SFF-TA-1017

Specification for

Test Board Specification for SFF-TA-1002 Straight Connector

Rev 1.0 June 19, 2020

SECRETARIAT: SFF TA TWG
This specification is made available for public review at http://www.snia.org/sff/specifications. Comments may be submitted at http://www.snia.org/feedback. Comments received will be considered for inclusion in future revisions of this specification.

The description of the connector test board in this specification does not assure that the specific component test board is available from connector test board suppliers. If such a connector test board is supplied, it should comply with this specification to achieve interoperability between suppliers and consistent.

This specification provides a common reference for host systems manufacturers, host system integrators, and device suppliers. This specification originates from the Gen Z Consortium and supersedes their prior documents.

ABSTRACT: This specification defines the SFF-TA-1002 Straight Connector Test Board. This document specifies a metrology grade characterization board that uses the 1C input/output (I/O) portion of an SFF-TA-1002 connector to determine high-speed electrical compliance. The test vehicle enables connectors to be tested using the same methodology and uniform hardware. This specification does not define a hot-plug test vehicle and is not intended to test every high-speed pair in every connector section.

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Intellectual Property

The user's attention is called to the possibility that implementation of this specification may require the use of an invention covered by patent rights. By distribution of this specification, no position is taken with respect to the validity of a claim or claims or of any patent rights in connection therewith.
This specification is considered SNIA Architecture and is covered by the SNIA IP Policy and as a result goes through a request for disclosure when it is published. Additional information can be found at the following locations:

- Results of IP Disclosures: http://www.snia.org/sffdisclosures
- SNIA IP Policy: http://www.snia.org/ippolicy

Suggestions for revisions should be directed to http://www.snia.org/feedback/.

Foreword

The development work on this specification was done by the SNIA SFF TWG, an industry group. Since its formation as the SFF Committee in August 1990, the membership has included a mix of companies which are leaders across the industry.

For those who wish to participate in the activities of the SFF TWG, the signup for membership can be found at http://www.snia.org/sff/join.

Revision History

Rev 1.0 *June 19, 2020*:
-Initial Release

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1. Scope

This specification defines a metrology grade characterization board that uses the 1C input/output (I/O) portion of a SFF-TA-1002 connector to determine high-speed electrical compliance. The test vehicle enables connectors to be tested using the same methodology and uniform hardware.

This specification does not define a hot-plug test vehicle and is not intended to test every high-speed pair in every connector section.

2. References and Conventions

2.1 Industry Documents

The following documents are relevant to this specification:

- ASME Y14.5 Dimensioning and Tolerancing
- REF-TA-1011 Cross Reference to Select SFF Connectors
- SFF-TA-1002 Protocol Agnostic Multi-Lane High Speed Connector
- SFF-TA-1009 Enterprise and Datacenter SSD Pin and Signal Specification
- SFF-TA-1018 Test Board Specification for SFF-TA-1002 Right Angle Connector
- SFF-TA-1019 Test Board Specification for SFF-TA-1002 Straddle Mount Connector
- SFF-TA-1020 Cables and Connector Variants Based on SFF-TA-1002

2.2 Sources

The complete list of SFF documents which have been published, are currently being worked on, or that have been expired by the SFF Committee can be found at http://www.snia.org/sff/specifications. Suggestions for improvement of this specification will be welcome, they should be submitted to http://www.snia.org/feedback.

Copies of ASME standards may be obtained from the American Society of Mechanical Engineers (https://www.asme.org).

2.3 Conventions

The following conventions are used throughout this document:

DEFINITIONS
Certain words and terms used in this standard have a specific meaning beyond the normal English meaning. These words and terms are defined either in the definitions or in the text where they first appear.

ORDER OF PRECEDENCE
If a conflict arises between text, tables, or figures, the order of precedence to resolve the conflicts is text; then tables; and finally figures. Not all tables or figures are fully described in the text. Tables show data format and values.

DIMENSIONING CONVENTIONS
The dimensioning conventions are described in ASME-Y14.5, Geometric Dimensioning and Tolerancing. All dimensions are in millimeters, which are the controlling dimensional units (if inches are supplied, they are for guidance only).

NUMBERING CONVENTIONS
The ISO convention of numbering is used (i.e., the thousands and higher multiples are separated by a space and a period is used as the decimal point). This is equivalent to the English/American convention of a comma and a period.

American	French	ISO
0.6	0,6	0.6
1,000	1 000	1 000
1,323,462.9	1 323 462,9	1 323 462.9

3. Keywords, Acronyms, and Definitions

For the purposes of this document, the following keywords, acronyms, and definitions apply.

3.1 Keywords

May/ may not: Indicates flexibility of choice with no implied preference.

Obsolete: Indicates that an item was defined in prior specifications but has been removed from this specification.

Optional: Describes features which are not required by the SFF specification. However, if any feature defined by the SFF specification is implemented, it shall be done in the same way as defined by the specification. Describing a feature as optional in the text is done to assist the reader.

Prohibited: Describes a feature, function, or coded value that is defined in a referenced specification to which this SFF specification makes a reference, where the use of said feature, function, or coded value is not allowed for implementations of this specification.

Reserved: Defines the signal on a connector contact [when] its actual function is set aside for future standardization. It is not available for vendor specific use. Where this term is used for bits, bytes, fields, and code values; the bits, bytes, fields, and code values are set aside for future standardization. The default value shall be zero. The originator is required to define a Reserved field or bit as zero, but the receiver should not check Reserved fields or bits for zero.

Restricted: Refers to features, bits, bytes, words, and fields that are set aside for other standardization purposes. If the context of the specification applies the restricted designation, then the restricted bit, byte, word, or field shall be treated as a reserved bit, byte, word, or field (e.g., a restricted byte uses the same value as defined for a reserved byte).

Shall: Indicates a mandatory requirement. Designers are required to implement all such mandatory requirements to ensure interoperability with other products that conform to this specification.

Should: Indicates flexibility of choice with a strongly preferred alternative.

Vendor specific: Indicates something (e.g., a bit, field, code value) that is not defined by this specification. Specification of the referenced item is determined by the manufacturer and may be used differently in various implementations.

3.2 Acronyms and Abbreviations

AIC: Add-In Card
AFR: Automatic Fixture Removal
DDIL: Differential Insertion Loss
DDRL: Differential Return Loss
DUT: Device Under Test
IL: Insertion Loss
HCB: Host Compliance Board
MCB: Module Compliance Board
PCB: Printed Circuit Board
PSFEXT: Power Sum Far End Crosstalk
PSNEXT: Power Sum Near End Crosstalk
PTH: Plated Through Hole
RL: Return Loss
SDD11: Input Differential Return Loss Measurement when using 4 port VNA
SDD12: Output Differential Insertion Loss Measurement when using 4 port VNA
SDD21: Input Differential Insertion Loss Measurement when using 4 port VNA
SDD22: Output Differential Return Loss Measurement when using 4 port VNA
SMT: Surface Mount Technology
SOLT: Short, Open, Load, Thru
TDR: Time Domain Reflectometry
VNA: Vector Network Analyzer

3.3 Definitions

Alignment guides: A term used to describe features that pre-align the two halves of a connector interface before electrical contact is established. Other common terms include: guide pins, guide posts, blind mating features, mating features, alignment features, and mating guides.

Connector: Each half of an interface that, when joined together, establish electrical contact and mechanical retention between two components. In this specification, the term connector does not apply to any specific gender; it is used to describe the receptacle, the plug or the card edge, or the union of receptacle to plug or card edge. Other common terms include: connector interface, mating interface, and separable interface.

Contact mating sequence: A term used to describe the order of electrical contact established/ terminated during mating/un-mating. Other terms include: contact sequencing, contact positioning, mate first/break last, EMLB (early mate late break) staggered contacts, and long pin/short pin.

Contacts: A term used to describe connector terminals that make electrical connections across a separable interface.

Module: In this specification, module may refer to a plug assembly at the end of a copper (electrical) cable (passive or active), an active optical cable (AOC), an optical transceiver, or a loopback.

Plug: A term used to describe the connector that contains the penetrating contacts of the connector interface as shown in Figure 3-1. Plugs typically contain stationary contacts. Other common terms include male, pin connector, and card edge.

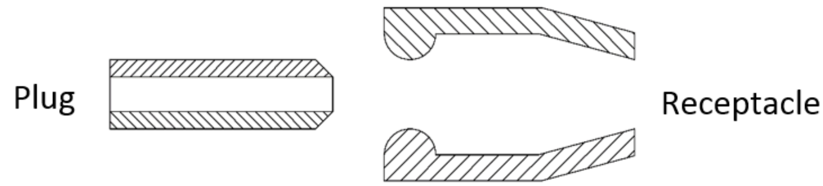

Figure 3-1: Plug and Receptacle Definition

Plated through hole termination: A term used to describe a termination style in which rigid pins extend into or through the PCB. Pins are soldered to keep the connector or cage in place. Other common terms are through hole or PTH.

Receptacle: A term used to describe the connector that contains the contacts that accept the plug contacts as shown in Figure 3-1. Receptacles typically contain spring contacts. Other common terms include female and socket connector.

Straight: A term used to describe a connector design where the mating direction is parallel to the bulk cable.

Surface mount: A term used to describe a termination style in which solder tails sit on pads on the surface of a PCB and are then soldered to keep the connector or cage in place. Other common terms are surface mount technology or SMT.

Termination: A term used to describe a connector's non-separable attachment point such as [a connector contact to a bulk cable/ a cage to a PCB or flex circuit/ bulk cable to a PCB or flex circuit/ solder tail to PCB]. Common PCB terminations include: surface mount (SMT), plated through hole termination (PTH), and press fit (PF). Common cable terminations include insulation displacement contact (IDC), insulation displacement termination (IDT), wire slots, solder, welds, crimps, and brazes.

Vertical: A term used to describe a connector design where the mating direction is perpendicular to the printed circuit board upon which the connector is mounted.

Wipe: The distance a contact travels on the surface of its mating contact during the mating cycle as shown in Figure 3-2.

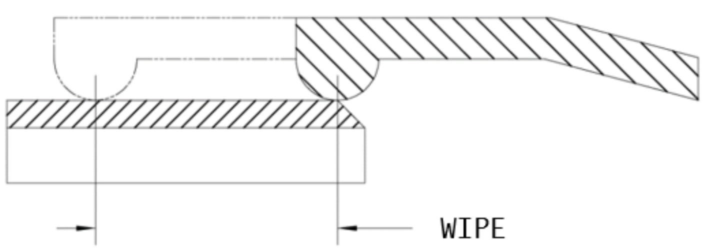

Figure 3-2: Wipe for a Continuous Contact

4. General Compliance Test Board Description

The compliance test board is intended to test the performance of the connector and footprint only. The set-up tests worst-case coupling and other electrical parameters using six differential pairs. Throughout this document the term straight will be synonymous with vertical.

4.1 Vertical Connector Test Board Design

This test board set consists of a Module Compliance Board (MCB) and a Host Compliance Board (HCB). The MCB and HCB shall be fabricated from the same PCB panel. The test board design utilizes single-ended traces with a 42.5 Ω impedance. Each trace shall be 30.5 mm in length that terminates to bulk head test points. The test point sizes shall be 2.92 mm or 2.40 mm. The 2.92 mm connector may be used for frequency measurements through 40 GHz. The 2.40 mm connector may be used for frequency measurements through 50 GHz. The total coupon size shall be as specified in *Vertical Connector Text Board Coupon Size* and illustrated in *Vertical Connector Test Board Coupon*.

Table 4-1: Vertical Connector Text Board Coupon Size

Length	159.102 mm (6.264”)
Width	100.000 mm (3.937”)
Thickness	1.57 mm (.062”)

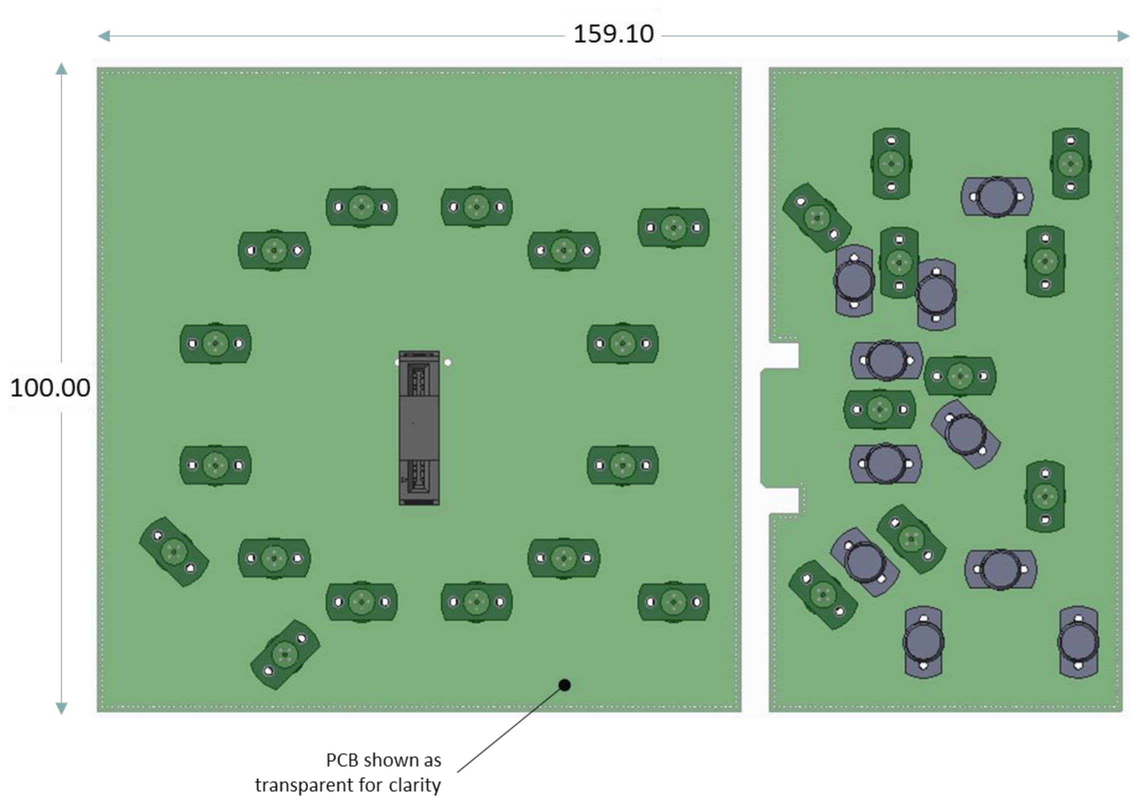

Figure 4-1: Vertical Connector Test Board Coupon

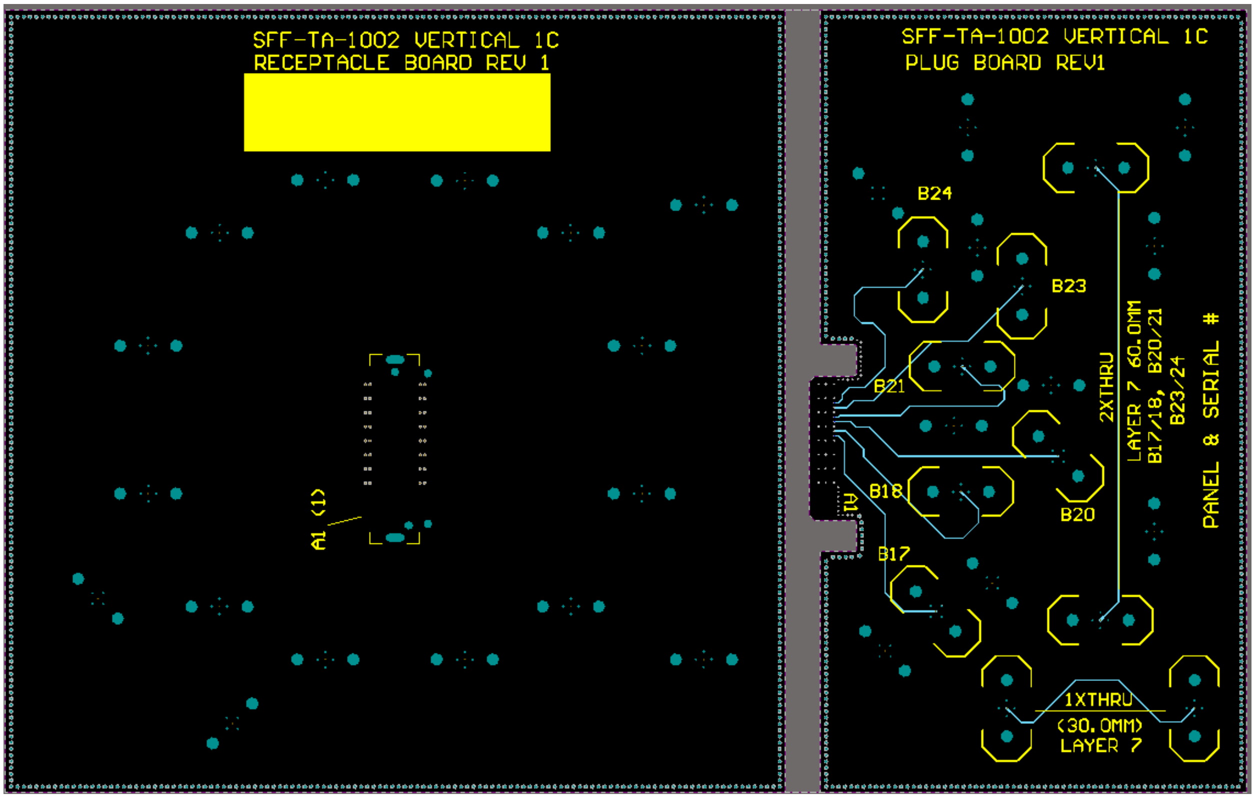

Figure 4-2: Top Side of Test Board Coupon

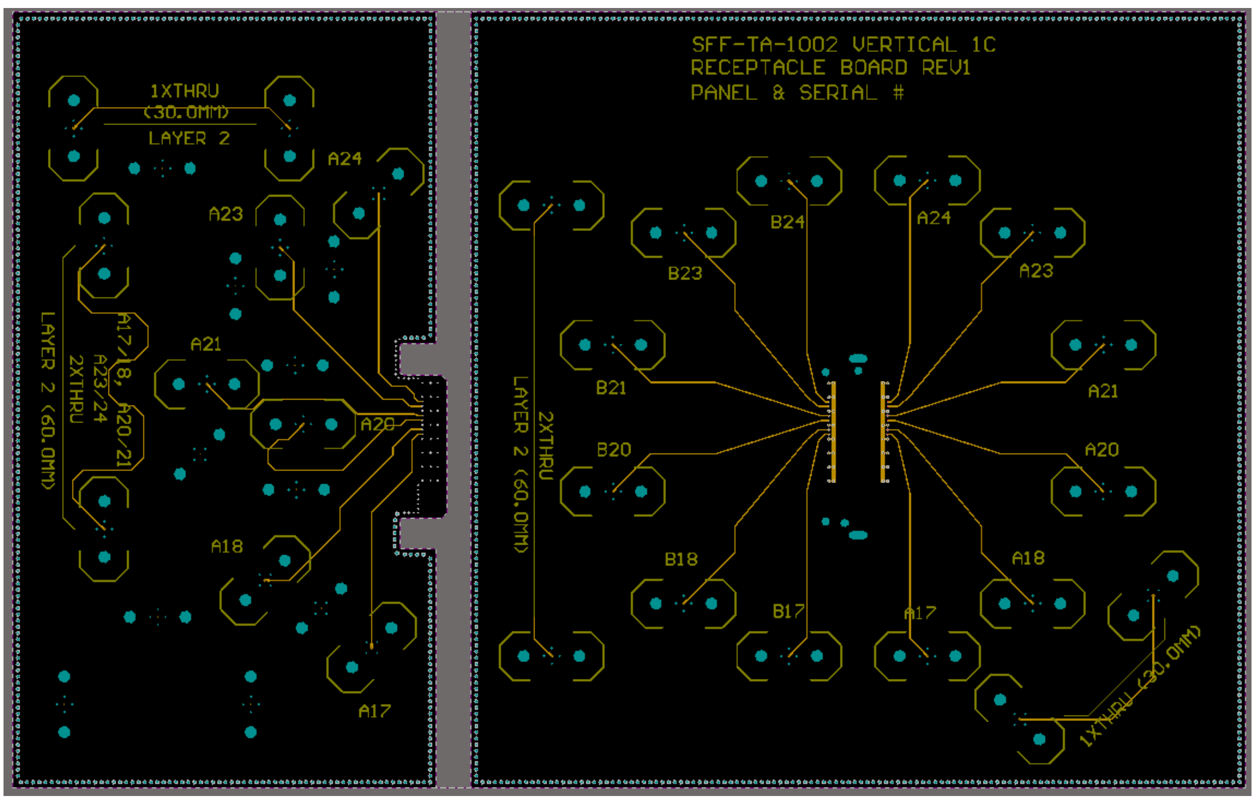

Figure 4-3: Bottom Side of Test Board Coupon

4.2 Vertical Test Board Stack-up

The test vehicle for both the MCB and HCB shall have the same stack-up. The vertical test board stack-up shall consist of 8 layers. The board material shall be Nelco 4000-13SI. The signal trace width is 7.5 mils (0.1905 mm) using ½ ounce copper weight. The board stack-up is illustrated in *Test Board Stack-Up*. Supporting Gerber package includes board stack-up and trace width details.

Developer's Note: *The supporting Gerber package includes trace width and impedance details. Should there be a contradiction between trace width and meeting impedance requirements as indicated on the Fab drawing for a PCB manufacturer the impedance requirement will take precedence.*

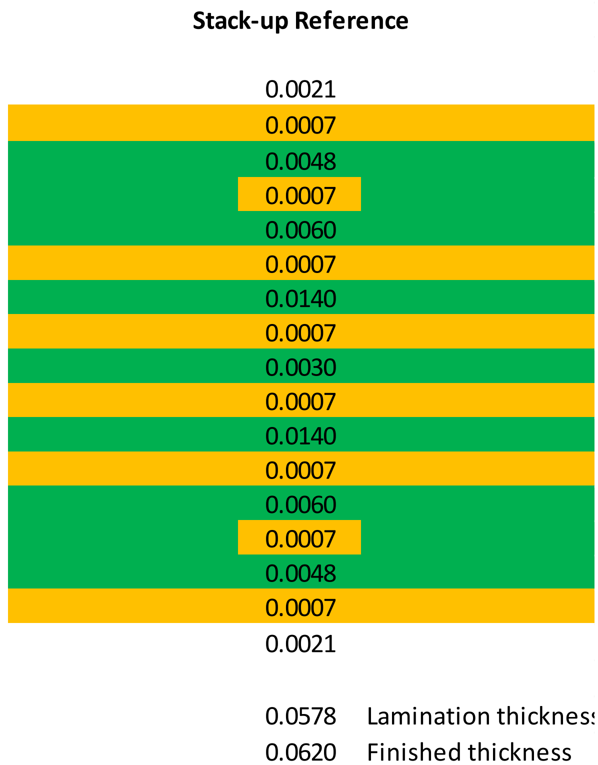

Figure 4-4: Test Board Stack-Up

4.3 Vertical Connector Footprint

The vertical connector footprint is per the testing connector design, and shall be as specified in *SFF-TA-1002* 1C Straight Connector Footprint located in the *Printed Circuit Board Footprints* section of the appendix. The signals use 6 mil (0.1524 mm) microvias from the top layer's SMT pads to the second layer. As illustrated in *SMT Pads with Microvias Reference View* microvias are used to move the stripline signals to the top layer with limited signal degradation.

The connector footprint contains a bus on the ground layer to bus the grounds together. This structure mitigates crosstalk that can happen when transitioning from the stripline layer to the outer layers.

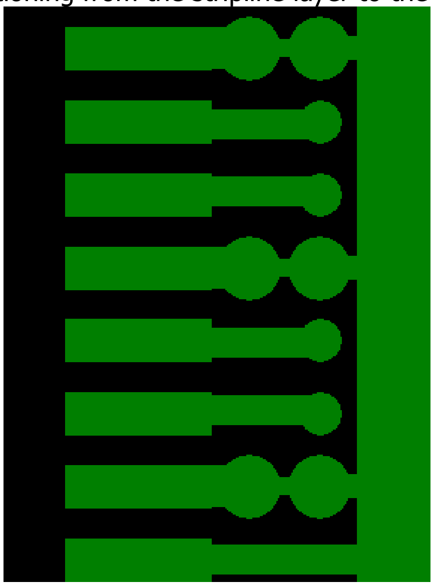

Figure 4-5: SMT Pads with Microvias Reference View

4.4 Vertical Tested Pairs

The test board tests six high-speed pairs using three pairs within row A and three pairs within row B directly across from each other as illustrated in *Tested Pairs Position*. Pair positions align with the 1C connector section (positions A16-A25/B16-B25) of the EDSFF X4 Device Edge Pinout table in *SFF-TA-1009 Enterprise and Datacenter SSD Pin and Signal Specification*.

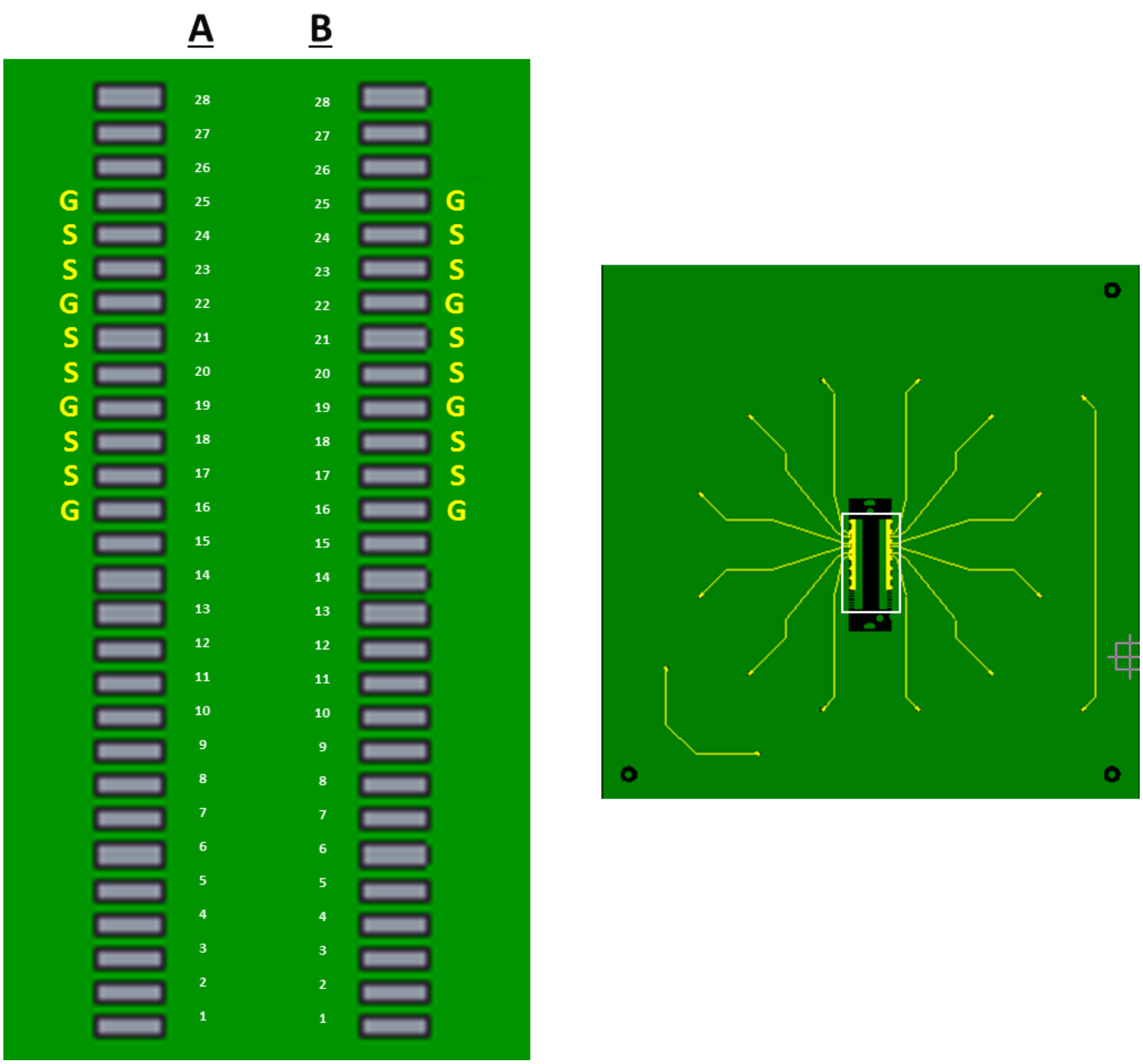

Figure 4-6: Tested Pairs Position

4.5 Vertical Module Compliance Board (MCB)

The vertical 1C connector to be tested is mounted on the Module Compliance Board (MCB) as illustrated in *MCB Coupon Top and Bottom-side View*.

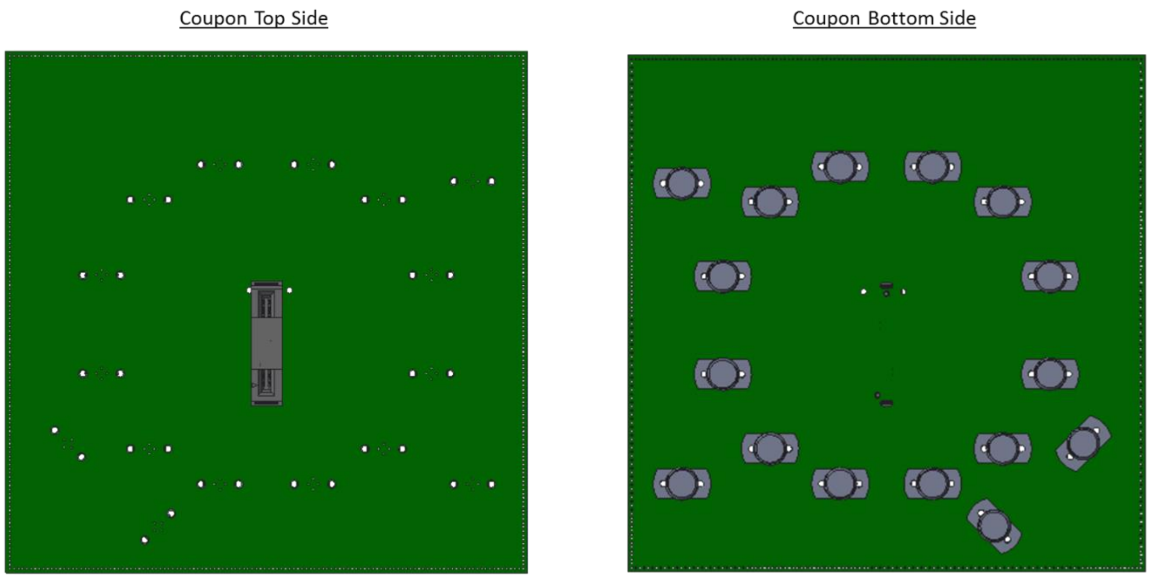

Figure 4-7: MCB Coupon Top and Bottom-side View

4.6 Vertical Host Compliance Board (HCB)

The Host Compliance Board (HCB) provides the card edge interface. The card edge interface shall be as specified in *SFF-TA-1002* 1C Add-in Card (AIC), and the pair positions align with the 1C connector section (positions A16-A25/B16-B25) of the EDSFF X4 Device Edge Pinout table in *SFF-TA-1009 Enterprise and Datacenter SSD Pin and Signal Specification*. The HCB shall be as illustrated in *HCB Coupon Top and Bottom Side View*.

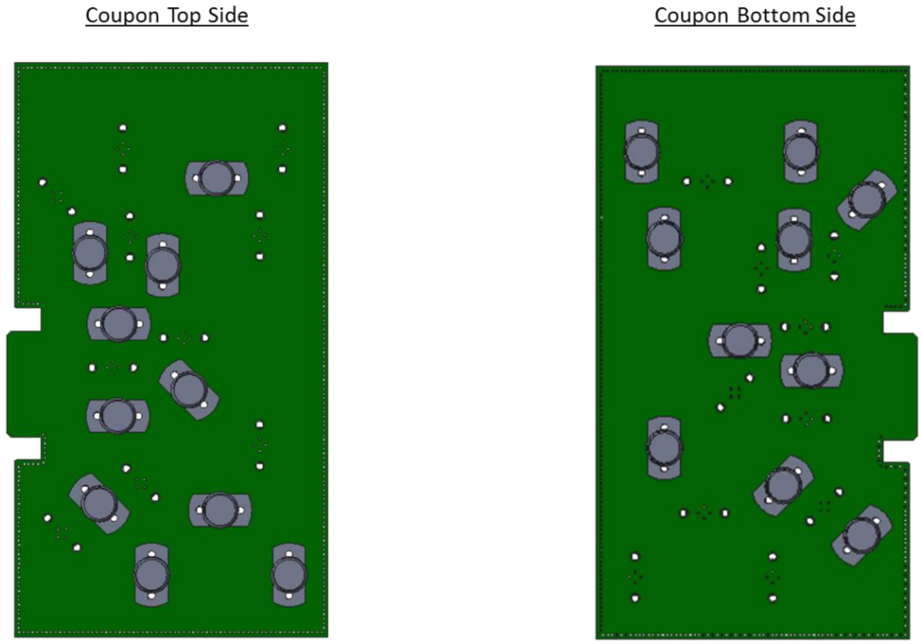

Figure 4-8: HCB Coupon Top and Bottom Side View

The mating interface shall use the *SFF-TA-1002* pad geometry. *AIC Gold Finger Top View* and *AIC Mating Interface Side View* illustrate the in-pad ground vias on the pads adjacent to the high-speed signal pads. Dimensional details are specified in the supporting Gerber files.

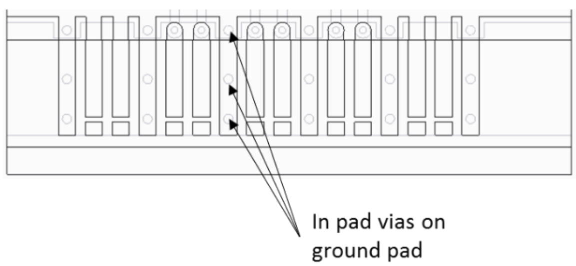

Figure 4-9: AIC Gold Finger Top View

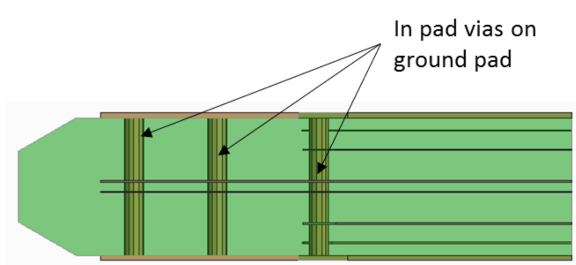

Figure 4-10: AIC Mating Interface Side View

4.7 Vertical Mated Test Set-up

To ensure proper and stable mating during the test of this board the HCB and MCB shall be secured into position once mated as illustrated in *HCB-to-MCB Mated Angle Views*.

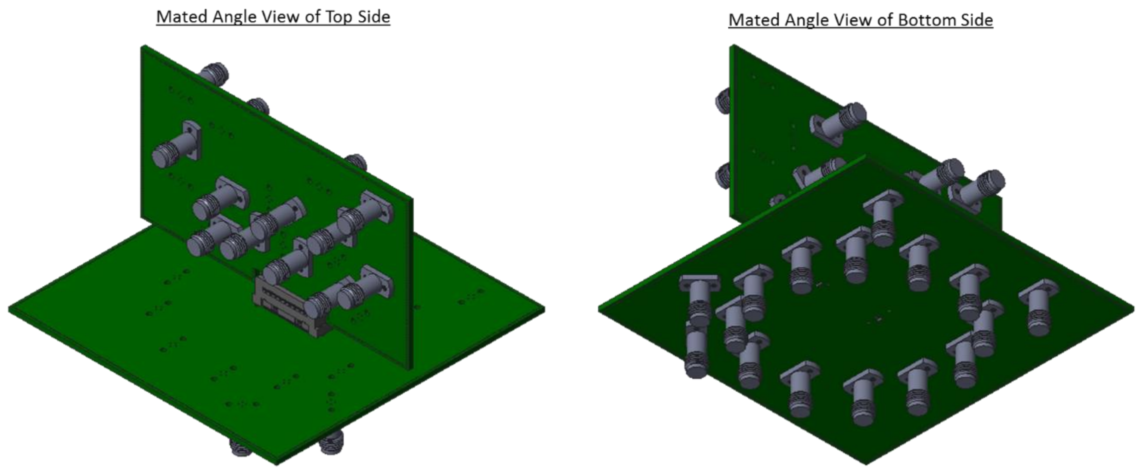

Figure 4-11: HCB-to-MCB Mated Angle Views

When mating the HCB into the connector on the MCB the leading edge shall be fully inserted such that the card bottoms out inside the connector slot on the seating plane. Testing shall be performed at a fully-mated condition where there is a nominal 1.30 mm wipe length on the signal pads and 1.70 mm wipe length on the ground pads. This may require an additional mechanical structure to provide stability and to prevent cables from disturbing the mated interface during measurement. See Appendix A. System Mechanical Specification (Informative) for additional details.

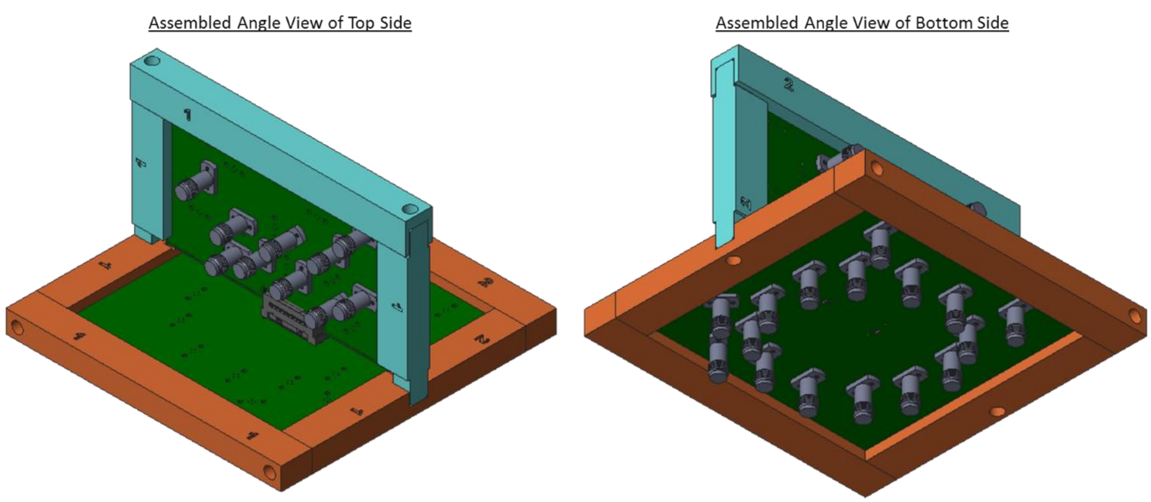

Figure 4-12: HCB-to-MCB Mated Angle Views with a Representative Mechanical Fixture

5. Equipment Setting, Calibration, Verification

5.1 AFR Calibration

The test fixture is designed for automatic fixture removal (AFR) calibration with 2x thru traces. The 2x thru trace is on the MCB. After de-embedding the 2x Thru, the reference plane shall be set immediately before the anti-pad to ensure clean calibration.

Developer's Note: *This specification references AFR throughout, but it is acceptable to use an AFR equivalent.*

Developer's Note: *This fixture includes the microvias and microstrip length of 35mils in the electrical characterization.*

The traces are short to provide higher metrology grade bandwidth to the test fixture. After the traces are de-embedded with AFR, the resulting device under test (DUT) shall contain a 0.5mm trace before the footprint as illustrated in *Remaining Trace after De-embedding*.

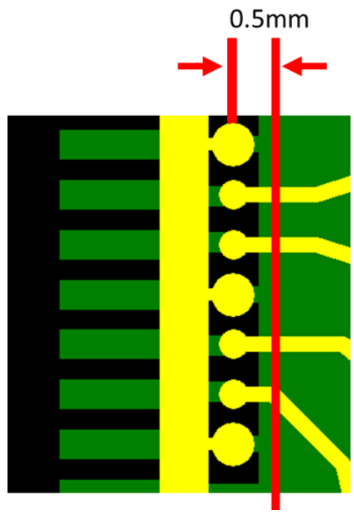

Figure 5-1: Remaining Trace after De-embedding

5.2 AFR Measurement Flow

The flowchart below provides the steps needed for repeatable and accurate measurements.

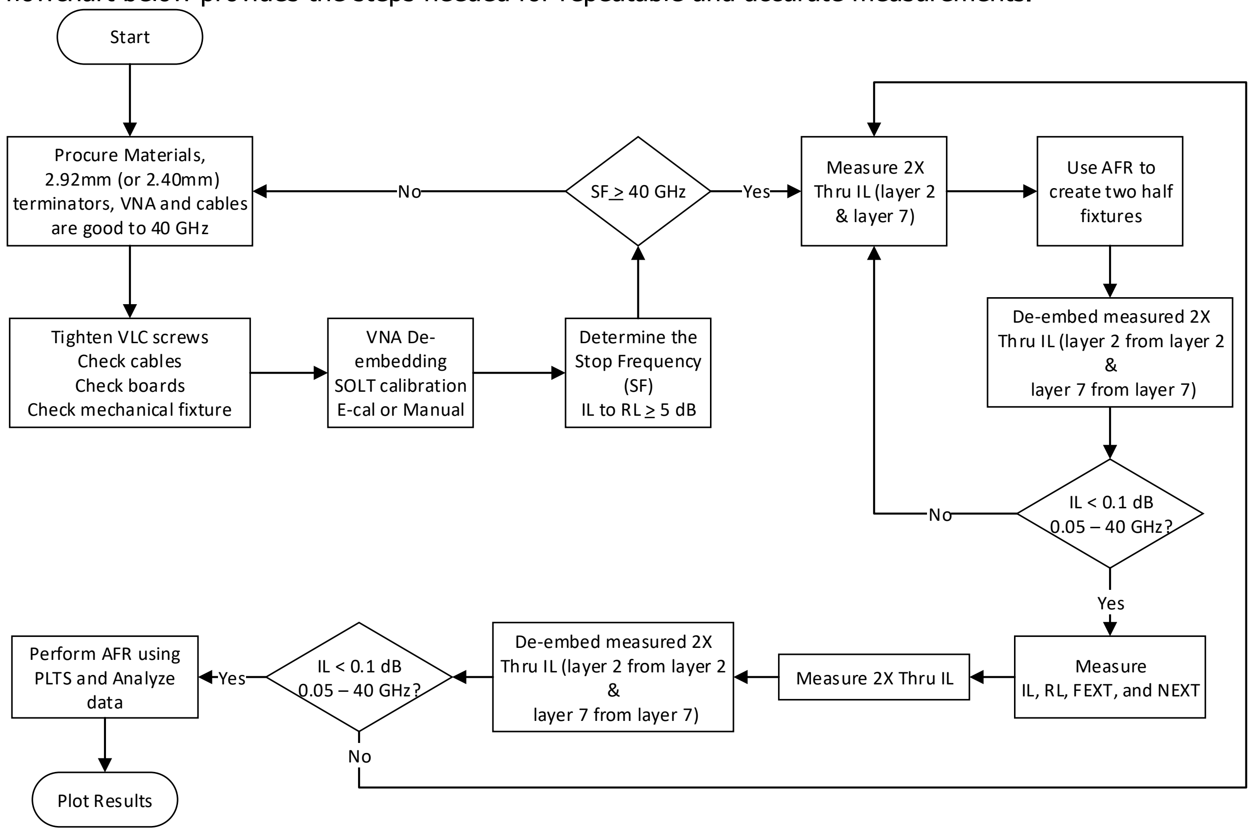

Figure 5-2: AFR Measurement Flow Diagram

5.3 VNA Settings

The vector network analyzer (VNA) should be set to the settings provided in the table below.

Table 5-1: VNA settings

Setting	Value
Averaging	3
Step Size	10 MHz
IF Bandwidth	≤ 1 kHz
Start Frequency	10 MHz
Stop Frequency	40 GHz

The VNA system impedance should be set to 50 Ohms.

5.4 End of Cable SOLT Calibration

A standard end of cable SOLT calibration needs to be performed in order to move the reference plane to the end of the test point cables. The SOLT calibration may be done with an eCAL or manually with the standards kit that comes with the VNA.

5.5 Determine Stop Frequency

The Stop Frequency is determined by measuring the 2x Thru after the SOLT Calibration. The resultant IL and RL should be plotted on the same graph to determine the Stop Frequency. The Stop Frequency is determined by the frequency where the IL is not greater than the RL by 5dB. The Stop Frequency depends on board quality. An example of the stop frequency that is good up to 40GHz.

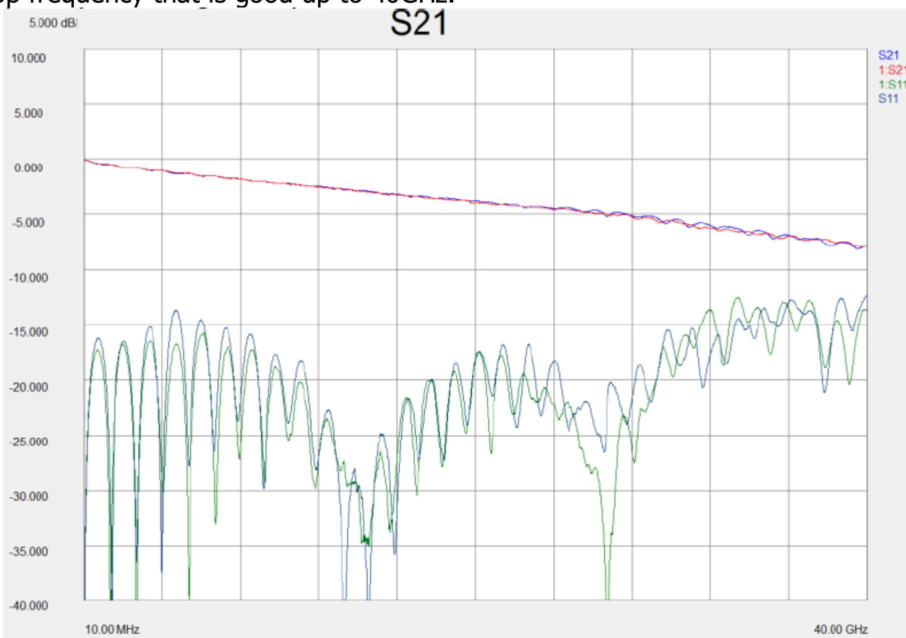

Figure 5-3: Example Plot for Determing Stop Frequency

5.6 Procedure

After the reference plane is moved to the end of the cable, the 2x Thrus may be measured to continue moving the reference plane to immediately before the DUT. There are three 2x Thrus measurements that need to be completed for the proper calibration. The MCB_2x Thru, HCB Layer2_2x Thru, and HCB Layer7_2xThru need to be measured. Half fixtures are derived from these three 2x Thru measurements and are used to de-embed their respective boards.

- The 2x Thru on the MCB is used to de-embed all pairs both A and B on the MCB board
- The 2x Thru on the HCB Layer 2 is used to de-embed all the A pairs (A17/A18, A20/A21, A23/A24)
- The 2x Thru on the HCB Layer 7 is used to de-embed all the B pairs (B17/B18, B20/B21, B23/B24)

5.7 Calibration Verification

The verification of the half fixture should be done by de-embedding the 2x Thru from which the half fixture was created.

5.8 TDR Option

A time domain reflectometry (TDR) using a 1x Thru trace to calibrate rise time of the incoming signal at the connector. A TDR may be used to verify any questionable frequency domain-to-time domain transformations due to causality and passivity issues during testing.

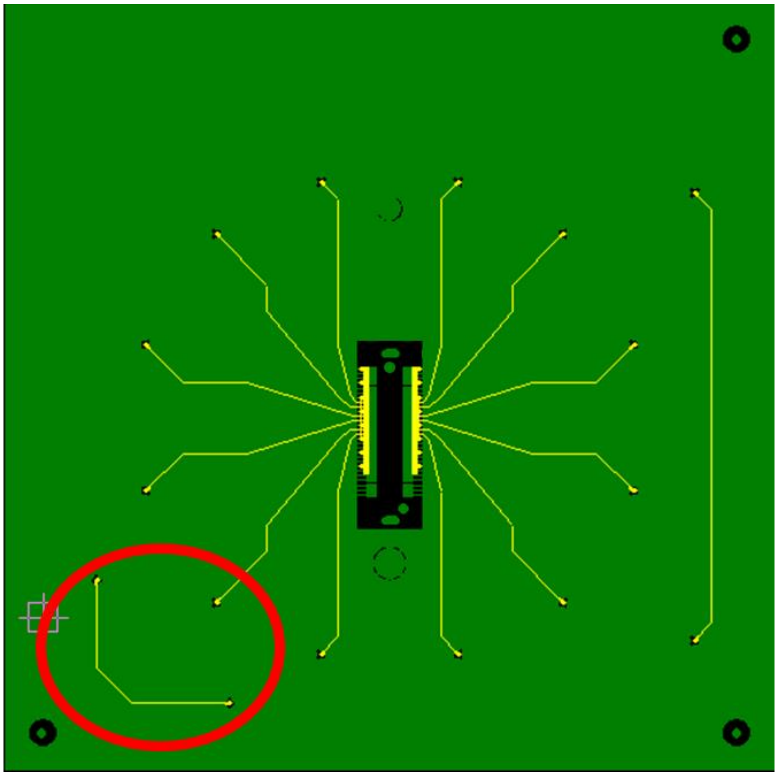

Figure 5-4: TDR Calibration Option for 1x Thru Trace

6. Electrical Measurements and Masks

SFF-TA-1002 Vertical, Right-angle and Straddle Mount Connector Signal Integrity Requirements specifies electrical performance masks for insertion loss (IL), return loss (RL), power sum near end crosstalk (PSNEXT), and power sum far end crosstalk (PSFEXT) for qualifying line rates.

Throughout this section are references to various test IDs. Refer to *Table A-1: 4-Port VNA AFR Measurement Template for additional details*.

6.1 VNA Port Naming Convention

Insertion loss and return loss are multi-port measurements. The port naming conventions are illustrated in the figure below.

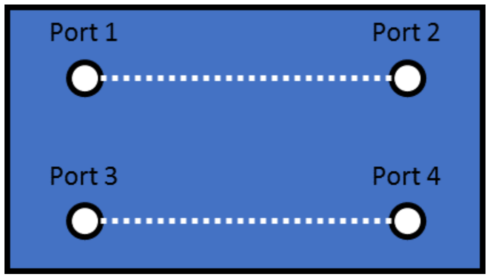

Figure 6-1: VNA port naming convention

Any ports not under test should be terminated with high bandwidth 50 Ohm terminations.

6.2 Differential Insertion Loss and Return Loss (DDIL\DDRL)

There are six differential through pairs and results in six insertion loss and return loss measurements. An example of an IL\RL measurement along with the associated equations for computing DDIL is shown below.

$$DDIL = 20\,log_{10}[|(S21 + S43 - S23 - S41)| \div 2]$$

Equation 6-1: Differential Insertion Loss (SDD21)

$$DDRL = 20\,log_{10}[|(S11 + S33 - S13 - S31)| \div 2]$$

Equation 6-2: Differential Return Loss (SDD11)

$$DDRL = 20\,log_{10}[|(S22 + S44 - S24 - S42)| \div 2]$$

Equation 6-3: Differential Return Loss (SDD22)

6.3 Crosstalk Measurement

There are 15 separate measurements for the worst-case crosstalk. Five aggressors for each side of the NEXT and 5 aggressors for the Far End Crosstalk. Reciprocity is assumed for all the crosstalk measurements to limit the number of measurements. An example of equations for crosstalk measurements are shown below.

6.3.1 Power Sum Near-End Cross Talk (PSNEXT)

The power sum near-end cross talk is measured from the perspective of the MCB and the HCB.

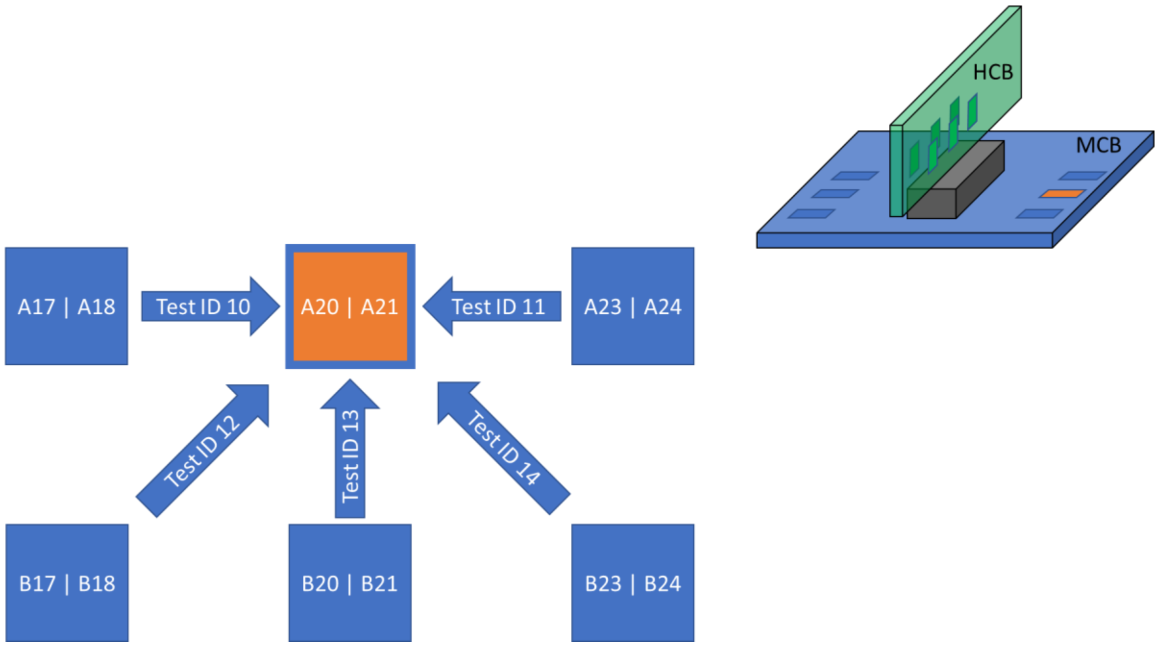

Figure 6-2: Victim-Aggressor Illustration for MCB PSNEXT

$$TestID_n = 20\log_{10}[|(S21 + S43 - S23 - S41)| \div 2]$$

Equation 6-4: MCB NEXT per Test ID Measurement

$$PSNEXT_{MCB} = 10\log_{10}\left(\sum_{n=10}^{14} 10^{TestID_n \div 10}\right)$$

Equation 6-5: MCB PSNEXT with Five Aggressors

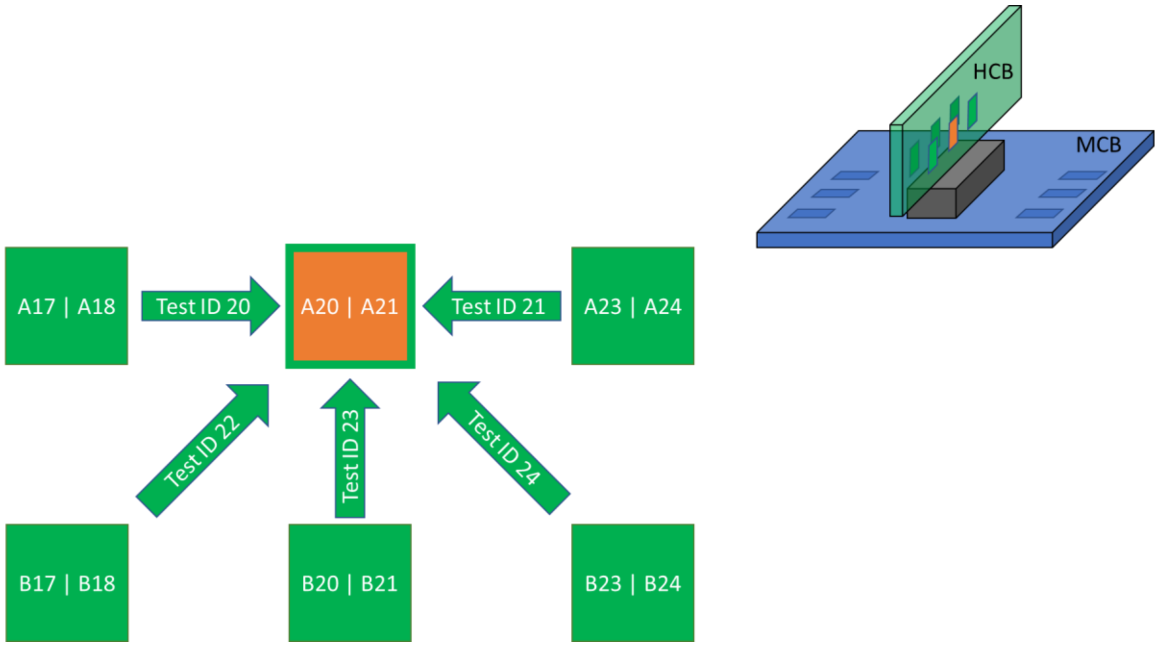

Figure 6-3: Victim-Aggressor Illustration for HCB PSNEXT

$$TestID_n = 20\log_{10}[|(S21 + S43 - S23 - S41)| \div 2]$$

Equation 6-6: HCB NEXT per Test ID Measurement

$$PSNEXT_{HCB} = 10\, log_{10}\left(\sum_{n=20}^{24} 10^{TestID_n \div 10}\right)$$

Equation 6-7: HCB PSNEXT with Five Aggressors

6.3.2 Power Sum Far End Cross Talk (PSFEXT)

The power sum far end cross talk is measured from the perspective of the MCB in the illustration below. The perspective of the HCB may be obtained by using the recipricoll of the MCB measurements.

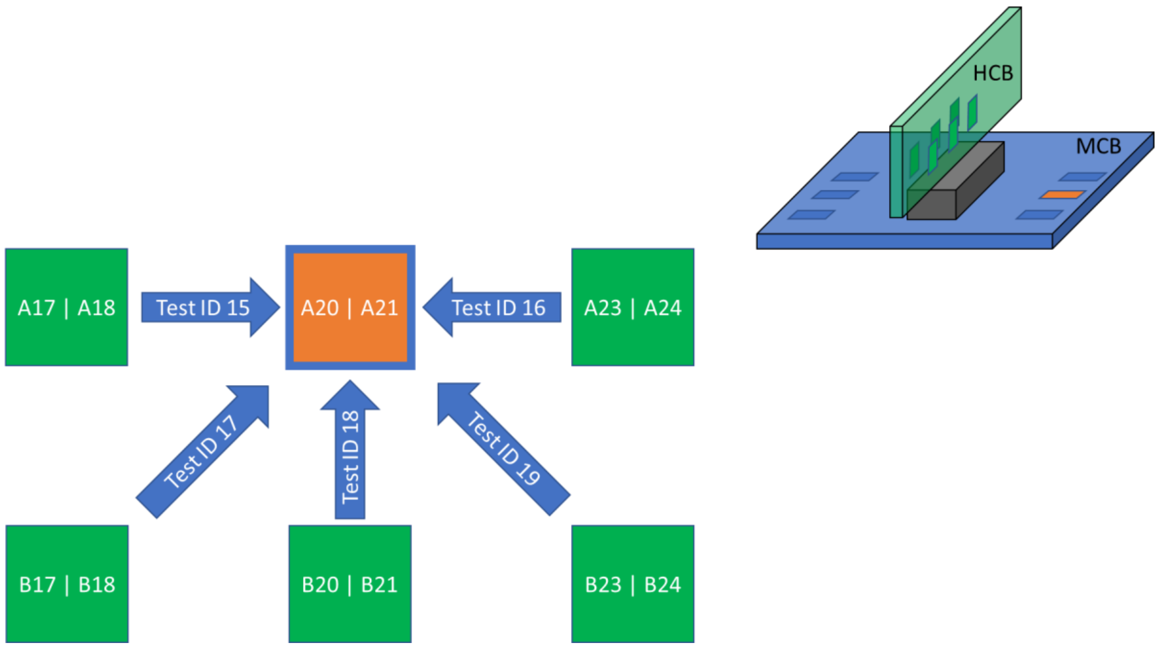

Figure 6-4: Victim-Aggressor Illustration for MCB PSFEXT

$$TestID_n = 20\log_{10}[|(S21 + S43 - S23 - S41)| \div 2]$$

Equation 6-8: MCB FEXT per Test ID Measurement

$$PSFEXT_{MCB} = 10\,log_{10}\left(\sum_{n=15}^{19} 10^{TestID_n \div 10}\right)$$

Equation 6-9: MCB PSFEXT with Five Aggressors

Appendix A. System Mechanical Specification (Informative)

A.1 VNA AFR Measurement Template

Table A-1: 4-Port VNA AFR Measurement Template

Test ID	Parameter	VNA Port 1	VNA Port 2	VNA Port 3	VNA Port 4	Comments
CAL1	SOLT cal check	Thru_1	Thru_2			
CAL2	SOLT cal check			Thru_1	Thur_2	
1	MCB_2x Thru	2x Thru_1	2x Thru_2			
2	HCB_Layer2_2x Thru	2x Thru_1	2x Thru_2			
3	HCB_Layer7_2x Thru	2x Thru_1	2x Thru_2			
4	IL 1	MCB A17	HCB A17	MCB A18	HCB A18	Thru pair A17A18
5	IL 2	MCB A20	HCB A20	MCB A21	HCB A21	Thru pair A20A21
6	IL 3	MCB A23	HCB A23	MCB A24	HCB A24	Thru pair A23A24
7	IL 4	MCB B17	HCB B17	MCB B18	HCB B18	Thru pair B17B18
8	IL 5	MCB B20	HCB B20	MCB B21	HCB B21	Thru pair B20B21
9	IL 6	MCB B23	HCB B23	MCB B24	HCB B24	Thru pair B23B24
10	MCB NEXT 1	MCB A20	MCB A17	MCB A21	MCB A18	MCB NEXT A20A21 -- A17A18
11	MCB NEXT 2	MCB A20	MCB A23	MCB A21	MCB A24	MCB NEXT A20A21 -- A23A24
12	MCB NEXT 3	MCB A20	MCB B17	MCB A21	MCB B18	MCB NEXT A20A21 -- B17B18
13	MCB NEXT 4	MCB A20	MCB B20	MCB A21	MCB B21	MCB NEXT A20A21 -- B20B21
14	MCB NEXT 5	MCB A20	MCB B23	MCB A21	MCB B24	MCB NEXT A20A21 -- B23B24
15	MCB FEXT 1	MCB A20	HCB A17	MCB A21	HCB A18	FEXT MCB A20A21 -- HCB A17A18
16	MCB FEXT 2	MCB A20	HCB A23	MCB A21	HCB A24	FEXT MCB A20A21 -- HCB A23A24
17	MCB FEXT 3	MCB A20	HCB B17	MCB A21	HCB B18	FEXT MCB A20A21 -- HCB B17B18
18	MCB FEXT 4	MCB A20	HCB B20	MCB A21	HCB B21	FEXT MCB A20A21 -- HCB B20B21
19	MCB FEXT 5	MCB A20	HCB B23	MCB A21	HCB B24	FEXT MCB A20A21 -- HCB B23B24
20	HCB NEXT 1	HCB A20	HCB A17	HCB A21	HCB A18	HCB NEXT A20A21 -- A17A18
21	HCB NEXT 2	HCB A20	HCB A23	HCB A21	HCB A24	HCB NEXT A20A21 -- A23A24
22	HCB NEXT 3	HCB A20	HCB B17	HCB A21	HCB B18	HCB NEXT A20A21 -- B17B18
23	HCB NEXT 4	HCB A20	HCB B20	HCB A21	HCB B21	HCB NEXT A20A21 -- B20B21
24	HCB NEXT 5	HCB A20	HCB B23	HCB A21	HCB B24	HCB NEXT A20A21 -- B23B24
25	MCB_2x Thru	2x Thru_1	2x Thru_2			Re-check of IL to confirm no change
26	HCB_Layer2_2x Thru	2x Thru_1	2x Thru_2			Re-check of IL to confirm no change
27	HCB_Layer7_2x Thru	2x Thru_1	2x Thru_2			Re-check of IL to confirm no change

Note: Option to measure 1X thru for rise time calibration in time domain.

A.2 Vertical Mechanical Fixture

The supporting mechanical test fixture 3D CAD files are provided in a complimentary ZIP file (filename: "SFF-TA-1002_Vertical_Mechanical_Fixture_*"). This fixture may be created using machined components or 3D printing technology. *Mechanical Fixture Assembly Steps Reference*
illustrates a reference to assembly method of the fixture with the MCB and HCB.

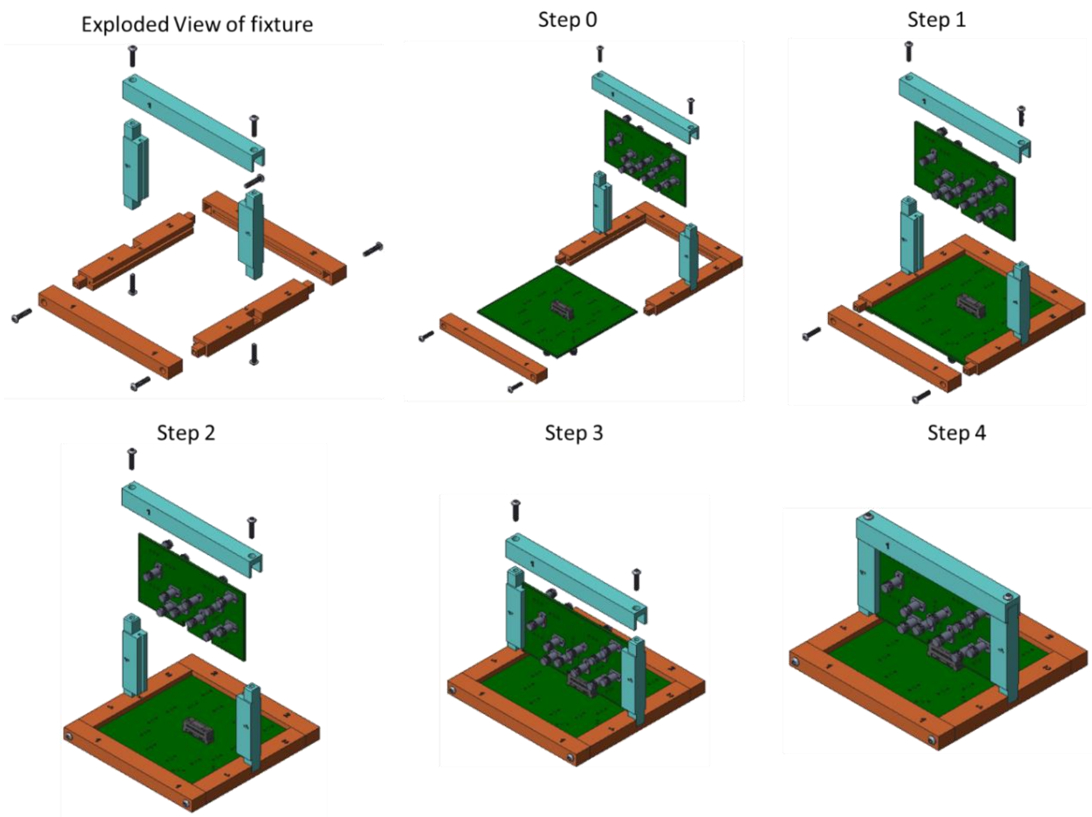

Figure A-1: Mechanical Fixture Assembly Steps Reference

A.3 Vertical Connector Test Board Bill of Materials

Table A-2: Bill of Materials for Vertical Scalable Connector Compliance Test Board

Item No.	Item Description	Quantity	UOM	Notes
01	Printed Circuit Board, Test Fixture, SFF-TA-1002 Vertical 1C, MCB	1	EA	MCB and HCB are produced on the same panel during manufacturing.
02	Printed Circuit Board, Test Fixture, SFF-TA-1002 Vertical 1C, HCB	1	EA	MCB and HCB are produced on the same panel during manufacturing.
03	Connector, Vertical, 1C, SFF-TA-1002	1	EA	
04	Test Point, 2.40MM Connector	36	EA	2.40MM good through 50 GHz. May substitute with 2.92MM connector test point that is good through 40 GHz.
05	Test Point Termination Resistors	20	EA	Test point termination resistor to be compatible with Item 04