Internal Mini-SAS HD Connector System

1. INTRODUCTION

1.1 Purpose

Testing was performed on the TE Connectivity (TE) Internal Mini-SAS HD Connector System to determine its conformance to the requirements of Product Specification 108-32038 Revision A.

1.2 Scope

This report covers the electrical, mechanical and environmental performance of the TE Internal Mini-SAS HD Connector System. Testing was performed at the Harrisburg Electrical Components Test Laboratory (HECTL). This documentation is on file under EA20140195T and EA20140535T.

1.3 Conclusion

All part numbers listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-32038 Revision A.

1.4 Product Description

This specification covers the Mini Multilane connector system conforming to SFF-8643 requirements. This product platform is intended for use in high speed serial interconnect applications at multi-gigabit speeds and is commonly referred to as the Mini-Sas High Density Connector system. The product platform consists of both vertical and right angle multi-port press fit receptacles along with cabled plug connectors in both straight and right angle configurations.

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1.5 Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for test (Table 1).

Table 1 – Test Specimens

Test Group	Qty	Part Number	Description
1	1	2227582-1, Rev. 4	1x4 Right Angle Receptacle
1	1	2227581-1, Rev. 2	1x2 Right Angle Receptacle
1	2	2227580-1, Rev. 4	1x1 Right Angle Receptacle
1	1	2227642-1, Rev. 3	1x4 Vertical Receptacle
1	1	2227640-1, Rev. 3	1x2 Vertical Receptacle
1	2	2227595-1, Rev. 3	1x1 Vertical Receptacle
1	16	2227603-1, Rev. 2	1x1 Plug Assembly
2	2	2227580-1, Rev 4	1x1 Right Angle Receptacle
2	2	2227595-1, Rev 3	1x1 Vertical Receptacle
2	2	2227582-1, Rev 5	1x4 Right Angle Receptacle
2	2	2227642-1, Rev 3	1x4 Vertical Receptacle
2	20	2231171-4, Rev 6	1x1 Plug Assembly
3	2	2227580-1, Rev 4	1x1 Right Angle Receptacle
3	2	2227595-1, Rev 3	1x1 Vertical Receptacle
3	4	2231171-4, Rev 6	1x1 Plug Assembly ***(Lubed with HM15)***
4	4	2227595-1, Rev. 3	1x1 Vertical Receptacle
4	4	2227603-1, Rev. 2	1x1 Plug Assembly
5	2	2227580-1, Rev 4	1x1 Right Angle Receptacle
5	2	2227595-1, Rev 3	1x1 Vertical Receptacle
5	2	2227582-1, Rev 5	1x4 Right Angle Receptacle
5	2	2227642-1, Rev 3	1x4 Vertical Receptacle
5	20	2231171-4, Rev 6	1x1 Plug Assembly

NOTES

All Internal Mini-SAS HD R/A Receptacle Connectors from Test Groups 1, 2, 3 and 5 were mounted to PCB P/N 60-1824393-1, Rev A. All Internal Mini-SAS HD Vertical Receptacle Connectors from Test Groups 1, 2, 3 and 5 were mounted to PCB P/N 60-1824394-1, Rev A. The Test Group 4 specimens were not mounted to PCB's.

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1.6 Qualification Test Sequence

Table 2 - Test Sequence

Test or Examination	Test Group (a)				
	1	2	3	4	5
	Test Sequence (b)				
Initial Examination of Product	1	1	1	1	1
LLCR	2(e),4,6	3,5,8	2(e),4(e),6(e),8		
Insulation Resistance				2,6	
Withstanding Voltage				3,7	
Random Vibration		6			
Mechanical Shock		7			
Durability	5(c)	4(c)			
Plug Insertion Force		2			
Plug Extraction Force		9			
Latch Retention					2(e)
Right Angle Cable Pull					3
Cable Retention in Plug					4
Thermal Shock				4(d)	
Humidity Temperature Cycling				5	
Temperature Life	3				
Mixed Flowing Gas			3,5		
Minute Disturbance			7		
Final Examination of Product	7	10	9	8	5

NOTES

(a) Each test group shall consist of 4 specimens.
(b) Numbers indicate sequence which tests were performed.
(c) Latches engaged.
(d) Precondition specimens with 25 durability cycles with latches engaged.
(e) Precondition specimens with 5 durability cycles with latches engaged.

1.7 Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature: 15°C to 35°C
Relative Humidity: 20% to 80%

2. SUMMARY OF TESTING

2.1 Initial Examination of Product – All Test Groups

The specimens were visually examined and no evidence of physical damage detrimental to the operation of the part was observed.

2.2 Low Level Contact Resistance (LLCR) – Test Groups 1, 2 and 3

All delta resistance measurements were less than the maximum delta requirement of 20 milliohms, as specified in Product Specification 108-32038 Revision A. Refer to Tables 3 to 5 for the summary low level contact resistance data. The cable bulk resistance has been removed from the measurements. There are 4 rows in each connector which have varying amounts contact bulk resistance in the Right Angle Receptacles. These differences account for the variation between minimum and maximum values in the initial termination resistance measurements. See Tables 3 thru 7 for all summary data.

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Table 3 - Test Group 1 – LLCR Summary Data

Reading	Initial (Actual)	After T-Life Delta (R)	After Durability Delta (R)
Test Set Description	**Right Angle Receptacle – 1x4**		
Min	32.20	-1.87	-2.29
Max	56.23	2.13	15.03
Average	43.89	0.10	1.14
Std Dev	7.81	0.72	2.82
N =	96	96	96
Test Set Description	**Right Angle Receptacle – 1x2**		
Min	30.55	-1.43	-3.22
Max	57.26	10.80	10.64
Average	43.25	1.65	-0.18
Std Dev	8.21	2.53	1.82
N =	48	48	48
Test Set Description	**Right Angle Receptacle – 1x1**		
Min	31.32	-0.13	-1.69
Max	55.27	3.93	1.38
Average	43.00	1.00	0.17
Std Dev	7.76	0.74	0.61
N =	48	48	48
Test Set Description	**Vertical Receptacle – 1x4**		
Min	34.69	-2.34	-3.18
Max	41.18	4.11	11.21
Average	37.28	0.34	0.34
Std Dev	1.37	1.02	2.18
N =	96	96	96
Test Set Description	**Vertical Receptacle – 1x2**		
Min	35.28	-1.50	-2.24
Max	40.63	2.76	2.47
Average	37.96	0.30	-0.18
Std Dev	1.20	0.65	0.95
N =	48	48	48
Test Set Description	**Vertical Receptacle – 1x1**		
Min	34.76	-1.57	-1.81
Max	38.85	3.08	4.28
Average	36.58	0.65	-0.54
Std Dev	0.98	0.87	0.94
N =	48	48	48

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Table 4 - Test Group 2 – LLCR Summary Data

Reading	Initial (Actual)	After Durability Delta (R)	Final Delta (R)
Test Set Description	**Right Angle Receptacle – 1x4**		
Min	26.97	-1.98	-7.23
Max	56.24	13.88	3.31
Average	42.11	1.13	-1.25
Std Dev	8.25	2.08	1.23
N =	192	192	192
Test Set Description	**Right Angle Receptacle – 1x1**		
Min	28.45	-3.15	-6.45
Max	53.02	2.69	-0.92
Average	40.92	-0.18	-2.68
Std Dev	7.60	1.20	1.50
N =	48	48	48
Test Set Description	**Vertical Receptacle – 1x4**		
Min	30.50	-5.46	-6.97
Max	45.27	5.82	5.40
Average	36.45	-0.23	-1.68
Std Dev	3.03	1.60	1.62
N =	192	192	192
Test Set Description	**Vertical Receptacle – 1x1**		
Min	30.11	-4.33	-4.94
Max	39.67	2.56	2.12
Average	34.57	-0.39	-0.92
Std Dev	2.70	1.36	1.33
N =	48	48	48

Table 5 - Test Group 3 – LLCR Summary Data

Reading	Initial (Actual)	After 7 Days MFG Delta (R)	After 14 Days MFG Delta (R)	Final Delta (R)
Test Set Description	**Right Angle Receptacle – 1x1**			
Min	25.80	-1.91	-1.91	-2.09
Max	51.97	0.58	0.83	0.56
Average	39.34	-0.42	-0.29	-0.51
Std Dev	7.80	0.57	0.62	0.62
N =	48	48	48	48
Test Set Description	**Vertical Receptacle – 1x1**			
Min	27.53	-2.49	-2.80	-2.83
Max	39.96	1.32	0.57	0.30
Average	33.61	-0.25	-0.79	-0.96
Std Dev	2.98	0.84	0.86	0.82
N =	48	48	48	48

2.3 Insulation Resistance – Test Group 4

Initially and finally, all specimens had insulation resistance measurements greater than the 1000 megaohms minimum requirement as specified in Product Specification 108-32038 Revision A.

2.4 Withstanding Voltage – Test Group 4

Initially and finally, none of the specimens had any breakdown or flashover when subjected to 300 volts AC for a period of one minute as specified in Product Specification 108-32038 Revision A.

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2.5 Random Vibration – Test Group 1

The specimens met the performance requirements having no apparent physical damage or discontinuities of one microsecond or greater occurred during testing.

2.6 Mechanical Shock – Test Group 1

The specimens met the performance requirements having no apparent physical damage or discontinuities of one microsecond or greater occurred during testing.

2.7 Durability – Test Group 1

After mating and unmating the specimens 250 times by hand with the latches engaged, no evidence of physical damage detrimental to the operation of the part was observed.

2.8 Plug Insertion Force – Test Group 2

The specimens met the performance requirements having a plug insertion force less than the 50N [11.25lb] maximum per port requirement as specified in Product Specification 108-32038 Revision A.

2.9 Plug Extraction Force – Test Group 2

The specimens met the performance requirements having a plug extraction force less than the 25N [5.625lb] maximum per port requirement as specified in Product Specification 108-32038 Revision A.

2.10 Latch Retention – Test Group 5

The specimens met the performance requirements holding a 40 N load for 60 seconds as specified in Product Specification 108-32038 Revision A.

2.11 Right Angle Cable Pull – Test Group 5

The specimens met the performance requirements holding a 15 N load for 60 seconds at 90 degree angles from the connector mating direction as specified in Product Specification 108-32038 Revision A.

2.12 Cable Retention in Plug – Test Group 5

The specimens met the performance requirements holding a 135 N load for 5 seconds as specified in Product Specification 108-32038 Revision A.

2.13 Thermal Shock – Test Group 4

Specimens did not show evidence of damage detrimental to the performance of the product after exposure to thermal shock.

2.14 Humidity-Temperature Cycling – Test Group 4

Specimens did not show evidence of damage detrimental to the performance of the product after exposure to humidity-temperature cycling.

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2.15 Temperature Life – Test Group 1

Specimens did not show evidence of damage detrimental to the performance of the product after exposure to Temperature Life.

2.16 Mixed Flowing Gas – Test Group 3

Specimens did not show evidence of damage detrimental to the performance of the product after exposure to Mixed Flowing Gas.

2.17 Minute Disturbance – Test Group 3

Specimens did not show evidence of damage detrimental to the performance of the product after mating and unmating the specimens for 1 cycle.

2.18 Final Examination – All Test Groups

Specimens were visually examined and no evidence of physical damage detrimental to the operation of the part was observed.

3. TEST METHODS

3.1 Initial Examination of Product

A Certificate of Conformance was issued stating that all specimens in this test package were produced, inspected, and accepted as conforming to product drawing requirements, and were manufactured using the same core manufacturing processes and technologies as production parts.

3.2 Low Level Contact Resistance (LLCR)

The specimens were subjected to a low level contact resistance test in accordance with test procedure EIA-364-23C. Using a four terminal measuring technique, low level contact resistance was measured using a test current maintained at a 100 milliamperes maximum with a 20 millivolt maximum open circuit voltage. Current and voltage (+) were applied to the receptacle connector PCB utilizing a custom wire harness that was plugged into an automated low level scanning station. Current and voltage (-) were applied to the plug connector cable. Equal lengths of cable were measured and bulk cable resistance was subtracted from all measurements.

3.3 Insulation Resistance

The specimens were subjected to an insulation resistance test in accordance with test procedure EIA-364-21D. A specified test potential of 100 volts DC was applied between adjacent contacts of mated specimens for 2 minutes.

3.4 Withstanding Voltage

The specimens were subjected to a withstanding voltage test in accordance with test procedure EIA-364-20D. A specified test potential of 300 volts AC was applied between adjacent contacts of mated specimens for 1 minute.

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3.5 Random Vibration

The specimens were subjected to a random vibration test in accordance with test procedure EIA-364-28F, Test Condition “VII”, Test Condition Letter “D”. The receptacle half of the connector was mounted on the proper pc board for testing. The plug half of the connector was mated with the receptacle half of the connector. As per the requestors instruction spacer blocks and Mylar shims were used to rigidly secure the connector plug and keep it from moving in either a side to side or up and down motion. The parameters of this test condition are specified by a random vibration spectrum with excitation frequency bounds of 20 and 500 Hertz (Hz). The spectrum remains flat at 0.02 G^2/Hz from 20 Hz to the upper bound frequency of 500 Hz. The root-mean square amplitude of the excitation was 3.10 GRMS.

The test specimens were subjected to this test for 15 minutes in each of the three mutually perpendicular axes, for a total test time of 45 minutes per test specimen. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.6 Mechanical Shock

The specimens were subjected to a mechanical shock test in accordance with test procedure EIA-364-27C, Test Condition “H”. The parameters of this test condition are a half-sine waveform with an acceleration amplitude of 30 gravity units (g's peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the three mutually perpendicular axes of the test specimens, for a total of eighteen shocks. The test specimens were monitored for discontinuities of 1 microsecond or greater using an energizing current of 100 milliamperes.

3.7 Durability

The specimens were subjected to a durability test in accordance with test procedure EIA-364-09C. The specimens were mated and unmated by hand for 250 cycles at a maximum rate of 500 cycles per hour with latches engaged.

3.8 Plug Insertion Force

The specimens were subjected to a plug insertion force test in accordance with test procedure EIA-364-13E. Plug insertion force was performed with a tensile/compression machine. The receptacle and board were rigidly clamped to a floating X/Y table, which was secured to the base of the tensile/compression machine. The plug was pushed into the receptacle with a slotted plate mounted to the load cell of the tensile/compression machine crosshead. The crosshead was lowered at a rate of 0.50 inches/min until the specimen was fully mated and the peak force was recorded.

3.9 Plug Extraction Force

The specimens were subjected to a plug extraction force test. Plug extraction force was performed with a tensile/compression machine. The receptacle and board was rigidly clamped to a floating X/Y table, which was secured to the base of the tensile/compression machine. The plug was clamped in a vise mounted to the load cell of the tensile/compression machine crosshead with the latch disengaged. The latch was disengaged by utilizing a plastic zip tie and plastic wedge. The crosshead was raised at a rate of 0.50 inches/min until the specimen was fully unmated and the peak force was recorded.

3.10 Latch Retention

Latch retention force was performed with a tensile/compression machine. The receptacle and board was rigidly clamped to a floating X/Y table, which was secured to the base of the tensile/compression machine. The plug was clamped in a vise mounted to the load cell of the tensile/compression machine crosshead. A load of 40 N was applied to the housing of the plug connector and held for a minimum of 60 seconds.

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3.11 Right Angle Cable Pull

The right angle cable pull force test was performed with a tensile/compression machine. The receptacle and board were rigidly clamped to a floating X/Y table in four different positions 90° from the connector mating direction, which was secured to the base of the tensile/compression machine. The cable was clamped in an air vise mounted to the load cell of the tensile/compression machine crosshead. A load of 15N was applied to the cable of the plug connector and held for a minimum of 5 seconds in each direction.

3.12 Cable Retention in Plug

Cable retention in plug was performed with a tensile/compression machine. The plug was rigidly clamped to a vise attached to a floating X/Y table, which was secured to the base of the tensile/compression machine. The cable was clamped in air jaws mounted to the load cell of the tensile/compression machine crosshead. A load of 135N was applied to the cable of the plug connector and held for a minimum of 5 seconds.

3.13 Thermal Shock

The specimens were subjected to a thermal shock test in accordance with EIA 364-32F, Test Condition I. The mated specimens were subjected to 10 cycles of thermal shock between -55 and 85 °C with 30 minute dwells at temperature extremes and 1 minute transition between temperatures.

3.14 Humidity-Temperature Cycling

The specimens were subjected to a humidity/temperature cycling test in accordance with EIA 364-31C, Method III. The mated specimens were subjected to 10 cycles of humidity/temperature cycling between 25 and 65 °C at 80 to 100% RH.

3.15 Temperature Life

The mated specimens were subjected to a temperature life test in accordance with EIA 364-17C, Method A, Test Condition 3, Test Time Condition C. The specimens were exposed in an air circulating temperature chamber to 85°C for 500 hours.

3.16 Mixed Flowing Gas

All specimens were subjected to a 4 gas environment in accordance with EIA-364-65B, class IIA, the test parameters listed in Table 6.

The connectors were exposed for 7 days unmated and 7 days mated for a total of 14 days. LLCR measurements were taken after the 7 days unmated and after 7 days mated.

Table 6 – MFG Test Parameters

Environment	IIA
Temperature (°C)	30
Relative Humidity (%)	70
Chlorine (Cl_2) Concentration (ppb)	10±3
Hydrogen Sulfide (H_2S) Concentration (ppb)	10±3
Nitrogen Dioxide (NO_2) Concentration (ppb)	200±50
Sulfur Dioxide (SO_2) Concentration (ppb)	100±20
Exposure Period	14 days

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3.17 Minute Disturbance

The specimens were mated and unmated by hand for a single cycle with the latches engaged.

3.18 Final Examination

The specimens were visually examined in accordance with test procedure EIA-364-18B. The specimens were visually examined for evidence of physical damage detrimental to the operation of the part.

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