1.0 Objective

This specification defines the performance, test, quality and reliability requirements of SAS / PCIe host and device series products.

2.0 Scope

This specification is applicable to the termination characteristics of the SAS / PCIe family of products which provides for direct blind mate interconnection of disk drives to backplanes.

3.0 Ratings

3.1 Operating Voltage Rating = 30 Volts Max (V_{AC} or V_{DC})
3.2 Operating Current Rating = 1.5 Amperes per contact (DC or AC (RMS) MAX. @ 60 HZ)
3.3 Operating Temperature Range = 0 to 55 (^{o}C) (SFF-8639 Rev 1.6)
3.4 Non-Operating Temperature Range = -40 to 85 (^{o}C)

4.0 Applicable Documents

4.1 FCI Specifications

4.1.1 Engineering drawings

4.1.2 Process drawings

4.1.3 Application specification(s)

4.1.3.1 BUS-03-114: Capacitance Measurement
4.1.3.2 BUS-15-002/X: Nickel Plating
4.1.3.3 GS-15-007: Electrodeposited Tin
4.1.3.4 GS-15-015: Gold in Contact Plating
4.1.3.5 BUS-19-002: Solderability
4.1.3.6 GS-19-048: Porosity
4.1.3.7 GS-19-039: Plating Adhesion
4.1.3.8 BUS-19-122: Solder Joint Reliability
4.1.3.9 GS-19-027: Moisture Sensitivity Level
4.1.3.10 GS-19-028: Test Procedure for Tin Whisker Formation in Lead-free Connector Terminal Finishes
4.1.3.11 GS-22-011: Pb-free Solder Heat Resistance Procedure – Convection Oven Flow
4.1.3.12 GS-22-012: Pb-free Solder Heat Resistance Procedure – Wave Solder

4.1.4 Material specification(s)

4.1.4.1 Refer to the respective FCI engineering drawings

4.2 Industry or Trade Association standards

MIL-STD-2166: Connectors, Electrical and Compliant Pin
List any applicable specifications, such as Telcordia Technologies, USB, etc.

4.3 National or International Standards

4.3.1 Flammability: UL94V-0
4.3.2 EIA 364: Electrical Connector/Socket Test Procedures Including Environmental Classifications.
4.3.3 SFF-8639

5.0 Requirements

5.1 Qualification

Connectors furnished under this specification shall be capable of meeting the qualification test requirements specified herein. Unless otherwise specified, all measurements shall be performed within the following lab conditions:

Temperature: 15 to 35°C

Relative Humidity: 20% to 80%

Atmospheric Pressure: 650mm to 800mm of Hg (86~106Kpa)

5.2 Material

The material for each component shall be as specified herein or equivalent. Substitute material shall meet the performance requirements of this specification.

5.2.1 Receptacle Terminal - The base material shall be phosphor bronze strip or equivalent.

5.2.2 Plug Terminal – The base material shall be brass or equivalent.

5.2.3 Plug and Receptacle Insulator Housings – The insulators for the plug and receptacle connectors shall be molded of glass filled high performance polyplastic that is rated UL94V-0 or better in accordance with UL-94. See applicable product drawing for material.

5.2.4 Plug Hold-down Terminal – The base material shall be brass or equivalent.

5.2.5 Receptacle Hold-down Terminal – The base material shall be phosphor or brass. See applicable product drawing for material.

Refer to GS-01-029 section 5.5 for additional material content recommendations

5.3 Finish

5.3.1 The finish for applicable components shall be as specified herein or equivalent. The plug and receptacle terminals shall be plated in the contact area to the minimum gold or palladium nickel with gold flash plating thickness specified on product prints (over 1,27um/50u" minimum nickel underplate). The plug and receptacle terminal soldertail section shall be plated with 1,27um/50u" minimum tin as specified on product print (over 1,27um/50u" nickel minimum underplate). The plug and receptacle press fit area shall be plated with 0,5um/20u" minimum – 1,5um/60u" maximum tin (over 1,27um/50u" nickel minimum underplate). No plating at cut-off point.

5.3.2 The metal hold down terminals for the plug and receptacle connectors shall be plated with 1,27um/50u" minimum tin as specified on product prints (over 1,27um/50um minimum nickel underplate). No plating at cut-off point.

Refer to GS-01-029 section 5.5 for additional finish content recommendations

5.4 Design and Construction

Connectors shall be of the design, construction, and physical dimensions specified on the applicable product drawing. The plug connector shall be a multi-piece assembly having dual row of contacts in the mating area which dividing into multi signal segments (S1-S7, S8-S14, S16-S28, E9-E15, E17-E22) and power segment (P1-P15) or either one which transition out to either surface mount style or solder style soldertail to accommodate various P.C. board thickness. The contact pattern in the mating area will have short and long terminals in a specific pattern that results in a 0.5mm (0,020') differential between contact points in the long and short terminals. (This allows for first mate-last break capability - see respective product prints for location of short and long terminals.)

The receptacle connector shall be a multi-piece assembly having dual row of contacts in the mating area which dividing into multi signal segments (S1-S7, S8-S14, S16-S28, E9-E15, E17-E22) and a power segment (P1-P15) which transit out to a in-line or stagger through hole pattern or surface mount pad. The contact pattern in the mating area will have short and long terminals in a specific pattern that results in a 0.5mm (0.020") differential between contact points in the long and short terminals. (This allows for first mate-last break capability – see respective product prints for location of short and long terminals.) The receptacle hold down terminal has the board retention features that secures the connector to the board in preparation for solder reflow (through-hole) or board termination (press-fit or SMT).

A polarization peg (optional) on the bottom of the connector housing assures proper connector orientation during board mounting. The receptacle through hole connector and press fit connector are designed to terminate to board thickness of 1.57mm (0.062"), 2.36mm (0.093") and 3.18mm (0.125"). Visual examinations of connectors are to be done per EIA 364-18.

5.4.1 Mating. The connectors shall be capable of mating and unmating manually without the use of special tools.

5.4.2 Workmanship. Connectors shall be uniform in quality and shall be free from burrs, scratches, cracks, voids, chips, blisters, pin holes, sharp edges, and other defects that will adversely affect product's life or serviceability.

6.0 Electrical Characteristics

6.1 Current Rating

The temperature rise above ambient shall not exceed 30°C at any point in the system when all contacts are powered at _1.5___ (amperes) or one contact is powered at _1.5___ (amperes).

The following details shall apply:

a. Ambient Conditions – still air at 25°C

b. Current Rating – 1.5A min per contact, continuous

c. Test configuration – (i) Mount the connector to a test PCB.

(ii) Wire power pins P1, P2, P8 and P9 in parallel for power.

(iii) Wire ground pins P4, P5, P6 and P10 and P12 in parallel for return.

(iv) Supply 6A in total of DC current to the power pins in parallel, returning from the parallel ground pins (P4, P5, P6, P10 and P12).

(v) Measure and record the temperature after 96 hours (45 minutes ON and 15 minutes OFF per hour).

d. Reference SFF-8639 - Power section (per pin):

- Continuous Current 1.5A
- Peak Current 2.5A 1.5s
- Peak Current Pre-charge 6A 1ms
- Signal section (per pin):
- Continuous current 500 mA

6.2 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 __15___ milliohms increase 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 DC max at open circuit.

b. Test Current - Not to exceed 100 milli-amperes.

6.3 Insulation Resistance

The insulation resistance of *mated* connectors shall not be less than _1000M_ ohms initially and after environmental exposure.

Measurements shall be in accordance with EIA 364-21.

The following details shall apply:

a. Test Voltage - _500__ volts DC.

b. Preparation – The connectors shall be mated but not soldered to a PC board

c. Electrification Time - 1 minute.

d. Points of Measurement - Between adjacent contacts

6.4 Dielectric Withstanding Voltage

There shall be no evidence of arc-over, insulation breakdown, or excessive leakage current > _0.5mA max (amperes) when the *mated* connectors are tested in accordance with EIA 364-20, method B

The following details shall apply:

a. Test Voltage – DC 500V or AC 500Vrms___ volts (DC or AC RMS, 60Hz).

b. Preparation – The connectors shall be mated but not soldered to a PC board

c. Test Duration – 1 minute.

d. Test Condition : 1 (760 Torr, or sea level)

e. Points of Measurement - Between adjacent contacts.

6.5 Press-fit Interface Contact Resistance, Low Level (LLCR)

The interface between compliant section and plated through hole. The change in low level contact resistance shall not exceed __1.0_ milliohms after environmental exposure when measured in accordance with EIA 364-23.

The following details shall apply:

a. Test Voltage - 20 milli-volts DC max at open circuit.

b. Test Current - Not to exceed 100 milli-amperes.

7.0 Mechanical Characteristics

7.1 Mating/Unmating Force

Backplane/ Blindmate: The force to mate a receptacle connector and compatible plug connector shall not exceed _59 N (6.0 kgf). The unmating force shall not be less than 12 N (1.22 kgf) initial and after 500 cycles.

The following details shall apply:

a. Cross Head Speed - max. rate 25 mm per minute.

b. Utilize free floating fixtures.

d. Reference – EIA 364-13.

7.2 Durability

Backplane/ Blindmate : The connector pairs shall be capable of withstanding _500___ mating/unmating cycles.

When used for pre-conditioning treatment, __50__ mating/unmating cycles shall be applied prior to mechanical/environmental exposure and _500___ mating/unmating cycles shall be applied after mechanical/environmental exposure.

Cable : The connector pairs shall be capable of withstanding _25___ mating/unmating cycles.

When used for pre-conditioning treatment, __20__ mating/unmating cycles shall be applied prior to mechanical/environmental exposure and _25___ mating/unmating cycles shall be applied after mechanical/environmental exposure.

The following details shall apply:

a. Cycle Rated – Automated Equipment : max rate 200 cycles per hour.

b. Reference – EIA 364-09.

c. No physical damage shall be observed

7.3 Contact Retention

The individual contacts (signal and hold down terminal) in the plug and receptacle housing shall withstand an axial load of 0.7 lbs (320 grams) minimum applied at a rate of 0.20 inches/ minute without disloging from the housing cavity. Reference EIA 364-29

7.4 Normal Force

The contact normal force shall not be less than _60_ grams (nor greater than 200 grams) when tested in accordance with FCI test specification BUS-03-404.

7.5 Press-fit Individual Pin Insertion/ Retention Force

The force required to insert an individual compliant pin into a plated through hole in a printed circuit board at a rate of 5mm/0.2 inches per minute shall not exceed 50N. The retention force in the axial direction opposite that of insertion shall not be less than 5N.

7.6 PCB Hole Deformation Radius

Cross-section parallel to board surface. Photograph and measure hole deformation (deformation on board material) radius at a point 0.25 mm/ 0.010" from the surface and at the center of the compliant pin section. Include 10 holes. The minimum average (of 10 holes) hole deformation radius shall be no greater than 37,5um/ 0.0015" when measured from the drilled hole. The absolute maximum deformation radius shall not exceed 50um/ 0.002". Reference MIL-STD-2166 or EIA-364-96.

Prior to cross-section preparation, perform _3___ compliant pin insertions and __3__ compliant pin withdrawals.

7.7 PCB Hole Wall Damage

Cross-section perpendicular to board surface and through the compliant section wear track. Photograph and measure the copper thickness remaining between the compliant section and the printed wiring board laminate. Include 10 holes. The minimum average (of 10 holes) copper thickness remaining between the compliant pin and the printed wiring board laminate shall not be less than 7.5um/ 0.0003". In addition, there shall be no copper cracks, separations between conductive interfaces, or laminate-to-copper separations. Reference MIL-STD-2166 or EIA-364-96.

Prior to cross-section preparation, perform _3__ compliant pin insertions and _3__ compliant pin withdrawals.

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. Product subjected to these environmental tests must be applied to printed circuit boards. Unless specified otherwise, assemblies shall be mated during exposure.

8.1 Thermal Shock – EIA 364-32, Test Condition I.

a. Number of Cycles - _10_____

b. Temperature Range - Between _– 55°C +0/-3°C_ and +85°C +3/-0° C

c. Time at Each Temperature - _30_ minutes

d. Transfer Time - _5_ minutes, maximum

8.2 Humidity-Temperature Cycling - EIA 364-31 method II, Test Condition A

a. Relative Humidity - _90% ~ 95%

b. Temperature Range - + 40°C ± 2° C

c. Duration - __10_cycles__

8.3 High Temperature Life – EIA 364-17, Test Condition III, Method A
a. Test Temperature - +85°C ± 2° C

b. Test Duration - 500 hours

8.4 Mixed Flowing Gas (MFG) – EIA 364-65
a. Class – IIA

b. Duration – 14 days

c. Temperature – 30°C ± 1°C, 70± 2% RH

d. Gas Concentration - Cl_2 10±3ppb, NO_2 200±50ppb, H_2S 10±5ppb, SO_2 100±20ppb

e. Half of the samples are exposed unmated for seven days, then mated for the remaining seven days. Other half of the samples are exposed mated for full duration test period.

8.5 Mechanical Shock – EIA 364-27
a. Condition – Subject mated connectors to 50G's half-sine shock pulses of 11 milliseconds during each x, y and z axis (18 shocks total).

b. Mounting - Rigidly mount assemblies

c. No discontinuities greater than 1 microseconds and no physical damage observed

d. Free from any defect such as break, deformation, loosing and falling off etc. on each portion of the connector

8.6 Vibration (Random) – EIA 364-28
a. Test Condition – VII

b. Vibration Amplitude – Subject mated connectors to 3.10G's RMS between 20-500 Hz

c. Duration – 15 minutes in each of three mutually perpendicular planes

d. Mounting - Rigidly mount assemblies.

e. No discontinuities greater than 1 microsecond

8.7 Solderability (Lead-Free)

a) Pre-heating : +150°C ± 10°C, 60 ~ 120 sec

b) Soldering : 230°C ± 5°C MIN, 10 ± 1 sec

c) Solder paste to be used is JIS Z 3282 H60A or H63A. Soldering particle is more than 200 meshes. Flux used shall be from Inactive Rosin family

d) Acceptable Wet Solder Coverage: 95% minimum

e) Reference : GS-19-037 or EIA-364-52 or ANSI-J-STD-002

8.8 Resistance to Soldering Heat (Lead-Free)

For reflow Solder :

a) Pre-heating : 150°C ~ 200°C, 60 ~ 180 sec

b) Soldering : 230°C min, 60 sec max

c) Peak Temperature : 260°C ± 5°C MIN, 10 ± 1 sec

d) Number of times : 3 times

e) Reference : GS-22-011 Peak Reflow – 260 °C

For Dip and Wave Solder :

a) Test Temperature : 260°C ± 5°C, 5 ~ 10 sec ± 1 sec

b) Reference : GS-22-012

8.9 Whisker Test (Lead-Free)

8.9.1 Temperature Cycling

a) Temperature Range : -55°C to +85°C

b) Time at Temperature : 10 minutes soak, 3 cycles per hour

c) Test Duration : 1500 cycles

8.9.2 High Temperature/ Humidity Aging :

a) Test Condition: +55°C

b) Relative Humidity : 85%

c) Test Duration : 4000 hours

Whisker length acceptance criteria: Class 2

Maximum whisker length: 45um for temperature cycling and 40um for high temperature/high humidity storage.

Reference : GS-19-028

8.10 Moisture Sensitivity Testing (For lead free SMT)

8.10.1 Baking :

a) Temperature : +125°C ± 5°C

b) Test Duration : 24 hours ± 2 hours

8.10.2 Humidification :

a) Temperature : +85°C

b) Relative Humidity : 85%

c) Test Duration : 168 hours ± 4 hours

8.10.3 Reflow Soldering

a) Pre-heating : 150°C ~ 200°C, 60 ~ 180 sec

b) Soldering : 217°C min, 60 ~ 150 sec

c) Peak Temperature (at solder joint) : 260°C , 10 ± 1 sec

d) Number of times : 3 times

Reference : GS-19-027

8.11 Salt Spray Test. After exposure of the mate connectors to a salt fog atmosphere, the LLCR shall not exceed 30 milliohms. The test shall be in accordance with EIA 364-26.

a) Mate connectors

b) Salt Solution : 5 percent (by weight)

c) Test Condition (Duration) : B (48 hours)

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:

a. Temperature: 25 ± 5 deg C

b. Relative Humidity: 30% to 60%

c. Barometric Pressure: Local ambient

9.3 Sample Quantity and Description

The numbers of samples to be tested in each group shown in Table 1 are defined as follows:

Group 1 through 11

5 samples in each group: All samples must be free of defects that would impair normal connector operation. All samples must meet dimensional requirements of connector.

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 Table 1.

Visual Examination: EIA 364-18

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 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, contact surface geometry, insulator design, contact base material, or contact lubrication requirements.

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.

9.7 Qualification Test Table

Table 1 Qualification Testing Matrix

	TEST GROUP												
		1	2	3	4	5	6	7	8	9	10	11	
TEST OR EXAMINATION	PARA												
Examination of Product(s)	5.4	1, 5	1, 9	1, 8	1, 8	1, 7	1, 4	1,3	1,5, 8	1	1,3	1,5	
Low Level Contact Resistance	6.2	2(a), 4	3(a), 7	2(a), 4, 6		4(a), 6						2,4	
Insulation Resistance	6.3				2, 6								
Dielectric Withstanding Voltage	6.4				3, 7								
Current Rating	6.1			7									
Low Level Press Fit Interface Resistance	6.5	2(b)*	3(b)*	2(b)*		4(b)*							
Mating (Insertion) Force	7.1		2										
Unmating (Removal) Force	7.1		8										
Durability	7.2	3											
Thermal Shock	8.1				4								
Humidity, Temperature Cycling	8.2				5								
High Temperature Life	8.3			3					4				
Mixed Flowing Gas	8.4					3							
Mechanical Shock	8.5		6										
Vibration	8.6		5										
Durability (Pre-Condition)	7.2		4			2							
Reseating (manually unplug/plug three times)				5		5							
Contact Retention	7.3								3,7				
Normal Force	7.4								2,6				
Insertion Force (Press Fit Only)	7.5									2,4,6			
Retention Force (Press Fit Only)	7.5									3,5,7			
PCB Hole Deformation Radius	7.6									8			
PCB Hole Wall Damage	7.7									9			
Solderability (Lead Free)	8.7						2						
Resistance to Soldering Heat (Lead Free)	8.8						3						
Whisker Test (Lead Free)	8.9							2					
Moisture Sensitivity Test (Lead Free-For SMT only)	8.10										2		
Salt Spray	8.11											3	

* Press Fit Connector

REVISION RECORD

Rev	Page	Description	EC#	Date
A	ALL	New Release	S15-0026	10Jun15