERATURE	7.2				8	12				
TEMPERATURE LIFE	7.3			3						
MFG, UNMATED, 10-DAYS (see noted sect.)	7.4		7							
MFG, MATED, 10-DAYS (see noted section)	7.4		10							
VIBRATION	7.5						10 <sup>(1)</sup>			
MECHANICAL SHOCK	7.6						12 <sup>(1)</sup>			
DURABILITY, 99 CYCLES	7.7	4	4, 14			6,14	4			
DUST CONTAMINATION (see noted section)	7.8					9	7			
DISTURB	7.9		12							

**TEST SEQUENCE NOTES:**

1. Discontinuity is measured only on the set of connectors that are not being monitored for LLCR (Test Group 4)
2. The largest version of each product configuration is exposed to the entire qualification program (groups 1-7). Product extensions using the same design, but fewer rows are exposed to test group P only for design verification.

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**Table 2: Qualification Sample Requirements**

TEST GROUP ID►	P	1	2	3a	3b	4	5	6	7
<b>SAMPLE DESCRIPTION<sup>(2)</sup></b>	Design verification for product extension <sup>2</sup>	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	PCB Hole Deform	Press-fit Forces & Mating Force	Current Rating
<b>Product and Test Samples Required (All 150 Position<sup>2</sup>): BACKPANEL RECEPTACLE APPLICATION</b>									
VERTICAL RECEPTACLE	4	4	4	3	4	5	18	10	1
RIGHT ANGLE HEADER	4	4	4	3	4	5	9	10	1
LLCR TEST BOARD SETS	4	4	4		4	4			
CONTINUITY BOARDS (BACKPANEL)						1			1
CONTINUITY BOARDS (DAUGHTER CARD / NOMINAL HOLE)						1		10	1
MINIMUM HOLE MECH TEST BOARDS, 4 LAYER							9 <sup>(1)</sup>		
MAXIMUM HOLE MECHANICAL TEST BOARDS								10	
<b>Product and Test Samples Required (All 150 Position<sup>2</sup>): BACKPANEL HEADER and ORTHOGONAL APPLICATIONS</b>									
VERTICAL HEADER SAMPLES	4	4	4	3	4	5	18	10	1
RIGHT ANGLE RECEPTACLE SAMPLES	4	4	4	3	4	5	9	10	1
LLCR TEST BOARD SETS	4	4	4		4	4			
CONTINUITY BOARDS (BACKPANEL)						1			1
CONTINUITY BOARDS (DAUGHTER CARD / NOMINAL HOLE)						1		10	1
MINIMUM HOLE MECH TEST BOARDS, 4 LAYER							9 <sup>(1)</sup>		
MAXIMUM HOLE MECHANICAL TEST BOARDS								10	
<b>Product and Test Samples Required (All 150 Position<sup>2</sup>): COPLANAR APPLICATION</b>									
RIGHT ANGLE HEADER SAMPLES	4	8	4	3	4	5		10	1
RIGHT ANGLE RECEPTACLE SAMPLES	4	8	4	3	4	5		10	1
LLCR TEST BOARD SETS	4	8	4		4	4			
CONTINUITY BOARDS (BACKPANEL)						1			1
CONTINUITY BOARDS (DAUGHTER CARD / NOMINAL HOLE)						1		10	1
MINIMUM HOLE MECH TEST BOARDS, 4 LAYER									
MAXIMUM HOLE MECHANICAL TEST BOARDS								10	

**SAMPLE REQUIREMENT NOTES:**

- Three of the backpanel test boards are to be back-drilled to a depth of 0.8mm (Test Group 5 / Backpanel Application only)
- The largest version of each product configuration is exposed to the entire qualification program (groups 1-7). Product extensions using the same design, but fewer rows are exposed to test group P only for design verification.

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### REVISION RECORD

REV	PAGE	DESCRIPTION	EC #	DATE
A	all	Initial release	V04-1019	8 Oct 04
B	5, 7	Increased min un-mating force to 0.15H in sec 6.1; Changed vibration sweep cycle time from 20 min to 15 min in sec 7.5c; Added "200 total mating cycles" to sec 7.7a	V05-0843	9 Sep 05
C	all	Updated FCI logo; added details related to coplanar and backpanel header product configurations; added test group P to table 1	V06-0527	12 Jun 06
D	2,3,6,7, 9, 10	Updated for coplanar applications and performance-based plating	V06-0869	8 Sept 06
E	1, 3-7, 10 3	Added orthogonal header and receptacle; section 1.0, 5.1, 6.2, 6.3, 7.4, 7.8 & Table 2 Section 3.3: Update test report information	S07-0293	30 Aug 07
F	5	Update orthogonal mating force: section 6.1 Update orthogonal header compliant pin insertion and retention force(similar to standard vertical receptacle): Section 6.2 & 6.3	S08-0315	30 Sep 08

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