Agilent Method of Implementation (MOI) for MIPI M-PHY Conformance Tests Using Agilent E5071C ENA Network Analyzer Option TDR
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1. **Modification Record**

<table>
<thead>
<tr>
<th>Revision</th>
<th>Comments</th>
<th>Issue Date</th>
</tr>
</thead>
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<tr>
<td>1.00</td>
<td>First Release</td>
<td>Dec 1, 2011</td>
</tr>
<tr>
<td>1.10</td>
<td>Updated procedures to spec version 3.0.</td>
<td>Mar 20, 2014</td>
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</table>

2. **Purpose**

This document is intended to provide the measurement procedures for the interface S-parameter and impedance tests defined in the MIPI Alliance Specification for M-PHY. The instrument operations contained in this document are designed for Agilent E5071C ENA Network Analyzer Option TDR.

3. **References**

- MIPI Alliance Specification for M-PHY v3.0
- MIPI Alliance Conformance Test Suite for M-PHY Physical Layer v1.0

4. **Resource Requirements**

1. ENA Series Network Analyzer with Enhanced Time Domain Option  
   *Note: Use the test set option of 4.5 GHz or above, and either of 2-port and 4-port.*  
   *Note: Ensure that E5071C firmware revision A.11.31 or above is installed.*  
   *Note: E5071C-TDR application software revision A.01.56 or above is installed.*

2. Electronic Calibration Module N4431B (for 4.5/6.5/8.5 GHz models) or N4433A (for 14/20 GHz models)

3. 3.5 mm cables of 4.5 GHz bandwidth or above x2
5. Test Procedure

5.1. Outline of Test Procedure

1. Instrument Setup

2. Calibration and Adjustment
   
   Time Domain Calibration with the setup wizard in the TDR application software
   
   Frequency Domain Calibration with the VBA macro program

3. Measurements and Data Analysis

   **Time Domain Measurements**
   
   - Single-Ended Output Resistance
   
   - HS-TX Single-Ended Output Resistance Mismatch
   
   - Single-Ended Output Resistance, STALL or SLEEP State
   
   - M-RX Differential Termination Resistance

   **Frequency Domain Measurements**
   
   - M-TX Differential Return Loss
   
   - M-TX Common-Mode Return Loss
   
   - M-RX Differential Return Loss

*Note: Hard Keys (Keys located on the Front panel of E5071C) are displayed in Blue color and Bold. (Example: Avg, Analysis)*

*Note: Soft keys (Keys on the screen) are displayed in Bold. (Example: S11, Real, Transform)*

*Note: Buttons (in the TDR or VBA) are displayed in Green color and Bold. (Example: Trace, Rise Time)*

*Note: Tabs (in the TDR) are displayed in Brown color and Bold. (Example: Setup, Trace Control)*
5.2. Instrument Setup
This section describes the procedures for recalling the state file and VBA macro that support the instrument setup. Download “E5071C-TDR Test Package for MIPI M-PHY Tx/Rx Devices” from www.agilent.com/find/ena-tdr_mphy-txrx.
Extract the zip file and transfer the extracted files to the instrument with a USB flash memory. For manual measurement settings, refer to 6 Appendix.

5.2.1. Recalling State File
1. If TDR setup wizard appears, click Close button on the wizard.
2. Open Setup tab (item 1).
3. Click Advanced Mode (item 2).
4. A dialog box appears requesting for confirmation. Then click Yes. (Clear the check box for “Use Advanced Calibration Methods”)
5. Click File (item 3) and select Recall State to open the Recall State dialog box.
6. Specify the folder and appropriate state file name, and click Open.
5.2.2. Running VBA macro program

1. Installing the VBA macro program

Obtain the VBA macro program from Agilent and install it on the E5071C.
- Press **Save/Recall** on the front panel, then press the **Explorer** soft key.
- Using **Explorer**, copy the file to the “D:\VBA” folder.
2. Running the VBA macro program

- Press **Macro Setup** button from the front panel, then click the **Load & Run** soft key.
- Select “MIPI_M-PHYv3_TxRx” from the soft key menu and click on it.
5.3. Screen Configuration

This section describes the screen configuration of ENA Option TDR.

Channel1 dedicated to time domain measurements is controlled by the TDR application software located at the bottom of the screen and Channel2 dedicated to frequency domain measurements is controlled by the VBA macro program located at the upper right of the screen.
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**Description of Measurement Window**

<table>
<thead>
<tr>
<th>Channel 1</th>
<th>Time Domain</th>
<th>Channel 2</th>
<th>Frequency Domain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Single-Ended Output Resistance (M-TX)</strong></td>
<td></td>
<td><strong>Differential Return Loss (M-TX/M-RX)</strong></td>
</tr>
<tr>
<td></td>
<td>Tr1: T11</td>
<td></td>
<td>Tr1: Sdd11</td>
</tr>
<tr>
<td></td>
<td>Tr4: T22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Single-Ended Output Resistance, STALL or SLEEP State (M-TX)</strong></td>
<td></td>
<td><strong>Common-Mode Return Loss (M-TX)</strong></td>
</tr>
<tr>
<td></td>
<td>Tr2: T11</td>
<td></td>
<td>Tr2: Sc11</td>
</tr>
<tr>
<td></td>
<td>Tr5: T22</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Differential Termination Resistance (M-RX)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tr3: Tdd11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5.4. Calibration and Adjustment

5.4.1. Time Domain Calibration

1. Connect the test cables to the port 1 and port 2 on the E5071C.
2. Press **Channel Next** key to select Channel1.
3. Open **Setup** tab (item1).
4. Click **ECal** (item2) to launch the Full Calibration (ECal) and Fixture Compensation wizard.

5. Connect the test cables to the ECal module.
6. Click **Calibrate** (item3), then it will start the full calibration. Wait until the check-mark appears on the right of Calibrate button.
7. Click **Next** (item4).
8. Connect port 1 and port 2 cables to the test fixtures and make the fixture end open.

9. Click **Fixture Comp** (item5), then it will start the fixture compensation. Wait until the check-mark appears on the right of Fixture Comp button.

10. Click **Finish** (item6).
5.4.2. Frequency Domain Calibration

1. Select the GEARs (RATE series), then VBA sets the initial value to the data rate defined in the spec, and input the data rate according to the DUT if needed (item1).

2. Click Set Limit (item2).

3. Connect port 1 and port 2 cables to the ECal module.

4. Click ECal (item3) to perform the Full Calibration (ECal).
5.5. M-TX S-Parameter and Impedance

5.5.1. Differential Return Loss (SDD\textsubscript{TX})

5.5.1.1. Purpose

To verify that the Differential Return Loss (SDD\textsubscript{TX}) of the DUT’s M-TX exceeds the minimum conformance limits.

5.5.1.2. Test Procedure

1. Press Channel Next key to select Channel2.
2. Press Channel Max key to enlarge Channel2.
3. Ensure the VBA shows the desired bit rate.
4. On the VBA macro, select “M-PHY Tx” from the drop down list and click Set Limit button.
5. Power on and configure the DUT to force its M-TX into a continuously transmitting HS state, transmitting a continuous CRPAT repeating pattern, using the Large Amplitude.
6. Connect the DUT’s M-TX to the Test System.
7. Click Run button on the VBA macro.
8. Read the pass/fail sign on the trace (item 1 in Figure 5-1).
9. Repeat the previous three steps for the Small Amplitude case (if the DUT supports Small Amplitude).
10. Repeat the previous four steps for all other LANEs (if the DUT implements multiple LANEs).

5.5.1.3. Observable Results

For all LANEs, verify that the SDD\textsubscript{TX} Differential Return Loss meets or exceeds the limit shown in the figure below, for all supported Amplitude cases (e.g., Large/Small).
5.5.2. Common-Mode Return Loss (SCC\textsubscript{TX})

5.5.2.1. Purpose

To verify that the Common-Mode Return Loss (SCC\textsubscript{TX}) of the DUT’s M-TX exceeds the minimum conformance limits.

5.5.2.2. Test Procedure

1. Press \textbf{Channel Next} key to select Channel2.
2. Press \textbf{Channel Max} key to enlarge Channel2.
3. Ensure the VBA shows the desired bit rate.
4. On the VBA macro, select “M-PHY Tx” from the drop down list and click Set Limit button.
5. Power on and configure the DUT to force its M-TX into a continuously transmitting HS state, transmitting a continuous CRPAT repeating pattern, using the Large Amplitude.
6. Connect the DUT’s M-TX to the Test System.
7. Click \textbf{Run} button on the VBA macro.
8. Read the pass/fail sign on the trace (item 2 in Figure 5-1).
9. Repeat the previous three steps for the Small Amplitude case (if the DUT supports Small Amplitude).
10. Repeat the previous four steps for all other LANE(s) (if the DUT implements multiple LANE(s)).

5.5.2.3. Observable Results
For all LANE(s), verify that the SCC\textsubscript{TX} Common-Mode Return Loss meets or exceeds the limits shown in the figure below, for all supported Amplitude cases (e.g., Large/Small).

5.5.3. Single-Ended Output Resistance (R\textsubscript{SE-TX})

5.5.3.1. Purpose
To verify that the Single-Ended Output Resistance (R\textsubscript{SE-TX}) of the DUT’s M-TX is within the conformance limits.

5.5.3.2. Test Procedure
1. Press Channel Next key to select Channel1.
2. Press Channel Max key to enlarge Channel1.
3. Power on and configure the DUT to force its M-TX into a fixed HS state, transmitting a continuous, DIF-P state.
4. Connect the DUT’s M-TX LANE transmitter to the Test System.
5. Click Stop Single for Time Domain measurement.
6. Read the marker values\textsuperscript{1} (item 1 in Figure 5-2) as R\textsubscript{SE-TX} for the TXDP and TXDN pins.
7. Repeat the previous three steps for the DIF-N state.
8. Repeat the previous four steps for all other LANE(s).

5.5.3.3. Observable Results
For all LANE(s), verify that R\textsubscript{SE-TX} is between 40 and 60 ohms for both the TXDP and TXDN pins, for both the DIF-P and DIF-N state.

\textsuperscript{1} The markers are placed at 8 nsec by default. If the DUT response is not flat around the marker, adjust the marker position and horizontal scale.
5.5.4. HS-TX Single-Ended Output Resistance Mismatch ($\Delta R_{SE-TX}$)

5.5.4.1. Purpose

To verify that the Single-Ended Output Resistance Mismatch ($\Delta R_{SE-TX}$) of the DUT’s HS-TX is within the conformance limits.

5.5.4.2. Test Procedure

1. Obtain the four LAN 0 $R_{SE-TX}$ results from Single-Ended Output Resistance.

2. Compute the four $\Delta R_{SE-TX}$ values, as described below.
   - $\Delta R_{SE-TX}(1) = R_{SE-TX}(TXDP_{DIF-P}) - R_{SE-TX}(TXDN_{DIF-P})$
   - $\Delta R_{SE-TX}(2) = R_{SE-TX}(TXDP_{DIF-P}) - R_{SE-TX}(TXDN_{DIF-N})$
   - $\Delta R_{SE-TX}(3) = R_{SE-TX}(TXDP_{DIF-N}) - R_{SE-TX}(TXDN_{DIF-P})$
   - $\Delta R_{SE-TX}(4) = R_{SE-TX}(TXDP_{DIF-N}) - R_{SE-TX}(TXDN_{DIF-N})$

3. Repeat the previous two steps for all other LANEs.

5.5.4.3. Observable Results

Verify that all four $\Delta R_{SE-TX}$ values are less than +/- 6 ohms.
5.5.5. Single-Ended Output Resistance, STALL or SLEEP ($R_{SE-PO-TX}$)

5.5.5.1. Purpose
To verify that the Single-Ended Output Resistance during the STALL or SLEEP state ($R_{SE-PO-TX}$) of the DUT’s M-TX is within the conformance limits.

5.5.5.2. Test Procedure
1. Press Channel Next key to select Channel1.
2. Press Channel Max key to enlarge Channel1.
3. Power on and configure the DUT to force its M-TX into a SLEEP state.
4. Connect the DUT’s M-TX LANE transmitter to the Test System.
5. Click Stop Single for Time Domain measurement.
6. Read the marker values\(^2\) (item 2 in Figure 5-2) as $R_{SE-TX}$ for the TXDP and TXDN pins.
7. Repeat the previous three steps for the STALL state.
8. Repeat the previous four steps for all other LANEs.

5.5.5.3. Observable Results
For all LANEs, verify that $R_{SE-PO-TX}$ is less than 500 ohms for both the TXDP and TXDN pins, for both the SLEEP and STALL states.

\(^2\) The markers are placed at 8 nsec by default. If the DUT response is not flat around the marker, adjust the marker position and horizontal scale.
5.6. M-RX S-Parameters and Impedance

5.6.1. Differential Return Loss (SDD_{RX})

5.6.1.1. Purpose
To verify that the Differential Return Loss (SDD_{RX}) of the DUT’s M-RX exceeds the minimum conformance limits.

5.6.1.2. Test Procedure
1. Press **Channel Next** key to select Channel2.
2. Press **Channel Max** key to enlarge Channel2.
3. Ensure the VBA shows the desired bit rate.
4. On the VBA macro, select “M-PHY Rx” from the drop down list and click Set Limit button.
5. Power on and configure the DUT to force its RX into fixed state where the HS-RX termination is enabled.
6. Connect the DUT’s M-RX LANE to the Test System.
7. Click **Run** button on the VBA macro.
8. Read the pass/fail sign on the trace (item 1 in Figure 5-3).
9. Repeat the previous three steps for all other LANEs.

5.6.1.3. Observable Results
For all LANEs, verify that the SDD_{RX} Differential Return Loss meets or exceeds the limits shown in the figure below.
5.6.2. Differential Termination Resistance (R$_{\text{DEF-RX}}$)

5.6.2.1. Purpose

To verify that the Differential Termination Resistance of the DUT’s M-RX is within the conformance limits.

5.6.2.2. Test Procedure

1. Press Channel Next key to select Channel1.
2. Press Channel Max key to enlarge Channel1.
3. Power on and configure the DUT to force its RX into fixed state where the HS-RX termination is enabled.
4. Connect the DUT’s M-RX LANE to the Test System.
5. Click Stop Single for Time Domain measurement.
6. Read the marker value$^3$ (item 1 in Figure 5-4) as R$_{\text{DIF-RX}}$ for the RXDP and RXDN

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$^3$ The markers are placed at 8 nsec by default. If the DUT response is not flat around the marker, adjust the marker position and horizontal scale.
7. Repeat the previous three steps for all other LANEs.

5.6.2.3. Observable Results

For all LANEs, verify that $R_{\text{DEF-RX}}$ is between 80 and 110 ohms for both the TXDP and TXDN pins.

![Figure 5-4 Differential Termination Resistance ($R_{\text{DEF-RX}}$) Example](image)

Figure 5-4 Differential Termination Resistance ($R_{\text{DEF-RX}}$) Example
6. Appendix


6.1.1. Starting Setup

1. If TDR setup wizard was appeared, click Close button in the TDR setup wizard.
2. Open Setup tab (item1).
3. Click Preset (item2).
4. A dialog box appears requesting for confirmation. Then click OK.
5. Set DUT Topology (item3) to “Single-Ended 2-port”.
6. Set Source Power to -20 dBm. (in More Function Tab)
7. Set IF Bandwidth to 1 kHz. (in Average Tab)
8. Click Advanced Mode (item4).
9. A dialog box appears requesting for confirmation. Then click Yes (Clear the check box for “Use Advanced Calibration Methods”).

10. Click Stop Single.
11. Press Display.
12. Set Num of Traces to 5.
13. Click Allocate Traces > .
6.1.2. Impedance Single-Ended Output Resistance

6.1.2.1. Measurement Setup

1. Open **TDR/TDT** tab.
2. Select **Trace1**.
3. Open **Parameters** tab.
4. Select the **Topology** (item1) of DUT to Single-Ended.
5. Set **Measure** to Time Domain.
6. Select **Format** to Impedance.
7. Set **Rise Time** to 200 ps (10-90%).
8. Click **T11** in the table.
9. Click the box below the left knob under **Horizontal**.
10. Input 1 nsec/div with the Entry dialog box.
11. Click the box below the right knob under **Horizontal**.
12. Input -1 nsec with the Entry dialog box.
13. Click the box below the left knob under **Vertical**.
14. Input 5 Ohm/div with the Entry dialog box.
15. Click the box below the right knob under **Vertical**.
16. Input 25 Ohm with the Entry dialog box.
17. Open **Trace Control** tab.
18. Clear Marker check box under **Coupling**.
19. Click **Trace Settings Copy** button. Then Trace Settings Copy dialog box appears.
20. Select **Trace1** in the From list.
21. Select **Trace4** in the To list.
22. Click **Copy**.
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23. Click Close.
25. Open Parameters tab.
26. Click T22 in the table.
27. Select Trace1.
28. Click Maker menu and select 1.
29. On Trace1, drag and drop the marker to 8 nsec.
30. Repeat the previous three steps for Trace4.

6.1.3. Impedance Single-Ended Output Resistance, STALL or SLEEP State
1. Open TDR/TDT tab.
2. Select Trace2.
3. Open Parameters tab.
4. Select Measure to Time Domain.
5. Select Format to Impedance.
6. Set Rise Time to 200 ps (10-90%).
7. Click T11 in the table.
8. Click the box below the left knob under Horizontal.
9. Input 1 nsec/div with the Entry dialog box.
10. Click the box below the right knob under Horizontal.
11. Input -1 nsec with the Entry dialog box.
12. Click the box below the left knob under Vertical.
13. Input 2 kOhm/div with the Entry dialog box
14. Click the box below the right knob under Vertical.
15. Input 0 Ohm with the Entry dialog box.
16. Open Trace Control tab.
17. Click Trace Settings Copy button. Then Trace Settings Copy dialog box appears.
18. Select Trace2 in the From list.
19. Select Trace5 in the To list.
20. Click Copy.
21. Click Close.
22. Open Parameters tab.
23. Select Trace5.
24. Click T22 in the table.
25. Select Trace2.
26. Click Marker menu and select 1.
27. On Trace2, drag and drop the marker to 8 nsec.
28. Repeat the previous three steps for trace5.

6.1.4. M-RX Differential Termination Resistance
1. Open TDR/TDT tab.
2. Select Trace3.
3. Open Parameters tab.
4. Select the Topology (item1) of DUT to Differential.
5. Select Format to Impedance.
6. Set Rise Time to 200 ps (10-90%).
7. Click Tdd11 in the table.
8. Click the box below the left knob under Horizontal.
9. Input 1 nsec/div with the Entry dialog box.
10. Click the box below the right knob under Horizontal.
11. Input -1 nsec with the Entry dialog box.
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12. Click the box below the left knob under Vertical.
13. Input 5 Ohm/div with the Entry dialog box.
14. Click the box below the right knob under Vertical.
15. Input 75 Ohm with the Entry dialog box.


6.2.1. Channel and Trace Settings
1. Press Display.
2. Click Allocate Channels. 
3. Press Channel Next.
4. Click Num of Traces > 2.
5. Click Allocate Traces. 

6.2.2. Differential Return Loss
1. Press Trace Next to select Trace1.
2. Press Sweep Setup > Power > Set Power to -20 dBm.
3. Click Return.
4. Set Points to 1001.
5. Set Sweep Type to Log Freq.
6. Press Start > Set start value to 300 kHz.
7. Press Stop > Set stop value to 4.5 GHz.
8. Press Avg > Set IF Bandwidth to 1 kHz.
9. Press Analysis > Fixture Simulator > Fixture Simulator to turn it ON.
10. Click Topology > Device > Bal.
11. Click Port1 (bal) > 1-2.
12. Click Return.
13. Click BalUn ON All Traces.
15. Press **Format** > **Log Mag**.
16. Press **Scale**.
17. Set **Scale/Div** to 5 dB/div.
18. Set **Reference position** to 9 Div.

6.2.3. Common-Mode Return Loss

1. Press **Trace Next** to select Trace2.
2. Press **Meas** > **Sec11**.
3. Press **Format** > **Log Mag**.
4. Press **Scale**.
5. Set **Scale/Div** to 2 dB/div.

6.3. Limit Test Settings

The E5071C-TDR provides a capability of setting limit lines to perform pass/fail test on each measurement.

6.3.1. Turning On/Off Fail Sign

If this option is turned on, a fail sign appears when one or more measurement items violate the limit lines. It is useful to check overall test result.

1. Press **Analysis** > **Limit Test** > **Fail Sign** to switch the fail sign ON/OFF.

6.3.2. Setting the Warning Beeper

If this option is turned on, a beep is generated when one or more measurement items violate the limit lines.

1. Press **System** > **Misc Setup** > **Beeper** > **Beep Warning** to switch the warning beeper ON/OFF.
6.3.3. Defining the Limit Line

Set limit lines to perform pass/fail tests on the following measurement items.

- M-TX Differential Return Loss (Trace1 in Channel2)
- M-TX Common-Mode Return Loss (Trace2 in Channel2)
- M-RX Differential Return Loss (Trace1 in Channel2)

*Note: If using the VBA, appropriate limit lines are automatically selected for Attenuation and Phase in accordance with the DUT cable type.*

1. Press **Channel Next** key and **Trace Next** key to activate the trace on which limit lines should be set.

2. Press **Analysis > Limit Test > Edit Limit Line** to display the limit table shown below (Initially, no segments are entered in the limit table). Using the limit table, create/edit a segment.

3. Enter the limit line data following the tables below.

4. Click **Return**.

5. Click **Limit Line** and turn it **ON**.

6. Click **Limit Test** and turn it **ON**.

7. Repeat 1 to 6 for each Measurement item.
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- HS-G1

Differential Return Loss (M-TX)

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
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<tbody>
<tr>
<td>Max</td>
<td>$F_{HS_{MIN}}$</td>
<td>$F_{HS}$</td>
<td>-17 dB</td>
<td>-10 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS}$</td>
<td>$F_{HS_{MAX}}$</td>
<td>-10 dB</td>
<td>-7 dB</td>
</tr>
</tbody>
</table>

Differential Return Loss (M-RX)

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
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</thead>
<tbody>
<tr>
<td>Max</td>
<td>0</td>
<td>$F_{HS_{MIN}}$</td>
<td>-17 dB</td>
<td>-17 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS_{MIN}}$</td>
<td>$F_{HS}$</td>
<td>-17 dB</td>
<td>-10 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS}$</td>
<td>$F_{HS_{MAX}}$</td>
<td>-10 dB</td>
<td>-7 dB</td>
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</tbody>
</table>

Common-Mode Return Loss (M-TX)

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
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</thead>
<tbody>
<tr>
<td>Max</td>
<td>0</td>
<td>$F_{HS_{MAX}}$</td>
<td>-6 dB</td>
<td>-6 dB</td>
</tr>
</tbody>
</table>

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$F_{HS_{MIN}}$: Data Rate * 0.1

$F_{HS}$: Data Rate * 0.5

$F_{HS_{MAX}}$: Data Rate * 0.75
**Agilent MOI for MIPI M-PHY Conformance Tests**

- **HS-G2**

**Differential Return Loss (M-TX)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>$F_{HS,MIN}$</td>
<td>$F_{HS}$</td>
<td>-17 dB</td>
<td>-4.8 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS}$</td>
<td>$F_{HS,MAX}$</td>
<td>-4.8 dB</td>
<td>-3 dB</td>
</tr>
</tbody>
</table>

**Differential Return Loss (M-RX)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>0</td>
<td>$F_{HS,MIN}$</td>
<td>-17 dB</td>
<td>-17 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS,MIN}$</td>
<td>$F_{HS}$</td>
<td>-17 dB</td>
<td>-4.8 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS}$</td>
<td>$F_{HS,MAX}$</td>
<td>-4.8 dB</td>
<td>-3 dB</td>
</tr>
</tbody>
</table>

**Common-Mode Return Loss (M-TX)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>0</td>
<td>$F_{HS,MAX}$</td>
<td>-4 dB</td>
<td>-4 dB</td>
</tr>
</tbody>
</table>

---

$F_{HS,MIN}$: Data Rate * 0.1

$F_{HS}$: Data Rate * 0.5

$F_{HS,MAX}$: Data Rate * 0.75
Agilent MOI for MIPI M-PHY Conformance Tests

- HS-G3

Differential Return Loss (M-TX)

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>$F_{HS,MIN}$</td>
<td>$F_{HS}$</td>
<td>-13 dB</td>
<td>-3.8 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS}$</td>
<td>$F_{HS,MAX}$</td>
<td>-3.8 dB</td>
<td>-2 dB</td>
</tr>
</tbody>
</table>

Differential Return Loss (M-RX)

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>0</td>
<td>$F_{HS,MIN}$</td>
<td>-13 dB</td>
<td>-13 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS,MIN}$</td>
<td>$F_{HS}$</td>
<td>-13 dB</td>
<td>-3.8 dB</td>
</tr>
<tr>
<td>Max</td>
<td>$F_{HS}$</td>
<td>$F_{HS,MAX}$</td>
<td>-3.8 dB</td>
<td>-2 dB</td>
</tr>
</tbody>
</table>

Common-Mode Return Loss (M-TX)

<table>
<thead>
<tr>
<th>Type</th>
<th>Begin Stimulus</th>
<th>End Stimulus</th>
<th>Begin Response</th>
<th>End Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max</td>
<td>0</td>
<td>$F_{HS,MAX}$</td>
<td>-2 dB</td>
<td>-2 dB</td>
</tr>
</tbody>
</table>

---

$F_{HS,MIN}$: Data Rate * 0.1

$F_{HS}$: Data Rate * 0.5

$F_{HS,MAX}$: Data Rate * 0.75