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Evaluation of VITA 46 R-VPX Evolution 2 series connectors to product standards	Revision #:	A
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Distribution List:

Revision History

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Summary

1.1. Purpose of Test

Testing was performed on Amphenol's R-VPX Evolution 2 (EVO2) ruggedized VITA 46 connector to determine if its performance meets or exceeds the requirements of the rugged Military/Aerospace market.

1.2. Product Description

The EVO2 connector is a derivative of Amphenol's previously qualified R-VPX connector, with design modifications to improve data transfer speeds, delivering in excess of 32 Gbps (Engineering report S20-0221). These connectors form a ruggedized, high-speed, board-to-board interconnect system, meeting and exceeding VITA 46 standards. This connector system gives users modularity and flexibility by utilizing PCB wafer construction with customized wafer-loading patterns, a copper alloy cantilever beam type contact system, in a rugged LCP housing. As a product derivative where the mating interface design remained unchanged (thereby establishing intermateability), several qualification tests which were deemed a test of that mating interface were "Qualified through Similarity" as listed herein.

1.3. References

The following documents were referenced for testing in this report. Unless specified, the version in effect at the time of testing shall have been followed.

- ESR-9553_rev3 (2-19-2018 Amphenol R-VPX Qualification summary)
- ESR-9702_A (2-8-2018 Amphenol R-VPX Mate/Unmate test report)
- CE15-0519 (AAO R-VPX Test plan)
- CE19-0614 (AAO EVO2 Test plan)
- CE20-0221 (AAO EVO2 Signal Integrity Test Results)
- Telecordia GR-1217-CORE
- EN-61000-4-2, Electrostatic Discharge Immunity Test
- MIL-STD-1344
- MIL-STD-810G
- EIA Publication 364
- ASTM G85

1.4. Testing Agencies

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Conclusion

The R-VPX Evolution 2 ruggedized VITA 46 connectors listed in paragraph 2.1., conform to the electrical, mechanical, and environmental performance requirements of test plan CE19-0614 which demonstrates reliable performance in the Mil/Aero market.

Samples and Test Schedule

2.1. Samples

Test specimens selected for testing were representative of normal production lots. Specimens identified with the following part numbers were used for test.

Sample	Part Number	Description	Sample Coding
EVO2 Mated pair (5) Mixed flowing gas	RVPX-PE216DM2	Vertical Backplane, 16 pos.	E24A, E24B, E24C, E24D, E24E
	RVPX-JE216MM2	Right angle daughtercard 16 pos.	
EVO2 Mated pair (3) Shock/Vibe Grp1	RVPX-PE216DM2	Vertical Backplane, 16 pos.	G1-1, G1-2, G1-3
	RVPX-JE216MM2	Right angle daughtercard 16 pos.	
EVO2 Mated pair (3) T-life/Shock/Vibe Grp2	RVPX-PE216DM2	Vertical Backplane, 16 pos.	G2-1, G2-2, G2-3
	RVPX-JE216MM2	Right angle daughtercard 16 pos.	

Table 1: Sample Description

2.2. Qualification through Similarity

There are a number of qualification requirements that are a test of the mating interface only. Since the mating interface is wholly unchanged from previously qualified product, these tests shall be considered as qualified through similarity as listed in Table 2 below and detailed in section 4 herein.

Test	Section
Safety Ground	3.14
Bench Handling	3.15
Humidity/Temperature Cycling	3.16
Salt Fog w/SO_2	3.17
Electrostatic Discharge	3.18
Current Overload	3.19

Table 2: Qualification through Similarity

2.3. Test sequence

Tests Performed	Coded Samples – Test sequence (numbers indicate order of tests)		
Sample ID ➡	E24A, E24B, E24C, E24D, E24E	G1-1, G1-2, G1-3	G2-1, G2-2, G2-3
Sample Preparation	1	1	1
LLCR	2,4,7, 14,17	3,5,7, 14	2,4,6, 8,10,17
Thermal Aging	3		
Durability	5,16	4,12	7,15
Mate/Unmate Force	6	2	5
MFG (UNMATE)	8		
LLCR 5th Day	9		
LLCR 10th Day	10		
MFG (MATED)	11		
LLCR 15th Day	12		
LLCR 20th Day	13		
Disturbance	15		
Temperature Life			3
Dust		6	9
Mechanical Shock		8	11
LLCR 1st, 2nd, 3rd Axis		9,11	12,14
Random Vibration		10	13
Mate/Unmate Force (Last Cycle)		13	16

Table 3: Test Sequence

Summary of Testing – Test Results (A) & Test Methods (B)

3.1. Initial Examination ofproduct

A. **RESULT: PASSED** - All specimens submitted for testing were representative of normal production lots. Specimens were visually examined and no evidence of physical defects detrimental to product performance was observed. (Reference 4.1 for Test Methods)

B. **METHODS:** Specimens were visually examined according to the product drawings. Parts were checked for proper assembly and mounting. Parts were checked for evidence of physical abnormality detrimental to product performance.

3.2. Low Level Contact Resistance (LLCR)

A. **RESULT: PASSED** - All low level contact resistance measurements were taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage. All measurements had a maximum average change in resistance (ΔR) of less than 5 milliohms after testing, and a maximum individual change in resistance (ΔR) of less than 10 milliohms after testing.

B. **METHODS:** LLCR measurements were performed per EIA-364-23B or MIL-STD-1344A, method 3002.1. LLCR testing was performed at the beginning of each test group to establish a baseline and after tests according to the test sequence plan. Failure is defined as a resistance increase of greater than 10 mΩ on any individual contact.

3.3. Thermal Aging

A. **RESULT: PASSED** - All specimens submitted for testing were exposed to a temperature of 105º C for 300 hours, then allowed to cool to room ambient temperature prior to measuring change in LLCR. There was no evidence of visual or physical damage and the change in LLCR was < 5 milliohm (< 10 milliohm requirement).

B. **METHODS**: The test samples were tested in accordance with TB-2023, Rev. F and EIA 364, Test Procedure 17. The samples were placed in the test chamber in the mated condition and mounted. Failure is defined as either evidence of physical damage or deterioration of the test samples after exposure or a change in LLCR of greater than 10.0 milliohms.

3.4. Dielectric Withstanding Voltage (DWV)

A. **RESULT: PASSED** - The connectors covered under this report were 100% DWV tested during an in-process production test. A passing DWV test result is indicated by a physical mark placed on the connector housing upon passing the test.

B. **METHODS:** In-Process Dielectric withstanding voltage was tested at the following parameters: 550 V AC, .1 milliamp max current, connection and LV insulation resistance of 1.0 K ohm, DC duration .01 second, Insulation resistance 10.0 M ohm, for .002 seconds, Max soak .1 second. The test is applied to all pins.

3.5. Random Vibration

A. **RESULT: PASSED** – Change in LLCR data did not exceed the +10 milliohms requirement. Following the vibration testing, no cracks, breaks, or loose parts on the specimens were visible.

B. **METHODS:** Samples underwent random vibration tests, according to EIA 364, Test Procedure 28, Test Condition V, Letter A. (Power spectral density 0.02 G^2/Hz, G 'RMS' 5.35, Frequency 50 to 2000 Hz, Duration 2 hours /axis (3 axes total). Failure is defined as evidence of physical damage to the test samples as tested, or a change in LLCR of greater than 10 milliohms.

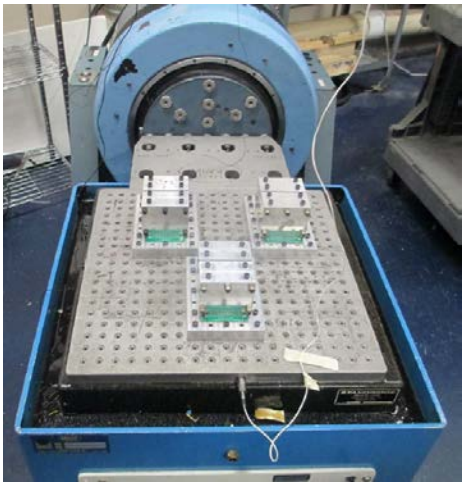

Figure 1: Vibration test set-up

3.6. Mechanical Shock

A. **RESULT: PASSED** – Change in LLCR measurements did not exceed the +10 milliohms requirement. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

B. **METHOD:** Each sample underwent shock following EIA 364, Test Procedure 27,Test Condition A, 30 g in all axes, 11 ms, 3 hits from both directions in each of 3 mutually perpendicular axes (for a total of 18 hits). Failure is defined as evidence of physical damage to the test samples as tested, or a change in LLCR of greater than 10 milliohms.

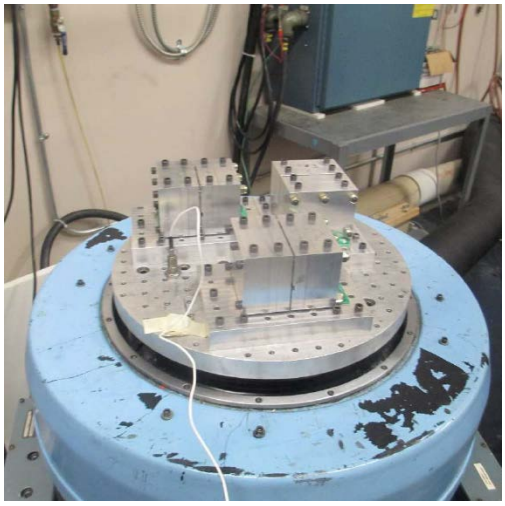

Figure 2: Mechanical Shock test set-up

3.7. Dust Contamination

A. **RESULT: PASSED** - No evidence of physical damage was visible as a result of exposure to dust particles.

B. **METHOD:** Each submitted sample underwent dust testing per EIA-364, Test Procedure 91 (Blowing Dust, particle size ranging from .01-6350 µm in a chamber of 11ft^3, with 9 grams/ft^3 of dust, 360 cfm Fan Speed, dust consisting of Silica-36%, Calcite-29%, Iron oxide-12%, Alumina-8%, Gypsum-5%, Paper fibers-3%, Cotton fibers-3%, Polyester fibers-3%, Carbon black-1%). The samples were exposed in an unmated condition. Failure is defined as evidence of physical damage to the test samples as tested, or a change in LLCR of greater than 10 milliohms.

3.8. Mixed Flowing Gas

A. **RESULT: PASSED** - All specimens submitted for testing were subjected to the environment described for 20 days total, LLCR measurements and observations taken at day 5, 10, 15, and 20. The addition of Disturbance (.1mm) and Durability cycles at the end of day 20 with LLCR measurement and observations was part of this test. There was no evidence of damage or corrosion to the test samples as a result of this test, and delta LLCR values did not exceed the 10 milliohm maximum requirement at any of the test intervals.

B. **METHOD:** The test environmental conditions were (in accordance with TB-2023, Rev. F and EIA 364, Test Procedure 65): Temperature of 30ºC ± 1ºC, Relative humidity of 70% ± 2%, Cl_2 10 ± ppb, NO_2 200 ± 50 ppb, H_2S 10 ± 5 ppb, SO_2 100 ± 20 ppb. The exposure time was 20 days and the samples were in the mated condition. At designated test intervals of 5, 10, 15, & 20 days, the specimens were removed from the test environment, allowed to stabilize to room ambient for 2 hours, tested for LLCR at signal & ground contacts, then returned to the test chamber for the next specified interval. Following completion of the final interval, the specimens were subjected to .1 mm disturbance test, LLCR, Durability of 100 cycles, and LLCR again. Failure is defined as evidence of damage or corrosion as a result of the exposure which will cause mechanical or electrical malfunction, or a ΔLLCR of more than +10 milliohms.

3.9. Temperature Life

A. **RESULT: PASSED** - All specimens submitted for testing were exposed to a temperature of 105º C for 500 hours, then allowed to cool to room ambient temperature prior to measuring change in LLCR. There was no evidence of visual or physical damage and the change in LLCR was < 10 milliohm maximum requirement.

B. **METHOD:** All specimens were tested in accordance with MIL-STD-202, Method 108, Test Condition D and EIA-364-17 Test Method A, Condition 5 (500 hours at 105º C). Failure is defined as a change in LLCR of greater than 10 milliohms after exposure.

3.10. Mating Force

A. **RESULT: PASSED** - All mating force measurements were less than 0.75 N [2.7 oz] than per contact.

B. **METHOD:** The module insertion and extraction forces were tested in accordance with EIA 364, Test Procedure 13. The test samples were attached with a fixture to the base plate of the test stand and applicable force gage. Fixturing was accomplished in a manner to prevent “bowing” of the test samples during the performance of the test, assure axial alignment, and allowed self-centering movement to exist. Forces required to mate and unmate the connectors were recorded at the specified intervals. The rate of mating and unmating was 1 inch per minute.

3.11. Unmating Force

A. **RESULT: PASSED** - All unmating force measurements were greater than 0.15 N [0.54 oz] per contact.

B. **METHOD:** The module insertion and extraction forces were tested in accordance with EIA 364, Test Procedure 13. The test samples were fixture to the base plate of the test stand and applicable force gage. Fixturing was accomplished in a manner to prevent "bowing" of the test samples during the performance of the test, assure axial alignment, and allowed self-centering movement to exist. Forces required to mate and unmate the connectors were recorded at the specified intervals were recorded. The rate of mating and unmating was 1 inch per minute.

3.12. Durability

A. **RESULT: PASSED** - No physical damage occurred as a result of mating and unmating the specimens 100 times (per durability event) for 200 total cycles.

B. **METHOD:** The test samples submitted were tested in accordance with TB-2023, Rev F. and EIA 364, Test Procedure 09. The number of cycles was 100 and the rate was 300 cycles per hour. The samples were assembled to special holding devices and attached to the automatic cycling equipment utilizing constant speed control and counter systems. The test samples were axially aligned to accomplish the mating and unmating function allowing for self-centering movement. There was no evidence of physical damage to the test samples as tested.

3.13. Final Examination of Product

A. **RESULT: PASSED** - Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

B. **METHOD:** Specimens were visually examined for evidence of physical damage detrimental to product performance and for compliance to the product drawings.

3.14. Safety Ground[1]

A. **RESULT: PASSED** – All low level contact resistance measurements, taken at 100 milliamperes maximum and 20 millivolts maximum open circuit voltage were less than 100 milliohm initially, and less than 100 milliohm after testing.

B. **METHOD:** Safety ground testing was performed using a 4 point measurement with low voltage and current. The measurement was taken across each of the three alignment pin/socket contacts. Resistance shall be less than 0.1 ohm (ref. MIL-STD-464, A5.10.4, Shock, fault, and ignitable vapor protection)

3.15. Bench Handling[1]

A. **RESULT: PASSED** – No discontinuities were detected during testing. Following mechanical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

B. **METHOD:** One group B sample was tested in accordance with MIL-STD-810F, Method 516.5, Procedure VI.

3.16. Humidity/Temperature Cycling[1]

A. **RESULT: PASSED** – No evidence of physical damage was visible as a result of humidity/temperature cycling.

B. **METHOD:** One Group C sample was exposed to humidity and temperature cycling per MIL-STD-1344A, Method 1002.2, Type III (240 hrs.). No polarizing voltage was used. The sample was in a mated condition.

3.17. Salt Fog with SO_2[1]

A. **RESULT: PASSED** – No evidence of physical damage was visible as a result of exposure.

B. **METHOD:** One Group D sample underwent Salt Fog with SO2 per ASTM G85 (Annex A4, Cycle A4.4.4.1). The test sample was exposed in the mated condition in a sheet metal container.

3.18. Electro Static Discharge(ESD)[1]

A. **RESULT: PASSED** – The submitted sample met the requirements of no discharge exceeding 20 volts to any contact measured relative to ground and no evidence of physical damage was visible as a result of testing.

B. **METHOD:** The submitted sample was tested in accordance with EN 61000-4-2. An ESD generator was used set to 8 KV and an oscilloscope was connected to a signal contact via a probe with a small diameter coax cable and the shield connected to the ground contact ground plane and to the signal contact through a 50 ohm resistor. Failure is defined as either evidence of physical damage or the discharge as stated above exceeding 20 volts to any contact measured relative to ground.

3.19. Current Overload[1]

A. **RESULT: PASSED** – The submitted sample met the requirements of less than a 25% increase in LLCR as specified and no evidence of physical damage as desrcibed was visible as a result of testing.

B. **METHOD:** The Group G samples were tested per IEC 60512-3. The current overload was done on both signal contacts (1 sample) and power contacts (1 sample), for two time periods; 5 minutes (at 150% of rated current) and 2 hours (at 125% of rated current). The samples were mated but without a mounting substrate. There was no electroplate peeling or discoloration. The allowable LLCR value after current overload is a 25% increase over the initial value (ref. MIL-C-28754).

[1] ***Reference section 2.2 and ESR-9553_rev3***