CE23-0105

GENERAL PRODUCT SPECIFICATION FOR MHD2 BACKPLANE AND DAUGHTERCARD INTERCONNECT SYSTEM

Revision “B”

Specification Revision Status

Revision	Description	Initial	Date
A	AAO Initial release (Ref TB-2343, Rev A)	GSP	1-4-2023
B	Added VITA 72 results, extended mating cycle test results, added sections 2.3, 12.5	GSP	3-19-2025

Preface:

Amphenol’s MHD2 connector system leverages a proven, high MRL/TRL solution first introduced into the commercial market under the XCede HD2 tradename that has shipped millions of connectors worldwide. This trusted product then underwent design ruggedization and additional qualification assessment and testing for military and aerospace markets as defined herein. The commercial product is not expected to perform at the same levels as those defined in this document.

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1.0 SCOPE

1.1 Content

1.1.1 This specification covers the performance, test, and quality requirements for the MHD2 backplane interconnect system. These connectors are two-piece devices that connect two printed circuit boards. Receptacle connectors and pin connectors are through-hole devices with eye-of-the-needle compliant pin contacts. The MHD2 connector family consists of modular configurations with custom power and guidance modules.

1.1.2 This specification covers the backplane and daughtercard interconnects.

1.2 Qualification

1.2.1 When tests are performed on subject product line, procedures specified in EIA-364-B shall be used per the test sequences outlined in Amphenol TCS Technical Bulletin TB2023, unless otherwise noted herein. All inspections shall be performed using applicable inspection plan and product drawings.

2.0 REFERENCE DOCUMENTS

2.1 The following documents form a part of this specification to the extent specified herein.

2.1.1 Amphenol AAO/TCS Documents
TB-2023 Amphenol TCS Commercial Connector Qualification Plan
CE23-0102 MHD2 Product Routing Guidelines
CE23-0106 MHD2 Connector Design Guidelines

2.2 Commercial Standards

2.2.1 EIA-364-B Electrical Connector Test Procedure Including Environmental Classifications

2.2.2 GR-1217-CORE-Generic Requirements for Separable Electrical Connectors used in Telecommunications Hardware

2.2.3 IEC-512-Electromechanical components for electronic equipment – Basic testing procedures and measuring methods, IEC-60352-6 international standards, solderless connections, press fit connections, general requirements, test method and practical guidance.

2.3 Other Standards and Documents

2.3.1 ANSI/VITA 91.0-2024
2.3.2 ANSI/VITA 46.0-2023 Errata
2.3.3 VITA 72
2.3.4 CE22-1208 Amphenol VITA 72 test report for MHD2
2.3.5 CE25-0316 Amphenol mating cycles report for MHD2

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3.0 MATERIAL FINISHES

3.1 Contacts

3.1.1 Backplane signal blades are 0.30 mm thick high performance copper alloy.
3.1.2 Backplane ground blades are 0.30 mm thick high performance copper alloy.
3.1.3 Backplane signal and ground blades are lubricated.
3.1.4 Receptacle signal contacts are 0.203 mm thick high performance copper alloy.
3.1.5 Daughter shields are 0.152 mm thick high performance copper alloy.
3.1.6 Power Blades are 0.30 mm thick high performance copper alloy. (Refers to HD Power connector modules)
3.1.7 Power Receptacle contacts are 0.30 mm thick high performance copper alloy. (Refers to HD Power connector modules)

Notes:
All contacts are plated and meet lead free requirements, refer to EGS205.

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3.2 Sub Components

Component	Material	Specification
Insulator	Glass reinforced polyester (LCP)	Color Grey or Black
Stiffener	Stainless steel, Type 301	N/A
Removed at Rev B		
Removed at Rev B		

4.0 SKEW DATA

4.1 HD2 3Pair Daughtercard

Wafer A			Wafer B		
Contact row	Delay, (ps)	Skew, (ps)	Contact row	Delay, (ps)	Skew, (ps)
GND1*	/	/	GND1	/	/
A	104.4	0.7	A	93.6	0.1
B	105.1		B	93.7	
GND2	/	/	GND2	/	/
C	121.2	1.1	C	115.3	0.9
D	122.3		D	116.2	
GND3	/	/	GND3	/	/
E	141.4	0.5	E	135.0	0.1
F	141.9		F	135.1	
GND4	/	/	GND4	/	/

* XCede HD2 3 pair DC and BMA connectors are available with and without wafer A Ground 1 lead.

4.2 HD2 4Pair Daughtercard

Wafer A			Wafer B		
Contact row	Delay, (ps)	Skew, (ps)	Contact row	Delay, (ps)	Skew, (ps)
GND1*	/	/	GND1	/	/
A	105.4	0.2	A	93.7	0.2
B	105.6		B	93.5	
GND2	/	/	GND2	/	/

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C	124.6	0.1	C	116.6	0.2
D	124.5		D	116.4	
GND3	/	/	GND3	/	/
E	144.4	0.1	E	137.6	0.1
F	144.3		F	137.5	
GND4	/	/	GND4	/	/
G	163.5	0.1	G	160.7	0.2
H	163.6		H	160.5	
GND5	/	/	GND5	/	/

* XCede HD2 4 pair DC and BMA connectors are available with and without wafer A Ground 1 lead.

4.3 HD2 6 Pair Daughtercard

Wafer A			Wafer B		
Contact row	Delay, (ps)	Skew, (ps)	Contact row	Delay, (ps)	Skew, (ps)
GND1*	/		GND1	/	/
A	138.3	0.7	A	124.7	0.8
B	137.6		B	123.9	
GND2	/	/	GND2	/	/
C	158.2	1.1	C	149.2	1.6
D	157.1		D	147.6	
GND3	/	/	GND3	/	/
E	178.1	1.1	E	171.3	2.3
F	177.0		F	169.0	
GND4	/	/	GND4	/	/
G	196.2	0.3	G	195.0	1.9
H	195.9		H	193.1	
GND5	/	/	GND5	/	/
J	220.0	0.8	J	219.1	1.4
K	219.2		K	217.7	
GND6	/	/	GND6	/	/
L	241.3	0.2	L	237.9	0.4
M	241.1		M	238.3	
GND7	/	/	GND7	/	/

* XCede HD2 6 pair DC and BMA connectors are available with and without wafer A Ground 1 lead.

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5.0 ELECTRICAL RATINGS

5.1 Resistance

Description	Value
Mating Interface Contact Resistance Change	10mΩ Maximum
Compliant Pin to Plated Through Hole Resistance	1 mΩ Maximum
Insulation Resistance	1000 Mega Ω

5.2 Voltage

Description	Agency	Working	DWV
Signal	UL 48 VAC (RMS)	250 VAC (RMS)	500 VAC (RMS)
Power	UL 48 VAC (RMS)	250 VAC (RMS)	500 VAC (RMS)

6.0 CURRENT AND TEMPERATURE RATINGS

Description	Value
Signal Contact	1.5 Amp per contact(1) (2)
Ground Contact	1.5 Amp per contact(1) (2)
Power Contact (Refers to HD Power connector)	10 Amps per blade(1) (2)
Maximum operating temperature rating	105°C
Minimum operating temperature rating	-40°C
Storage Temperature Rating	-65°C to +125°C

Note:

1,Current has been de-rated per EIA-364-TP70

2,Product was tested in worst-case conditions where the PCB did not have any power planes. For other test conditions please contact ATCS Application Engineering.

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7.0 MECHANICAL RATINGS

7.1 Mechanical Performance

	Value, per contact	
Description	**Grams**	**Newtons**
Signal and Shield Contact Normal Force	40 End Of Life (EOL)	0.40
Signal and Shield Contact Engagement Force[3]	60 max	0.60 max
Signal and Shield Contact Separation Force[3][4]	15 min	0.15 min
Power Contact Normal Force	70 End Of Life (EOL)	0.70
Power Contact Engagement Force[3]	85 max	0.85 max
Power Contact Separation Force[3][4]	40 min	0.40 min
Signal, Shield, and Power Contact Durability	Rated for 500+ Mating Cycles (see section 12.5.2)	
Connector Mating Angle	+/- 2 degrees X and Y axis	
Contact Mechanical Wipe Values	Signal 2.0 Shield 2.0	

	Value, per wafer	
Description	**Lbs**	**Newtons**
Front housing retention force	4 min	17.6 min

Note:

3. These values are maximum and minimum expected forces, averaged over the number of mating points (contacts) in a connector. This data is to be used for purposes of system mechanical sizing.
4. All engagement/separation force values assume the connector is pressed on a sufficiently rigid PCB without excessive flexing during mating.

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7.2 Backplane , Daughtercard and Mezzanine Module Assembly True Position Requirements

7.2.1 The true position of the compliant pin interface is defined prior to connector pressing onto board.

7.2.2 Compliant pin tips to be measured per best fit floating grid.

Type	True position specification	Detailed view
MHD2 Backplane	Blade TP:0.30 Compliant pin:0.24	20.90 0.66 GROUND Ø0.30 X_BP Y_BP 0.55 SIGNAL Ø0.30 X_BP Y_BP 12.0 0 4.03 Ø0.24 X_BP Y_BP (1.10) TAIL LENGTH X_BP
MHD2 Daughtercard	Compliant pin:0.24	Y_DC 5X1.80 =(9.00) 1.80 B A 0.127 Ø0.24 X_BP Y_BP A1 B A 0.42 FROM ℄ OF RAF COMPLIANT TO ℄ OF BP COMPLIANT Y_BP

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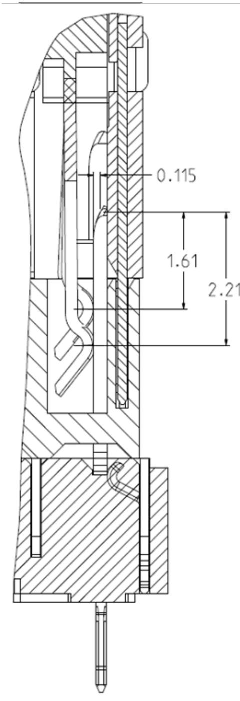
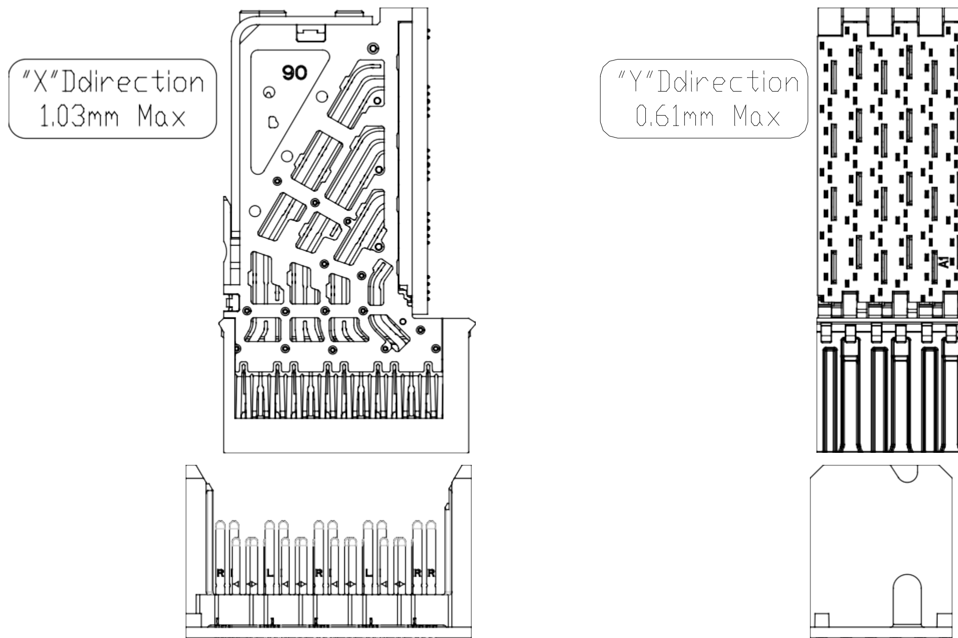
7.3 Contact wipe length (Both signal and ground for MHD2)



7.4 Gather ability



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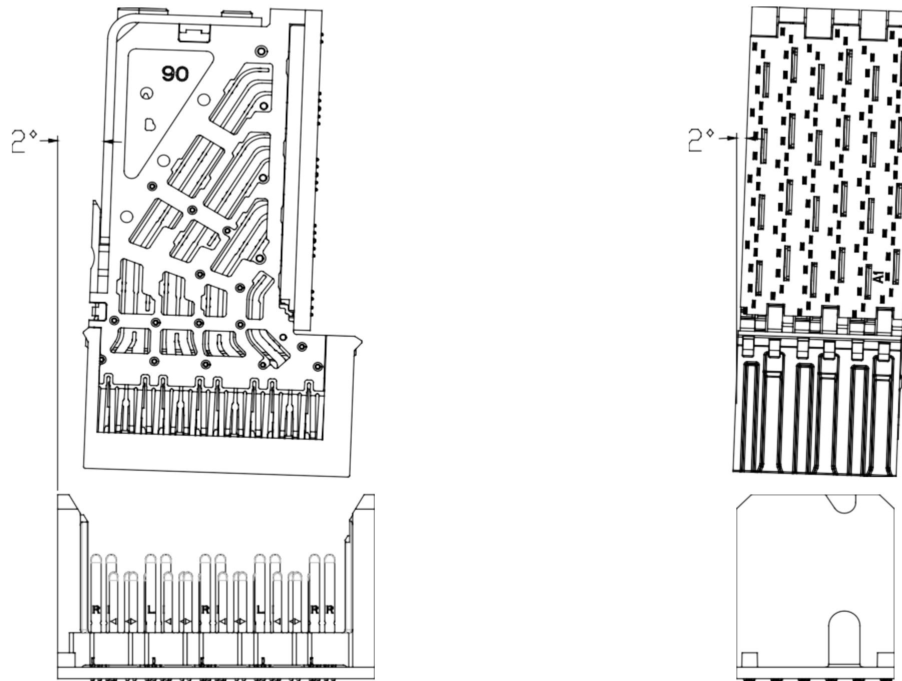
7.5 Mating angle



8.0 COMPLIANT PIN INTERFACE

Description	Value per Pin, lbs
0.0157" Drill (MHD2 Femto DC/BMA Pin)	
Signal and Shield Compliant Pin Insertion, 0.0157 drill	5 Maximum
Signal and Shield Compliant Pin Retention, 0.0157 drill	0.50 Minimum (5) (6)
0.033" Drill (XCede HD PLUS Power DC/BMA Pin) *	
Power Compliant Pin Insertion	15 Maximum
Power Compliant Pin Retention	2.0 Minimum (5)

* XCede HD2 power share with XCede HD PLUS Power module.

8.1 Radial hole deformation not to exceed 70µm measured from drilled hole

8.2 Axial hole deformation not to exceed 50µm per IEC 60352-5 measured in the vertical plane

Notes:

5. Refer to technical bulletin CE23-0102 MHD2 Family Routing Guidelines, for drilled and finished hole requirements.
6. The average compliant pin retention shall not be less than 0.5lbf with no more than 10% of retention values between 0.5lbf and 0.4lbf, and no retention values below 0.4lbf.

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9.0 QUALIFICATION TESTING

9.1 Sample Selection: Refer to Section 13 for minimum recommended connector sample size

9.2 Test Sequence: Qualification testing shall be performed per the sequences listed in Section 13 of this document.

9.3 Except as noted, the qualification for the MHD2 product line was performed with the 6 Pair XCede HD2 interconnect and by similarity all other derivatives of the product line are considered qualified.

10.0 REQUALIFICATION TESTING

10.1 If changes affecting form, fit or function are made to the product or to the manufacturing process, Product Engineering and Mechanical Integrity Engineering shall coordinate re-qualification testing of all or part of the original testing sequence as required.

11.0 ACCEPTANCE

11.1 Acceptance is based on verification that the product meets the requirements of Section 12. Failures attributed to equipment, test set-up, or operator deficiencies shall not disqualify the product. If product failure occurs, corrective action shall be taken and samples resubmitted for qualification. Verification of corrective action is required before re-submittal.

12.0 SPECIFICATION SUMMARY

12.1 Material

Parameters	Specification	MHD2 Value	Reference Document
Plating Integrity	Acceptable Porosity	3 Pores per cm^2	EIA-364-TP53 Exposed to nitric vapors
Contact Metallization XCede HD2 MHD2	30µin Gold min over 50-150µin Ni 50µin Gold min over 80µin Ni min (mating interface)	50µin Gold min over 80µin min Ni or 10µin Gold min over 20-40µin NiW alloy or 10µin Gold min over 20 Pd-Ni over 50-150µin Ni	GR-1217-CORE Per paragraph 5.2.5 EIA-364-TP09
Durability XCede HD2	200 Cycles	250 Cycles	GR-1217-CORE Per paragraph 5.2.5 EIA-364-TP09
Durability MHD2	500 Cycles Min	700+ with no plating degradation or resistance change greater than 5 mΩ	CE25-0316 **(tested in worst-case with no guide hardware)** **See section 12.5.2**
Base	Surface finish is 16 RMS or otherwise specified	16 RMS on mating surfaces	GR-1217-CORE
Lubrication	Must be present on all backplane blades/shields	Must be present on all backplane blades/RAM blades/shields	GR-1217-CORE R5-67
Flammability Rating	94V-0	Must Pass Requirement	UL94

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12.2 Mechanical

Parameters	Specification	MHD2 Value	Reference Document
Contact Normal Force	40 Grams End of Life (EOL)	40 Grams End of Life (EOL)	GR-1217-CORE EIA-364-TP04
Engagement Force	NA	SEE SECTION 7.1	EIA-364-TP37A
Contact Strength	Apply 0.25 lbs. Axial Force per contact	Apply 0.25 lbs. Axial Force per contact	GB-1217-CORE Per paragraph 6.1.7
Contact Wipe Distance	0.51 mm (0.020") min.	SEE SECTION 7.4	GR-1217-CORE R5-28
Polarization Force	100 N (22.5 lbs)	Mate Samples 180° out of Phase	GR-1217-CORE Per paragraph 5.1.9
Compliant Pin Retention	N/A	SEE SECTION 8.0	GR-1217-CORE EIA-364-TP29
Contact Geometry	Minimum one curved surface in mating area	Minimum one curved surface in mating area	N/A
Hertzian Stress	N/A	Greater than 150 Kpsi	N/A

12.3 Electrical

Parameters	Specification	MHD2 Value	Reference Document
Contact Resistance Stability (LLCR)	Less than 10mΩ change from initial reading	Less than 10milli-Ohms change from initial reading	GR-1217-CORE Per paragraph 6.2.1 EIA-364-TP23
Compliant Pin to PTH Resistance	1mΩ maximum Test current 100mA and 20mV open circuit	1milli-Ohms maximum	GR-1217-CORE EIA-364-TP23
Signal Continuity	Less than 10 nanosecond interrupt	Less than 10 nanosecond interrupt	GR-1217-CORE
Current Rating	Less than 30°C Temperature Rise	SEE SECTION 6.0	GR-1217-CORE EIA-364-TP70
Insulation Resistance	1,000 Mega Ohms	1,000 Mega Ohms	GR-1217-CORE
Dielectric Withstanding	1,000 VAC Peak	500 VAC Peak De-rated value	GR-1217-CORE EIA-364-TP20

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12.4 Environmental

Parameters	Specification	MHD2 Value	Reference Document
Temperature Life	No Change in LLCR greater than 10mΩ	10milli-Ohms Maximum change	GR-1217-CORE EIA-364-TP17 Test condition 4 Per paragraph 6.3.2
Thermal Shock	No Change in LLCR greater than 10mΩ 5 cycles for –55°C to 85°C	Same as above	GR-1217-CORE Per paragraph 6.3.3 EIA-364-TP32
Humidity Cycling	No Change in LLCR greater than 10mΩ Relative Humidity 90 to 95% For 500 hrs	Same as above	GR-1217-CORE EIA-364-TP31 Procedure II
Dust	No Change in LLCR greater than 10mΩ	Same as above	GR-1217-CORE Per paragraph 9.1.1.1 EIA-364-TP91
Vibration	No Change in LLCR greater than 10mΩ Random Vibration 9.26g RMS	Same as above	GR-1217-CORE EIA-364-TP28E Condition V-C-9.26g rms Random. Per paragraph 9.1.2.1
Mechanical Shock	No Change in LLCR greater than 10mΩ 50g Half sine excitation.	Same as above	GR-1217-CORE EIA-364-TP27 Test condition A
Mixed Flowing Gas	No Change in LLCR greater than 10mΩ 300 hrs at 105°C thermal conditioning also included	Same as above	GR-1217-CORE Per paragraph 9.1.3 EIA-364-TP65 Class IIA

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12.5 Extended Mechanical MHD2

12.5.1 VITA 72 vibration/mechanical shock

Purpose of Test:

Testing was performed on Amphenol’s Xcede HD2 connector to determine its ability to withstand VITA 72 vibration levels. The test was performed on a 3U slot configuration, representative of a true product end-use. The samples, pcbs, fixture, covers, and associated physical construction intentionally mimicked the typical use in embedded applications. The test followed the “RVPX 6U Connector module test plan, Rev. 6 (JAN, 2005)” plan defined by the VITA 72 working group with the added monitoring for interruptions of greater than 1 nanosecond as well as any changes in LLCR of greater than 10 mΩ on any individual contact, or greater than an average of 5 mΩ per connector module.

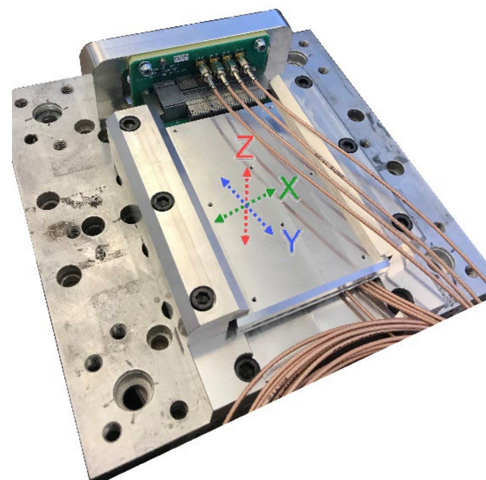
Samples:

Sample	Part Number	Description
VITA 46 3U Daughtercard *Amphenol*	MHD24P800M1	Right angle daughtercard 8 pos. end
VITA 46 3U Backplane *Amphenol*	MHD24J800M1	Vertical receptacle backplane 8 pos. end

Test Sequence:

Pre-test		
Test	Exposure	Duration (hours)
Sin Sweep resonance	1 octave/minute 5Hz to 2,000Hz 1 sweep per axis	~25 minutes
Test sequence A (1 sequence per axis)		
Test	Exposure	Duration (hours)
Random Vibe L3	1 hour	1 hours
Sine Vibe L3	1 hour	1 hours
Shock L3	3pos/3neg pulses	
Total sequence A (All 3 axis)		6 hours
Test sequence B (1 sequence per axis)		
Test	Exposure	Duration (hours)
Random Vibe L3	1 hour	1 hours
Sine Vibe L3	1 hour	1 hours
Shock L3	3pos/3neg pulses	
Total sequence B (All 3 axis)		6 hours
Test sequence C (1 sequence per axis)		
Test	Exposure	Duration (hours)
Random Vibe L3+3dB	1 hour	3 hours
Total sequence C (All 3 Axis)		3 hours
Test sequence D (Z axis only)		
Test	Exposure	Duration (hours)
Random Vibe L3+3dB	12 hours	12
Total sequence D		12

Test Fixture:



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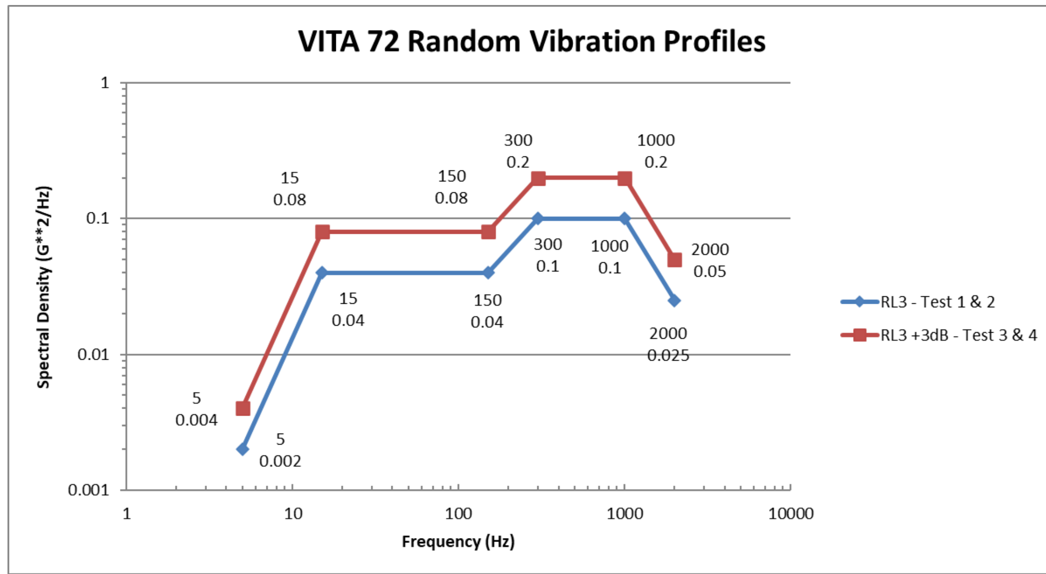

Test Summary:

Pre-test			
Test	Exposure	Duration (hours)	Result
Sin Sweep resonance	1 octave/minute 5Hz to 2,000Hz 1 sweep per axis	~25 minutes	Pass
Test sequence A (1 sequence per axis)			
Test	Exposure	Duration (hours)	Pass
Random Vibe L3	1 hour	1 hours	
Sine Vibe L3	1 hour	1 hours	
Shock L3	3pos/3neg pulses		
Total sequence A (All 3 axis)		6 hours	
Test sequence B (1 sequence per axis)			
Test	Exposure	Duration (hours)	Pass
Random Vibe L3	1 hour	1 hours	
Sine Vibe L3	1 hour	1 hours	
Shock L3	3pos/3neg pulses		
Total sequence B (All 3 axis)		6 hours	
Test sequence C (1 sequence per axis)			
Test	Exposure	Duration (hours)	Pass
Random Vibe L3+3dB	1 hour	3 hours	
Total sequence C (All 3 Axis)		3 hours	
Test sequence D (Z axis only)			
Test	Exposure	Duration (hours)	Pass
Random Vibe L3+3dB	12 hours	12	
Total sequence D		12	

In addition the largest change in LLCR was 2.8 mΩ and there were zero nanosecond signal interruptions observed during the testing.

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12.5.2 Extended durability cycles

Purpose of Test:

Validate the acceptability of a higher mating cycle rating than the 250 originally tested as part of the Telcordia qualification in section 12.1 on the ruggedized military version (MHD2) connector.

Samples:

Sample	Part Number	Description
VITA 46 3U Daughtercard *Amphenol*	MHD24P800M1	Right angle daughtercard 8 pos. end
VITA 46 3U Backplane *Amphenol*	MHD24J800M1	Vertical receptacle backplane 8 pos. end

Test sequence:

Mated pairs of samples listed above were assembled to test pcbs and mounted to a fixture attached to the durability test machine. High-resolution images of the mating interfaces were taken prior to the test for all sample sets. Sample set 1 was wired as described in section 14 with LLCR monitoring and no LLCR changes greater than 5mΩ were observed through 10,000 mating cycles. Sample set 2 was removed from the test fixture and had high-resolution images of the mating interfaces at intervals of 250, 500, and 750 mating cycles. Sample set 2 was not wired, but readings of LLCR were taken at those intervals and no LLCR changes greater than 5mΩ were observed at those intervals.

Test Summary:

Results of testing so far validate rating the mating cycles for the MHD2 connector to greater than 500 cycles. Further testing is expected to increase this rating in the future.

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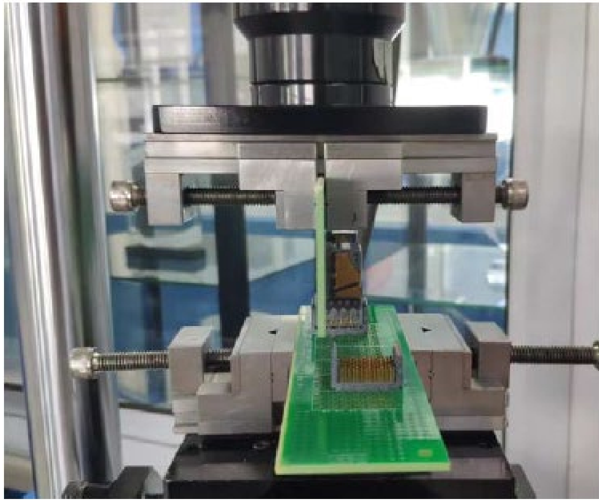
12.5.3 Mating force (50 micro-inch gold mating interface)

Purpose of Test:

Validate the MHD2 increased plating thickness in the mating interface area does not significantly increase mating forces.

Test Setup

Summary

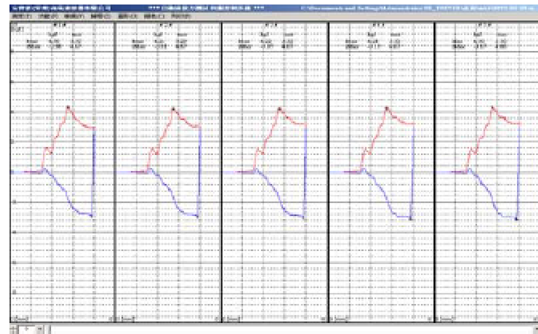


Max mating force ≤60gf Min un-mating force ≥15gf

MHD2 4Pr DC VS BMA (838Plating) Mating&Unmating_#1

NO.	Full pin/unit:kgf		Per pin/unit:gf	
	mating	unmating	mating	unmating
1	4.30	2.98	41.35	28.65
2	4.21	3.01	40.48	28.94
3	4.22	3.07	40.58	29.52
4	4.24	3.13	40.77	30.10

Sample#1



Mating and Un-Mating forces were within original qualification parameters and insignificantly different from the original values.

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13.0 TELCORDIA QUALIFICATION TEST GROUP SUMMARY

13.1 Test Groups

Group 1: Vibration and mechanical shock with dust and durability
Group 2: Thermal shock and humidity with dust and durability
Group 3: Temperature life, 500 hrs @ 105°C
Group 4: Mixed flowing gas, 4 gases with durability-thermal conditioning included prior to test
Group 5: Porosity and plating thickness
Note: Compliant pins are tested separately.

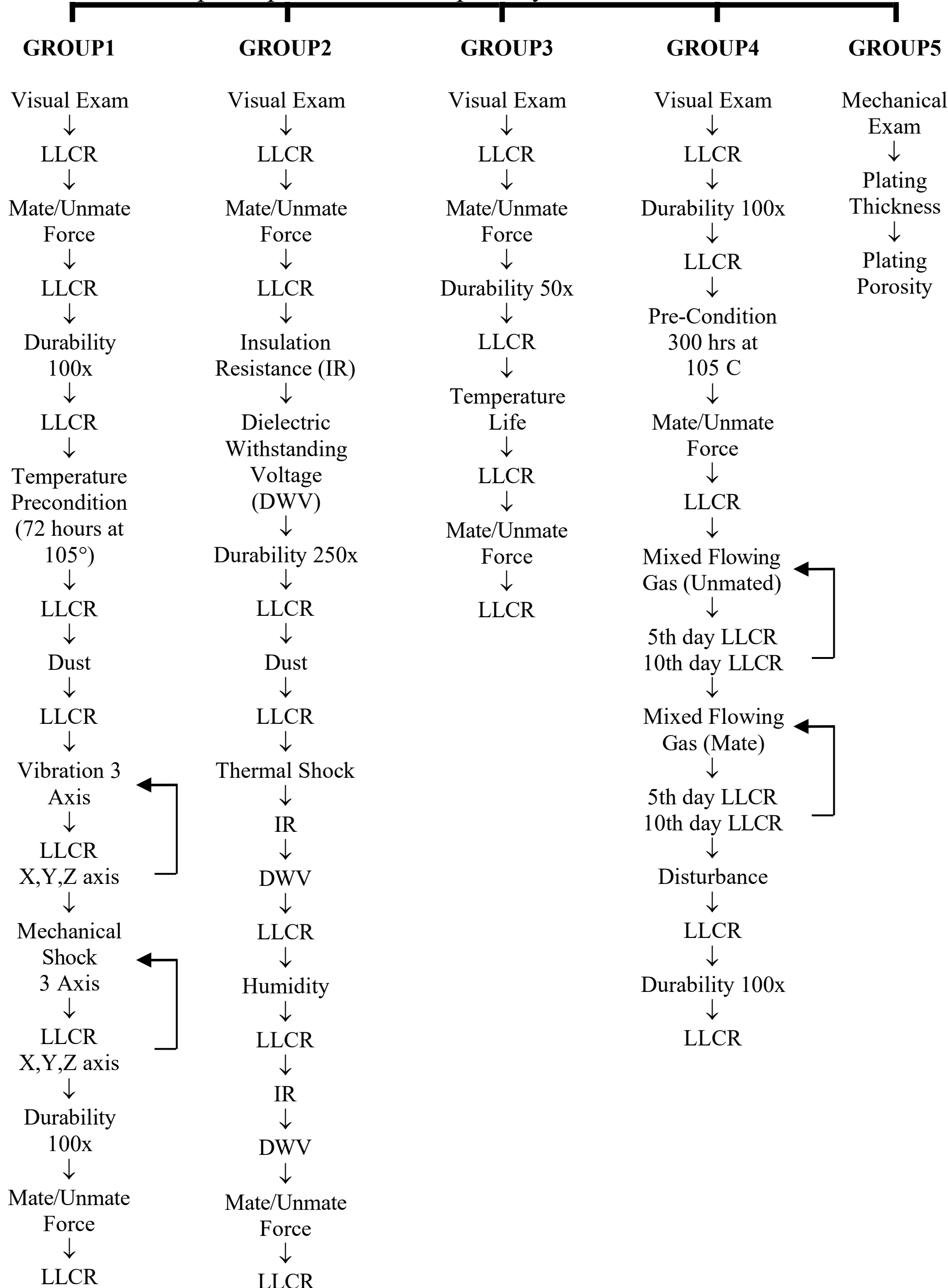

FIGURE 1, Telcordia Test Plan GR-1217-CORE, CENTRAL OFFICE

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13.2 Each test group will have a minimum 200 LLCR measurements.

13.3 Definitions

13.3.1 LLCR- Low Level Contact Resistance
13.3.2 CPIR- Compliant Pin Interface Resistance
13.3.3 DWV- Dielectric Withstanding Voltage
13.3.4 IR- Insulation Resistance

14.0 RESISTANCE MEASUREMENT SET-UP

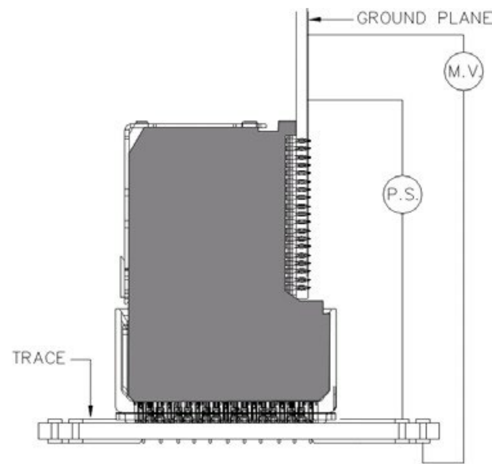

FIGURE 2. Typical contact resistance set-up.
Kelvin 4 wire traces from connector hole to monitoring hole.

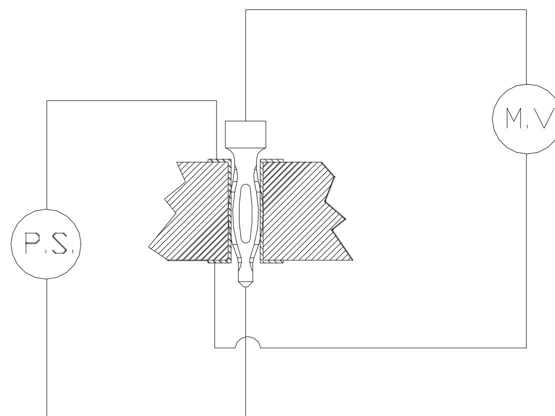

FIGURE 3. Typical compliant pin interface resistance (CPIR) set-up.

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