Keysight Method of Implementation (MOI) for HDMI 1.4b Ethernet and Audio Return Channel (HEAC) Cable Assembly Test Using Keysight E5071C ENA Option TDR
# Table of Contents

1. Modification Record ................................................................. 4
2. Purpose ....................................................................................... 4
3. References .................................................................................. 4
4. Resource Requirements ............................................................ 5
5. Test Procedure ........................................................................... 6
   5.1. Outline of Test Procedure ..................................................... 6
   5.2. Instrument Setup ................................................................. 7
      5.2.1. Recalling State File ....................................................... 7
      5.2.2. Running VBA macro program ...................................... 8
   5.3. Screen Area and Cable Connection ...................................... 10
   5.4. Calibration and Adjustment ................................................ 13
      5.4.1. Time Domain Calibration .............................................. 13
      5.4.2. Measure DUT Length ................................................. 15
      5.4.3. Rise time adjustment ................................................ 16
      5.4.4. Frequency Domain Calibration .................................... 18
      5.4.5. Perform Auto Port Extension ........................................ 18
   5.5. Measurement and Data Analysis ........................................... 19
      5.5.1. Intra-Pair Skew ........................................................... 19
      5.5.2. Differential Attenuation .............................................. 21
      5.5.3. Differential Impedance .............................................. 22
      5.5.4. Common Mode Impedance ........................................ 24
6. Appendix ..................................................................................... 25
      6.1.1. Starting Setup ............................................................ 25
      6.1.2. Intra-Pair Skew .......................................................... 25
      6.1.3. Differential Impedance .............................................. 27
6.2.1. Channel and Trace Settings ................................................................. 31
6.2.2. Attenuation ......................................................................................... 31
6.3. Limit Test Settings ................................................................................ 32
  6.3.1. Turning On/Off Fail Sign ................................................................. 32
  6.3.2. Setting the Warning Beeper ............................................................. 32
  6.3.3. Defining the Limit Line .................................................................... 32
1. Modification Record

<table>
<thead>
<tr>
<th>Revision</th>
<th>Comments</th>
<th>Issue Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.00</td>
<td>Initial release</td>
<td>Oct 10, 2014</td>
</tr>
<tr>
<td>1.02</td>
<td>Fixed a few typos</td>
<td>Oct 20, 2014</td>
</tr>
</tbody>
</table>

2. Purpose

This document is intended to provide the measurement procedures for High-Definition Multimedia Interface (HDMI) Ethernet and Audio Return Channel (HEAC) cable assemblies with Keysight E5071C ENA Option TDR. The procedures are designed to perform tests equivalent to the methodologies defined in the HDMI Compliance Test Specification (CTS) Version 1.4b.

3. References

High-Definition Multimedia Interface Specification Version 1.4b
High-Definition Multimedia Interface Compliance Test Specification Version 1.4b
Keysight MOI for HDMI 1.4b Ethernet and Audio Return Channel (HEAC) Cable Assembly Test

4. Resource Requirements

1. E5071C ENA Series Network Analyzer with Enhanced Time Domain Analysis Option
   
   Note: Ensure that
   
   - Test set option is any one of 440/445/460/465/480/485/4D5/4K5
   - E5071C firmware revision A.11.31 or above is installed.
   - E5071C-TDR application software revision A.01.56 or above is installed.

2. Electronic Calibration Module N4431B (for 440/445/460/465/480/485) or N4433A (for 4D5/4K5)

3. 3.5 mm cables 8 GHz bandwidth or equivalent x4

4. Certified HDMI receptacle fixtures (ex. Keysight N1080B-H05) x2

5. Female to female adaptors to connect fixture and test cables (if necessary) x4
5. Test Procedure
5.1. Outline of Test Procedure
1. Instrument Setup
2. Calibration and Adjustment
   - Time domain calibration with the setup wizard in TDR application software
   - Frequency domain calibration with the VBA macro program
3. Measurements and Data Analysis
   Time Domain Measurements
   - Intra-pair Skew Test
   - Differential Impedance Test
   - Common Mode Impedance Test
   Frequency Domain Measurements
   - Differential Attenuation Test

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 procedures for recalling the state file and VBA macro that support the instrument setup. Download “HEAC cable assembly test package” from http://www.keysight.com/find/ena-tdr_hmdi-cabcon.

Extract the zip file and transfer the extracted files to the instrument with a USB flash memory.

5.2.1. Recalling State File
1. If TDR setup wizard appears, click Close button on the wizard.
2. Open Setup tab (item1).
3. Click More Function (item2).
4. Click Advanced Mode (item3).
5. A dialog box appears requesting for confirmation. Then click Yes. (Clear the check box for “Use Advanced Calibration Methods”)
6. Click File (item4) and select Recall State to open the Recall State dialog box.
7. Specify a folder and a file name, and click Open.

For manual measurement setup, refer to Error! Reference source not found. Error! Reference source not found..
5.2.2. Running VBA macro program

1. Installing the VBA macro program

Obtain the VBA macro program from Keysight 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 “HEAC_Cab…” from the soft key menu and click on it.
5.3. Screen Area and Cable Connection

This section explains the screen area of ENA Option TDR and the test cable connections. ENA Option TDR screen area consists of two channels as shown in Figure 5-1. 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.

Figure 5-1 Screen area of ENA Option TDR
The cables and fixtures are connected to the instrument as shown in Figure 5-2, but do not connect fixtures and Cable DUT yet.

Table 5-1 and Figure 5-3 show the cable connections and corresponding measurement areas on the screen, respectively. The measurement items of the same background color can be measured with the same cable connections.

Table 5-1 Cable and Fixture Connection

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture PIN Number</td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

Note: A and B represent each one of the test fixtures.
Figure 5-3 Measurement areas when Channel 1 is in TDR/TDT mode.
5.4. Calibration and Adjustment

5.4.1. Time Domain Calibration

1. Connect the cables and ECal module to 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 all 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 all cables to the test fixtures in accordance with the table below.

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture PIN Number</td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

Note: A and B represent each one of the test fixtures.

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. Measure DUT Length

1. Click **Auto** (item1) to measure the DUT Length.

2. Connect the DUT.

3. Click **Measure** (item2), then it will measure the DUT length. Wait until the check-mark appears on the right of Measure button.

4. Click **Finish** (item3).

5. If the value of the DUT Length is smaller than 20 ns, enter 20 ns for enabling to set the rise time to 1 ns at the fixture open end in the next step.
5.4.3. Rise time adjustment

1. Disconnect DUT.

2. Select Trace3.

3. Click **TDR/TDT** tab and click **Parameters**. Change the format to **Volt**.

4. Click Marker Search and select Rise Time (10-90%).

5. Set effective rise time at the open end of the test fixture to 1 ns.

6. Turn off the rise time marker, and revert the format to **Impedance**.
7. Set same rise time value to Trace2, Trace4, Trace6, Trace7, and Trace8.
5.4.4. Frequency Domain Calibration

1. Connect all cables to the ECal module.
2. Click ECal to perform the Full Calibration (ECal).

5.4.5. Perform Auto Port Extension

1. Connect the test fixtures as follows. Make the fixture ends open.

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture PIN Number</td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

*Note: A and B represent each one of the test fixtures.*

2. Click Auto Port Extension to perform the Auto Port Extension.
5.5. Measurement and Data Analysis

5.5.1. Intra-Pair Skew

1. Press Channel Next key to select Channel1.
2. Press Channel Max key to enlarge Channel1.
3. Open TDR/TDT tab.
4. Connect the test fixtures as follows.

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture PIN Number</td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

*Note: A and B represent each one of the test fixtures.*

5. Connect the DUT (HDMI cable) to the test fixture.
6. Click Stop Single for Time Domain measurement.
7. Select Trace1.
8. Click Auto Scale and X to show the overall step response.
9. Apply the same horizontal scale settings to Trace5.
10. Click Stop Single for Time Domain measurement.
Data Analysis
Read the delta time between Trace1 and Trace5 (top-left in Figure 5-4). Check if the value is within the limit: If the delta time $\leq$ 111 ps, then pass. Otherwise fail.
5.5.2. Differential Attenuation

Measurement

1. Press **Channel Next** key to activate Channel2.
2. Press **Channel Max** key to enlarge Channel2.
3. Connect the test fixtures as follows. Unused fixture pins should be terminated.

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture PIN Number</td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

*Note: A and B represent each one of the test fixtures.*

4. Connect the DUT (HDMI) cable to the test fixture.
5. Click **Stop Single** for Frequency Domain measurement.

![Figure 5-5 Differential Attenuation Measurement Example](image)

**Data Analysis**

Read Pass/Fail sign on Trace1 and Trace2 (Figure 5-5).
5.5.3. Differential Impedance

Measurement

1. Press **Channel Next** key to select Channel 1.
2. Press **Channel Max** key to enlarge Channel 1.
3. Open **TDR/TDT** tab.
4. Connect the test fixtures as follows. Unused fixture pins should be terminated.

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixture PIN Number</td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

*Note: A and B represent each one of the test fixtures.*

5. Connect the DUT (HDMI) cable to the test fixture.
6. Click **Stop Single** for Time Domain measurement.

Data Analysis

The result must meet following criteria.

- **Connection point and transition area (up to 1 ns):** within 100 Ω ± 15%*

  *A single excursion is permitted out to a max/min of 100 Ω ± 25% and of a duration less than 250ps.*

- **Cable area (1 ns – 2.5 ns):** within 100 Ω ± 10%.

1. Read Pass/Fail sign on Trace 3 and Trace 7, and find an overall result from the following table:

<table>
<thead>
<tr>
<th>Trace3 (Trace4)</th>
<th>Trace7 (Trace8)</th>
<th>Overall Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>Pass</td>
<td>Pass</td>
</tr>
<tr>
<td>Pass</td>
<td>Fail</td>
<td>Check the duration of violation</td>
</tr>
<tr>
<td>Fail</td>
<td>Fail</td>
<td>Fail</td>
</tr>
</tbody>
</table>

2. If Trace 3 is pass and Trace 7 is fail (bottom-left in Figure 5-4), confirm if the excursion is only one time and the duration of violation is within 250 psec.

   Duration of violation = (Marker2 – Marker1) or (Marker4 – Marker3).
3. Repeat the same test with Trace4 and Trace8 (bottom-right in Figure 5-4).

![Connection point and transition area limits for Differential Impedance](image)

* A single excursion is permitted out to a max/min of 100Ω ± 25% and of a duration less than 250ps.

![Example for Impedance Judgment](image)

Figure 5-6 Connection point and transition area and Cable area limits for Differential Impedance

Figure 5-7 Example for Impedance Judgment
5.5.4. Common Mode Impedance

Measurement

1. Press **Channel Next** key to select Channel1.
2. Press **Channel Max** key to enlarge Channel1.
3. Open **TDR/TDT** tab.
4. Connect the test fixtures as follows. Unused fixture pins should be terminated.

<table>
<thead>
<tr>
<th>ENA Port Number</th>
<th>Port1</th>
<th>Port2</th>
<th>Port3</th>
<th>Port4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixture PIN Number</strong></td>
<td>A HEAC+</td>
<td>A HEAC-</td>
<td>B HEAC+</td>
<td>B HEAC-</td>
</tr>
</tbody>
</table>

*Note: A and B represent each one of the test fixtures.*

5. Connect the DUT (HDMI) cable to the test fixture.
6. Click **Stop Single** for Time Domain measurement.

Data Analysis

The result must meet following criteria.

- *Cable area (1 ns – 2.5 ns): within 30 Ω ± 20%.*

Read Pass/Fail sign on Trace2 and Trace6 (top-right in Figure 5-4).
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 “Differential 2-port”.
6. Set DUT Length to 20 ns.
7. Open More Functions tab (item4).
8. Click Advanced Mode (item5).
9. A dialog box appears requesting for confirmation. Then click Yes. (Clear the check box for “Use Advanced Calibration Methods”)

6.1.2. Intra-Pair Skew

6.1.2.1. Measurement Setup

1. Open TDR/TDT tab.
2. Select Trace1.
3. Open Parameters tab.
4. Set **Measure** to “Time Domain” and “Single-Ended”.
5. Set **Format** to Volt.
6. Click **T31** in the table.
7. Click the box below the left knob under **Horizontal**.
8. Input 5 nsec/div with the Entry dialog box.
9. Click the box below the right knob under **Horizontal**.
10. Input -10 sec with the Entry dialog box.
11. Click the box below the left knob under **Vertical**.
12. Input 50 mV/div with the Entry dialog box
13. Click the box below the right knob under **Vertical**.
14. Input 50 mV with the Entry dialog box
15. Open **Trace Control** tab.
16. Clear **Time** and **Marker** check box under **Coupling**.
17. Click **Trace Settings Copy** button. Then Trace Settings Copy dialog box appears.
18. Select **Trace1** in the **From** list.
19. Select **Trace5** in the **To** list.
20. Click **Copy**.
21. Click **Close**.
22. Select **Trace5**.
23. Open **Parameters** tab.
24. Click **T42** in the table.
25. Select **Trace1**.
26. Click **Marker Search** and select **Δ Time**. Then Delta Time dialog box appears.
27. Check the **Δ Time** check box.
28. Select Trace5 (T42) for **Target (Stop)**.
29. Input **Position (%)** to 50.
30. Click **OK**.
6.1.2.2. Crosstalk Compensation

1. Select Trace1.
2. Press Display > Equation Editor… > Enter an equation “\(\text{Intra}+ = S31-S32\)”.
3. Check Equation Enabled check box.
4. Click Apply.
5. Click Close.
6. Select Trace5.
7. Press Display > Equation Editor… > Enter an equation “\(\text{Intra}- = S42-S41\)”.
8. Check Equation Enabled check box.
9. Click Apply.
10. Click Close.

6.1.3. Differential Impedance

1. Open TDR/TDT tab.
2. Open Parameters tab.
3. Select Trace3.
4. Set Format to Impedance.
5. Set Rise Time to 1 nsec (10-90%).
6. Click Tdd11 in the table.
7. Click the box below the left knob under Horizontal.
8. Input 500 psec/div with the Entry dialog box.
9. Click the box below the right knob under Horizontal.
10. Input -1 nsec with the Entry dialog box.
11. Click the box below the left knob under Vertical.
12. Input 5 Ohm/div with the Entry dialog box.
13. Click the box below the right knob under Vertical.
14. Input 75 Ohm with the Entry dialog box.
15. Open Trace Control tab.
16. Click **Trace Settings Copy** button. Then Trace Settings Copy dialog box appears.
17. Select **Trace3** in the From list.
18. Select **Trace4, Trace7** and **Trace8** in the To list.
19. Click **Copy**.
20. Click **Close**.
21. Open **Parameters** tab.
22. Select **Trace4**.
23. Click **Tdd22** in the table.
24. Select **Trace8**.
25. Click **Tdd22** in the table.
26. Select **Trace7**.
27. Press **Marker Search > Search Range**, and set **Start** to 0 and **Stop** to 1n.
28. Click **Search Range** to turn it ON.
29. Click **Couple** to turn it OFF.
30. Click **Return**.
31. Click **Maker** menu and select **1**.
32. Press **Marker Search > Target**, and set **Target Value** to 115.
33. Click **Target Transition > Positive**.
34. Click **Return**.
35. Click **Tracking** to turn it ON.
36. Click **Maker** menu and select **2**.
37. Press **Marker Search > Target**, and set **Target Value** to 115.
38. Click **Target Transition > Negative**.
39. Click **Return**.
40. Click **Tracking** to turn it ON.
41. Click **Maker** menu and select **3**.

---

1 Ignore the message “Target value not found” displayed at the bottom-left of screen.
42. Press **Marker Search** > **Target**, and set **Target Value** to 85.
43. Click **Target Transition** > **Negative**.
44. Click **Return**.
45. Click **Tracking** to turn it **ON**.
46. Click **Maker** menu and select **4**.
47. Press **Marker Search** > **Target**, and set **Target Value** to 85.
48. Click **Target Transition** > **Positive**.
49. Click **Return**.
50. Click **Tracking** to turn it **ON**.
51. Select **Trace8**.
52. Press **Marker Search** > **Search Range**, and set **Start** to 0 and **Stop** to 1n.
53. Click **Search Range** to turn it **ON**.
54. Click **Couple** to turn it **OFF**.
55. Click **Return**.
56. Click **Marker** menu and select **1**.
57. Press **Marker Search** > **Target**, and set **Target Value** to 115.
58. Click **Target Transition** > **Positive**.
59. Click **Return**.
60. Click **Tracking** to turn it **ON**.
61. Click **Marker** menu and select **2**.
62. Press **Marker Search** > **Target**, and set **Target Value** to 115.
63. Click **Target Transition** > **Negative**.
64. Click **Return**.
65. Click **Tracking** to turn it **ON**.
66. Click **Marker** menu and select **3**.
67. Press **Marker Search** > **Target**, and set **Target Value** to 85.
68. Click **Target Transition** > **Negative**.
69. Click **Return**.
Keysight MOI for HDMI 1.4b Ethernet and Audio Return Channel (HEAC) Cable Assembly Test

70. Click Tracking to turn it ON.
71. Click Maker menu and select 4.
72. Press Marker Search > Target, and set Target Value to 85.¹
73. Click Target Transition > Positive.
74. Click Return.
75. Click Tracking to turn it ON.

6.1.4. Common Mode Impedance
1. Open TDR/TDT tab.
2. Open Parameters tab.
3. Select Trace2.
4. Set Format to Impedance.
5. Set Rise Time to 1 nsec (10-90%).
6. Click Tcc11 in the table.
7. Click the box below the left knob under Horizontal.
8. Input 500 psec/div with the Entry dialog box.
9. Click the box below the right knob under Horizontal.
10. Input -1 nsec with the Entry dialog box.
11. Click the box below the left knob under Vertical.
12. Input 5 Ohm/div with the Entry dialog box.
13. Click the box below the right knob under Vertical.
14. Input 5 Ohm with the Entry dialog box.
15. Open Trace Control tab.
16. Click Trace Settings Copy button. Then Trace Settings Copy dialog box appears.
17. Select Trace2 in the From list.
18. Select Trace6 in the To list.
19. Click Copy.
20. Click Close.
21. Open **Parameters** tab.
22. Select **Trace6**.
23. Click **Tcc22** in the table.

### 6.2. Manual Setup for Frequency Domain Measurement

#### 6.2.1. Channel and Trace Settings

1. Press **Display**.
2. Click **Allocate Channels >**.
3. Press **Channel Next**.
4. Click **Num of Traces > 2**.

#### 6.2.2. Differential Attenuation

1. Press **Trace Next** to select Trace1.
2. Press **Sweep Setup > Sweep Type > Lin Freq**.
3. Set **Points** to 1601.
4. Press **Start > Set start value to 300 kHz**.
5. Press **Stop > Set stop value to 200 MHz**.
6. Press **Avg > Set IF Bandwidth** to 70 kHz.
7. Press **Analysis > Fixture Simulator > Fixture Simulator** to turn it ON.
8. Click **Topology > Device > Bal-Bal**.
9. Click **Port1 (bal) > 1-2**.
10. Click **Port2 (bal) > 3-4**.
11. Click **Return**.
12. Click **BalUn ON All Traces**.
13. Click **Measurement > Sdd21**.
14. Press **Format > Log Mag**.
15. Press **Scale**.
16. Set **Scale/Div** to 1 dB/div.
17. Set Reference position to 9 Div.
18. Press Trace Next to select Trace2.
20. Press Scale.
21. Set Scale/Div to 1 dB/div.
22. Set Reference position to 9 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.
- Differential Impedance (Trace3, 4, 7, 8 in Ch1)
- Common Mode Impedance (Trace2, 6 in Ch1)
- Differential Attenuation (Trace1, 2 in Ch2)

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.

<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 s</td>
<td>600 ps</td>
<td>105 U</td>
<td>103 U</td>
</tr>
<tr>
<td>MIN</td>
<td>0 s</td>
<td>600 ps</td>
<td>75 U</td>
<td>75 U</td>
</tr>
</tbody>
</table>

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 items.
**Keysight MOI for HDMI 1.4b Ethernet and Audio Return Channel (HEAC) Cable Assembly Test**

**Differential Impedance**
- (Trace3, 4 in Ch1)

<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 s</td>
<td>1 ns</td>
<td>125 Ohm</td>
<td>125 Ohm</td>
</tr>
<tr>
<td>Max</td>
<td>1 ns</td>
<td>2.5 ns</td>
<td>110 Ohm</td>
<td>110 Ohm</td>
</tr>
<tr>
<td>Min</td>
<td>0 s</td>
<td>1 ns</td>
<td>75 Ohm</td>
<td>75 Ohm</td>
</tr>
<tr>
<td>Min</td>
<td>1 ns</td>
<td>2.5 ns</td>
<td>90 Ohm</td>
<td>90 Ohm</td>
</tr>
</tbody>
</table>

- (Trace7, 8 in Ch1)

<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 s</td>
<td>1 ns</td>
<td>115 Ohm</td>
<td>115 Ohm</td>
</tr>
<tr>
<td>Min</td>
<td>0 s</td>
<td>1 ns</td>
<td>85 Ohm</td>
<td>85 Ohm</td>
</tr>
</tbody>
</table>

**Common Mode Impedance**
- (Trace2, 6 in Ch1)

<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>1 ns</td>
<td>2.5 ns</td>
<td>36 Ohm</td>
<td>36 Ohm</td>
</tr>
<tr>
<td>Min</td>
<td>1 ns</td>
<td>2.5 ns</td>
<td>24 Ohm</td>
<td>24 Ohm</td>
</tr>
</tbody>
</table>

**Differential Attenuation**
- (Trace1, 2 in Ch2)

<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>Min</td>
<td>300 kHz</td>
<td>10 MHz</td>
<td>-1.6 dB</td>
<td>-1.6 dB</td>
</tr>
<tr>
<td>Min</td>
<td>10 MHz</td>
<td>100 MHz</td>
<td>-5.0 dB</td>
<td>-5.0 dB</td>
</tr>
<tr>
<td>Min</td>
<td>100 MHz</td>
<td>200 MHz</td>
<td>-7.1 dB</td>
<td>-7.1 dB</td>
</tr>
</tbody>
</table>