

# HDMI 2.1 Test Fixture

## User Manual



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Product Name	Version	Date	Comments
HDMI 2.1 Test Fixture Series	01	Sep.22,2020	Initial release

## 1. Introduction

This document describes the Dimension and electrical specification for HDMI

2.1 Type-A test fixture.

## 2. Objectives

This specification provides the requirements for test fixture performances and test methods of HDMI 2.1 Type-A test fixture.

## 3. Method of operation & Cleaning

### 3-1. Handling

Before each use of the test fixture, ensure that all connectors are clean.

### 3-2. Visual Inspection

Be sure to inspect all test fixture carefully before making a connection. Inspect all test fixture for metal particles, scratches, deformed threads, dents, or bent, broken, or misaligned center conductors. Do not use damaged test fixture.



### Cleaning method

If necessary, clean the connectors using low-pressure (less than 60 PSI) compressed air or nitrogen with an effective oil-vapor filter and condensation trap. Clean the cable threads, if necessary, using a lint-free swab or cleaning cloth moistened with isopropyl alcohol. Always completely dry a connector before use. Do not use abrasives to clean the connectors. Re- inspect connectors, making sure no particles or residue remains.

### **3-3. Precautions**

Before making any connections, review the “Handling Precautions” section.

Follow these guidelines when making connections:

- Align test fixture carefully
- Make preliminary connection lightly
- To tighten, turn connector nut only
- Do not apply bending force to test fixture
- Do not over-tighten preliminary connections
- Do not twist or screw-in test fixture
- Use an appropriately sized torque wrench (depends on SMA gender), and do not tighten past the “break” point of the torque wrench (normally set to 5 in-lbs.)

### **3-4. Calibration Through De-Embedding**

The HDMI Test Adapters are fully passive components. Therefore, calibration compensating for the losses must occur within the test instrumentation that drives the Creating S2P files. These files will soon be available to de-embed the electrical length and losses within the test fixture up to the HDMI connector interface pads.

## 4. Dimension Specification

### 4-1. CABLE ASSEMBLY

ELECTRICAL		
Item	Test Conditions(at 25 °C±5 °C)	Specification
Impedance	DC~18GHz	50Ω
Voltage Standing Wave Ratio (VSWR)	DC~18GHz	1.3 Max.
Dielectric Withstanding Voltage	AC, time:60sec	500 Vrms Min.
Insulation Resistance	DC 500V time:120sec	5000 MΩ Min

MECHANICAL / ENVIRONMENT	
Item	Specification
Nominal Outer Diameter of cable	1,42 mm
Min. Bend Radius Static/ Single	5 mm
Min. Bend Radius Dynamic	10 mm
Temperature Range	-65 °C~165 °C
Cable Retention	10 N Min. Or When Cable Gets Broken

### 4-2. SMA DIRECT SOLDER JACK

ELECTRICAL		
Item	Test Conditions(at 25 °C±5 °C)	Specification
Impedance	DC~18GHz	50Ω
Return Loss	DC~18GHz	-17db Max.
Dielectric Withstanding Voltage	AC, time:60sec	500 Vrms Min.
Contact Resistance	Center Contact DC 0.2V, 1A	3mΩMax.
	Outer Contact DC 0.2V, 1A	2mΩMax.
Insulation Resistance	DC 500V, time: 120sec	5000 MΩMin.

MECHANICAL / ENVIRONMENT		
Item	Test Conditions	Specification
Force To Engage/Disengage	N/A	2 in-lbs. Max
Contact Retention	60mm/min	6 lbs. Min

### 4-3. Drawing

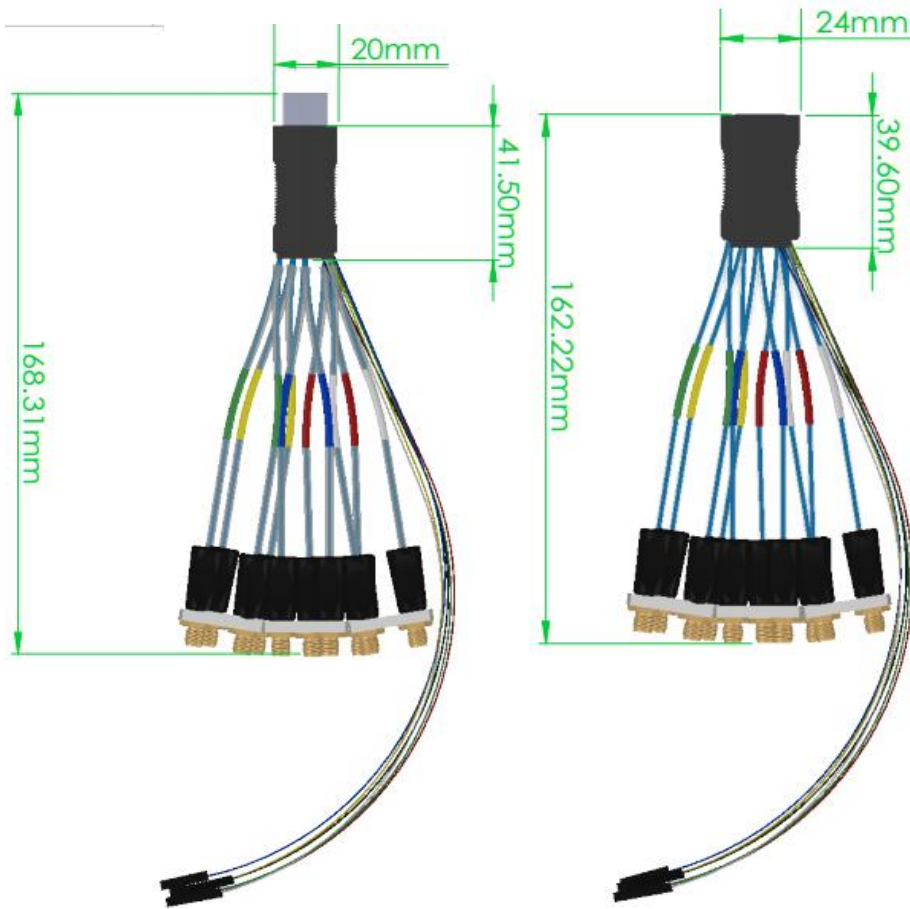







Figure 4-1. HDMI 2.1 Type-A Plug Fixture & HDMI 2.1 Type-A Receptacle Fixture

Test Fixture	Temperature Range	Weight
HDMI 2.1 Type-A Plug Fixture	< 110°C	91g
HDMI 2.1 Type-A Receptacle Fixture	< 110°C	90g

<p>TFH-08P1U</p>  <p>Figure 4-2. HDMI 2.1 Type-A Plug Fixture</p>	<p>TFH-08R1U</p>  <p>Figure 4-3. HDMI 2.1 Type-A Receptacle Fixture</p>
<p>TFH-08C1U</p>  <p>Figure 4-4. HDMI 2.1 2x Calibration Flexible cable</p>	<p>TFH-08M1U</p>  <p>Figure 4-5. MICRO-FIT to DuPont Cable</p>
<p>TFH-08S1U</p>  <p>Figure 4-6 SMA to DuPont Cable</p>	

## 5. Test Equipment

Item	Product Model	Name	Manufacturer
01	1220S	Auto Inserting Pulling Force (Tension, Compression) Tester	Se-tester
02	E5071C-TDR	300KHz~20GHz ENA Network Analyzer	Keysight
03	N4433A	200KHz~20GHz Electronic Calibration Module	Keysight

## 6. Test Conditions

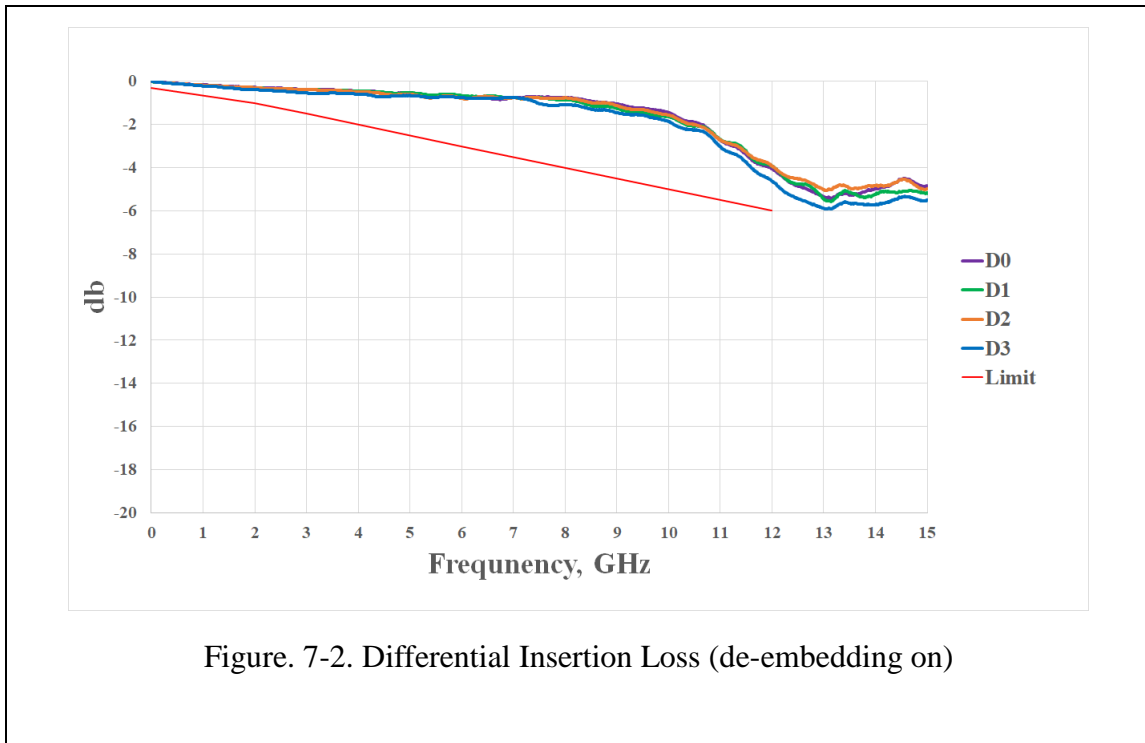
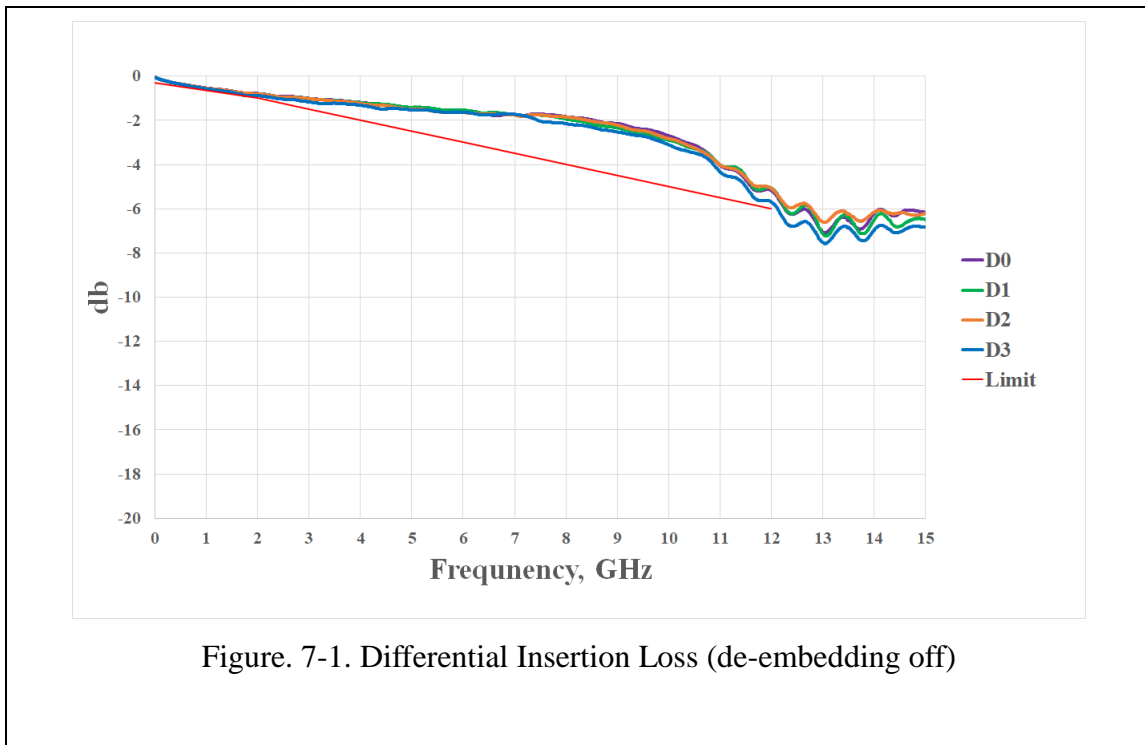
Test Fixture	Part No.	S/N
HDMI 2.1 Type-A Plug Fixture	TFH-08P1U	011
HDMI 2.1 Type-A Receptacle Fixture	TFH-08R1U	001
HDMI 2.1 Calibration 2x Calibration Flexible cable	TFH-08C1U	001

Test Item:	Condition	Requirement
Attenuation (Differential Insertion Loss)	Frequency range : 10MHz~12GHz IF Bandwidth : 1kHz	-0.3dB @ 0GHz -1dB @ 2GHz -1.5dB @ 3GHz -3dB @ 6GHz -6dB @ 12GHz Reference HDMI 2.1 Connector CTS.
ACR (Attenuation to Crosstalk Ratio)	Sweep points : 1200	≤ -35 dB @ 0 GHz to 1 GHz, ≤ -25 dB @ 1 GHz to 4 GHz, ≤ -15 dB @ 4 GHz to 7 GHz, ≤ -10 dB @ 7 GHz to 12 GHz
Intra-Pair Skew	60ps (10% - 90%)	< 7.5 ps
Inter-Pair Skew	60ps (10% - 90%)	< 10 ps
Differential Impedance	75ps (10% - 90%)	If ( Cable_Low < 85 ohm) or (Cable_Hi > 115 ohm) then Fail. If (Conn2_Low < 90 ohm) or (Conn2_Hi > 110 ohm) then If the duration of violation (t) is 150 psec or longer or there is more than one excursion then Fail.



## 7. Test Result

### 7-1. Attenuation (Differential Insertion Loss)



7-2. ACR (Attenuation to Crosstalk Ratio)

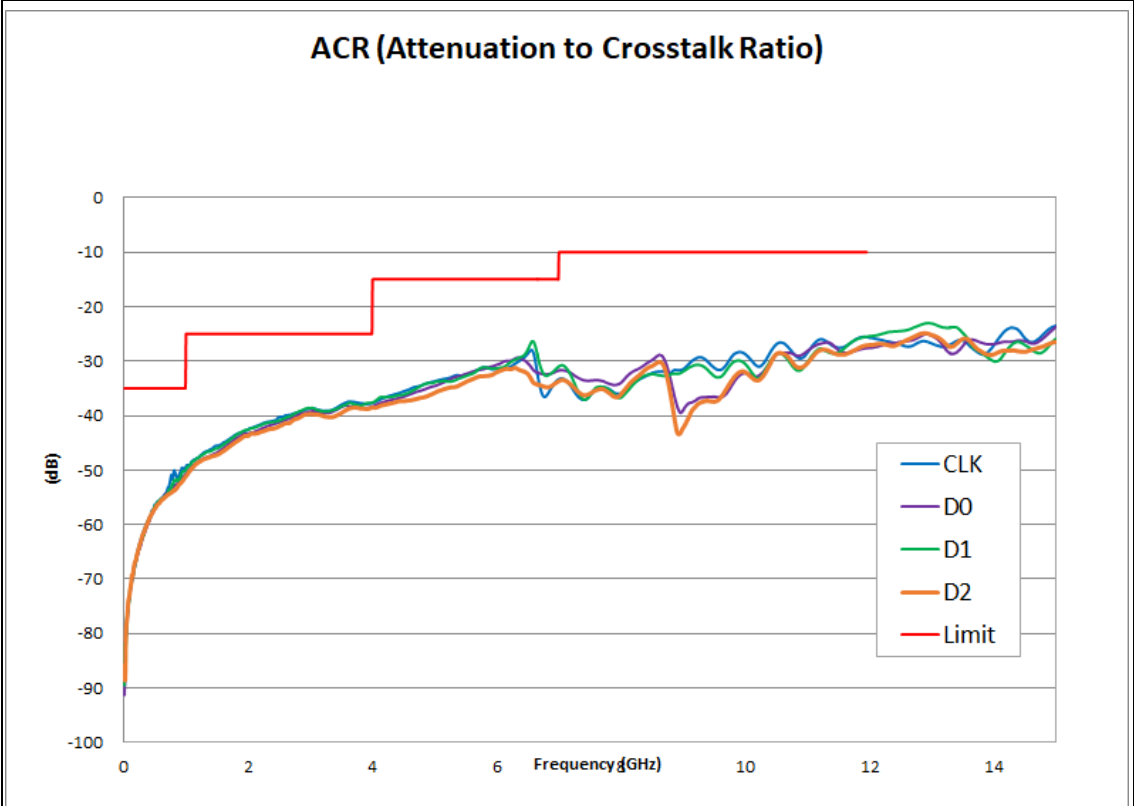


Figure. 7-3. ACR (Attenuation to Crosstalk Ratio)

### 7-3. Differential Intra-Pair Skew

Test Pair \ DUT	Result (ps)	Remark
D0	3.841ps	Refer to Fig. 7-4
D1	2.5423ps	Refer to Fig. 7-5
D2	1.4582ps	Refer to Fig. 7-6
D3	383.73fs	Refer to Fig. 7-7

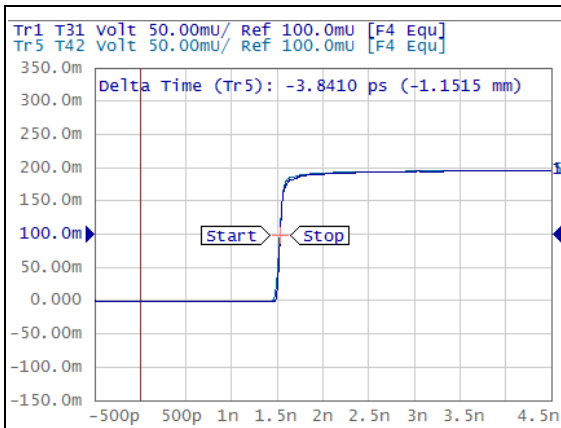


Figure 7-4. D0 Pair

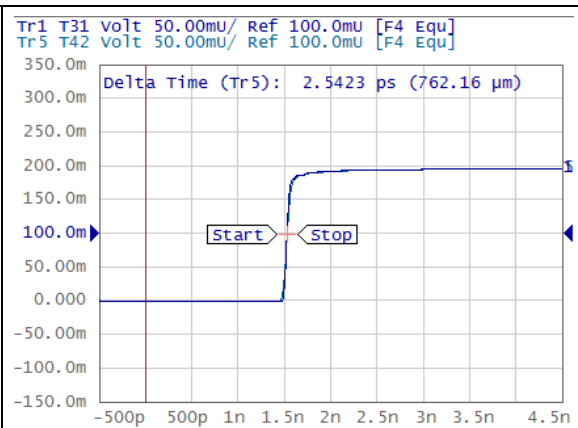


Figure 7-5. D1 Pair

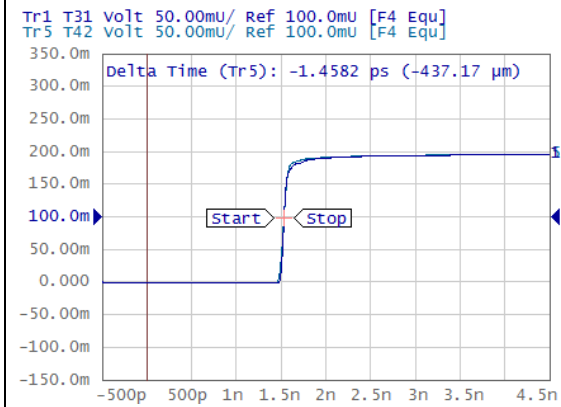


Figure 7-6. D2 Pair

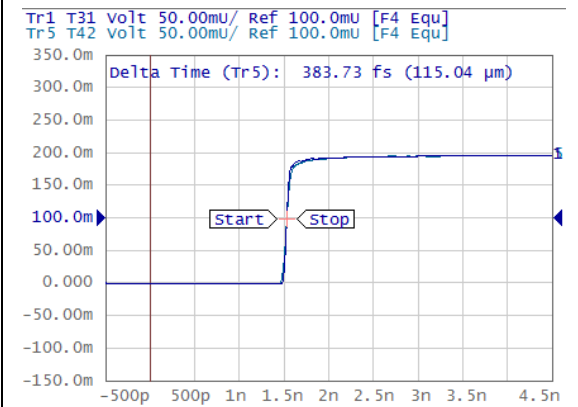


Figure 7-7. D3 Pair

### 7-4. Differential Inter-Pair Skew

Test Pair \ DUT	Result (ps)	Remark
D0	1.5294ns	Refer to Fig. 7-8
D1	1.5302ns	Refer to Fig. 7-9
D2	1.5323ns	Refer to Fig. 7-10
D3	1.5305ns	Refer to Fig. 7-11

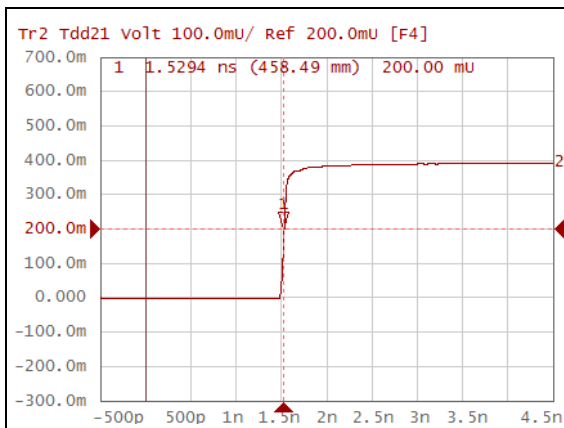


Figure 7-8. D0 Pair

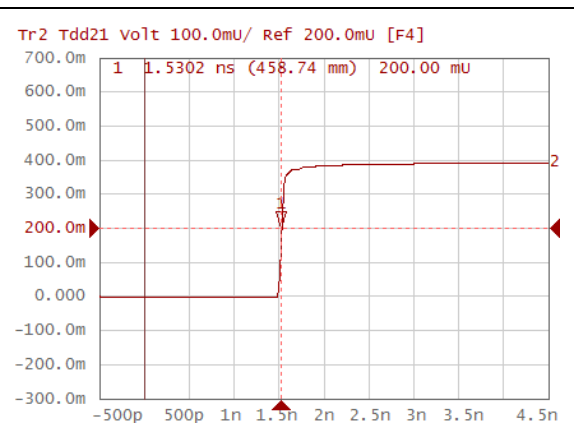


Figure. 7-9 D1 Pair

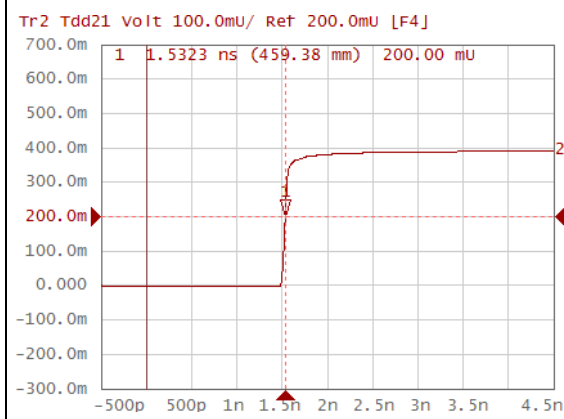


Figure 7-10. D2 Pair

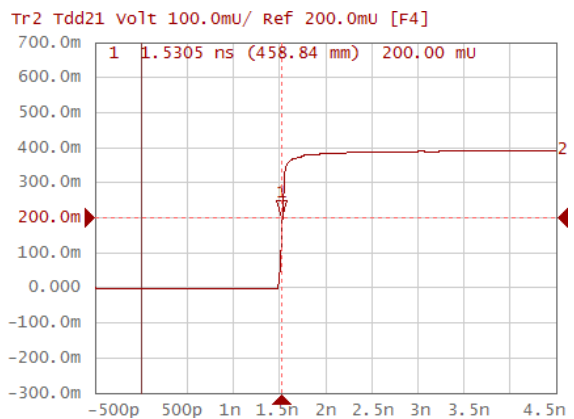
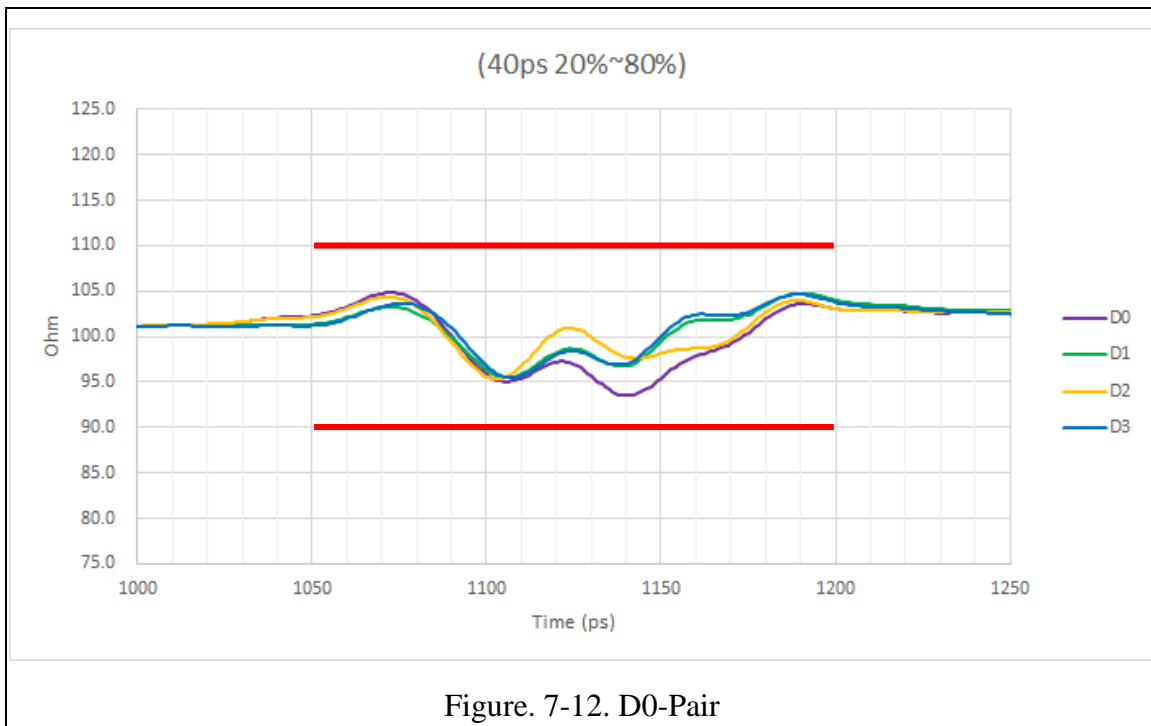


Figure. 7-11. D3 Pair

### 7-5. Differential Impedance

Test Item	Impedance ( $\Omega$ )			
DUT Test Pin	HDMI 2.1 Type-A Receptacle Fixture			
	Max	Min	$\Delta$	Remark
D0	104.84	95.05	9.79	Refer to Fig. 7-12
D1	103.23	95.52	7.71	
D2	104.36	95.34	8.96	
D3	103.65	95.50	8.15	



# HDMI 2.1 Test Fixture

## User Manual



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Product Name	Version	Date	Comments
HDMI 2.1 Test Fixture Series	01	Sep.22,2020	Initial release

## 1. 簡介

本文介紹 HDMI 2.1 Type-A test fixture 的機械規格與電氣規格。

## 2. 目的

本規範提供了 HDMI 2.1 Type-A test fixture 的特性規格與測試結果。

## 3. 操作方式與清潔

### 3-1. 處理

在每次使用測試治具之前，確保所有連接器都乾淨。

### 3-2. 目測檢查

在連接之前，一定要仔細檢查所有的測試治具。檢查所有測試治具是否有金屬顆粒，划痕，變形螺紋，凹痕或彎曲，斷裂或中心導體未對齊。不要使用損壞的測試治具。

### 清潔方法

如需清潔，請使用低壓（小於 60 PSI）的壓縮空氣或氮氣與有效的油氣過濾器  
和冷凝器。如有需要清潔內部，使用沾有異丙醇的清潔布清潔測試治具。  
清潔後請確認連接器是否為乾燥狀態。請勿使用研磨劑清潔連接器。使用前確  
保連接器內無殘留物。



### 3-3. 注意事項

在進行任何連接之前，請查看“注意事項”部分。連接時請遵循以下準則：

- 仔細對齊測試治具
- 輕微進行初步連接
- 確認 SMA 接頭對鎖狀態
- 不要對測試治具施加彎曲力
- 請勿使用磅數過高之扭力扳手(5 in-lbs 上)
- 測試治具端請勿旋轉或扭動
- 使用適當尺寸的扭矩扳手(取決於 SMA 的規格), 並且不要擰過扭矩扳手的“斷開”點 (通常設置為 5 in-lbs)。

### 3-4. 校正

HDMI 測試適配器是完全無源組件。因此，校準在驅動的測試儀器中必須補償損失。創建 S2P 文件。這些文件將很快用於將測試夾具內的電氣長度和損耗去除到 HDMI 連接器接口焊盤。

## 4. 尺寸規格

### 4-1. CABLE ASSEMBLY

ELECTRICAL		
Item	Test Conditions(at 25 °C±5 °C)	Specification
Impedance	DC~18GHz	50Ω
Voltage Standing Wave Ratio (VSWR)	DC~18GHz	1.3 Max.
Dielectric Withstanding Voltage	AC, time:60sec	500 Vrms Min.
Insulation Resistance	DC 500V time:120sec	5000 MΩ Min

MECHANICAL / ENVIRONMENT	
Item	Specification
Nominal Outer Diameter of cable	1,42 mm
Min. Bend Radius Static/ Single	5 mm
Min. Bend Radius Dynamic	10 mm
Temperature Range	-65 °C~165 °C
Cable Retention	10 N Min. Or When Cable Gets Broken

### 4-2. SMA DIRECT SOLDER JACK

ELECTRICAL		
Item	Test Conditions(at 25 °C±5 °C)	Specification
Impedance	DC~18GHz	50Ω
Return Loss	DC~18GHz	-17db Max.
Dielectric Withstanding Voltage	AC, time:60sec	500 Vrms Min.
Contact Resistance	Center Contact DC 0.2V, 1A	3mΩMax.
	Outer Contact DC 0.2V, 1A	2mΩMax.
Insulation Resistance	DC 500V, time: 120sec	5000 MΩMin.

MECHANICAL / ENVIRONMENT		
Item	Test Conditions	Specification
Force To Engage/Disengage	N/A	2 in-lbs. Max
Contact Retention	60mm/min	6 lbs. Min

### 4-3. 工程圖

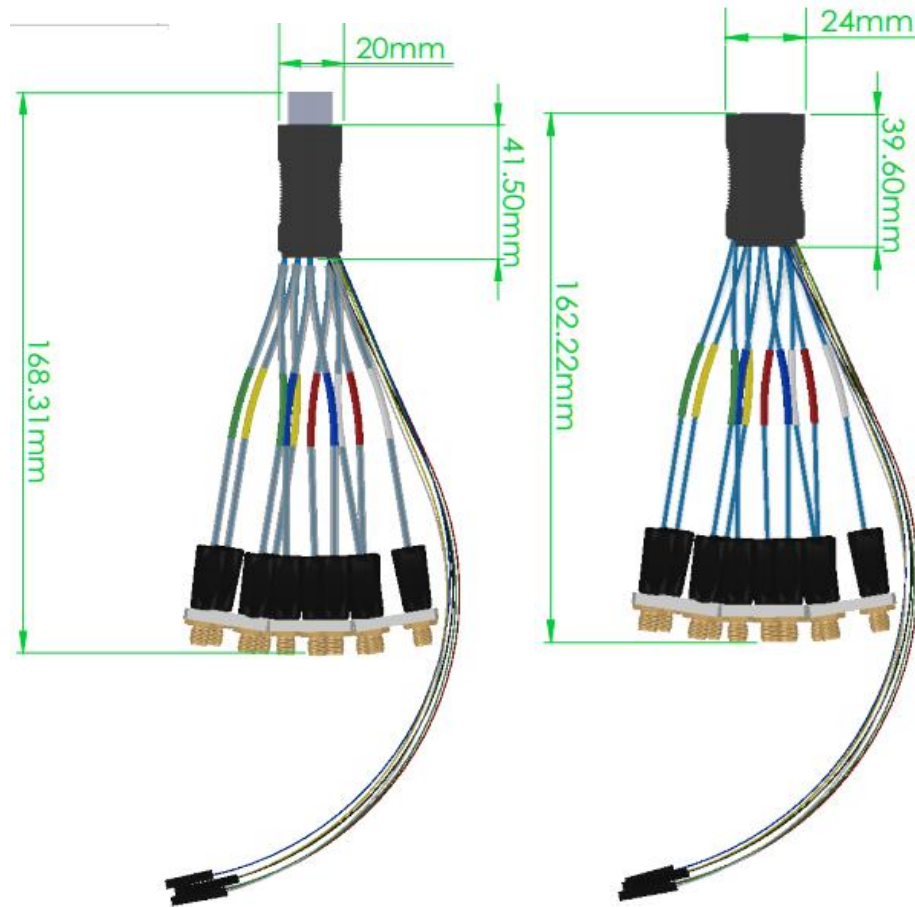







Figure 4-1. HDMI 2.1 Type-A Plug Fixture & HDMI 2.1 Type-A Receptacle Fixture

Test Fixture	Temperature Range	Weight
HDMI 2.1 System Type-A Plug Fixture	< 110°C	91g
HDMI 2.1 System Type-A Receptacle Fixture	< 110°C	90g

<p style="text-align: center;">TFH-08P1U</p>  <p style="text-align: center;">Figure 4-2. HDMI 2.1 Type-A Plug Fixture</p>	<p style="text-align: center;">TFH-08R1U</p>  <p style="text-align: center;">Figure 4-3. HDMI 2.1 Type-A Receptacle Fixture</p>
<p style="text-align: center;">TFH-08C1U</p>  <p style="text-align: center;">Figure 4-4. HDMI 2.1 2x Calibration Flexible cable</p>	<p style="text-align: center;">TFH-08M1U</p>  <p style="text-align: center;">Figure 4-5. MICRO-FIT to DuPont Cable</p>
<p style="text-align: center;">TFH-08S1U</p>  <p style="text-align: center;">Figure 4-6. SMA to DuPont Cable</p>	

## 5. 測試設備

Item	Product Model	Name	Manufacturer
01	1220S	Auto Inserting Pulling Force (Tension, Compression) Tester	Se-tester
02	E5071C-TDR	300KHz~20GHz ENA Network Analyzer	Keysight
03	N4433A	200KHz~20GHz Electronic Calibration Module	Keysight

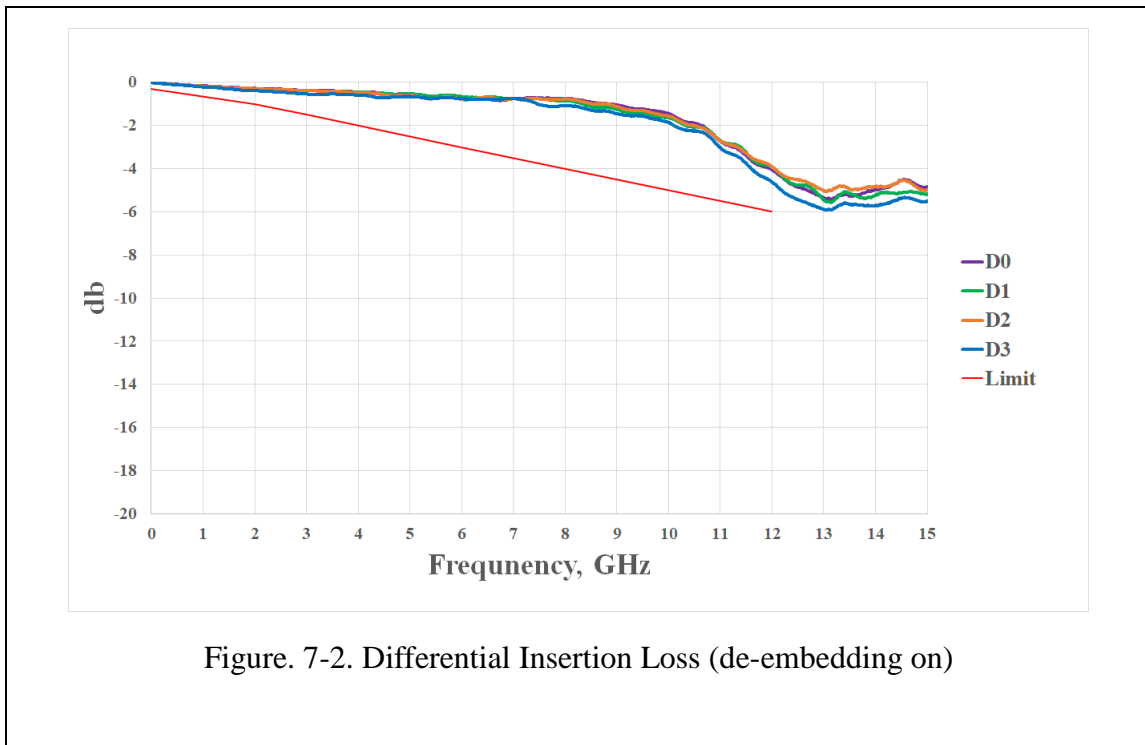
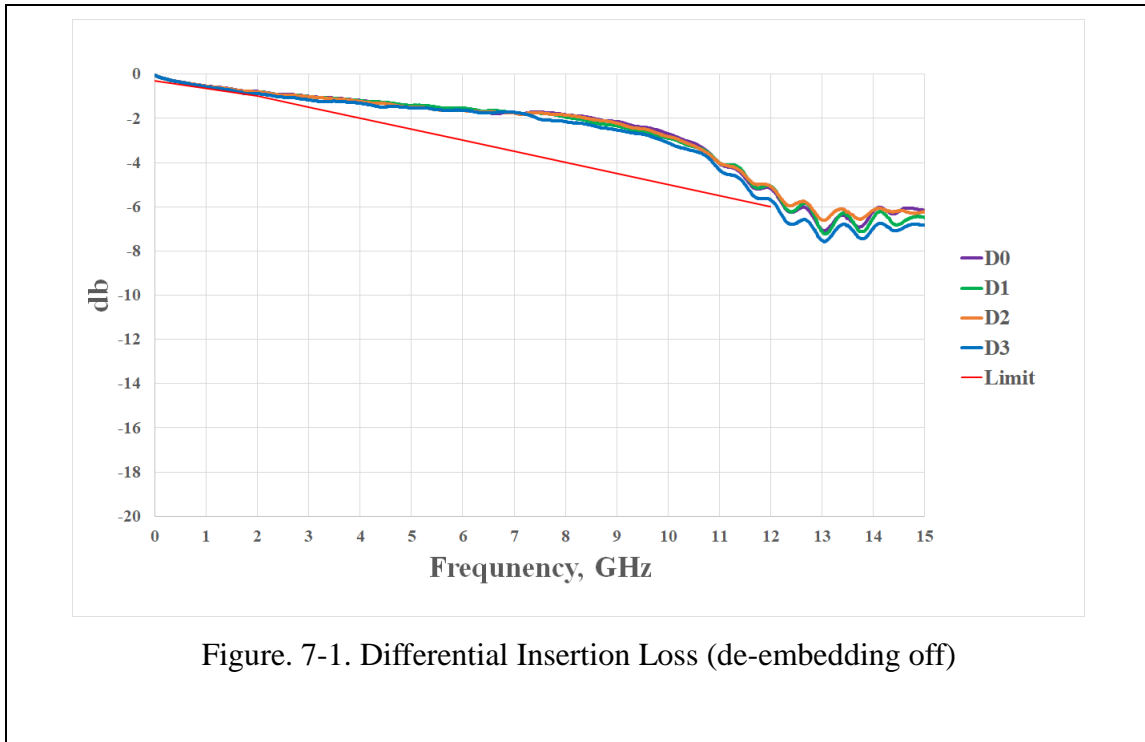
## 6. 測試條件

Test Fixture	Part No.	S/N
HDMI 2.1 Type-A Plug Fixture	TFH-08P1U	011
HDMI 2.1 Type-A Receptacle Fixture	TFH-08R1U	001
HDMI 2.1 Calibration 2x Calibration Flexible cable	TFH-08C1U	001

Test Item:	Condition	Requirement
Attenuation (Differential Insertion Loss)	Frequency range : 10MHz~18GHz IF Bandwidth : 1kHz	-0.3dB @ 0GHz -1dB @ 2GHz -1.5dB @ 3GHz -3dB @ 6GHz -6dB @ 12GHz Reference HDMI 2.1 Connector CTS.
ACR (Attenuation to Crosstalk Ratio)	Sweep points : 1800	≤ -35 dB @ 0 GHz to 1 GHz, ≤ -25 dB @ 1 GHz to 4 GHz, ≤ -15 dB @ 4 GHz to 7 GHz, ≤ -10 dB @ 7 GHz to 12 GHz
Intra-Pair Skew	60ps (10% - 90%)	< 7.5 ps
Inter-Pair Skew	60ps (10% - 90%)	< 10 ps
Differential Impedance	75ps (10% - 90%)	If ( Cable_Low < 85 ohm) or (Cable_Hi > 115 ohm) then Fail. If (Conn2_Low < 90 ohm) or (Conn2_Hi > 110 ohm) then If the duration of violation (t) is 150 psec or longer or there is more than one excursion then Fail.

## 7. 測試結果

### 7-1. Attenuation (Differential Insertion Loss)



7-2. ACR (Attenuation to Crosstalk Ratio)

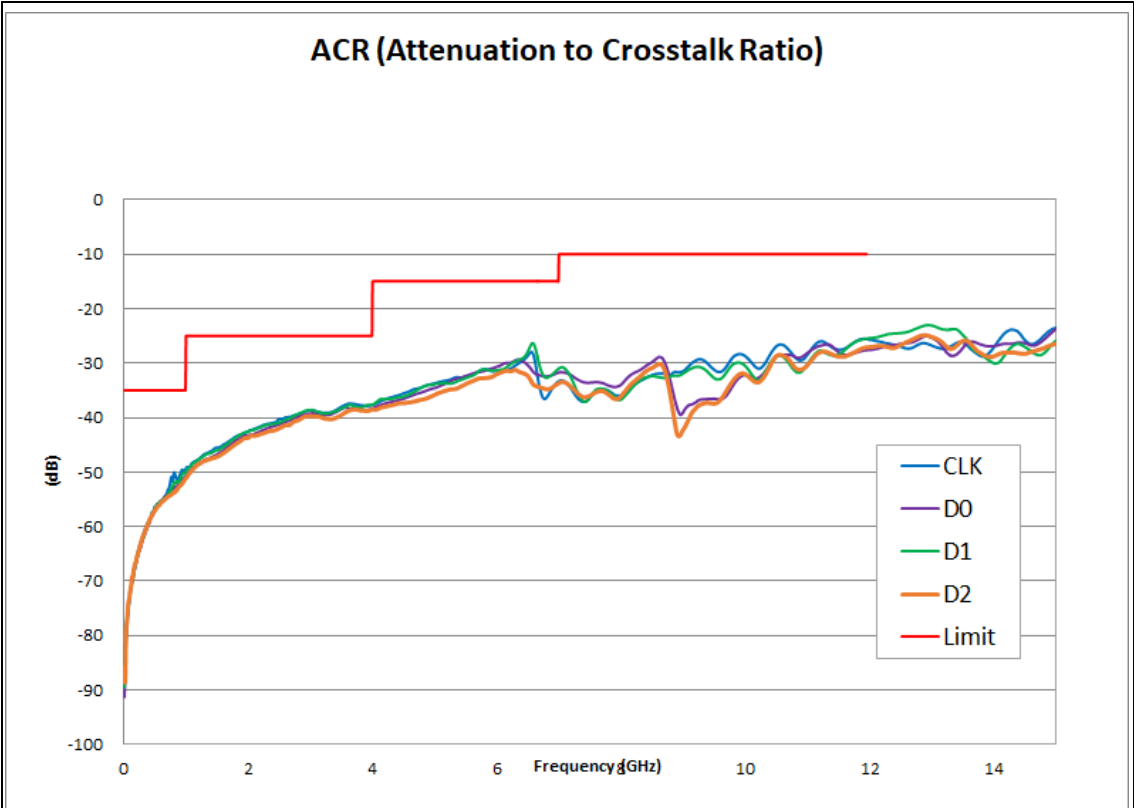


Figure 7-3. ACR (Attenuation to Crosstalk Ratio)

### 7-3. Differential Intra-Pair Skew

Test Pair \ DUT	Result (ps)	Remark
D0	3.841ps	Refer to Fig. 7-4
D1	2.5423ps	Refer to Fig. 7-5
D2	1.4582ps	Refer to Fig. 7-6
D3	383.73fs	Refer to Fig. 7-7

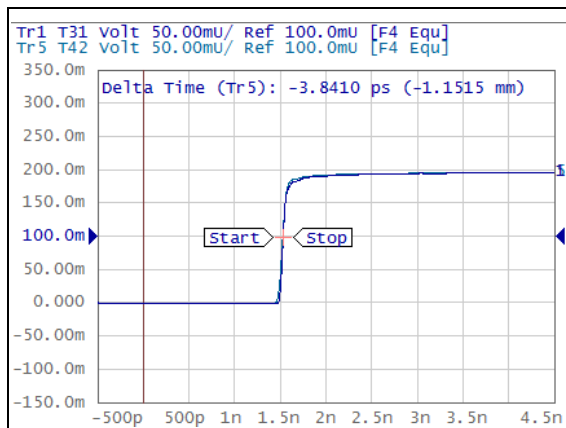


Figure 7-4. D0 Pair

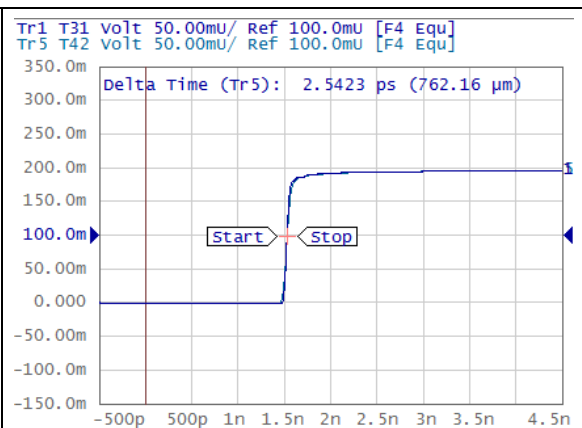


Figure 7-5. D1 Pair

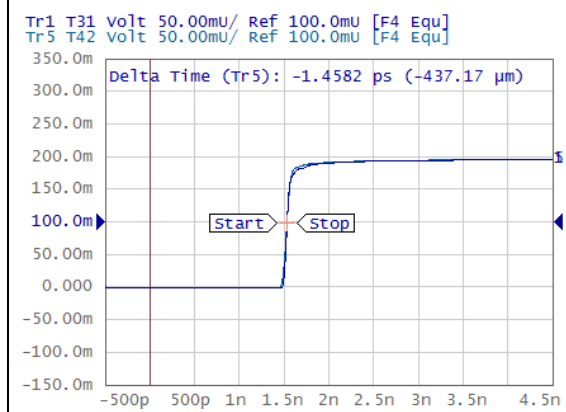


Figure 7-6 D2 Pair

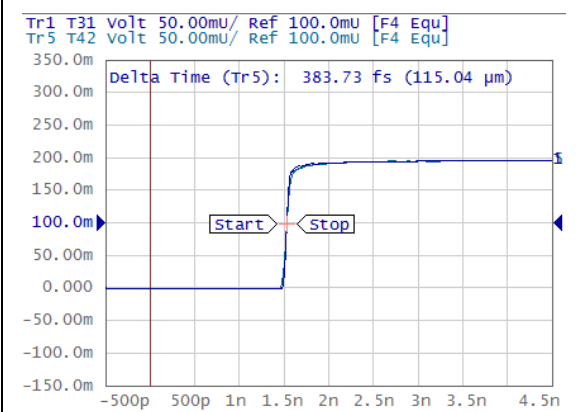


Figure 7-7 D3 Pair



### 7-4. Differential Inter-Pair Skew

Test Pair \ DUT	Result (ps)	Remark
D0	1.5294ns	Refer to Fig. 7-8
D1	1.5302ns	Refer to Fig. 7-9
D2	1.5323ns	Refer to Fig. 7-10
D3	1.5305ns	Refer to Fig. 7-11

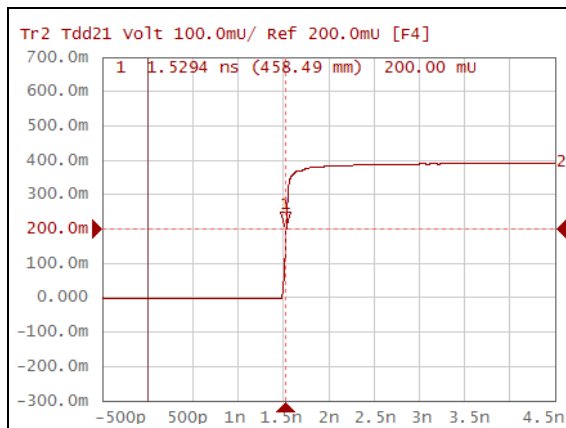


Figure 7-8. D0 Pair

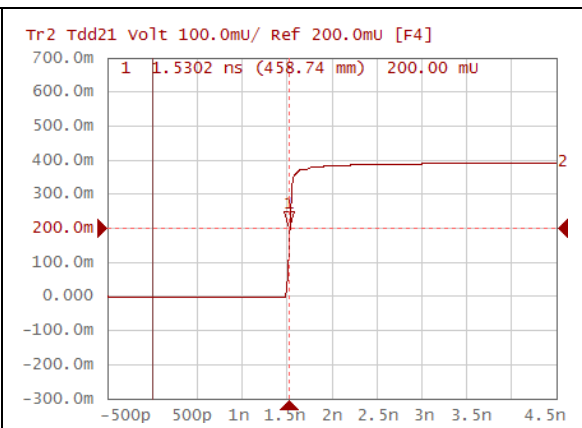


Figure 7-9. D1 Pair

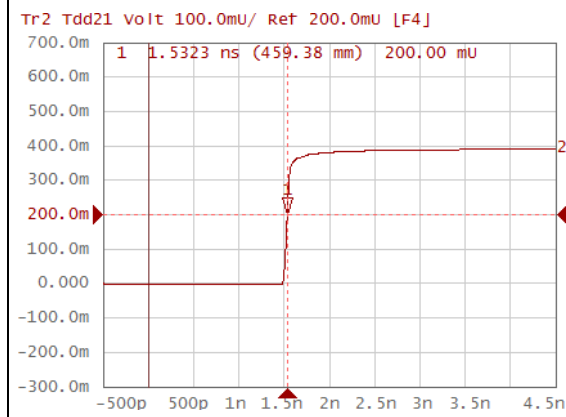


Figure 7-10. D2 Pair

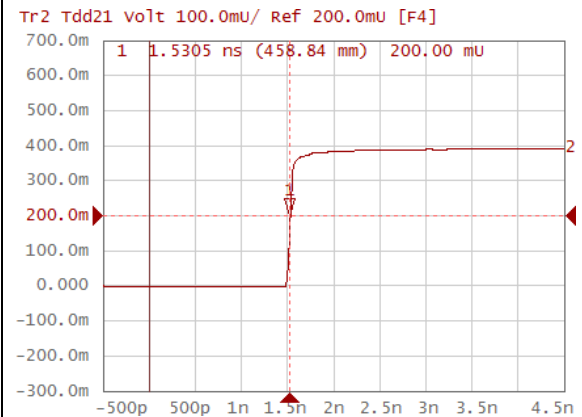


Figure 7-11. D3 Pair

### 7-5. Differential Impedance

Test Item	Impedance ( $\Omega$ )			
DUT Test Pin	HDMI 2.1 Type-A Receptacle Fixture			
	Max	Min	$\Delta$	Remark
D0	104.84	95.05	9.79	Refer to Fig. 7-12
D1	103.23	95.52	7.71	
D2	104.36	95.34	8.96	
D3	103.65	95.50	8.15	

