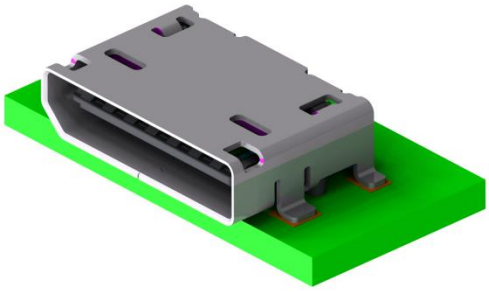
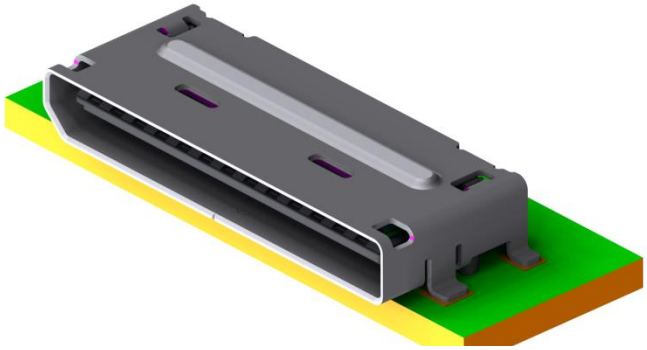
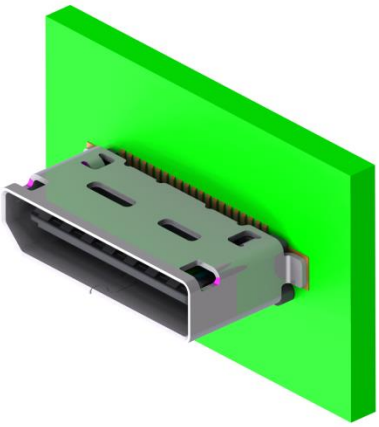
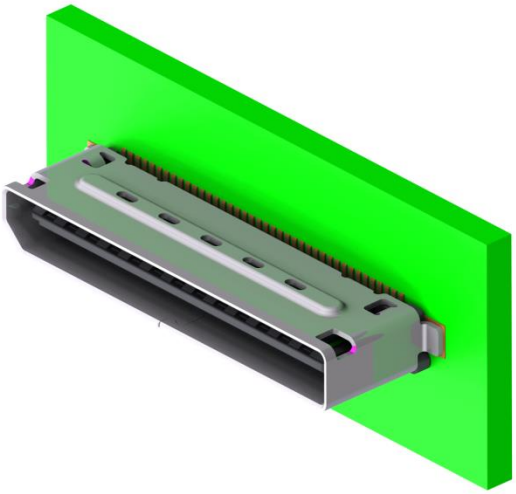
PRODUCT SPECIFICATION

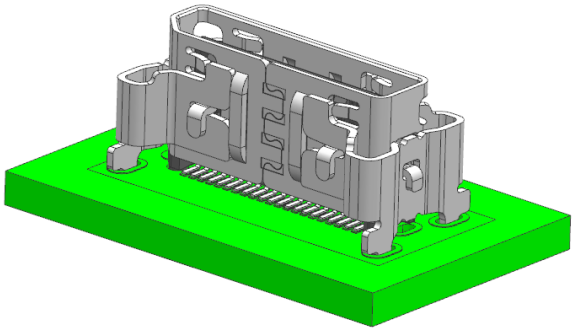
NANOPITCH I/O PLUGGABLE CONNECTOR SYSTEM

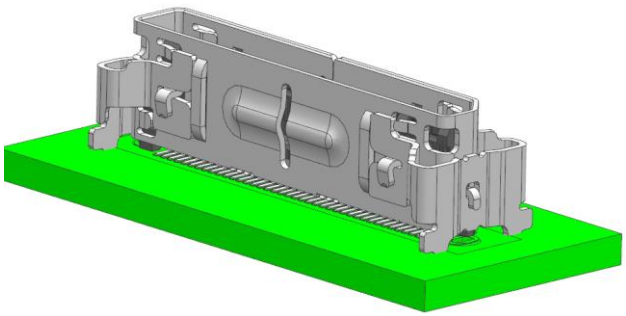






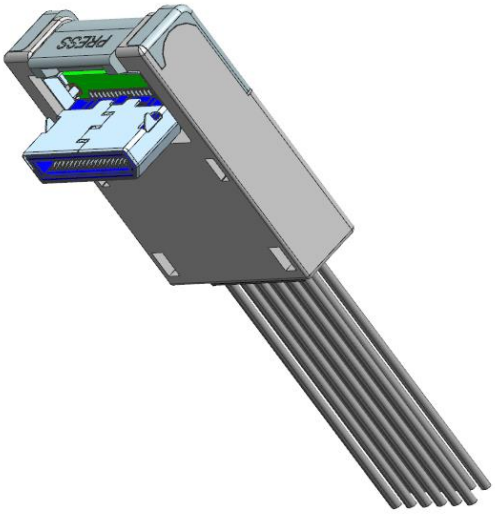


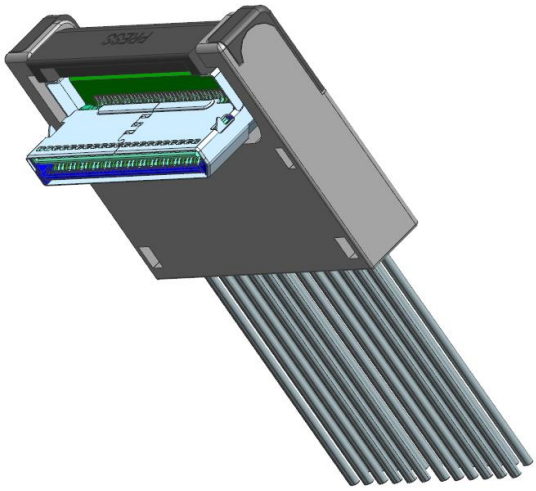


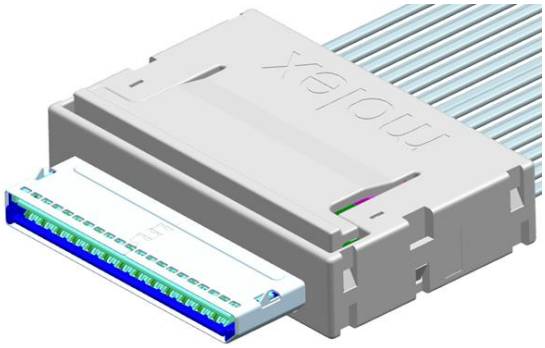


REVISION:	ECR/ECN INFORMATION:	TITLE:	SHEET No.
4	EC No: **UCP2016-4186** DATE: **2016/05/01**	**PRODUCT SPECIFICATION** **NanoPitch I/O Pluggable Connector**	**1** of **24**

DOCUMENT NUMBER:	CREATED / REVISED BY:	CHECKED BY:	APPROVED BY:
PS-173162-0001	**BJanowiak**	**JHolba**	**SMiller**







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1.0 SCOPE

This specification covers the 0.50 mm (.020 inch) centerline Small Form-factor Pluggable (NanoPitch I/O) Pluggable connectors and cable assemblies.

2.0 PRODUCT DESCRIPTION

2.1 PRODUCT NAME AND SERIES NUMBER(S)

Product Name:	NanoPitch I/O Connector and Cable System
Connector Series:	173162, 171982, 171983
Plug & Cable Series:	100436, 100203, 100153, 200226, 200227

2.2 DIMENSION, MATERIALS, PLATING AND MARKINGS

See the appropriate Sales Drawing for information on dimensions, materials, plating, marking, and footprint patterns.

2.3 SAFETY AGENCY APPROVALS

UL file:	E-29179
CSA file:	E-72548

2.4 PIN ASSIGNMENTS

Standard pinout generally follows SFF-9402 Specification for Universal Multi-Protocol Dual Cable for SAS / PCIe. However, pin assignment may vary depending on the cable assembly configuration. Different configurations will have different part numbers within the series. Reference the appropriate cable sales drawing of the specific part number for the correct pin assignment. Non-standard pinouts are subject to Molex review and approval.

2.5 MATERIAL SPECIFICATIONS

PCB:
- Material is halogen free
- Flammability rating: UL-94V0

Housing Materials:
- Backshells – LCP / Nylon
- Color: Black
- Flammability rating: UL-94V0

Active latch material:
- Stainless Steel

High Speed Bulk Cable – TwinAx – Center Drain:

- 85 Ohm, 34awg
- 85 Ohm, 32awg (under development)
- 100 Ohm, 34 awg (under development)
- 100 Ohm, 32 awg (under development)
- Flammability rating: VW-1

Low Speed Hookup Wire:

- 34awg – Solid conductor
- 30awg – Solid conductor (limited configurations)
- Flammability rating: VW-1

3.0 APPLICABLE DOCUMENTS AND SPECIFICATIONS

3.1 MOLEX DOCUMENTS

TS-171982-0001	Test Summary
TS-173162-0001	Test Summary (RESULTS PENDING)
AS-173162-0001	Application Specification NanoPitch
AS-173162-0002	Application Specification Routing Guide
PK-173982-9000	Packaging Specification
PK-173307-0001	Packaging Specification
PS-45499-002	Cosmetic Specification

3.2 INDUSTRY DOCUMENTS

EIA 364 Series	Electrical Connector Test Procedures Including Environmental Classifications with Test Procedures
EIA 364-1000	Environmental Test Methodology for Assessing the Performance of Connectors and Sockets Used in Business Office Applications
OCuLink 1.0	PCI Express® OCuLink Specification
T10 SAS-4	SAS-4 for 22.5Gbit/s connector
SFF-8611	Mini-Link 4/8 I/O Cable Assemblies
SFF-8612	Mini-Link 24 Gb/s 8/4X Unshielded Connector

4.0 QUALIFICATION

Laboratory condition and sample selection are in accordance with EIA 364-1000.

5.0 RATINGS

5.1 VOLTAGE

30 Volts AC (RMS)/DC Max.

5.2 CURRENT

0.5 Amps Max.

5.3 TEMPERATURE

Cable Assembly & connector

Field Operating Temperature:	-25°C to +65°C
Non-operating	-40°C to +85°C

Connector Only

Operating:	-40ºC to +60ºC
Non-operating:	-55°C to +85°C

5.4 DURABILITY

Cable: 0.76 µm Au – 250 cycles

6.0 PERFORMANCE (MECHANICAL & ENVIRONMENTAL)

6.1.1 TEST GROUP 6.1 TEMPERATURE LIFE (CONNECTOR INTERFACE)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Low Level Contact Resistance**	EIA 364-23	Mated	Base line
2	**Durability (precondition)**	EIA-364-09; perform plug & unplug cycles: 50.		No evidence of physical damage
3	**Temperature Life**	EIA-364-17 Method A, 112 hours at 105°±2°C	Mated	None
4	**Low Level Contact Resistance**	EIA 364-23	Mated	≤30 mΩ Δ max
5	**Reseating**	Manually unplug & plug the connector, 3 cycles		No evidence of physical damage
6	**Low Level Contact Resistance**	EIA 364-23	Mated	≤30 mΩ Δ max

6.1.2 TEST GROUP 6.2 TEMPERATURE LIFE (CABLE ASSEMBLY)

	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements
2	**Temperature Life**	EIA-364-17, method A (No electrical load), Test Condition 1 (65°C), test time condition C, (500hrs)	Unmated	None
3	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements

6.2.1 TEST GROUP 2.1 CYCLIC TEMPERATURE & HUMIDITY (CONNECTOR INTERFACE)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Low Level Contact Resistance**	EIA 364-23	Mated	Base line
2	**Durability (precondition)**	EIA-364-09; perform plug & unplug cycles: 50.		No evidence of physical damage
3	**Thermal Shock**	EIA 364-32, Method A, test condition I; Duration A-4	Mated	None
4	**Low Level Contact Resistance**	EIA 364-23	Mated	≤30 mΩ Δ max
5	**Cyclic Temperature & Humidity**	EIA-364-31 Method III; refer to EIA-364-1000 for specifics regarding this test.	Mated	None
6	**Low Level Contact Resistance**	EIA 364-23	Mated	≤30 mΩ Δ max
7	**Reseating**	Manually unplug & plug the connector, 3 cycles		No evidence of physical damage
8	**Low Level Contact Resistance**	EIA 364-23	Mated	≤30 mΩ Δ max

6.2.2 TEST GROUP 2.2 CYCLIC TEMPERATURE & HUMIDITY (CABLE ASSEMBLY)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements
2	**Cyclic Temperature & Humidity**	Based upon EIA-364-31 Method III: Subject unmated specimens to 10 Cycles (10 days) between -30º and 65º C at 80-100% RH	Unmated	None
3	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements

6.2.3 TEST GROUP 2.3 THERMAL SHOCK (CABLE ASSEMBLY)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements
2	**Thermal Shock**	EIA-364-32G per modified test condition I (-40°C to 85°C) (100 cycles)	Unmated	None
3	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements

6.3 MECHANICAL VIBRATION

6.3.1 TEST GROUP 3.1 MECHANICAL VIBRATION (CONNECTOR INTERFACE)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Low Level Contact Resistance**	EIA-364-23	Mated	Base line
2	**Durability (precondition)**	EIA-364-09; perform plug & unplug cycles: 50.		No evidence of physical damage
3	**Temperature Life (precondition)**	EIA-364-17, Method A, ~~Test Condition 3~~ 570 hours at 90°±2°C	Mated	None
4	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max
5	**Mechanical Vibration**	EIA-364-28 test condition VII test condition letter D	Mated	Discontinuity < 1 µsec No evidence of physical damage
6	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max

6.3.2 TEST GROUP 3.2 MECHANICAL VIBRATION (CABLE ASSEMBLY)

	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements
2	**Mechanical Vibration**	EIA-364-28 test condition VII test condition letter D 15 minutes in each of 3 mutually perpendicular directions.	Mated	No Discontinuity > **1** µsec No evidence of physical damage
3	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements

6.3.3 TEST GROUP 3.3 MECHANICAL SHOCK (CABLE ASSEMBLY)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements
2	**Mechanical Shock**	EIA-364-27 test condition letter H 3 shocks in each axis (18 total)	Mated	No evidence of physical damage
3	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements

6.4 MIXED FLOWING GAS

6.4.1 Test Group 4.1– Mixed Flowing Gas (Connector Interface)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Low Level Contact Resistance**	EIA-364-23	Mated	Base line
2	**Durability (precondition)**	EIA-364-09; perform plug & unplug: 50 cycles		No evidence of physical damage
3	**Temperature Life (precondition)**	EIA-364-17; Method A, 570 hours at 90°±2°C	Mated	None (Conditioning Exposure)
4	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max
5	**Mixed Flowing Gas**	EIA-364-65; Class IIA, Option 2 (NOTE: OCuLink only requires 160 hrs unmated/ 80 hrs mated)	Unmated for 160 hours Mated for 80 hours	None (Conditioning Exposure)
6	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max
7	**Thermal Disturbance**	Cycle connectors **10** times between **15**º ± **3**ºC and **85** º± **3** ºC. Ramps should be a minimum of 5°C per minute and dwell times should insure that the contacts reach the temperature extremes for a minimum of 10 minutes.	Mated	None (Conditioning Exposure)
8	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max
9	**Reseating**	Manually unplug & plug the connector, 3 cycles		No evidence of physical damage
10	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max

6.4.2 Test Group 4.2 Mixed Flowing Gas (Cable Assembly)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**High performance test (Cable only)**	High performance electrical test, Cross talk testing not required	Mated	Must pass signal integrity test requirements.
2	**4 wire resistance test**	EIA 364-23	Mated	Record value for later comparison
3	**Pre-condition**	Mate/Unmate with connector	------	25 X
4	**Mixed Flowing Gas**	EIA-364-65 class IIA	Unmated (7 days)	None
5	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Pass impedance & IL
6	**4 wire resistance test**	EIA 364-23	Mated	Resistance change < 150 mΩ
7	**Pre-condition**	Mate/Unmate with connector	------	25 X
8	**Mixed Flowing Gas**	EIA-364-65 class IIA	Mated (7 days)	None
9	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Mated	Pass impedance & IL
10	**4 wire resistance test**	Measure resistance using custom Molex test fixture.	Mated	Resistance change < 150 mΩ

6.5 DURABILITY

6.5.1 TEST GROUP 5.1 DURABILITY (CABLE ASSEMBLY)

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
1	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Must pass Signal Integrity Test Requirements
2	**4 wire resistance test**	EIA 364-.23	Record data for later comparison
3	**Durability**	Reference EIA 364-09	250 cycles
4	**High Performance Electrical Test**	High performance electrical test, Cross talk testing not required	Must pass Signal Integrity Test Requirements
5	**4 wire resistance test**	EIA 364-23	Resistance change < **150** mΩ

6.6 Solderability

6.6.1 TEST GROUP 6 – SOLDERABILITY (CONNECTOR INTERFACE)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Dielectric Withstanding Voltage**	EIA-364-23	Unmated	No evidence of physical damage
2	**Solderability**	EIA-364-52 Category 1, no steam RMA class 1 flux Immerse in molten solder at 245°C at a rate of 25.4mm per second. Solder Duration: **5 ± 0.5** seconds	Unmated	Solderable area shall have a minimum of 95% solder coverage when testing 30 random loose contacts.
3	**Temperature Life**	EIA-364-17, Method A, Test Condition 3 290 hours at 90°±2°C (60°C for 7 years)	Unmated	No evidence of physical damage

6.7 Dielectric Withstanding Voltage

6.7.1 TEST GROUP 7.1 DIELECTRIC WITHSTANDING VOLTAGE (CONNECTOR INTERFACE)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Dielectric Withstanding Voltage**	EIA-364-20; Method A, Test Condition I, 250VDC minimum for 100ms	Mated	No disruptive discharge No leakage current in excess of 5mA
2	**Low Level Contact Resistance**	EIA-364-23	Mated	Base line
3	**Durability**	EIA-364-09; perform plug & unplug cycles: 250		No evidence of physical damage
4	**Low Level Contact Resistance**	EIA-364-23	Mated	≤30 mΩ Δ max
5	**Dielectric Withstanding Voltage**	EIA-364-20; Method A, Test Condition I, 250VDC minimum for 100ms	Mated	No disruptive discharge No leakage current in excess of 5mA

7.0 PERFORMANCE (MECHANICAL)

7.1 Latching

7.1.1 Test Group 1.1 – Current Rise (Connector Interface)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	**Temperature Rise Verses Current**	EIA-364-70; Method 3	Mated	Temperature Rise: **+30**°C maximum

7.2.1 Test Group 2.1 Connector Interface / Cable Assembly Latching

ITEM	TEST	TEST PROCEDURE	4X (42 CIRCUIT)		8X (80 CIRCUIT)	
			MINIMUM (N)	MAXIMUM (N)	MINIMUM (N)	MAXIMUM (N)
1a	**Mating Forces Connector Only (No latch)**	EIA-364-13	2.5	10.5	5.5	16.0
2a	**Mating Forces Passive Latch**		2.5	20.0	5.5	23.0
3a	**Mating Forces Active Latch**		3.5	20.0	6.0	23.0
1b	**Unmating Forces Connector Only (No latch)**	EIA-364-13	2.0	4.5	3.5	6.0
2b	**Unmating Forces Passive Latch**		10.5	20.0	11.0	23.0
3b	**Unmating Forces Active Latch**		10.5	19.0	11.0	22.0
4a	**Wrenching Strength Passive Latch**	With mated Cable. Bend cable 90-degrees at minimum bend radius. Pull in 2 Directions for ribbon cable. No Damage to plug/cable assembly		25 (tbd)		25(tbd)
4b	**Wrenching Strength Active Latch**	With mated Cable. Bend cable 90-degrees at minimum bend radius. Pull in 2 directions for ribbon cable. No Damage to plug/cable assembly		40(tbd)		40(tbd)
5	**Retention Strength Active Latch**	No damage to plug/cable assembly below Minimum value	30		30	

7.2.2 Test Group 2.2 Mating and Retention Forces (Cable Assembly)

ITEM	DESCRIPTION	TEST CONDITION	REQUIREMENT
1	**Retention in Plug**	Per EIA-364-38 Test Method A	TBD

7.3 Peel Strength

7.3.1Test Group 3.1 – Connector Peel Strength (Connector Interface)

ITEM	TEST (ORIENTATION)	TEST PROCEDURE	4X (42 CIRCUIT)			8X (80 CIRCUIT)		
			SMT	Thru-Hole	Heavy Duty	SMT	Thru-Hole	Heavy Duty
1a	SMT Peel Failure (Vertical)	Using the probe location in Section 9 Figure A, apply force at a rate of 25.4mm/min. until failure of one SMT joint.	3N Min	N/A	N/A	3N Min	N/A	N/A
1b	SMT Peel Failure (Right Angle)		25N Min	N/A	N/A	25N Min	N/A	N/A
2	Tail Permanent Set 10N Load (Vertical Only)	Using the probe location in Section 9 Figure B, apply force at a rate of 25.4mm/min. until force of 10N is acheived and record displacement in mm. Remove force at the rate of 25.4mm/min until a force of 0N is acheived and record displacement in mm. Record permanent set in mm.	N/A	2mm Max (3.91º)	0.5mm Max (0.98º)	N/A	2mm Max (3.91º)	0.5mm Max (0.98º)

7.4 Wire Flex (Cable Assembly)

7.4.1 Test Group 4.1 Wire Flex (Cable Assembly)

ITEM	TEST	TEST PROCEDURE	CONDITION	REQUIREMENT
1	High Performance Electrical Test	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements
2	Wire Flex	Flex cable 180° for 20 cycles at 12-14 cycles per minute w/ a sufficient load to ensure that the cable follows the contour of the mandrels (EIA-364-41C) Test cable to both round and flat cable test requirements and see what passes.	Mated	Monitor test for opens, and record number of flexes to failure.
3	High Performance Electrical Test	High performance electrical test, Cross talk testing not required	Mated	Must pass Signal Integrity Test Requirements

8.0 SIGNAL INTEGRITY REQUIREMENTS (CABLE ASSEMBLY)

ITEM	DESCRIPTION	TEST LIMITS (per PCIe OCuLink Spec Rev 1.0)
1	**Differential Insertion Loss (SDD21)**	Maximum Insertion loss = -15dB for 0 ≤ f ≤ 4GHz
2	**Fitted IL**	ILCablefitted(f) = $a_1\sqrt{f} + a_2 f + a_4 f^2$ Where f is frequency in GHz The coefficients for the maximum loss curve are: a1 = 6.9, a2 = 0.6, a4 = 0.05. The coefficients for the maximum loss curve are: a1 = 0.5, a2 = 0.18, a4 = 0
3	**Differential Return Loss (SDD11 AND SDD22)**	RLCable(f) = -10 dB for 0.05 < f < 2 GHz (f-12) dB for 2 < f < 8 GHz -4 dB for 8 < f < 12 GHz
4	**Differential to Common Mode Return Loss (SCD11 and SCD22)**	Diffto CMRLCable(f) = (2/3)f – 20 dB for 0.05 GHz < f < 12GHZ
5	**Common mode to Common Mode Return Loss (SCC11 and**	CMtoCMRLCable(f) = -2dB for 0.05 < f < 12 GHz
6	**Differential to Common Mode Conversion Loss – Differential Insertion Loss (SCD21 – SDD21)**	DifftoCMConv – ILCable(f)= -10dB for 0.05 < f < 12 GHz
7	**Multi-Disturber Near End Cross Talk loss (MDNEXT)**	MDNEXT_loss(f) ≥ 31.5 – 12.5* log(f/4) dB for 0.05 GHz ≤ f ≤ 12GHz
8	**Multi-Disturber Far End Cross Talk loss (MDFEXT)**	MDNEXT_loss(f) ≥ 31 – 15 * log(f/4) dB for 0.05 GHz ≤ f ≤ 12GHz

TEST SEQUENCE (CABLE ASSEMBLY)

Test Description	6.1.1	6.2.2	6.2.3	6.3.2	6.3.3	6.4.2	6.5	7.2	7.3.1	8.0	QTY
High performance test except cross talk	1,3	1,3	1,3	1,3	1,3	1,5,9	1,4		1.3		
4 wire resistance test						2,6,10	2,5				
Temperature Life (6.1.1)	2										3
Cyclic Temperature / Humidity (6.2.2)		2									3
Thermal Shock (6.2.3)			2								3
Mechanical Vibration (6.3.2)				2							9
Mechanical Shock (6.3.3)					2						9
Mixed Flowing Gas (unmated & mated) (6.4.2)						4,8					3
Durability (6.5)							3				
Connector Mating force (7.2.)								1			
Connector Un-mating force 7.2)								1			
Wire Flex (7.3.1)									2		3
Signal Integrity										1	5
Precondition 25x						3,7					3

TEST SEQUENCE (CONNECTOR)

Test Description	6.1.1	6.2.2	6.2.3	6.3.2	6.3.3	6.4.2	6.5	7.2	7.3.1	8.0	QTY
High performance test except cross talk	1,3	1,3	1,3	1,3	1,3	1,5,9	1,4		1.3		
4 wire resistance test						2,6,10	2,5				
Temperature Life (6.1.1)	2										3
Cyclic Temperature / Humidity (6.2.2)		2									3
Thermal Shock (6.2.3)			2								3
Mechanical Vibration (6.3.2)				2							9
Mechanical Shock (6.3.3)					2						9
Mixed Flowing Gas (unmated & mated) (6.4.2)						4,8					3
Durability (6.5)							3				
Connector Mating force (7.2.)								1			
Connector Un-mating force 7.2)								1			
Wire Flex (7.3.1)									2		3
Signal Integrity										1	5
Precondition 25x						3,7					3

SIGNAL INTEGRITY TEST SEQUENCE (CABLE ASSEMBLY)

Test Description	Test Number (Sample QTY = 5 each, 0.3m and 1.0m)					
	7.X.X	7.X.X	7.X.X	7.X.X	7.X.X	7.X.X
Differential Impedance (7.**X.X**)	1					
Return Loss (SDD22) (7.**X.X**)		1				
Return Loss (SCD22) (7.**X.X**)			1			
Conversion Loss (SCD21) (7.**X.X**)				1		
Conversion Loss - Insertion Loss (SCD21-SDD21) (7.**X.X**)					1	
Cross Talk (NEXT) (7.**X.X**)						1

9.0 Packaging

9.1 Connector And Shell

9.1.1 Product shall be packaged in tape and reel per the packaging specification as called out on the applicable assembly print.
9.1.2 Packaging shall meet the requirements of and be tested per the packaging specification as called out on the applicable assembly print.

10.0 GAGES AND FIXTURES

Fixture setup for mated plug load testing. Probe to be approximately 3mm diameter with a full radius nose. Position the probe as illustrated in the figures below.

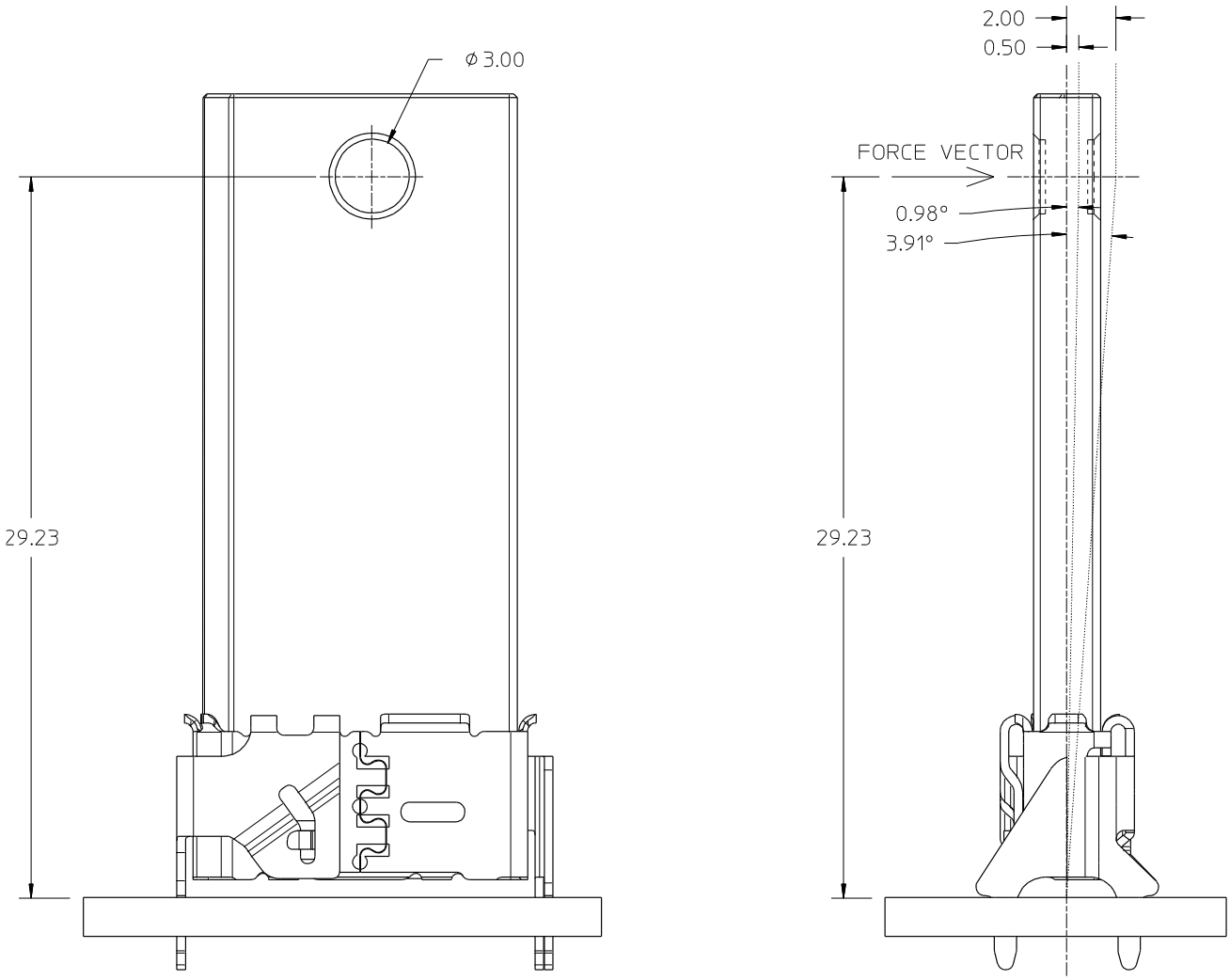

Figure A

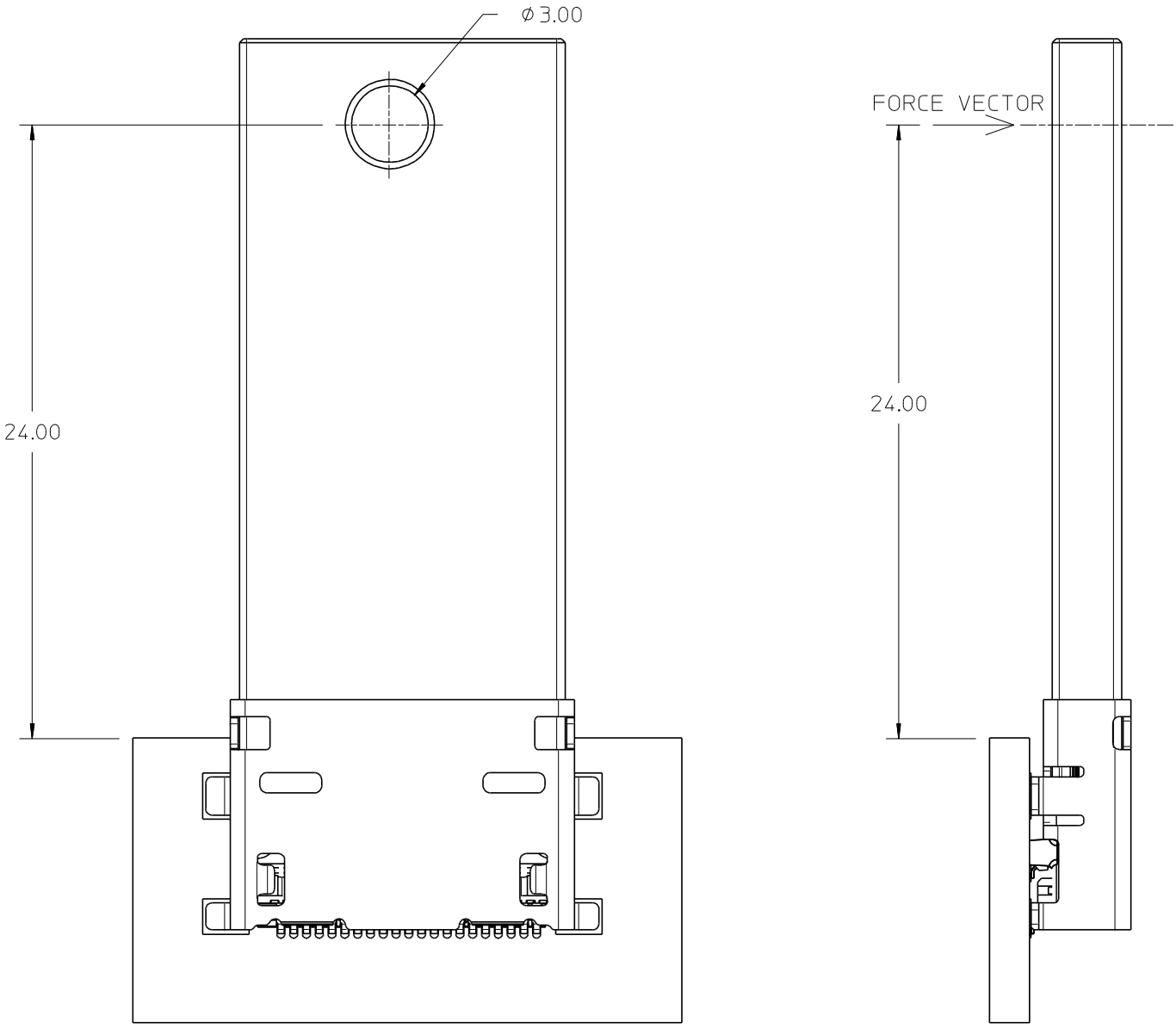

Figure B

11.0 OTHER INFORMATION

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