
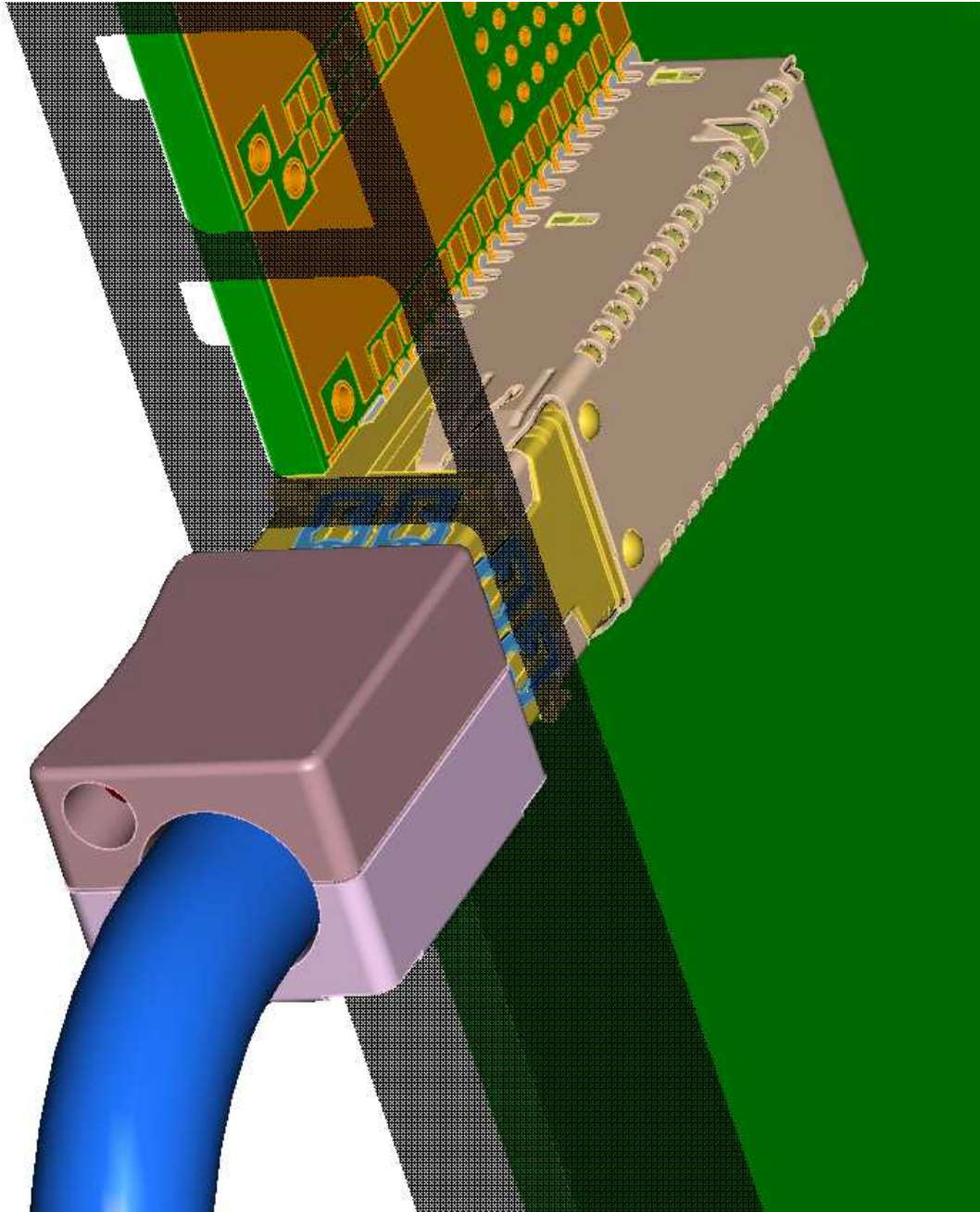



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## OBJECTIVE

This specification defines the relevant product characteristics and the applicable qualification tests of a fully shielded I/O cable to board interconnection system for low- or high-speed signal transmission.



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## 1 General

### 1.1 General information.


The DENSI-SHIELD I/O™ connector system consists of fully EMC shielded cable and connector assemblies for use in a CO (Central Office) environment, to provide an interconnection path for single ended or differential signals at a density of maximum 16 lines or 8 shielded AWG26 twin-axial pairs on minimum 12,5mm board edge and minimum 15 mm component printed circuit board spacing.

The cable and board connector modules are tightened together by means of a locking screw and both consist of a contact unit and shielding covers made out of sheet metal and die-cast components. The contact unit in the cable connector unit consists of a number of stacked terminal blocks, which one on one mate with IMLA's (Insert Molded Lead Assemblies) of the one-piece SMT compatible board connector. Each terminal block has 4 terminals for signals and 1 terminal for ground. The cable connector module has a built-in cable strain relief.

### 1.2 Ratings and characteristics.

Table 1:

<b>Current rating / signal pole at 85°C</b>	0.5 A max.
<b>System impedance</b>	Differential impedance 100 Ω Common mode impedance 32 Ω Signal risetime of 100 picosec. (10-90%)
<b>Cable (round)</b>	Total diameter Ø 8.1 mm max. Max. 8 twin-axial or twisted pairs Solid conductors max. AWG26
<b>Printed Circuit Board termination type</b>	Pin In Paste solder connections in plated-through holes
<b>Printed Circuit Board thickness</b>	(1.6 - 3.2) ±10%

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## 2 Applicable documents

### 2.1 FCI Specifications.

- Product customer drawings "10044471" ," 10076181" and "10044473"
- GS-12-305: Cable Specification for DENSI-SHIELD™ IO connector
- GS-20-047: Application guide DENSI-SHIELD™ IO cable connector
- GS-20-048: Application guide DENSI-SHIELD™ IO board connector

### 2.2 Other standards and specifications.

- UL94-VO : Flammability
- EIA 364 : Electrical Connector / Socket Test Procedures Including Environmental Classifications
- GR-1217-CORE : Telcordia Specification "Generic Requirements for Separable Electrical Connectors"
- EIA 481 : Embossed and Punched Carrier Tape of Surface Mount Components for Automated Handling

## 3 Requirements

### 3.1 Qualification

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein

### 3.2 Design and construction


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

### 3.3 Materials

All materials shall be as specified on the applicable product customer drawings.

### 3.4 Mounting information.

The dimension of the connector system, front panel interface, board and stencil layout shall be of the design, construction and physical dimensions specified on the applicable product customer drawings.

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## 4 Application.

### 4.1 Application tooling cable connector.

- Solder tooling
- Crimp tooling
- Cover closing tooling

For more details see FCI application guide GS-20-047.

### 4.2 Recommended cable layout.

The cable connector components and application tooling has been designed to hold twin-axial, 100 Ohm, solid AWG30-26 cable constructions. For the recommended cable layout, see FCI specification GS-12-305.

### 4.3 Board connector handling features.

Flat sheet metal Area on top for Vacuum Nozzle round 9 mm max., front and rear edges for Mechanical Gripper. For more details see FCI application guide GS-20-048.

## 5 Characteristics.


### 5.1 General.

Unless specified otherwise, all characteristics refer to a mated pair of cable and board connector in which the board connector is properly soldered to the printed circuit board.

### 5.2 Reference environment.

Table 2:

<b>Temperature</b>	15°-35°C
<b>Relative humidity</b>	25% -75%
<b>Atmospheric pressure</b>	86-106 kPa

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### 5.3 Climatic category.

Table 3:

<b>Storage</b>	<b>Max. temperature</b>	50°C
	<b>Min. temperature</b>	-40°C
<b>Range of uses</b>	<b>Max. temperature</b>	85°C
	<b>Min. temperature</b>	-40°C

### 5.4 Electrical.

#### 5.4.1 Creepage and clearance distances.

Minimum creepage and clearance distance between signals (within a pair) is 0.35 mm and between a signal and a ground is 0.35 mm.

#### 5.4.2 Insulation resistance.

The insulation resistance shall not be less than 1000 MΩ after mechanical (cable clamp and durability) and environmental tests (heat ageing and damp heat steady state).

Conditions: EIA 364-21C

Test voltage: 500 V DC

Electrification time: 60 s.

Measurement from signal terminal to adjacent signal terminal and from signal terminal to adjacent ground terminal or overall shielding.

#### 5.4.3 Dielectric withstanding voltage.


Initially and after mechanical (cable clamp and durability) and environmental tests (heat ageing and damp heat steady state test) withstand the specified voltage with no evidence of arc over, insulation breakdown or excessive leakage current (> 1 mA).

Conditions: EIA 364-20C under test condition - 1 (760 Torr - sea level)

Test voltage - 750 V DC

Test duration - 60 s

Measurement from signal terminal to adjacent signal terminal and from signal terminal to adjacent ground terminal or overall shielding.

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#### 5.4.4 Maximum operating voltage

The operating voltage is 42 V (DC or AC peak) according to IPC-2221, table 6-1, condition A6.

#### 5.4.5 Low level contact resistance (LLCR).

Initial contact resistance according to table 4. Contact resistance max. increase 10 mΩ after mechanical (cable clamp and durability) and environmental tests (heat ageing and damp heat steady state test).

Conditions: EIA-364-23B

Test Voltage - 20 mV DC max. open circuit

Test current - Not to exceed 100 mA

Board connector mounted on the PCB with solid ground plane.

Measured between the solder tail of the board connector and the solder pad of the cable connector transition board as indicated in fig.1.

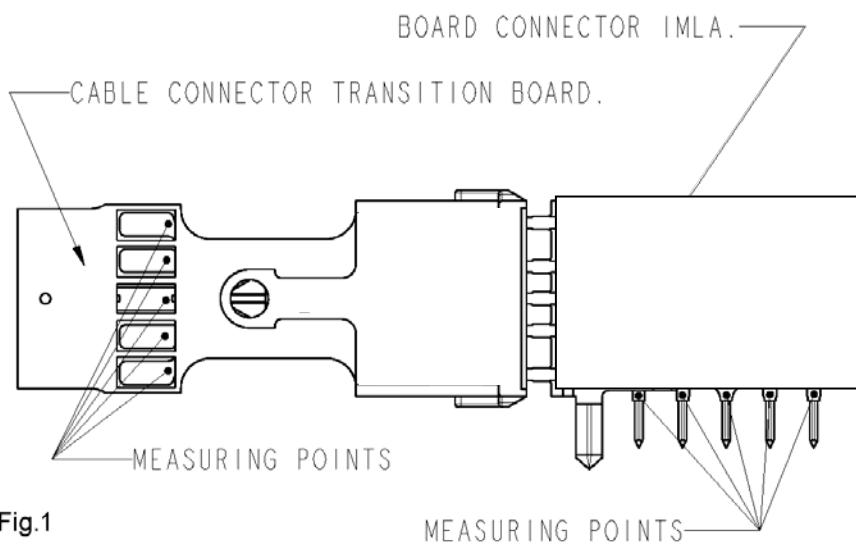



Fig.1

Table 4:

Arrangement	Row	Resistance
Contact / contact	<b>A</b>	35 mΩ max
Contact / contact	<b>B</b>	30 mΩ max
Contact / contact	<b>C</b>	20 mΩ max
Contact / contact	<b>D</b>	30 mΩ max
Contact / contact	<b>E</b>	40 mΩ max



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#### 5.4.6 Current carrying capacity

The temperature rise above ambient shall not exceed 30 °C at any point in the system when all signal terminals are powered at 0.5 A.

Conditions: EIA 364-70A

Ambient Conditions - still air at temperature of 25 °C.

#### 5.4.7 Shielding effectiveness

- Over 0 - 1.2 Ghz > 45 dB
- Over 1.2 - 1.75 Ghz > 30 dB

Conditions: EIA 364-66.

#### 5.4.8 Cross-talk ratio

Pair to pair NEXT (one pair is "listening" and one pair is driven, 100 Ω differential impedance), periodic differential signals at 100 ps risetime (10-90 %)

- Cross (with ground included) < 0.2 %
- Between pairs located in the same column < 0.5 %
- Between pairs located in the same rows < 1.3 %

Conditions: EIA 364-90

Applicable to High Speed versions only

#### 5.4.9 Connector impedance

Differential impedance at 100 ps risetime (10-90 %) = 100 ± 15 Ω. Connector performance only, solder connections and via holes are not included.

Conditions: EIA 364-108

Applicable to High Speed versions only


To be measured between begin solder tail board-connector and just after the solder path of the cable-connector transition board as indicated in fig.1.

#### 5.4.10 Insertion loss

- Over 0 - 3 GHz < 1 dB
- Over 3 - 5 GHz < 1.5 dB

Conditions: EIA 364-101

Applicable to High Speed versions only

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#### 5.4.11 Skew.

- Skew within pair AB < 10 ps
- Skew within pair DE < 20 ps
- Skew between pairs < 40 ps

Conditions: Determinated by full wave simulations of the design.

Applicable to High Speed versions only

### 5.5 Mechanical

#### 5.5.1 Mating and unmating forces

- Mating force : max. 50 N total force
- Unmating force : min. 10 N, max. 40 N total force

Conditions: EIA 364-13B

Rate of engagement and separation: 25.4 mm/minute max., utilize free floating fixtures

Fully equipped connectors

#### 5.5.2 Durability

Number of operations: 200 minimum, without evidence of physical damage or exceeding low level contact resistance change when mated and maximum 10% of the wear track area with exposed non-noble metal.

Conditions: EIA-364-09C, perform 200 unplug/plug cycles

Cycling rate: 12.5 cm per minute

Rest: 30s unmated

Standard atmospheric conditions

#### 5.5.3 Cable clamp robustness (Applicable to cable assembly only)

##### 5.5.3.1 Pull test


Axial retention force: 100 N min. as shown in fig.2

Conditions: IEC 68-2-21 test Ua<sub>1</sub>

Distance from cable clamp 100 mm; load 100 N.

Number of cycles: 5 min.

Duration of each cycle: 10 ± 1 s

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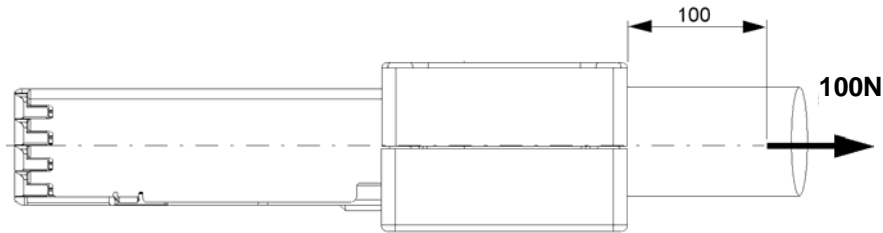


Fig.2

### 5.5.3.2 Bend test.

Conditions: IEC 68-2-21 test Ub  
 Distance from cable clamp 100 mm; load 10 N.  
 Number of 90° bends: 2 min. per direction indicated in fig.3  
 Duration of each 90° bend: 2 - 3 s

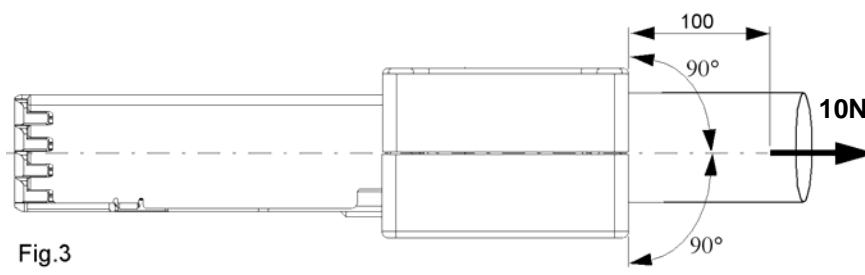


Fig.3

### 5.5.3.3 Twist test.

Conditions: IEC 68-2-21 test Uc  
 Distance from cable clamp 100 mm; load 10 N.  
 Number of 180° bends: 2 min. per direction indicated in fig.4  
 Duration of each 180° bend: 4 - 6 s

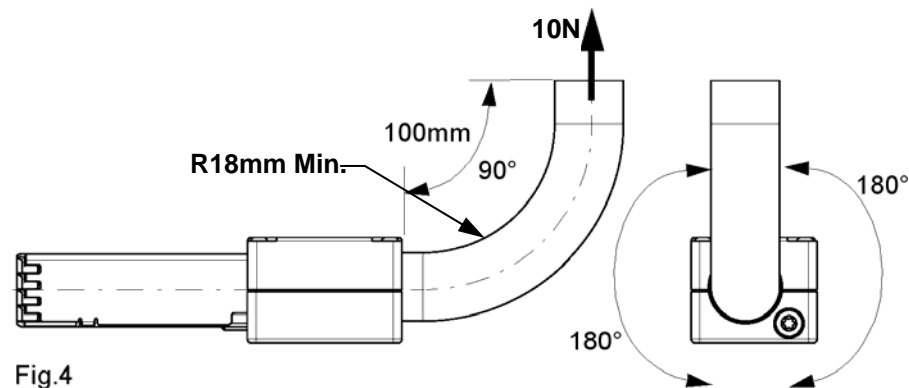



Fig.4

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#### 5.5.4 Polarization

The board connector shall withstand improper orientated mating of the cable connector without making electrical contact of the signals and causing any damage to the connectors.

Conditions: Applied abuse load: 100 N.

#### 5.5.5 Side load capacity

The cable and board connector shall not exhibit any damage or dis-continuities with the LLCR test ( $2 \Omega$  maximum) when a load is applied to the cable connector in a direction parallel to the front panel and perpendicular to the printed circuit board as indicated in fig.5.

Conditions: Applied abuse load = 100 N  
Fully mated and screw locked connectors  
Rate of engagement: 25.4 mm/minute.

#### 5.5.6 Longitudinal load capacity

The cable and board connector shall not exhibit any damage or dis-continuities with the LLCR test ( $2 \Omega$  maximum) when a load is applied to the cable connector in a direction parallel to the front panel and the printed circuit board as indicated in fig 5.

Conditions: Applied abuse load = 100 N  
Fully mated and screw locked connectors  
Rate of engagement: 25.4 mm/minute.

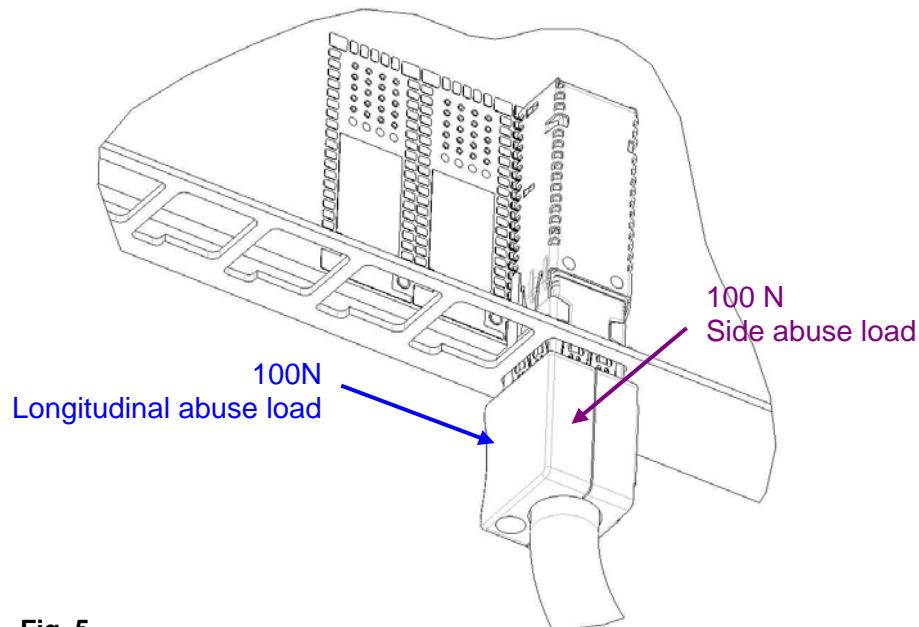



Fig. 5

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## 5.6 Environmental Conditions

After exposure to the following environmental conditions as specified in Table 6 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 in sections 5.4 and 5.5.

### 5.6.1 Thermal shock

Conditions: EIA 364-32C

Number of cycles: 5 min.

Temperature Range: Between -55 °C and +85 °C

Time at each temperature: 30 minutes

Transfer time: 30 seconds max.

### 5.6.2 Cyclical humidity and temperature

Conditions: EIA 364-31B

Samples are to be subjected to 50 cycles of 10 hours durations for a total of 500 hours (after 24 hours in a conditioning oven at 50±2 °C). 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

### 5.6.3 High Temperature Life

Conditions: EIA 364-17B

Connectors shall remain mated without any electrical load.

Temperature: 85 °C min.


Duration: 500 hours min.

### 5.6.4 Industrial mixed flowing gas (Class IIA, 4-gas)

Conditions: Samples are to be exposed to an industrial gas mixture in accordance with Telcordia GR-1217-CORE, November 1995, Section 9.1.3., Central Office requirements.

The connectors are to be exposed UNMATED and MATED for 10 days to the gas mixture detailed in Table 5. The following details shall apply:

- a. Temperature: 30 °C
- b. Relative humidity: 70%
- c. Mandatory readings after the 10<sup>th</sup> days for unmated and mated connectors

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**Table 5:**

Gas	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

### 5.6.5 Vibration sinusoidal

No discontinuities greater than 1 micro-second.

Conditions: Telcordia GR-1217-CORE, November 1995, Sections 6.3.5 and 9.1.2.1.  
Fully mated and screw locked connectors  
Vibration amplitude: 1.5 mm double amplitude or 10g acceleration.  
Frequency range: 10 to 500 Hz  
Sweep time: 20 minutes per cycle  
Duration: 8 hours along each of three orthogonal axes (24 hours total)

### 5.6.6 Mechanical shock

No discontinuities greater than 1 micro-second.


Conditions: Telcordia GR-1217-CORE, November 1995, Sections 6.3.5 and 9.1.2.1.  
Fully mated and screw locked connectors  
Amplitude: half-sine 30G  
Duration: 11 milliseconds  
Number of shocks: 3 shocks along each of three orthogonal axis (18 total)  
Take resistance measurements after shock in each axis

### 5.6.7 Dust contamination

Conditions: Telcordia GR-1217-CORE, November 1995, Section 9.1.1.1 & Table 9-1  
Unmated board connector shall be subjected to a one-hour dust exposure using a dust composition as specified in Table 9-1 of Telcordia GR-1217-CORE, November 1995

### 5.6.8 Disturb

Conditions: 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 0.1 mm. The sample is then resealed and measurements are made.

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## 6 Quality assurance provisions

### 6.1 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

### 6.2 Inspection conditions

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

- a) Temperature: 25 ± 5 °C
- b) Relative humidity: 30 % to 60 %
- c) Barometric pressure: Local ambient

### 6.3 Acceptance

Electrical and mechanical requirements placed on test samples as indicated in the sections 5.4 and 5.5 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.


### 6.4 Qualification testing

Qualification testing shall be performed on sample units with equipment and procedures normally used in production. The test sequence is shown in Table 6.

### 6.5 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 matrix, Table 6.

- 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 cable layout, 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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## 6.6 Qualification test matrix

Visual examination before and after any testing should confirm that the sample is suitable for testing and has not been damaged during testing, except for the effect of the testing itself.

**Table 6:**

TEST GROUP ID:		1	2	3a	3b	4	5	6	7
<b>QTY OF CABLE CONNECTORS</b>		12	6	6	6	4	12	6	1
<b>QTY OF HIGH SPEED BOARD CONNECTORS</b>		6	6	6	6	4		6	
<b>QTY OF STANDARD BOARD CONNECTORS</b>		6					12		1
<b>QTY OF LLCR TEST BOARD SLOTS</b>		12	6		6	4	12		
TEST DESCRIPTION	SECTION	Mixed Flowing Gas	Temp Life	Thermal Shock & Humidity	Thermal Shock & Humidity	Vibration & Mech. Shock	Load Capacity	Mating Force	Current Rating
VISUAL EXAMINATION OF PRODUCT		1,16	1,6	1,11	1,16	1,14	1,10	1,3	1,3
MATE BOARD AND CABLE CONNECTOR		2,8	2	2	2,10	2,8	2		
UNMATE BOARD AND CABLE CONN.		6			8	6			
<b>ELECTRICAL:</b>									
INSULATION RESISTANCE	5.4.2			3,6,9					
DIELECTRIC WITHSTANDING VOLTAGE	5.4.3			4,7,10					
LOW LEVEL CONTACT RESISTANCE	5.4.5	3,5,9,11,13,15	3,5		3,5,7,11,13,15	3,5,9,11,13	3,5,7,9		
CURRENT RATING	5.4.6								2
<b>MECHANICAL:</b>									
MATING / UNMATING FORCE	5.5.1							2	
DURABILITY, 99 CYCLES	5.5.2	4, 14			6,14	4			
CABLE CLAMP ROBUSTNESS	5.5.3						4		
SIDE LOAD CAPACITY	5.5.5						8		
LONGITUDINAL LOAD CAPACITY	5.5.6						6		
<b>ENVIRONMENTAL:</b>									
THERMAL SHOCK	5.6.1			5	4				
CYCLICAL HUMIDITY & TEMPERATURE	5.6.2			8	12				
HIGH TEMPERATURE LIFE	5.6.3		4						
MFG, UNMATED RECEPTACLE, 10-DAYS	5.6.4	7							
MFG, MATED, 10-DAYS	5.6.4	10							
VIBRATION	5.6.5					10			
MECHANICAL SHOCK	5.6.6					12			
DUST COMTAMINATION	5.6.7				9	7			
DISTURB	5.6.8	12							

### NOTE:

(Test Group 3a): Insulation resistance and dielectrical withstanding voltage are to be measured on different terminals. The board connectors are not mounted to the board.


**PDS: Rev -D**

**STATUS: Released**

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		AUTHORIZED BY Terran Huang	DATE 2011-03-22
		CLASSIFICATION <b>RELEASED</b>	

## 7 Product identification

The product part numbers and loading pattern shall be as specified on the applicable product customer drawings.

## 8 Packaging.

Packaging and labelling shall be as specified on the applicable product customer drawings.

## 9 Revision record

Rev.	Section	Description of modifications	By
0	all	Draft / preliminary specification	Gert Droesbeke
1	6.4.2	Test voltage changed from 750 V AC to 300 V DC	Gert Droesbeke
2	all	Draft / preliminary specification	Gert Droesbeke
3	all	Referenced to applicable product customer drawings	Gert Droesbeke
4	5.5.3	Conditions completed	Gert Droesbeke
A	all	H05-0015, document release	Gert Droesbeke
B	5.4.2, 5.4.3, 5.4.4, 5.4.5	Test voltage Insulation resistance increased from 300 to 500 V DC Dielectric withstand voltage increased from 300 to 750 V DC Section "Maximum operating voltage" added (42 V AC or DC peak) Initial values LLCR row A-D aligned to the qualification results	Gert Droesbeke
C	5.5.3 5.5.5 5.5.6 6.6	Add "cable assembly only". Add R18 figure 4. 25.4mm per minute 25.4mm per minute. Delete section 2.3 in table 6.	Terran Huang
D	5.5.3.1 5.5.3.2 5.5.3.3 5.5.5	Change pull load from 50N to 100N Change bend load from 5N to 10N Change twist load from 5N to 10N Change side load capacity from 75N to 100N	Terran Huang