Advanced Accelerator Adapter Compliance

25G I/O Test Harness and Test Suite

Workgroup Specification
Revision 1.0 (February 14, 2019)
Advanced Accelerator Adapter Compliance: 25G I/O Test Harness and Test Suite

Compliance Work Group<compliance-chair@openpowerfoundation.org>
OpenPower Foundation

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Abstract

The purpose of the OpenPOWER Advanced Accelerator Adapter Compliance: 25G I/O Test Harness and Test Suite (TH/TS) Specification is to provide the test suite requirements to be able to demonstrate OpenPOWER Advanced Accelerator Adapter 25G I/O compliance for POWER9™ systems.

This document is a Standard Track, Work Group Specification work product owned by the Compliance Workgroup and handled in compliance with the requirements outlined in the OpenPOWER Foundation Work Group (WG) Process document. It was created using the Master Template Guide version 1.0.0. Comments, questions, etc. can be submitted to the public mailing list for this document at <openpower-25gio-thts@mailinglist.openpowerfoundation.org>.
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Preface

1. Conventions

The OpenPOWER Foundation documentation uses several typesetting conventions.

Notices

Notices take these forms:

- **Note**
  A handy tip or reminder.

- **Important**
  Something you must be aware of before proceeding.

- **Warning**
  Critical information about the risk of data loss or security issues.

Changes

At certain points in the document lifecycle, knowing what changed in a document is important. In these situations, the following conventions will be used.

- **New text will appear like this.** Text marked in this way is completely new.

- **Deleted text will appear like this.** Text marked in this way was removed from the previous version and will not appear in the final, published document.

- **Changed text will appear like this.** Text marked in this way appeared in previous versions but has been modified.

Command prompts

In general, examples use commands from the Linux operating system. Many of these are also common with Mac OS, but may differ greatly from the Windows operating system equivalents.

For the Linux-based commands referenced, the following conventions will be followed:

- **$ prompt** Any user, including the root user, can run commands that are prefixed with the $ prompt.

- **# prompt** The root user must run commands that are prefixed with the # prompt. You can also prefix these commands with the sudo command, if available, to run them.
Document links

Document links frequently appear throughout the documents. Generally, these links include a text for the link, followed by a page number in parenthesis. For example, this link, Preface [v], references the Preface chapter on page v.

2. Document change history

This version of the guide replaces and obsoletes all earlier versions.

The following table describes the most recent changes:

<table>
<thead>
<tr>
<th>Revision Date</th>
<th>Summary of Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 4, 2019</td>
<td>• Updated Abstract and Intro to be consistent and use the title of the document</td>
</tr>
<tr>
<td></td>
<td>• Rev 1.0 - Advanced Accelerator Adapter Compliance: 25G I/O Test Harness and Test Suite Rev 1.0 - Approved Specification</td>
</tr>
<tr>
<td>August 22, 2018</td>
<td>• Rev 1.0-pre5 - Updates identified at the June 28, 2018 Compliance Work Group meeting</td>
</tr>
<tr>
<td>June 22, 2018</td>
<td>• Rev 1.0-pre4 - Updates to fill in missing content</td>
</tr>
<tr>
<td>May 23, 2018</td>
<td>• Rev 1.0-pre3 - Updates discussed at 4/26/2018 Compliance Work Group meeting</td>
</tr>
<tr>
<td>April 25, 2018</td>
<td>• Rev 1.0-pre2 - initial content draft</td>
</tr>
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</table>
1. Introduction

The purpose of the OpenPOWER Advanced Accelerator Adapter Compliance: 25G I/O Test Harness and Test Suite (TH/TS) Specification is to provide the test suite requirements to be able to demonstrate OpenPOWER Advanced Accelerator Adapter 25G I/O compliance for POWER9™ systems. It contains the following chapters:

- Chapter describing the Mezzanine Adapter Card compliance
- Chapter describing the Cabled Interface Extension compliance
- Chapter describing compliance with the 25Gbit/sec Electrical Channel

Each chapter contains the following:

- Section describing the test harness needed to execute the test suite
- Section describing the tests required to be in the test suite
- Section describing the successful execution of the test suite, including what it means for an optional feature to fail

The input to this specification is the following specification:

*OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* which describes electro-mechanical specification for advanced accelerator adapters within the OpenPOWER ecosystem supported by IBM® POWER9

There are two accelerator approaches for the 25Gbit/sec interface and the compliance for each approach is defined in this document. The first approach is a Mezzanine Adapter Card which is attached to the system planar via two connectors. The Mezzanine Adapter Card for OpenPOWER systems based on the POWER9 processor attaches to the 25Gbit/sec interface native to the POWER9 and plugs into the mezzanine card connectors. The following figure shows a Mezzanine Adapter Card.

**Figure 1.1. Mezzanine Adapter Card**

The second approach is a Cabled Interface Extension to an adapter card. It uses a PCIe card as an example but the cabled extension does not require the adapter card be PCIe. POWER9 platforms
support the optional cabling of the 25Gbit/sec Advanced Accelerator Interface to the advanced accelerator adapter in a riser card plugged into a PCIe slot in the same system. In addition, the adapter could be located in different drawer of the rack. The following figure shows a Cabled Interface Extension.

Figure 1.2. Cabled Interface Extension

1.1. Conformance to this Specification

The following lists a set of numbered conformance clauses to which any implementation of this specification must adhere in order to claim conformance to this specification (or any optional portion thereof):

1. For a Mezzanine Adapter Card, the required tests in the Mezzanine Adapter Card Test Suite Section and in the 25Gbit/sec Electrical Channel Section must be successfully executed.

2. For a Cabled Interface Extension implementation, the required tests in the Cabled Interface Extension Test Suite Section and in the 25Gbit/sec Electrical Channel Section must be successfully executed.

3. For a Mezzanine Adapter Card, the optional tests that are implemented in the Mezzanine Adapter Card Test Suite Section and in the 25Gbit/sec Electrical Channel Section must be successfully executed.

4. For a Cabled Interface Extension implementation, the optional tests that are implemented in the Cabled Interface Extension Test Suite Section and in the 25Gbit/sec Electrical Channel Section must be successfully executed.
2. Mezzanine Adapter Card Test Harness and Test Suite

The purpose of this chapter is to provide the test suite requirements to be able to demonstrate OpenPOWER Mezzanine Adapter Card compliance. The Mezzanine Adapter Card Test Harness and Test Suite are defined for testing the correct implementation of the Mezzanine Adapter Card taking into account the system mechanical requirements and the system electrical requirements.

2.1. Test Harness to Execute the Mezzanine Adapter Card Test Suite

The Mezzanine Adapter Card Test Harness or any other test harness should follow the methodology to ensure the checks are done prior to the card release and tests are run in the lab after the card is manufactured, to ensure it matches the OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification mechanical details in Section 2 and electrical details in Section 3.

2.2. Mezzanine Adapter Card Test Suite Required Tests

The Mezzanine Adapter Card test suite required tests should include the following:

- Design rule check, electrical rule check, and simulation rule check
- Lab analysis with clock measurements, signal integrity verification, RX analysis, TX analysis, BER measurements, and packaging tests

2.3. Mezzanine Adapter Card Test Suite Optional Tests

The following are suggested, but considered optional:

- Schematics review
- High speed bus topology review
- Logic review including attention to polarity reversal and lane swaps
- Pre-layout review including board stackup review and impedance verification
- Physical design review
- Post-layout review to ensure signal integrity rules are followed, high speed bus review (max length, number of vias, crosstalk spacing, skew), reference plane coverage
- Signal integrity simulation
2.4. Successful Execution of Mezzanine Adapter Card Required Tests

All lab analysis and measurements should demonstrate operating within the expected values in the OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification mechanical details in section 2 and electrical details in section 3.

2.5. Successful Execution of Mezzanine Adapter Card Optional Tests

All lab analysis and measurements should demonstrate operating within the expected values in the OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification mechanical details in section 2 and electrical details in section 3.
3. Cabled Interface Extension Test Harness and Test Suite

The purpose of this chapter is to provide the test suite requirements to be able to demonstrate OpenPOWER Cabled Interface Extension compliance. The Cabled Interface Extension Test Harness and Test Suite are defined for testing the correct implementation of the Cabled Interface Extension taking into account the POWER9 advanced accelerator cable interface and the advanced accelerator cable.

3.1. Test Harness to Execute the Cabled Interface Extension Test Suite

The Cabled Interface Extension Test Harness or any other test harness should follow the methodology to ensure the checks are done prior to the card release and tests are run in the lab after the PCIe Carrier Card and cable are manufactured, to ensure it matches the OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification POWER9 Advanced Accelerator Cable Interface details in Section 4.1 and Advanced Accelerator Cable details in section 4.2.

3.2. Cabled Interface Extension Test Suite Required Tests

The Cabled Interface Extension test suite required tests should include the following:

- Design rule check, electrical rule check, and simulation rule check
- Lab analysis with clock measurements, signal integrity verification, RX analysis, TX analysis, BER measurements, and packaging tests

3.3. Cabled Interface Extension Test Suite Optional Tests

The following are suggested, but considered optional:

- Schematics review
- High speed bus topology review
- Logic review including attention to polarity reversal and lane swaps
- Pre-layout review including board stackup review and impedance verification
- Physical design review
- Post-layout review to ensure signal integrity rules are followed, high speed bus review (max length, number of vias, crosstalk spacing, skew), reference plane coverage
- Signal integrity simulation

### 3.4. Successful Execution of Cabled Interface Extension Required Tests

All lab analysis and measurements should demonstrate operating within the expected values in the *OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* POWER9 Advanced Accelerator Cable Interface details in section 4.1 and Advanced Accelerator Cable details in section 4.2.

### 3.5. Successful Execution of Cabled Interface Extension Optional Tests

All lab analysis and measurements should demonstrate operating within the expected values in the *OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* POWER9 Advanced Accelerator Cable Interface details in section 4.1 and Advanced Accelerator Cable details in section 4.2.
4. 25Gbit/sec Electrical Channel Test Harness and Test Suite

The purpose of this chapter is to provide the test suite requirements to be able to demonstrate OpenPOWER 25Gbit/sec Electrical Channel compliance. The 25Gbit/sec Electrical Channel Test Harness and Test Suite are defined for testing the OIF CEI 28G Compliance, including

- Data dependent jitter measurement from CEI 28G SR,
- Endpoint compliance TX jitter models for channel simulation, and
- Receiver compliance.

The range of channel designs encountered when interfacing to the POWER9_25Gigabit PHY are expected to deviate somewhat from the Industry Standard Specs of OIF CEI 28G VSR and OIF CEI 28G SR. These channels will be greater in loss than the Industry Standard Spec of OIF CEI 28G VSR and less in loss than OIF CEI 28G SR. All compliance testing done for OIF CEI 28G SR is directly applicable and does not need to be repeated. If the endpoint PHY is SR compliant the endpoint PHY most likely has more RX equalization than would be optimal but should be adequate. The rational is as follows:

- The channel loss C4 to C4 is specified at 21 dB.
- The OIF CEI 28G VSR specifies the loss at 10dB module-module.
- If a token 3 dB per endpoint (module to c4) is assumed then the equivalent VSR C4 to C4 result would be 16dB. A loss of 16dB is typically CTLE equalizable.
- Assuming SR wire length adds another 5 dB if you use the same token 3dB per end giving the resultant to be 21dB.

Note

To ensure operating margin the endpoint IP provider is strongly suggested to simulate the full channel model in their simulator of choice. See OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification Section 7.1 for more details.

4.1. Test Harness to Execute the 25Gbit/sec Electrical Channel Test Suite

The Test Harness for verifying the 25Gbit/sec Electrical Channel includes using a high-resolution oscilloscope, time interval analyzer, or other instrument with equivalent capability. This will enable data dependent jitter measurement from CEI 28G SR, endpoint compliance TX jitter models for channel simulation, and receiver compliance.

4.2. 25Gbit/sec Electrical Channel Test Suite Required Tests

The 25Gbit/sec Electrical Channel Test Harness or any other test harness should test
• The Data Dependent Jitter (DDJ) measurement from CEI 28G SR as described in *OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* Section 7.2.

• Endpoint compliance TX jitter models for channel simulation as described in *OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* Section 7.3.

• Receiver Compliance as described in *OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* Section 7.4.

### 4.3. 25Gbit/sec Electrical Channel Test Suite Optional Tests

The 25Gbit/sec Electrical Channel Test Harness or any other test harness should test optional tests. There are no optional tests defined.

### 4.4. Successful Execution of 25Gbit/sec Electrical Channel Required Tests

All lab analysis and measurements should demonstrate operating within the expected values in the *OpenPOWER Advanced Accelerator Adapter: Electro-Mechanical Specification* Data Dependent Jitter (DDJ) measurement from CEI 28G SR in section 7.2, Endpoint compliance TX jitter models for channel simulation in section 7.3, and Receiver Compliance in section 7.4.

### 4.5. Successful Execution of 25Gbit/sec Electrical Channel Optional Tests

There are no optional tests defined.
Appendix A. OpenPOWER Foundation overview

The OpenPOWER Foundation was founded in 2013 as an open technical membership organization that will enable data centers to rethink their approach to technology. Member companies are enabled to customize POWER CPU processors and system platforms for optimization and innovation for their business needs. These innovations include custom systems for large or warehouse scale data centers, workload acceleration through GPU, FPGA or advanced I/O, platform optimization for SW appliances, or advanced hardware technology exploitation. OpenPOWER members are actively pursuing all of these innovations and more and welcome all parties to join in moving the state of the art of OpenPOWER systems design forward.

To learn more about the OpenPOWER Foundation, visit the organization website at openpowerfoundation.org.

A.1. Foundation documentation

Key foundation documents include:

- Bylaws of OpenPOWER Foundation
- OpenPOWER Foundation Intellectual Property Rights (IPR) Policy
- OpenPOWER Foundation Membership Agreement
- OpenPOWER Anti-Trust Guidelines

More information about the foundation governance can be found at openpowerfoundation.org/about-us/governance.

A.2. Technical resources

Development resources fall into the following general categories:

- Foundation work groups
- Remote development environments (VMs)
- Development systems
- Technical specifications
- Software
- Developer tools

The complete list of technical resources are maintained on the foundation Technical Resources web page.
A.3. Contact the foundation

To learn more about the OpenPOWER Foundation, please use the following contact points:

- General information -- <info@openpowerfoundation.org>
- Membership -- <membership@openpowerfoundation.org>
- Technical Work Groups and projects -- <tsc-chair@openpowerfoundation.org>
- Events and other activities -- <admin@openpowerfoundation.org>
- Press/Analysts -- <press@openpowerfoundation.org>

More contact information can be found at openpowerfoundation.org/get-involved/contact-us.