



Vita 72 VPX Connector Update for Open Standard Module Vibration Reliability Testing

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Original VITA 46 Connector Validation

- Leveraged original testing and combined with most extreme military environments.
- Need to test at higher data rates to capture short term opens (picoseconds)





Evidence of fretting corrosion from original VITA tests



Plots and images courtesy of TE, Curtis Wright and Contech Research

VPX RT2 Reliability Challenges...

- Mercury performed endurance random vibration on standard VPX RT2 connectors (VITA 46) and Viper connectors (VITA 60).
 - Exceptionally high bit errors were measured midway through the Z-axis random vibration test on the RT2 Connectors
 - LLCR measurements rose dramatically at the same time on the RT2
 - Note: Test fixture was a bolted structure lacking adequate stiffness
 - Test was run @ 2.5 G-baud and 3.125 G-baud
- Mercury engaged TE to address the issues J.R. & D.M.
 - A cross functional team was formed at each company to review the current connector design failure data
 - A VPX Connector Test plan was generated to compare existing connector designs and alternatives to the standard VPX solution.
- The RT2 connector upgrade was initiated.

Original Test Plan Overview for Vita 72

- Testing compares performance of OPEN VPX connectors in a VITA 48.2 conduction cooled rugged environment
- VPX Backplane and XMC connectors (42 60) were subjected to rugged vibration according to the test schedule shown below
- Connectors evaluated on LLCR measurements, bit error rate, and mechanical performance (high magnification inspection)
 - BER testing performed at 6.25 G-baud

Test 1	Duration/ Exposure	Test 2	Duration/ Exposure	Test 3	Duration/ Exposure
Random Vibe L3	1 hour/axis	Random Vibe L3 +3dB	1 hour/axis	Random Vibe L3 +3db	12 hour z-axis only

Reference Mercury PN: DOC TPN-10009

Test Backplane Design Overview

- Supports 7 differential pair signals
- 0.250 inch thick, 30 layer PCB
 - 1st Resonance @ 944 Hz (Analysis)



LLCR Headers 1 Header is a complete loop (pin 1 to pin 2)

SMA conns 4 SMAs complete 1 differential pair loop

Schematic Interconnect Block Diagram

Hi-speed signal traces



All signals loop back through the payload/carrier card

Schematic Interconnect Block Diagram

SINGLE ENDED SIGNALS



All signals loop back through the payload/carrier card

Test Configuration for VITA 48.2 VPX C/C Test

Viper, Tyco and Tyco Extreme Coldplate complete with wedgelocks and hardware: 3.08 lb (1.395 kg)		
Coldplate complete with wedgelocks and hardware: 3.08 lb (1.395 kg)		
Bare board: 0.22 lb (0.100 kg)		
Viper connector P/N: 400-1058-02 Weight: 0.43 lb (0.195 kg)		
Tyco connector P/N: 400-1058-01 Weight: 0.143 lb (0.065kg)		
Tyco Extreme connector P/N: 400-1058-03 Weight: 0.37 lb (0.168 kg)		
USB port to communicate with laptop computer.		
Used to program and run the BER device and monitor the UUT through the USB ports.		
Altera Statix IV v9.0.; Mercury Signal integrity test software		



6U CARRIER & COLDPLATES

- Conforms to VITA 48.2
 - Uses secondary side wedgelocks
- Simplified packaging that mimics standard conduction cooled module design
- Carrier card supports two XMC cards – centered





Vibration Test Fixture Assembly

Design leveraged from previous VITA 46 testing







Vibration Fixture FEA Analysis

- Machined from solid block of aluminum
 - 6061-T6
- Calculated Fixture 1st mode resonance of Fixture @ 6225Hz







Mercury VPX 3.125 G-Baud Signal Verification Test during "Rugged" Vibration



Extreme Vibration Test Setup



VPX Connector Vibration Profiles

- Tested per MIL-STD-810F, Method 514.5
- Extended Duration Random Vibration Testing will be conducted
 - 1 hour per orthogonal axis at Mercury RL3 standard profile
 - 1 hour per orthogonal axis at Mercury RL3 + 3dB standard profile
 - 12 hours, Z-axis only @ +3dB over Mercury RL3 standard profile
- Failure Analysis includes high resolution / SEMS photos of contact mating surfaces on all connectors for visual comparison



Electrical – Mechanical Test Execution Overview

- Loopback differential pairs from backplane and back across mated connectors (examining multiple transitions across connectors)
- Carrier Conduction-Cooled Cold Plate Design (1st mode ~500 Hz +)
- Altera Stratix IV FPGA test station used to generate and record signals
 - Up to 7 simultaneous Channels
 - Up to 8 Gbps (test run at 6.25 Gbps)
 - GUI interface. Records error rates. Can set drive levels.
- Low level contact resistance (LLCR) measurements taken before and after each test.
- Random Vibration environment only
- TE performed long term wear tests on the contacts to simulate 20,000 insertion and extractions





Test Results Overview



2012 Mercury Computer Systems, Inc

Extreme Fretting Corrosion & Contact Wear – RT2

Exposed PWB. Contacts wore through Gold, Nickel, & Copper pads on wafer





Vita 60 Viper Micro Action Fretting Corrosion

 Viper had signs of fretting corrosion, but performed substantially better in the original Extreme Vibration Testing





Comparison between worst wear spot from example samples



Wafer Wafer 50 µin Wafer 30 µin Wafer Guide Nickel pad gold gold Test Sample # Housing Fit hardware length thickness thickness Notes Date Contact thickness location 2/22/2012 Standard Tightened 'A" Standard Standard all positions 150 µin 1 1 none 3/1/2012 RT2-R Tightened "B" Standard P2, P6 150 µin 2 test cables failed 2 Standard P0,1,3,4,5 3/26/2012 Standard Standard Standard Baseline 3 Standard all positions none 150 µin 1 4 4/18/2012 RT2-R Standard Ruggedized Standard P0,1,2,4,5,6 **P**3 150 µin 1



RT2-R Improved Contact Design



- 4 Points of connector contact
- Contacts have different insertion mode displacement to impact Backplane bowing

Vita 72 VPX Test Overview Summary

- Vita 46/48 RT2 "R"BER results: Pass
- Vita 60 Viper BER results: Pass
- Vita 46/48 RT2 "R"LLCR results: Pass
- Vita 60 Viper LLCR results: Pass
- Vita 46/48 RT2 "R" Fretting Corrosion results: Pass
- Vita 60 Viper Fretting Corrosion results: Some Fretting Exists

Vita 72 VPX RT2 "R" Test Overview Summary

- Vita 46/48 RT2-R design provides:
 - Lower insertion force (~ 8%+ less insertion force)
 - Reduced Backplane Bowing
 - Increased Extreme Vibration Reliability
 - Performs at higher data rates (5 & 6.25 G-Baud) in rugged environments
 - Backwards/Forwards compatible with all existing VPX infrastructure
 - Intermatable
 - Intermountable
- Vita 46 46/48 60 63 Next Steps...
 - Execute Connector testing as they are available
 - Execute Test at PCIE 3.0 Data Rates (8 G-Baud)
 - Execute Test at 10KR Data Rates (10.3125 G-Baud)
 - Publish results under NDA's





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Questions ???

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