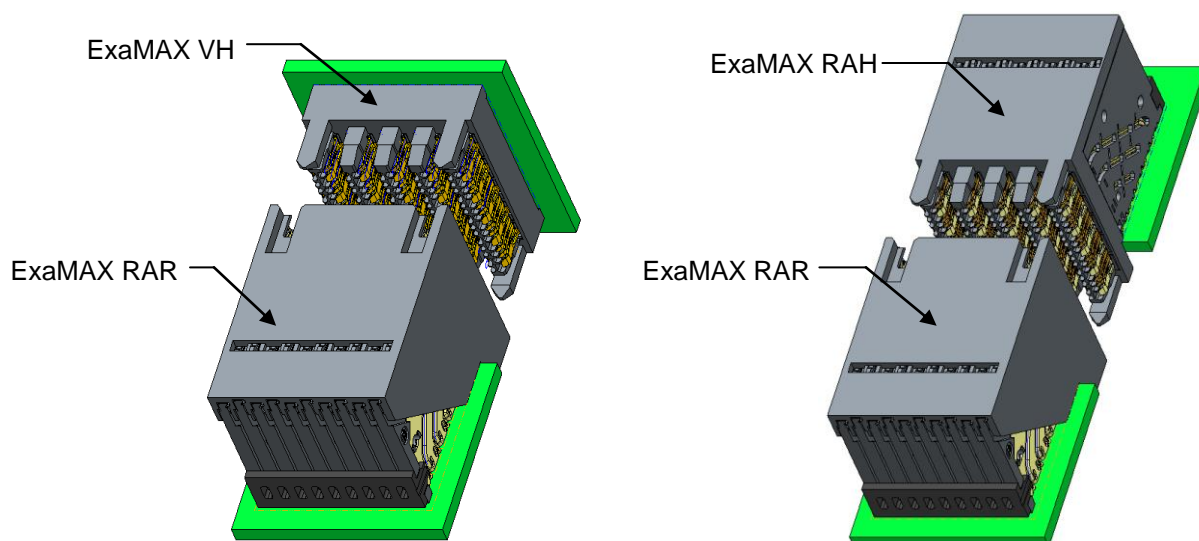


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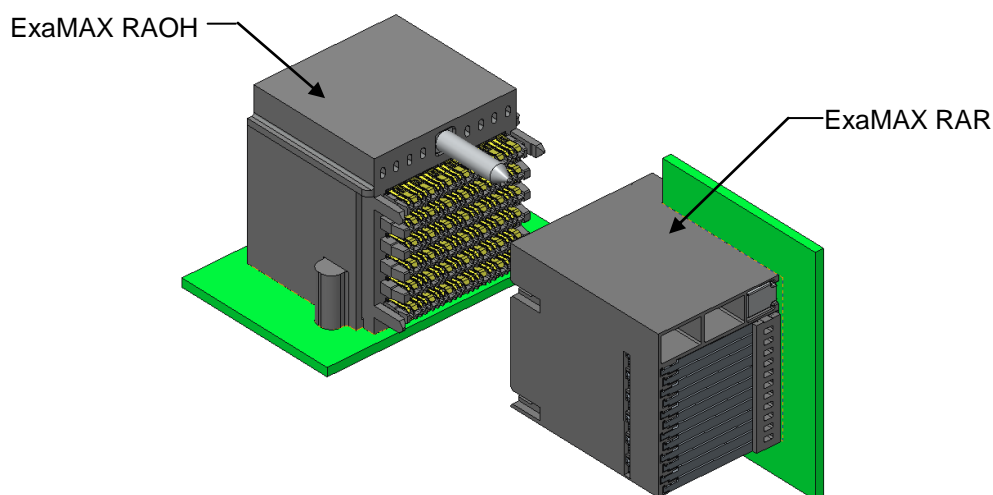
## **ExaMAX® Connector System**



**BACKPLANE RIGHT ANGLE RECEPTACLE (RAR)  
AND VERTICAL HEADER (VH)**

**COPLANAR RIGHT ANGLE RECEPTACLE (RAR)  
AND RIGHT ANGLE HEADER (RAH)**

(4-Pair, 10-Column Configuration Shown)



**RIGHT ANGLE ORTHOGONAL HEADER (RAOH) WITH RIGHT ANGLE RECEPTACLE (RAR)**

(6-Pair, 12-Column Configuration with Guides Shown)

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## 1.0 Objective

This specification defines the performance, test, quality and reliability requirements of the ExaMAX press-fit connector system.

## 2.0 Scope

This specification is applicable to the ExaMAX press-fit family of products, which provides a high speed board-to-board interconnect for differential pairs and single-ended lines. Connectors include 2-pair, 3-pair, 4-pair, 6-pair and 8-pair Right Angle Receptacle (RAR) , Vertical Receptacle (VR), Right Angle Header (RAH), Vertical Header (VH), and 6-pair Right Angle Orthogonal Header (RAOH) connectors. The test sequences defined in this specification meet the intent of Telcordia GR-1217-CORE requirements.

## 3.0 Ratings

### 3.1 Operating Voltage Rating:

- Agency Voltage Rating < 30 VAC RMS / DC
- Non-Agency Voltage Rating = 150 VAC RMS / DC Maximum

### 3.2 Operating Current Rating: See section 6.4

### 3.3 Operating Temperature Range = -55° C to +85° C

## 4.0 Applicable Documents

### 4.1 FCI Specifications

#### 4.1.1 Engineering drawings

- FCI product customer drawings (Various)
- FCI customer drawing 10119933 (Recommended Via Drill Sizes and Plating)

#### 4.1.2 Process drawings

- FCI product inspection drawings (Various)

#### 4.1.3 Application specification

- GS-20-0361 (ExaMAX Connector System, press-fit products)

#### 4.1.4 Power design guide specification

- GS-20-0456 (ExaMAX ExaMEZZ Power Design Guide)

### 4.2 Industry or Trade Association standards

Telcordia GR-1217-CORE (Separable Electrical Connectors Used in Telecommunications Hardware)

### 4.3 National or International Standards

#### 4.3.1 Flammability: UL94V-0 or similar applicable specification

#### 4.3.2 EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications.

#### 4.3.3 IEC 60512: Connectors for Electronic Equipment – Tests and Measurement

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#### 4.4 FCI Qualification Report and Supporting Data

- EL-2014-01-014, EL-2014-01-037
- EL-2013-12-014 and EL-2015-01-044A additional current rating test to support values in section 6.4

#### 4.5 Safety Agency Approvals

- UL File Number: E66906

### 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.

- Contacts: Copper alloy
- Housings and IMLAs: High temperature thermoplastic; UL 94V-0 compliant

#### 5.3 Finish

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

- Contact Areas: Performance-based plating, qualified to meet the requirements of this specification, including Telcordia GR-1217-CORE (November 1995) Central Office test sequence
- Press-Fit Tails: Tin over Nickel

#### 5.4 Design and Construction

Connectors shall be of the design, construction, and physical dimensions specified on the applicable product drawing.

#### 5.5 Workmanship

Connectors shall be visually examined in accordance with IEC 60512-1-1.

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## 6.0 Electrical Characteristics

### 6.1 Contact Resistance, Low Level (LLCR) – EIA 364-23

The low level contact resistance for 2 to 6 pair configurations shall not initially exceed 60 milliohms (Backplane) or 100 milliohms (Coplanar and RAOH to RAR). For 8 pair Plus Backplane (RAR to Vertical Header), the initial resistance shall not exceed 100 milliohms; For 8 pair Plus RAOH to RAR, the initial resistance for an 8 Column/Row shall not exceed 110 milliohms. For each 2 additional columns/rows, another 10 milliohms initial resistance is allowed. For example, an 8 pair Plus x 16 column RAR mated to an RAOH shall not have an initial resistance in column / row 16 greater than 150 milliohms. The low level contact resistance shall also not exceed 10 milliohms increase in resistance (from the initial measurement) after any treatment and/or environmental exposure. Note: grounds within each IMLA/column shall be measured or calculated in parallel.

The following details shall apply:

- Test Voltage - 20 milli-volts DC max open circuit.
- Test Current - Not to exceed 100 milli-amperes.
- Number of readings: 500 minimum

### 6.2 Insulation Resistance – EIA 364-21

The insulation resistance of mated connectors shall not be less than 1000 M-ohms.

The following details shall apply:

- Test Voltage - 500 volts DC
- Electrification Time – 60 seconds.
- Points of Measurement – Between signal-to-signal and signal-to-ground within same IMLA.
- Number of readings: 40 (10 readings per loose-piece connector set).

### 6.3 Dielectric Withstanding Voltage – EIA 364-20

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current > 0.5 mA.

The following details shall apply:

- Test Voltage – 500 volts DC.
- Test Duration - 60 seconds.
- Test Condition - 1 (760 Torr - sea level).
- Points of Measurement – Between signal-to-signal and signal-to-ground within same IMLA.
- Number of readings: 40 (10 readings per loose-piece connector set).

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#### 6.4 Current Rating – EIA 364-70

	Standard ExaMAX Backplane Current Rating (amperes)				
	2-Pair	3-Pair	4-Pair	6-Pair *	8-Pair
Individual Signal Contact (centrally located in connector)	4	4	4	4	TBD
Split Single IMLA (signal contacts carrying load, ground contacts carrying return)	8	11	13	17	TBD
Full Adjacent IMLAs (1 IMLA carrying load, 2nd adjacent IMLA carrying return)	11	15	19	25	TBD

*Note: "IMLA" = "Insert Molded Leadframe Assembly," sometimes termed "wafer" or "Chicklet"*

*\* - Includes RAOH to RAR Assembly*

	ExaMAX Plus Current Rating (amperes)	
	6-Pair *	8-Pair
Individual Signal Contact (centrally located in connector)	3	3
Split Single IMLA (signal contacts carrying load, ground contacts carrying return)	15	16
Full Adjacent IMLAs (1 IMLA carrying load, 2nd adjacent IMLA carrying return)	21	24

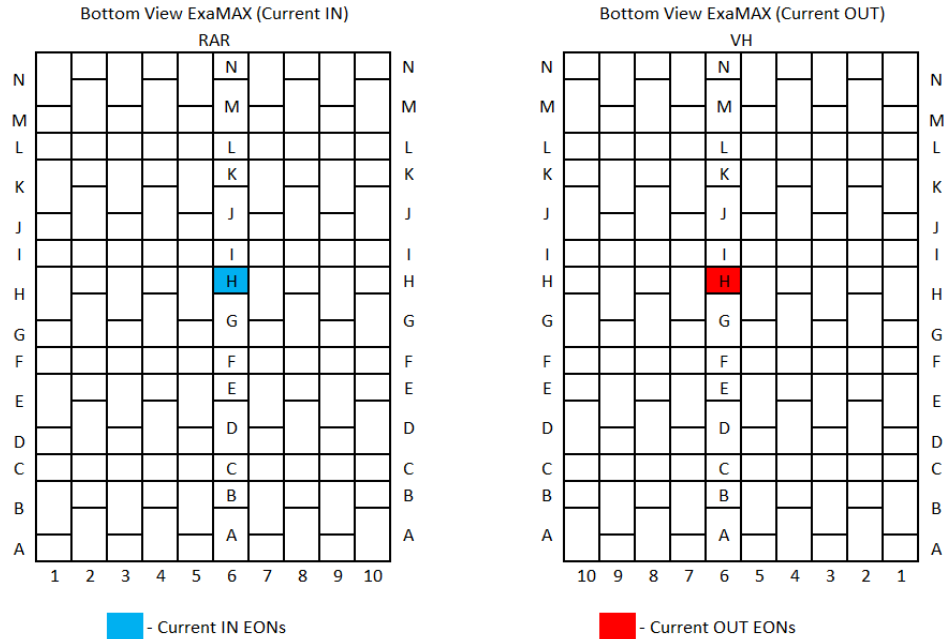
*\* - Includes RAOH to RAR Assembly*

The following details shall apply:

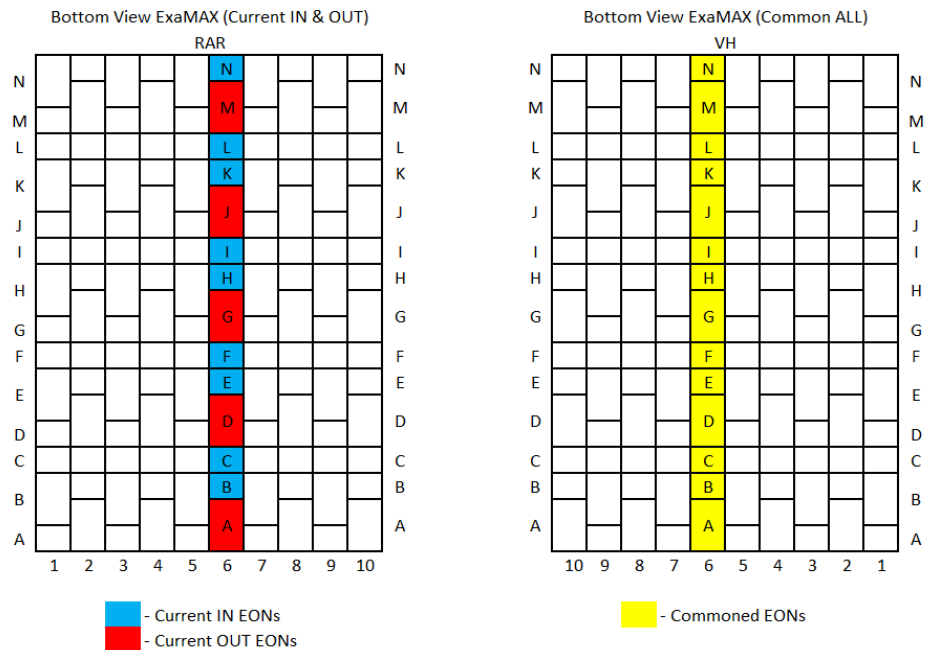
- Ambient Conditions – Still air at 25°C
- 30° C maximum temperature-rise over ambient
- Thermocouple location - mechanically attached near the center of the IMLA at the base of the contacts.
- Discrete 28 AWG wire is to be attached to each EON tail.
- For the full adjacent IMLAs test, the discrete 28 AWG wires are bundled to a 14 AWG wire on one half of the mated pair and a 16 AWG wire is commoned to all EON tails, both IMLAs, on the other mated half.

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### Individual Single Contact

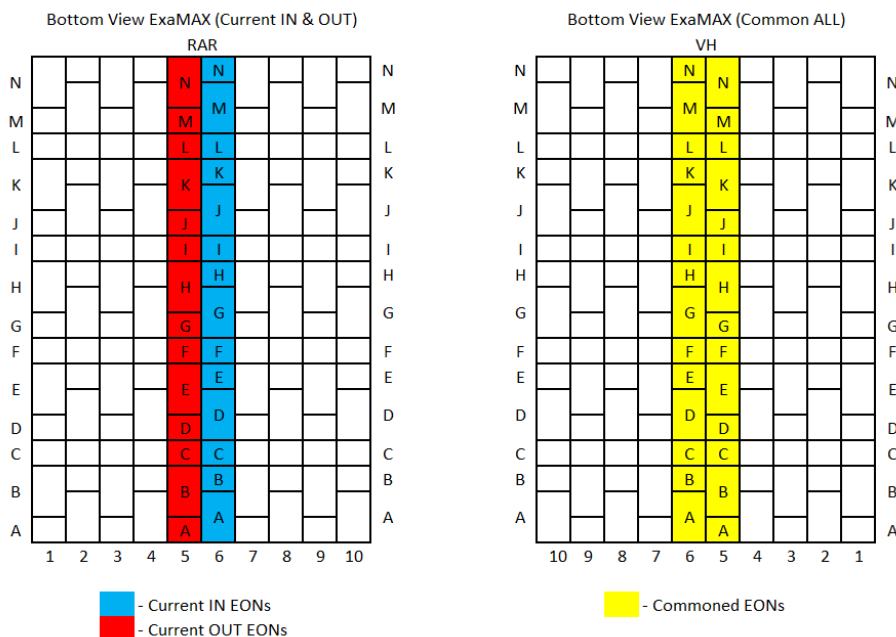


### Split Single IMLA



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### Full Adjacent IMLAs (Side by Side)



## 7.0 Mechanical Characteristics

### 7.1 Mating/Un-mating Force – EIA 364-13

The force to mate a receptacle connector and a corresponding header shall not exceed 0.45 N per contact. The un-mating force shall not be less than 0.10 N per contact.

The following details shall apply:

- Cross Head Speed – 25.4 mm per minute.
- Utilize free floating fixtures.
- Number of mate/un-mate cycles: 3

### 7.2 Compliant Pin Insertion Force – EIA 364-05

Fully populated connectors shall be applied to test boards in accordance with the ExaMAX application specification GS-20-0361. Testing shall consist of three boards in which three new connectors are inserted into each board in order to simulate three connector insertion repair cycles. See section 7.3 for details on connector removal between insertions. The following details shall apply:

- Average force to insert one EON: 12 N maximum, 18 N maximum (RAOH)
- Number of connector assemblies to be tested: 9 (3 boards, 3 connectors each)
- Number of readings: 1 per connector assembly tested.
- Test boards: Use nominal diameter PCB's with 0.36 mm or 0.31mm (signal, as applicable) and 0.50 mm (ground) diameter finished holes with immersion tin plating.
- Measure and record the test board's finished hole sizes prior to performing test.



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### 7.3 Compliant Pin Retention Force – EIA 364-05

Fully populated connectors shall be removed from test boards in accordance with the ExaMAX application specification GS-20-0361. The following details shall apply:

- a. Average force to remove one EON: 3.5 N minimum for ExaMAX, and 2.7 N min for ExaMAX+.

Product	Finished Hole Size (PCB)		Minimum average force per pin in a connector	Formula
	Signals	Grounds		[(Number of ground pins x 3.5N per pin) + (number of signal pins x $f$ N per pin)] divided by total qty of pins in the connector.
ExaMAX	Ø0.36mm	Ø0.50mm	<b>3.5N</b>	$f = 3.50$
ExaMAX+	Ø0.31mm	Ø0.50mm	<b>2.7N</b>	$f = 2.25$

- b. Number of readings: 1 per connector assembly tested.

- c. Test boards: Use nominal diameter PCB's with 0.36 mm or 0.31mm (signal, as applicable) and 0.50 mm (ground) diameter finished holes with immersion tin plating.

### 7.4 PCB Hole Deformation Radius and Remaining Cu Plating Thickness (compliant pin) – EIA 364-96

Use nominal diameter PCB's with 0.36 mm or 0.31mm (signal, as applicable) and 0.50 mm (ground) diameter finished holes with immersion tin plating, and 2.4 mm minimum 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, the PCB shall have had 3 compliant pin insertions and 2 compliant pin withdrawals as specified in sections 7.2 and 7.3.

The measurements and photographs shall be performed at 0.3 mm, from the connector side PCB laminate (not copper) surface on a minimum of 10 holes of each size. The average (of 10 holes for each size) hole deformation radius shall be no greater than 37.5 µm when measured from the drilled hole. The absolute maximum deformation radius shall not exceed 50 µm. The minimum average (of 10 holes for each size) copper thickness remaining between the compliant pin and the printed wiring board laminate shall not be less than 7.5 µm.

### 7.5 PCB Hole Wall Damage – EIA 364-96

Use nominal diameter PCB's with 0.36 mm or 0.31mm (signal, as applicable) and 0.50 mm (ground) diameter finished holes with immersion tin plating, and 2.4 mm minimum 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, the PCB shall have had 3 compliant pin insertions and 2 compliant pin withdrawals as specified in sections 7.2 and 7.3.

There shall be no copper cracks, separations between conductive interfaces, or laminate-to-copper separations. Inspect 10 pins/holes of each diameter.

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## 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 - 5
- Temperature Range - Between -55°C and +85° C
- Time at Each Temperature – 30 minutes minimum
- Transfer Time - 30 seconds, maximum

### 8.2 Cyclical Humidity and Temperature – EIA 364-31 method III. 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:

- 2 hour ramp from 25°C at 80%-98% RH to 65°C at 90%-98% RH
- 4 hour dwell at 65°C at 90%-98% RH
- 2 hour ramp down to 25°C at 80%-98% RH
- 2 hour dwell at 25°C at 80%-98% RH

### 8.3 Temperature Life – EIA 364-17. Headers and receptacles shall remain mated without any electrical load

- Test Temperature - 85° C
- Test Duration – 500 hours

### 8.4 Mixed Flowing Gas corrosion (MFG) – EIA 364-65, class IIA, 4-gas

- Duration – 20 days
- Temperature – 30°C
- Humidity – 70%
- Backplane and RAOH samples, backplane (VH or RAOH) connectors shall be exposed to gas mixture for 10 days, then mated to unexposed receptacles and exposed to gas for an additional 10 days. Coplanar, each gender (header and receptacle) shall be exposed for 10 days, and then mated to unexposed connectors for an additional 10 days.

e. 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

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8.5 Salt Spray – EIA 364-26

- a. Test Condition - B
- b. Duration – 48 hours
- c. Connector on the LLCR Header board shall be unmated during salt exposure. PCB shall be in a horizontal orientation with connector contacts facing down. To prevent salt solution pooling in PCB holes, the back side of the PCB shall be masked with tape.

8.6 Vibration – EIA 364-28, Test Condition II

- a. Vibration Amplitude – 1.5 mm double amplitude or 10G acceleration
- b. Frequency Range - 10 to 500 to 10 hertz
- c. Cycle Time – 15 minutes, 8 hours along each of three orthogonal axes (24 hours total)
- d. Mounting - Rigidly mount assemblies
- e. No discontinuities greater than 1 microsecond

8.7 Mechanical Shock – EIA 364-27, Test Condition H

- a. Amplitude – half sine 30G
- b. Duration – 11 milliseconds
- c. Shocks - 3 shocks along each of three orthogonal axes (18 shocks total)
- d. Mounting - Rigidly mount assemblies
- e. No discontinuities greater than 1 microsecond

8.8 Durability - EIA 364-09

- a. Number Cycles – See table 1 (200 total mating cycles)
- b. Cycling Rate – 127 mm/min.
- c. Use free floating fixtures

8.9 Dust – EIA 364-91

- a. Samples to be exposed to one-hour dust exposure
- b. Using a benign dust composition number 1
- c. Backplane and RAOH samples, only un-mated backplane header connectors (VH or RAOH) shall be exposed to dust. For co-planar applications, both connectors (header and receptacle) shall be exposed to dust and then mated to unexposed connectors.

8.10 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 un-mating the sample approximately 0.10 mm. The sample is then reseated and measurements are taken.

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## 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:

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

### 9.3 Sample Quantity and Description

The test sequences for qualification testing are shown in table 1 and the connector sample sizes are shown in Table 2. The number of readings is specified in the description for each test. For connector sizes with fewer contacts additional samples may be required to meet the minimum number of readings for specific tests.

### 9.4 Acceptance

- 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.
- 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, print revisions for components and assemblies, and plating composition and thickness

### 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.

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### 9.7 Qualification Test Tables

TEST GROUP ID ►		P <sup>(1)</sup>	1 <sup>(5)</sup>	2	3a	3b <sup>(5)</sup>	4 <sup>(2)(5)</sup>	5	6	7
TEST DESCRIPTION	SECTION	Design Verification for Product Extension	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	Press-Fit Evaluation	Salt Spray	Current Rating
VISUAL INSPECTION <sup>(6)</sup>	5.5	1,6	1,16	1, 7	1,11	1,12,14	1,14	1	1,5	1,3
MATE HEADER AND RECEPTACLE	--	2	2,8		2	2,10	2,8			
UN-MATE HEADER AND RECEPTACLE	--		6			8	6			
<b>ELECTRICAL:</b>										
LOW LEVEL CONTACT RESISTANCE	6.1	3,5	3,5,9,11,13,15	3, 5		3,5,7,11,13	3,5,9,11, 13		2,4	
INSULATION RESISTANCE	6.2				3,6,9					
DIELECTRIC WITHSTANDING VOLTAGE	6.3				4,7,10					
CURRENT RATING	6.4									2
<b>MECHANICAL:</b>										
MATING / UN-MATING FORCE	7.1	See Note3		2, 6		See Note3				
COMPLIANT PIN INSERTION FORCE	7.2							2,4,6		
COMPLIANT PIN RETENTION FORCE	7.3							3,5,7 See Note 4		
PCB HOLE DEFORMATION RADIUS	7.4							8		
PCB WALL DAMAGE	7.5							9		
<b>ENVIRONMENTAL:</b>										
THERMAL SHOCK	8.1				5	4				
CYCLICAL HUMIDITY & TEMPERATURE	8.2				8	12				
TEMPERATURE LIFE	8.3			4						
MFG, UN-MATED , 10-DAYS	8.4		7							
MFG, MATED, 10-DAYS	8.4		10							
SALT SPRAY	8.5								3	
VIBRATION	8.6						10			
MECHANICAL SHOCK	8.7						12			
DURABILITY, 100-CYCLES	8.8	4	4,14			6	4			
DUST CONTAMINATION	8.9					9	7			
DISTURB	8.10		12							

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**Table 1: Qualification Test Matrix**

TEST GROUP ID ►	P <sup>(1)</sup>	1 <sup>(5)</sup>	2	3a	3b <sup>(5)</sup>	4 <sup>(2)(5)</sup>	5	6	7
COMPONENT DESCRIPTION	Design Verification for Product Extension	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	Press-Fit Evaluation	Salt Spray	Current Rating
Number of RAR	4	4	4	4	4	4		4	3
Number of VH, RAH or RAOH	4	4	4	4	4	4	9	4	3
RAR LLCR Board	4	4	4		4	3		4	
VH, RAH or RAOH LLCR Board	4	4	4		4	3		4	
RAR Continuity or Mechanical Board						1			
VH, RAH or RAOH Continuity or Mechanical Board						1	3		

**Table 2: Qualification Sample Requirements**

**Notes:**

- Group P is not required for a full qualification. Group P is a design verification sequence for product extensions after a full qualification has been completed.
- For test group 4, LLCR is measured on 3 sample sets and one set is used for discontinuity monitoring.
- Record mating and un-mating forces on first three cycles of durability.
- The third compliant pin retention force test is performed on one of three samples only. The remaining two samples proceed to steps 8 and 9 for cross sectioning.
- For coplanar applications, additional spare header and receptacle connectors (4 each) are required for the mixed flowing gas and dust sequences.
- Any observations of concern or question shall be documented and communicated to the responsible product engineer immediately.

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### REVISION RECORD

Rev	Page	Description	EC #	Date
A	All	Release specification	-	2014-03-12
B	3,5,9	Added current qualification report, expanded current-rating, changed salt spray test condition	ELX-V-18241	2014-07-18
C	4	Modified Section 6.1	ELX-V-18367	2014-07-22
D	4-8	Modify current rating table and add Figures in section 6.4 and add MIN/MAX hole options to sections 7.2-7.5	ELX-V-19229	2014-10-24
E	1,3,5,7,9,10,12-14	Added current rating tests, modified current ratings, modified maximum compliant pin insertion force, clarified MFG and dust exposure, added note 5 to Table 2	ELX-V-20317	2015-02-26
F	5,7	Section 6.2, added Backplane to the title and asterisk for DMO in the current rating table. Section 7.1, removed the reference to vertical header and increased the mating force value from 0.36 N to 0.38 N.	ELX-V-21025	2015-06-01
G	1,3-6,8,10,11,14	Up-dated pictures and added coplanar, changed all DMO to RAOH, revised operating voltage, added power guide and UL file number, added RAOH EON insertion force, and clarified MFG and dust exposure	ELX-V-22319	2015-10-27
H	11, All	Changed section 8.6 from sweep time to cycle time and up-dated to Amphenol FCI format	ELX-V-23898	2016-04-19
J	8	Increase mating force spec from 0.38N to 0.45N max per contact.	ECN-ELX-DG-25340	2016-11-16
K	5,6,8,9	Define the LLCR spec for 8pair plus on section 6.1, Add current rating spec for ExaMAX plus on section 6.4, Add femto signal information regarding the PCB EON contents from section 7.2 to section 7.5	ECN-ELX-DG-29468	2018-03-07
L	6,8,9	Define the retention force of Femto/Copper EON in section 7.3 Remove the "or" MIN/MAX holes from the Spec for EON evaluation Add current rating specification for 8 pair plus RAR to VH	ECN-ELX-DG-30861	2018-08-02
M	4, All	Page 4 paragraph 5.4 – Simplified "Design and Construction" requirement to remove specific attributes that should be covered on the product drawing. Added Paragraph 5.5 for Workmanship (visual inspection) and updated line one of the test description table on page 13 accordingly. Underlined section headers clarity.	ECN-ELX-V-31837	2018-11-12

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