


NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION		
TITLE Serial Attached SCSI (SAS) Connector		PAGE 1 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

1.0 OBJECTIVE

This specification defines the performance, test, quality and reliability requirement of the Serial Attached SCSI host and device connectors.

2.0 SCOPE

This specification is applicable to the termination characteristics of the SAS family(up to 6Gb/s) 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 85 ($^{\circ}$ C)
- 3.4 Non-Operating Temperature Range = -40 to 85 ($^{\circ}$ C)

4.0 APPLICABLE DOCUMENTS

4.1 Application

- 4.1.1 Engineering drawings
- 4.1.2 Process drawings

4.2 Federal Specifications

- 4.2.1 QQ-N-290 : Nickel Plating (Electrodeposited)
- 4.2.2 QQ-S-571 : Solder

4.3 Other Standards and Specifications

- 4.3.1 UL94-V0 : Flammability
- 4.3.2 EIA 364 : Electrical Connector/Socket Test Procedures Including Environmental Classifications
- 4.3.3 SFF-8482 : Internal Serial Attachment Connector(Current revision)

4.4 FCI Specifications

- 4.4.1 BUS-03-114 : Capacitance Measurement
- 4.4.2 BUS-03-404 : Normal Force Measurement
- 4.4.3 BUS-03-405 : Insertion / Withdrawal Force Measurement
- 4.4.4 BUS-15-002/X : Nickel Plating
- 4.4.5 BUS-15-003/X : Electrodeposited Tin
- 4.4.6 BUS-15-005/X : Gold in Contact Plating
- 4.4.7 BUS-19-002: Solderability
- 4.4.8 BUS-19-020: Porosity
- 4.4.9 BUS-19-040: Plating Adhesion
- 4.4.10 BUS-19-122: Solder Joint Reliability

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 2 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

- 4.4.11 GS-19-027: Moisture Sensitivity Level
- 4.4.12 GS-22-011: Pb-free Solder Heat Resistance Procedure – Convection Oven Flow
- 4.4.13 GS-22-012: Pb-free Solder Heat Resistance Procedure – Wave Solder

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

Material for each part shall be 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-bronze or brass. See applicable product drawing for material.

5.3 Finish

- 5.3.1 Plated finished for qualification 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 sections 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.

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 3 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

5.4 Design and Construction

The plug connector shall be a multi-piece assembly having single row of contacts in the mating area which dividing into two signal segments (S1-S7, S8-S14) 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 single row of contacts in the mating area which dividing into two signal segments (S1-S7, S8-S14) 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 ELECTRICAL CHARACTERISTIC

6.1 Current Rating. The temperature rise above ambient shall not exceed 30°C at any point in the system when contact positions specified are powered at the power levels specified herein:

- a) Ambient Conditions : still air at 25°C
- b) Current Rating : 1.5A min per contact, continuous
- c) Preparation : (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, 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 : EIA-364-70A

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 4 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

- 6.2 Low Level Contact Resistance. The low-level contact resistance of a SAS receptacle connector mated with a SAS plug connector shall not exceed a change of 15mΩ after environmental exposure when measured in accordance with EIA 364-23. The maximum initial signal contact resistance is 30mΩ shall not be exceeded after environmental exposure when measured in accordance with EIA 364-23. The following details shall apply:
- a) Test Voltage : 20mV DC maximum at open circuit.
 - b) Test Current : not to exceed 100mA.
- 6.3 Insulation Resistance. The insulation resistance of mated connectors shall not be less than 1000MΩ when measured in accordance with EIA 364-21. The following details shall apply:
- a) Test Voltage : 500V DC
 - b) Preparation : The connectors shall be mated but not soldered to a PC board
 - c) Electrification Time : 1 minute
 - d) Point 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) 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 500V_{rms}.
 - b) Test Duration : 1 minute
 - c) Preparation : The connectors shall be mated but not soldered to a PC board
 - d) Test Condition : 1 (760 Torr, or sea level)
 - e) Points of measurement : Between adjacent contacts
- 6.5 Low Level Press-fit Interface Resistance. The interface between compliant section and plated through hole. The change in low-level contact resistance shall not exceed 1.0mΩ after environmental exposure when measured in accordance with EIA 364-23. The following details shall apply:
- a) Test Voltage: 20mV DC maximum at open circuit.
 - b) Test Current: not to exceed 100mA.

7. MECHANICAL CHARACTERISTIC

7.1 Mating / Unmating Force (Insertion / Removal)

Cross Head Speed: max. rate 25 mm per minute

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 5 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

- a) Utilise free floating fixtures
- b) Reference: EIA 364-13

Backplane/Blindmate : The force to mate a receptacle connector and compatible plug connector shall not exceed 25N (2.55kgf). The unmating force shall not be less than 5N (0.51kgf) after 500 cycles.

Cable : The force to mate a receptacle connector and compatible plug connector shall not exceed 50N (5.1kgf). The unmating force shall not be less than 20N (2.04kgf) after 25 cycles.

7.2 Durability. EIA 364-09C

- a) Number of cycles: Device / Host Connectors : 500 cycles
Internal Cabled Connector : 25 cycles
- b) Cycling Rates: Automated Equipment : 200 cycles per hour
- c) Preconditioning Cycles : Device / Host connectors : 50 cycles
Cabled Connector : 20 cycles
- d) No physical damage shall be observed

7.3 Contact Retention : Individual contacts (signal and hold down terminal) in the plug and receptacle housing shall withstand an axial load of 1.1 lbs (500 grams) minimum applied at a rate of 0.20 inches/ minute without dislogging from the housing cavity.

- a) Reference : EIA 364-29B

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 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.

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 6 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

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.

8 ENVIRONMENTAL CHARACTERISTIC

After exposure to the following environmental conditions in accordance with the specified test procedures 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 Table 1 test sequence. Product subjected to these environmental tests must be applied to printed circuit boards. Unless otherwise specified, the 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) Duration of Cycles : 96 hours
- b) Relative Humidity : 90% ~ 95%
- c) Temperature Range : +40°C ± 2°C

8.3 High Temperature Life. EIA 364-17, Test Condition III, Method A

- a) Test Duration : 500 hours
- b) Temperature : +85°C ± 2°C

8.4 Industrial Mixed Flowing Gas. EIA 364-65, Class II A

- a) Temperature: 30°C ± 1°C, 70± 2% RH
- b) Gas Concentration : Cl₂ 10±3ppb, NO₂ 200±50ppb, H₂S 10±5ppb, SO₂ 100±20ppb
- c) Half of the samples are exposed unmated for seven days, then mated for remaining seven days. Other half of the samples are exposed mated during entire testing.

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 7 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

8.5 Physical Shock. EIA 364 - 27, Test Condition H

- a) Condition: H (294 m/s² 50G, 11 msec, half-sine)
- b) Shocks: 3 shocks in both direction along each of three orthogonal axes (18 total)
- c) Mounting: Rigidly mount assemblies
- d) No discontinuities greater than 1 µs and no physical damage observed.
- e) Free from any defect such as break, deformation, loosening and falling off etc. on each portion of the connector.

8.6 Vibration (Random). EIA 364 - 28, Test Condition V, Letter A

- a) Test Condition : Random 50 Hz - 2000 Hz, 5.35 g's RMS overall
- b) Duration : 30 minutes per axis
- c) Direction : each of 3 orthogonal axis
- d) Power Spectral Density : 0.02G²/Hz
- e) Mounting : Rigidly mount assemblies.
- f) No discontinuities greater than 1 ms.

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 mesh. Flux used shall be from Inactive Rosin family
- d) Acceptable Wet Solder Coverage: 95% minimum

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

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 8 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

8.9 Whisker Test (Lead-Free)

8.9.1 Temperature Cycling

- a) Temperature Range : -55°C to +85°C
- b) Time at Temperature : Min 7 minutes
- c) Time Duration : 500 cycles for 3x cycling
- d) No whisker growth greater than 45µm for each and final

8.9.2 High Temperature / Humidity Aging :

- a) Temperature : +55°C
- b) Relative Humidity : 85%
- c) Test Duration : 1000 hours for 4x aging
- d) No whisker growth greater than 40µm for each aging and final

Reference: JEDEC JESD201

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

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 9 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

- b) Salt Solution : 5 percent (by weight)
- c) Test Condition (Duration) : B (48 hours)

9 QUALITY ASSUANCE 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 MIL-C-45662 and ISO 9000.

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

- a) Temperature : 25 ± 5°C
- b) Relative Humidity : 30% ~ 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:

Groups 1 through 12

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 actions 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 sequence shall be as shown in Table 1.

Visual Examination : EIA 364-18

9.6 Requalification 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.

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 10 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

- 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.

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 11 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

Table 1 Qualification Testing Matrix

		TEST GROUP													
		1	2A	2B	3	4	5A	5B	6	7	8	9	10	11	12
TEST OR EXAMINATION	PARA														
Examination of Product(s)	5.4	1, 5	1, 9	1, 9	1, 8	1, 8	1, 7	1, 7	1, 4	1,3	1,5, 8	1	1,3	1,3	1,5
Low Level Contact Resistance	6.2	2(a), 4	3(a), 7	3(a), 7	2(a), 4, 6		4(a), 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)*	3(b)*	2(b)*		4(b)*	4(b)*							
Mating (Insertion) Force	7.1		2	2#											
Unmating (Removal) Force	7.1		8	8#											
Durability	7.2	3													
Thermal Shock	8.1					4									
Humidity, Temperature Cycling	8.2					5									
High Temperature Life	8.3				3						4				
Industrial Mixed Flowing Gas(7day unmated +7day mated)	8.4						3								
Industrial Mixed Flowing Gas(14day Mated)	8.4							3							
Physical Shock	8.5		6	6											
Vibration	8.6		5	5											
Durability (Pre-Condition)	7.2		4	4			2	2							
Reseating (manually unplug/plug three times)					5		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	2	
Salt Spray	8.11														3

* Press Fit Connector

Follow cable Mating Force(50N Max.), UnMating Force(20N Min.)

NUMBER GS-12-282	TYPE PRODUCT SPECIFICATION	Amphenol FCI	
TITLE Serial Attached SCSI (SAS) Connector		PAGE 12 of 12	REVISION F
		AUTHORIZED BY HK LIM	DATE 19OCT2017
		CLASSIFICATION UNRESTRICTED	

REVISION RECORD

<u>REV.</u>	<u>PAGE</u>	<u>DESCRIPTION</u>	<u>ECR #</u>	<u>DATE</u>
A	ALL	New Release	S05-0028	08 Mar 05
B	2 8, 9	Remove 4.4.4 SS-00254, Add 4.5.12 GS-22-011, 4.5.13 GS-22-012 Update 8.7, 8.8, 8.9 and 8.10 to GS specs	S05-0128	28APR05
C	6	7.4 Normal force: ... shall not be less than 60 grams Was .. shall not be less than 30grams	S05-0346	23NOV05
D	ALL 11	Update the spec. to the latest company logo Table 1 - cancell the repeated test group 11	S08-0142	13MAY08
E	1 ALL	Add in Paragraph 3.0: Ratings Revise form template	ELX-S-24339-1	20JUN16
F	1 5 7 8 11	Remove 4.2 Military Standard Revise Mating force to 25N(was 50N) for Backplane/Blindmate Revise physical shock condition to 50G Revise Whisker Test reference spec. to JEDEC JESD201 Revise Qualification Test Matrix Table 1 by adding Test Group 2B and 5B	ELX-S-28189-1	19OCT17