

USB Type-C Alt-Mode Test Fixture User Manual



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Product Name	Version	Date	Comments
USB Type-C Alt-Mode Test Fixture Series	01	Jan.16,2019	Initial release

1. Introduction

This document describes the Dimension and electrical specification for USB Type-C Alt Mode Fixture.

2. Objectives

This specification provides the requirements for test fixture performances and test methods of USB Type-C Alt Mode 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 USB Type-C Alt mode Test Adapters are fully passive components. Therefore, calibration compensating for the losses must occur within the test instrumentation that drives the USB. Creating S4P files. These files will soon be available to de-embed the electrical length and losses within the test fixture up to the Type-C connector interface pads.

4. Product Inspection

Customers receive a rule, perform the following inspection procedures.

- Please check the parcels packaging and product for damage, to confirm the integrity of the contents of the product .When not in use Fixture , please close fixture fixture placed foam lined box.
- Locate the shipping list and verify the all iten ordered were received.
- In case the product is defective or incomplete, in the "Warranty Period" to discuss how to contact LUXSHARE-ICT technical support and product return issues.

5. Dimension Specification

5-1. Drawing

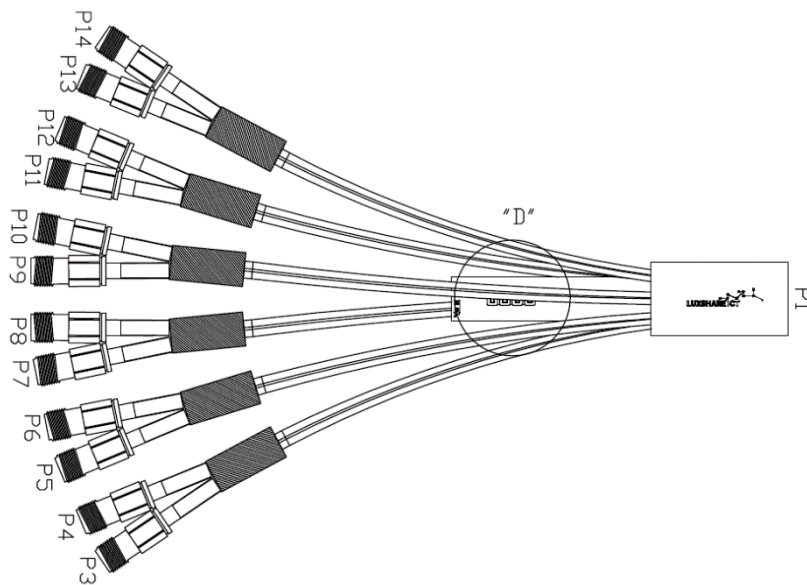


Figure 5-1. USB Type-C Receptacle Alt mode Fixture TF21-189G

P1	Type-C Receptacle		USB	DP		
			Fixture Pinout	Source (DFP)	Sink (UFP)	
A1	GND		GND			P2
A2	TX1+		USB_TX1+	DP_L2+	DP_L3+	P5
A3	TX1-		USB_TX1-	DP_L2-	DP_L3-	P6
A4	VBUS		VBUS			P2
A5	CC		CC1	CC1	CC1	P2
A6	D+		D1+	D1+	D1+	P9
A7	D-		D1-	D1-	D1-	P10
A8	SBU1		SBU1	AUX+	AUX+	P7
A9	VBUS		VBUS			P19
A10	RX2-		USB_RX2-	DP_L0-	DP_L1-	P13
A11	RX2+		USB_RX2+	DP_L0+	DP_L1+	P14
A12	GND		GND			P2
B1	GND		GND			P2
B2	TX2+		USB_TX2+	DP_L1+	DP_L0+	P12
B3	TX2-		USB_TX2-	DP_L1-	DP_L0-	P11
B4	VBUS		VBUS			P2
B5	Vconn		CC2	CC2	CC2	P2
B6						
B7						
B8	SBU2		SBU2	AUX-	AUX-	P8
B9	VBUS		VBUS			P2
B10	RX1-		USB_RX1-	DP_L3-	DP_L2-	P4
B11	RX1+		USB_RX1+	DP_L3+	DP_L2+	P3
B12	GND		GND			P2
SIGNAL GROUND : A1,A12,B1,B12						
SIGNAL VBUS : A5,A9,B5,B9						

Figure 5-2. USB Type-C Receptacle Alt mode Fixture Pin Assignment

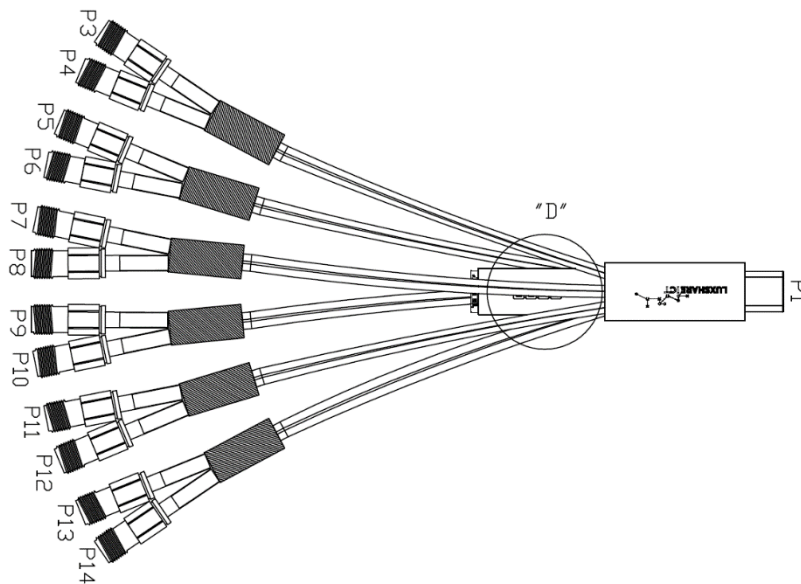


Figure 5-3. USB Type-C Plug Alt mode Fixture TF21-190G

P1	Type-C Plug		USB	DP		
			Fixture Pinout	Source(DFP)	Sink (UFP)	
A1	GND		GND			P2
A2	TX1+		USB_TX1+	DP_L2+	DP_L3+	P3
A3	TX1-		USB_TX1-	DP_L2-	DP_L3-	P4
A4	VBUS		VBUS			P2
A5	CC		CC1	CC1	CC1	P2
A6	D+		D1+	D1+	D1+	P7
A7	D-		D1-	D1-	D1-	P8
A8	SBU1		SBU1	AUX+	AUX+	P9
A9	VBUS		VBUS			P19
A10	RX2-		USB_RX2-	DP_L0-	DP_L1-	P11
A11	RX2+		USB_RX2+	DP_L0+	DP_L1+	P12
A12	GND		GND			P2
B1	GND		GND			P2
B2	TX2+		USB_TX2+	DP_L1+	DP_L0+	P14
B3	TX2-		USB_TX2-	DP_L1-	DP_L0-	P13
B4	VBUS		VBUS			P2
B5	Vconn		CC2	CC2	CC2	P2
B6						
B7						
B8	SBU2		SBU2	AUX-	AUX-	P10
B9	VBUS		VBUS			P2
B10	RX1-		USB_RX1-	DP_L3-	DP_L2-	P6
B11	RX1+		USB_RX1+	DP_L3+	DP_L2+	P5
B12	GND		GND			P2
SIGNAL GROUND : A1,A12,B1,B12						
SIGNAL VBUS : A5,A9,B5,B9						

Figure 5-4. USB Type-C Plug Alt mode Fixture Pin Assignment

TF21-189G



Figure 5-5. USB Type-C Receptacle
Alt mode Fixture

TF21-190G



Figure 5-6. USB Type-C Plug
Alt mode Fixture

TF21-239L



Figure 5-7.1x Calibration Flexible cable
(150mm)

TF21-240L



Figure 5-8. 2x Calibration Flexible cable
(300mm)

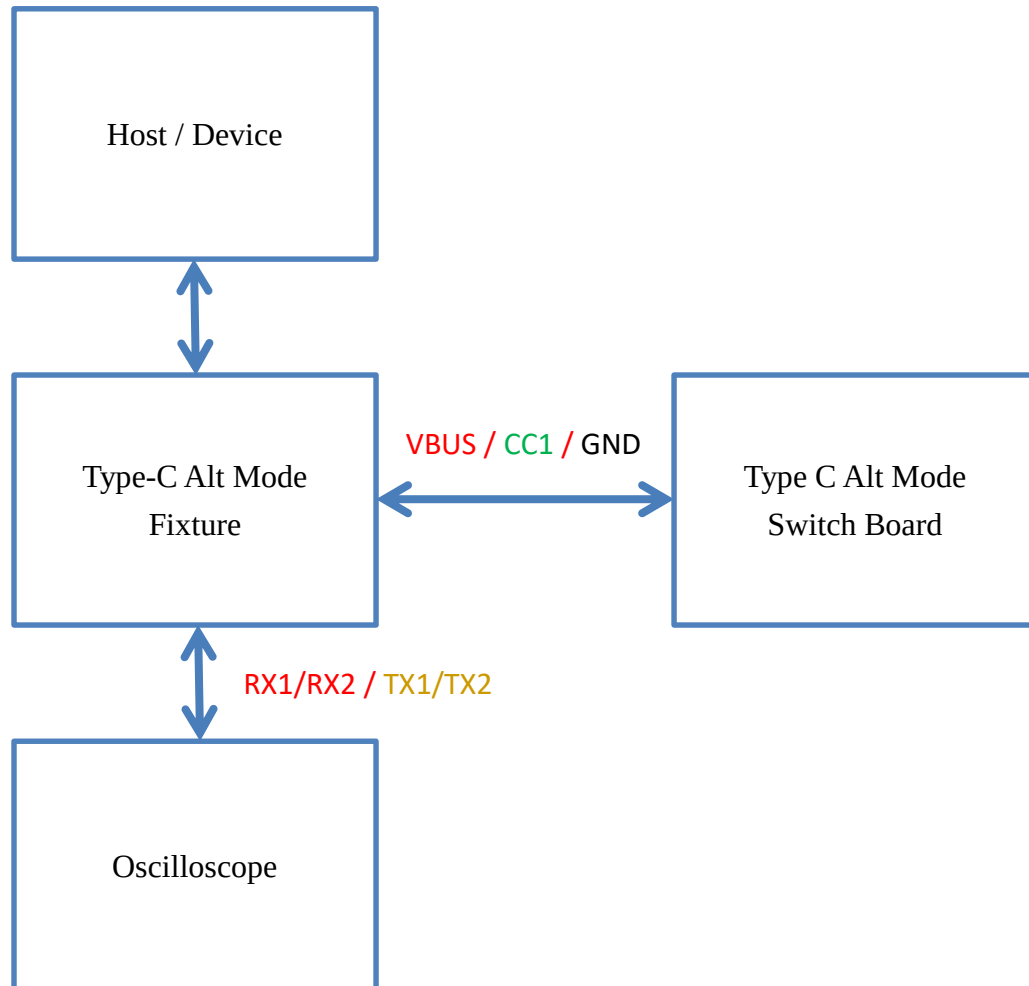
TF21-347G



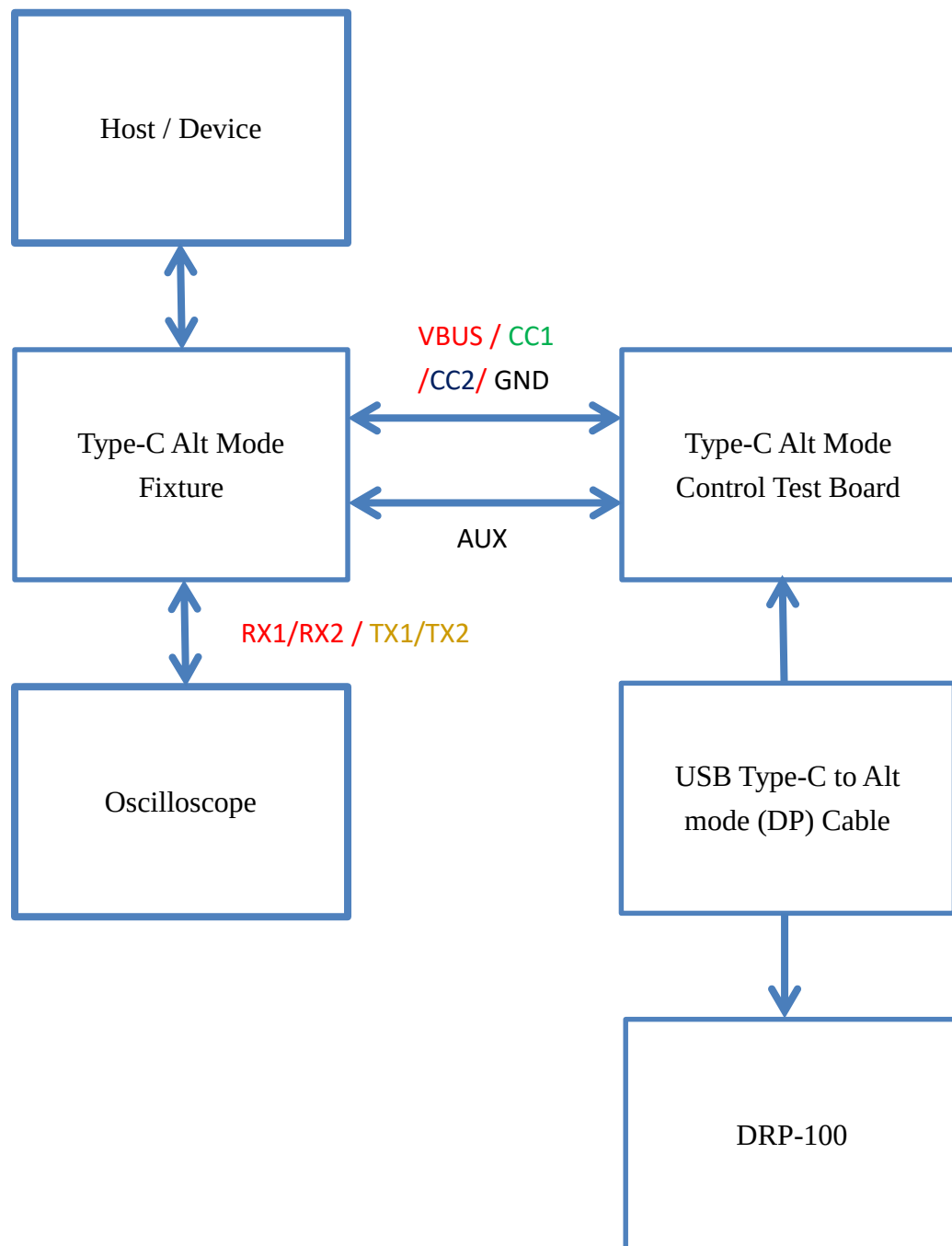
Figure 5-9. USB Type-C Alt Mode Switch
Board

6. User Models

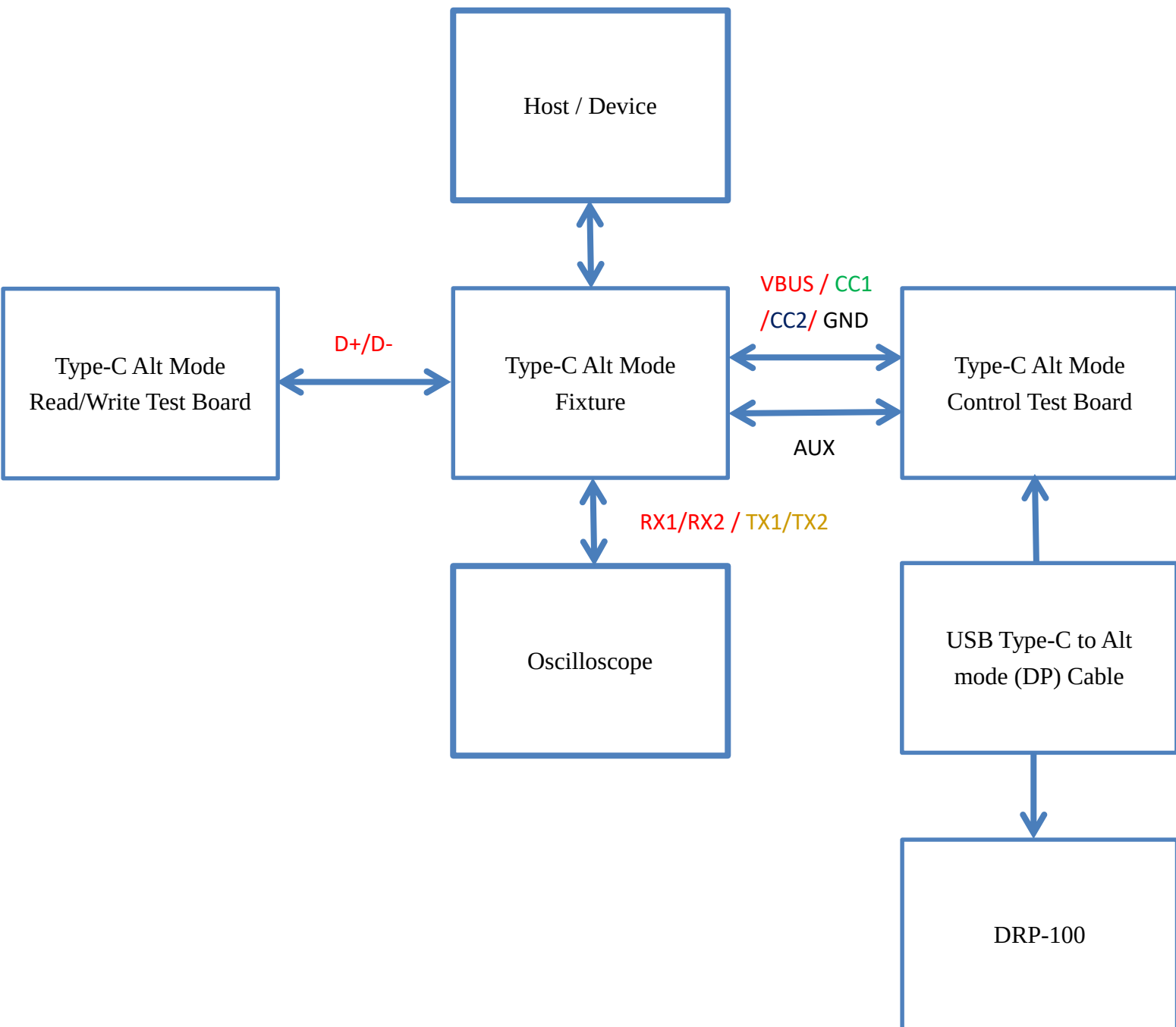
6-1. USB Type-C Mode



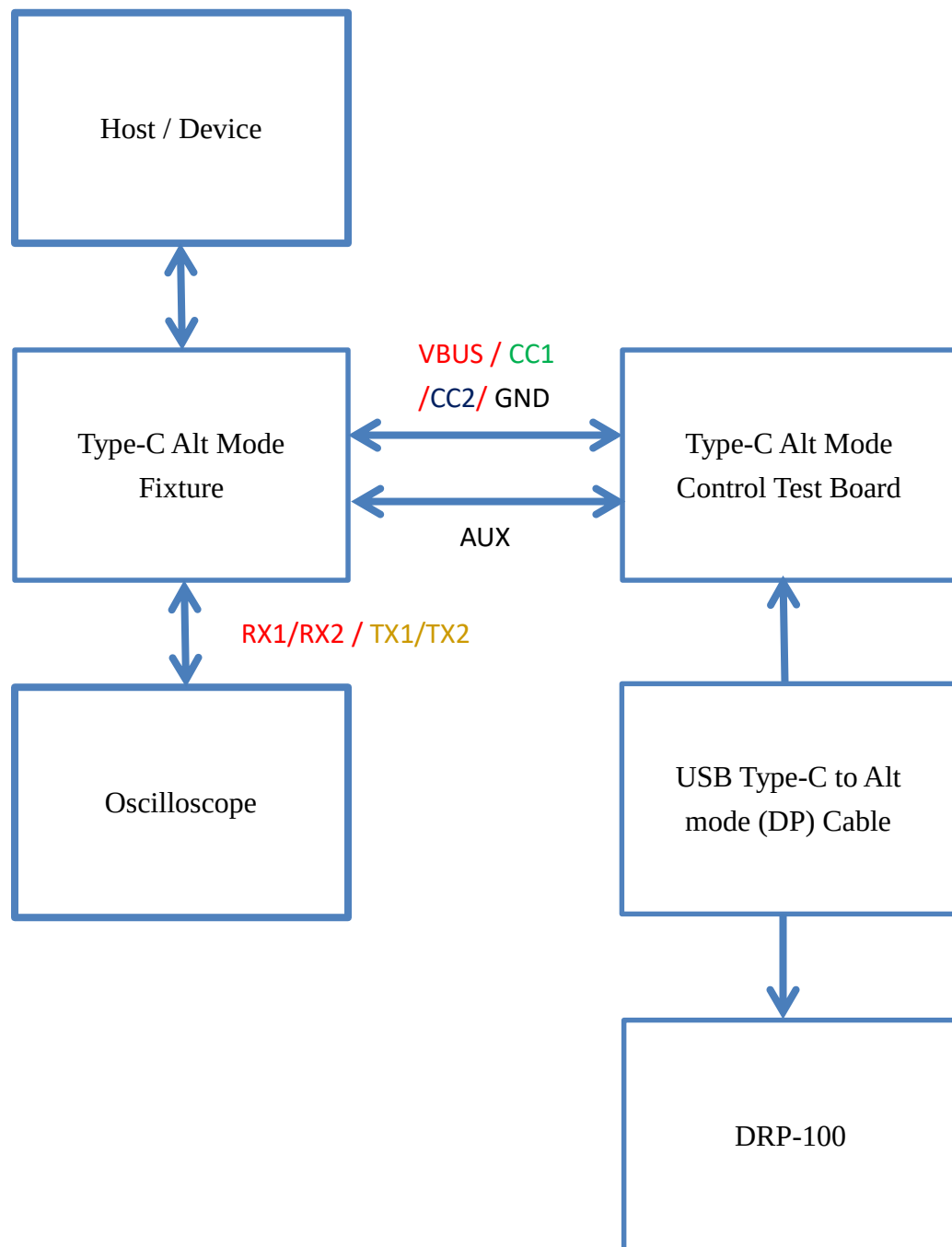
6-2. USB Type-C Alt mode (RX Test) 4-Lane



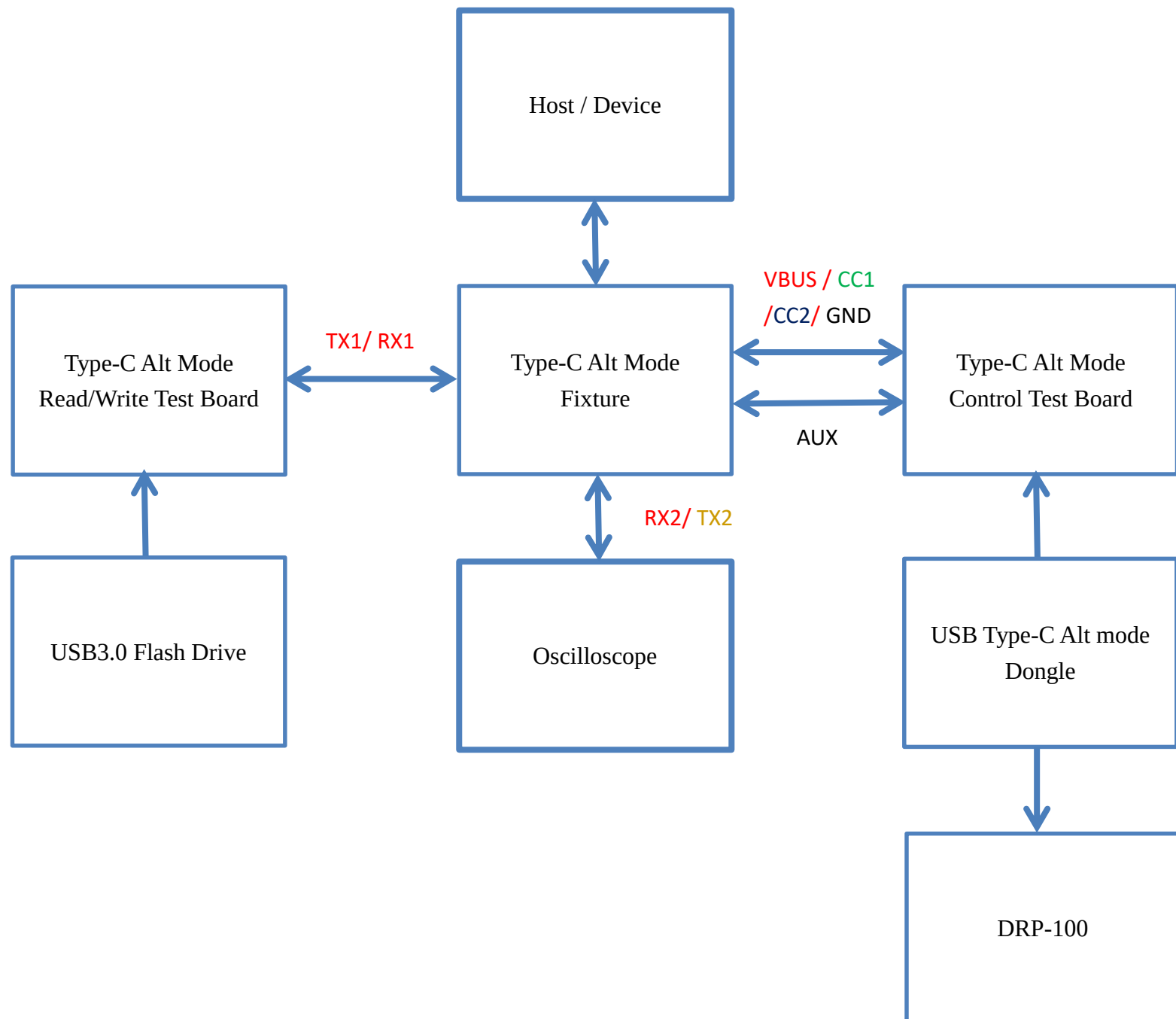
6-3. USB Type-C Alt mode (RX Test) –NEXT USB2.0 Read/Write



6-4. USB Type-C Alt mode (TX Test) 4-Lane



6-5. USB Type-C Alt mode (TX Test) –NEXT USB3.0 Read/Write



7. Electrical Specification

Test Item		Fixture PN	Requirements	Description
01	TX and RX Differential Pair Impedance	TF21-189G TF21-190G	$85 \pm 9 \text{ Ohm}$	Mated Connector with Receptacle and Plug , @40ps (20~80%)
02	D+/D- Pair Impedance	TF21-189G TF21-190G	$90 \pm 15 \text{ Ohm}$	Mated Connector with Receptacle and Plug , @200ps (20~80%)
03	TX and RX Differential Pair Insertion Loss @ -3dB	TF21-189G TF21-190G	$> 10 \text{ GHz}$	Mated Receptacle and Plug fixture with Connector and Pads.
04	SBU/AUX Differential Pair Insertion Loss @ -3dB	TF21-189G TF21-190G	$> 4.5 \text{ GHz}$	Mated Receptacle and Plug fixture with Connector and Pads.
05	Insertion Loss (1x/2x Calibration Flexible Cable)	TF21-239L TF21-240L	$> 20 \text{ GHz}$	Only SMA Jack Cable.
06	TX and RX Differential Pair Return Loss @ 10GHz	TF21-189G TF21-190G	$< -9 \text{ dB}$	Mated Receptacle and Plug fixture with Connector and Pads.
07	SBU Differential Pair Return Loss	TF21-189G TF21-190G	$< -6\text{dB}$	Mated Receptacle and Plug fixture with Connector and Pads.
08	Differential to Common Mode Conversion @ -20dB	TF21-189G TF21-190G	$> 10\text{GHz}$	Mated Receptacle and Plug fixture with Connector and Pads.
09	All Differential Pair Intra Pair Skew @200ps (20~80%)	TF21-189G TF21-190G	$< 4 \text{ ps}$	Mated Receptacle and Plug fixture with Connector and Pads,
10	NEXT @ -36dB	TF21-189G TF21-190G	$> 10 \text{ GHz}$	All Differential Pair Mated , Receptacle and Plug fixture
11	FEXT @ -38dB	TF21-189G TF21-190G	$> 10 \text{ GHz}$	All Differential Pair Mated , Receptacle and Plug fixture

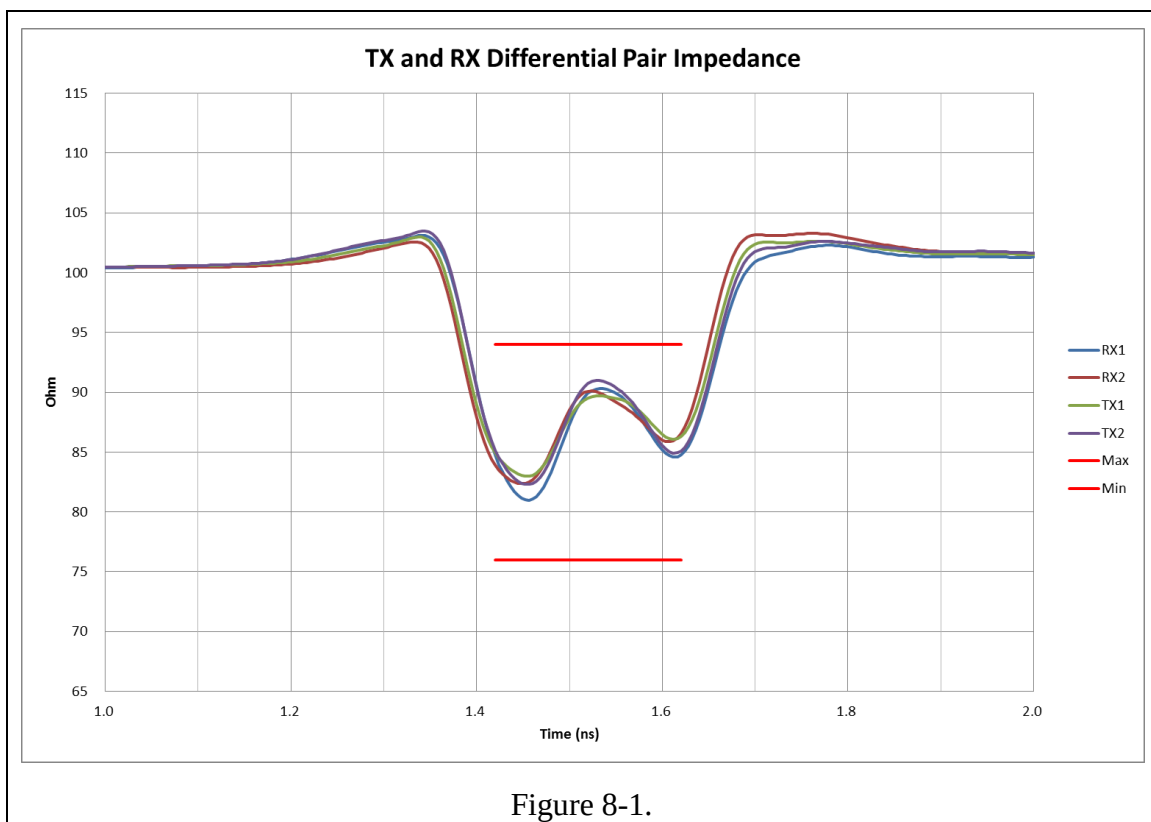
8. Testing Result

8-1. Testing Equipment

Item	Product Model	Name	Manufacturer
01	E5071C-TDR	300KHz~20GHz ENA Network Analyzer	Agilent
02	N4433A	200KHz~20GHz Electronic Calibration Module	Agilent

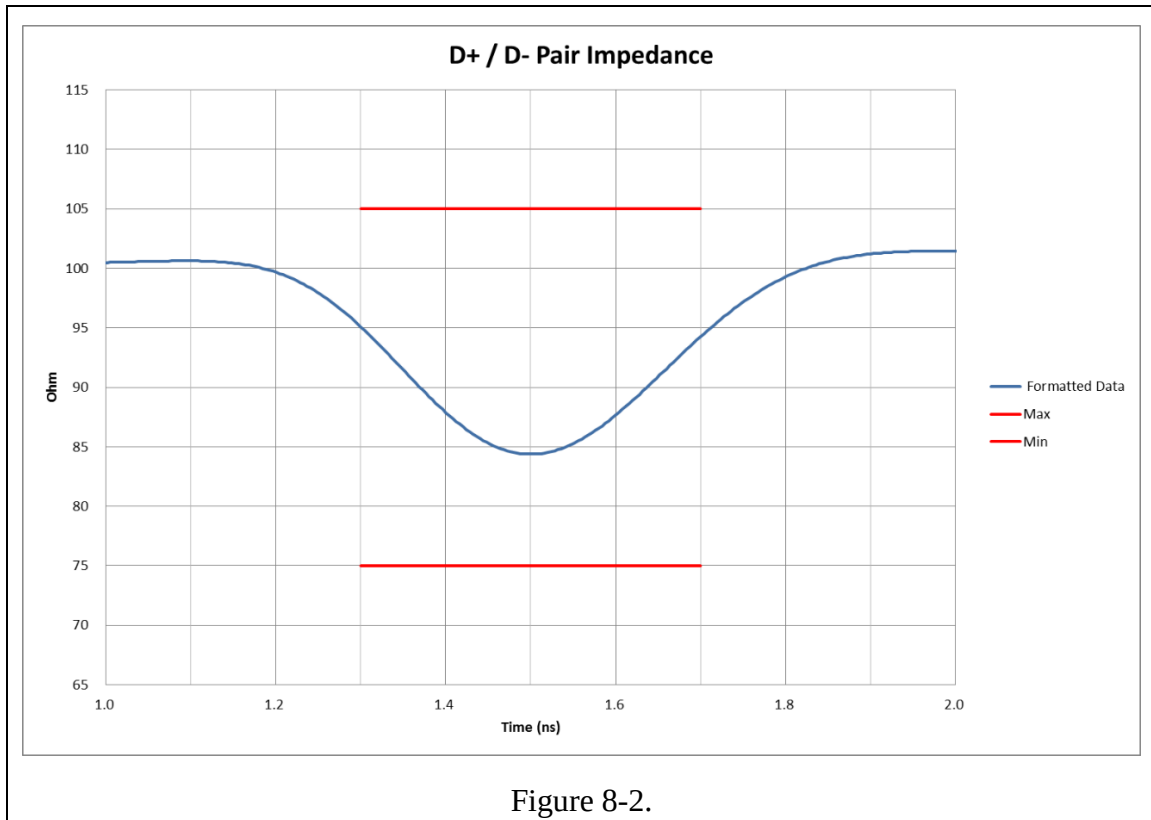
8-1-1. TX and RX Differential Pair Impedance

Pair Num	Maximum	Minimum	Unit	Figure
RX1	90.33	80.97	Ω	11
RX2	90.10	82.35		
TX1	89.68	82.98		
TX2	90.98	82.30		



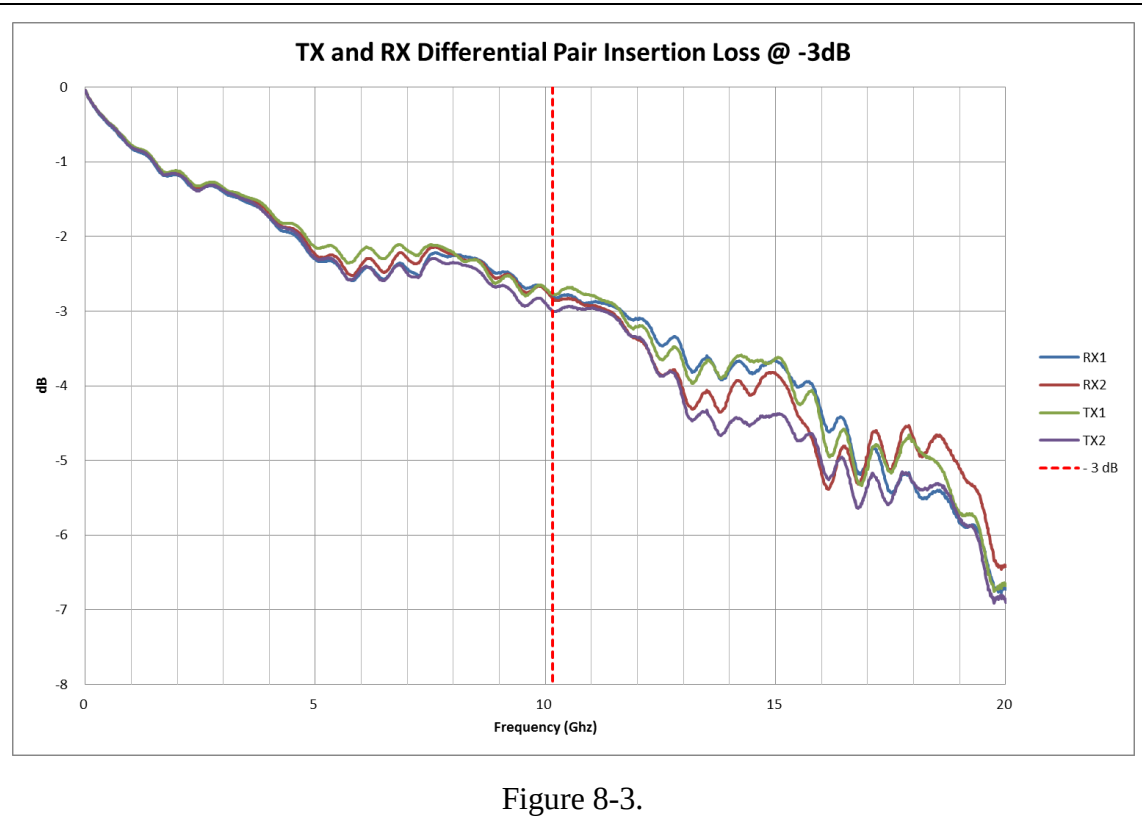
8-1-2. D+/D- Pair Impedance

Pair Num	Maximum	Minimum	Unit	Figure
D	95.32	84.38	Ω	12



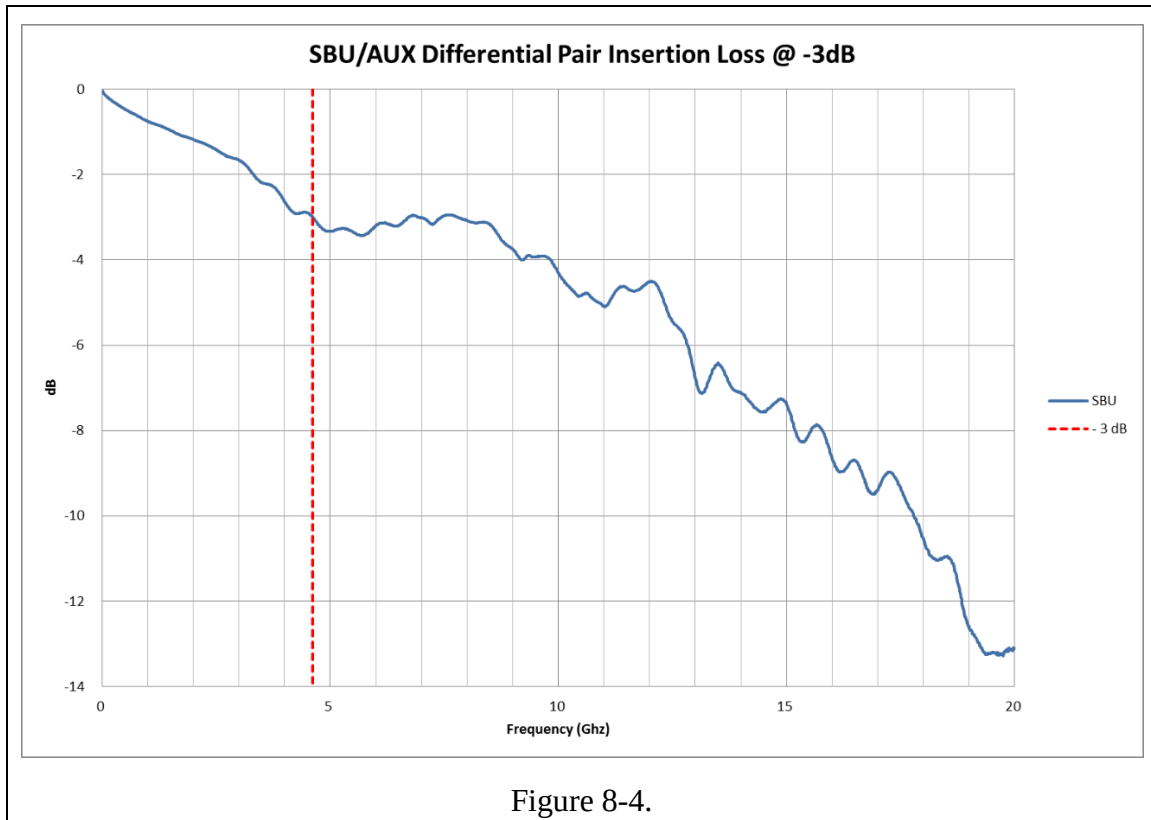
8-1-3. TX and RX Differential Pair Insertion Loss @ -3dB

Pair Num	Min	Unit	Figure
RX1	11.65	GHz	13
RX2	11.38		
TX1	11.63		
TX2	10.15		



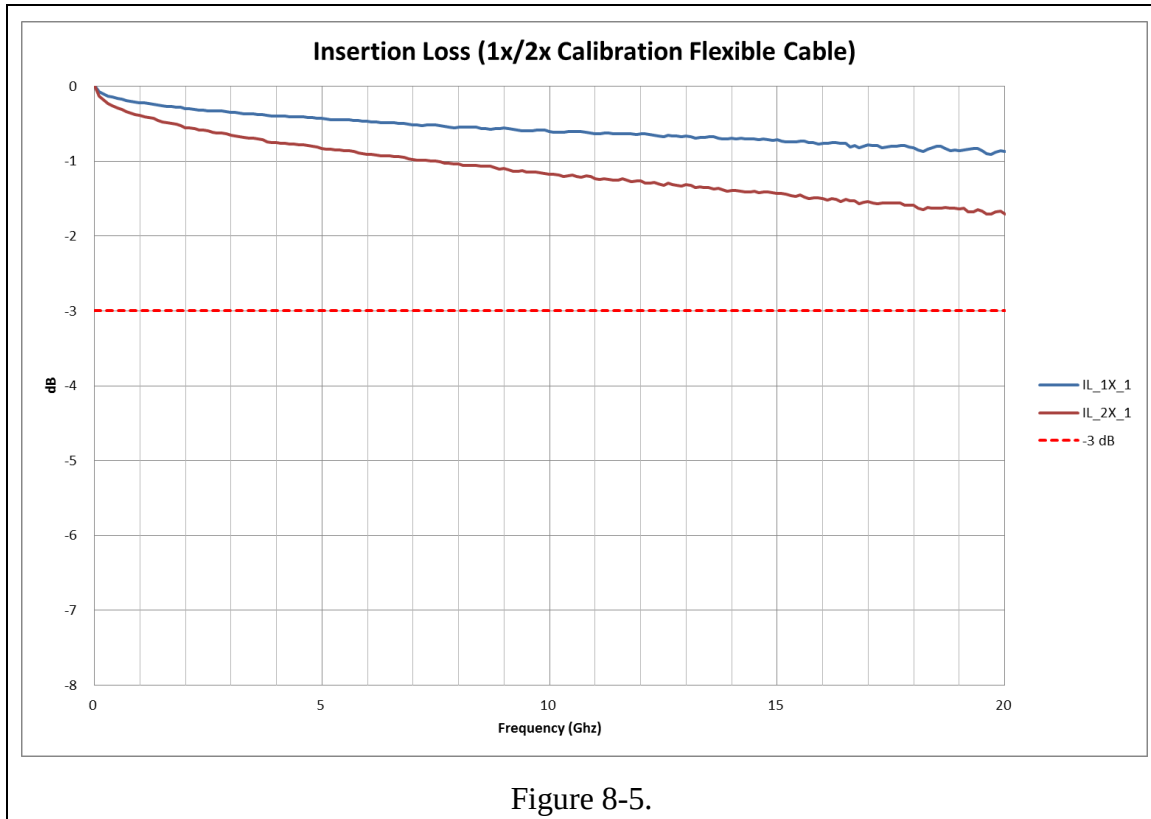
8-1-4. SBU/AUX Differential Pair Insertion Loss @ -3dB

Pair Num		Min	Unit	Figure
SBU	AUX	-4.6	GHz	14



8-1-5. Insertion Loss (1x/2x Calibration Flexible Cable)

Pair Num		Min	Unit	Figure
1X	TF21-239L	-0.91	dB	15
2X	TF21-240L	-1.71		



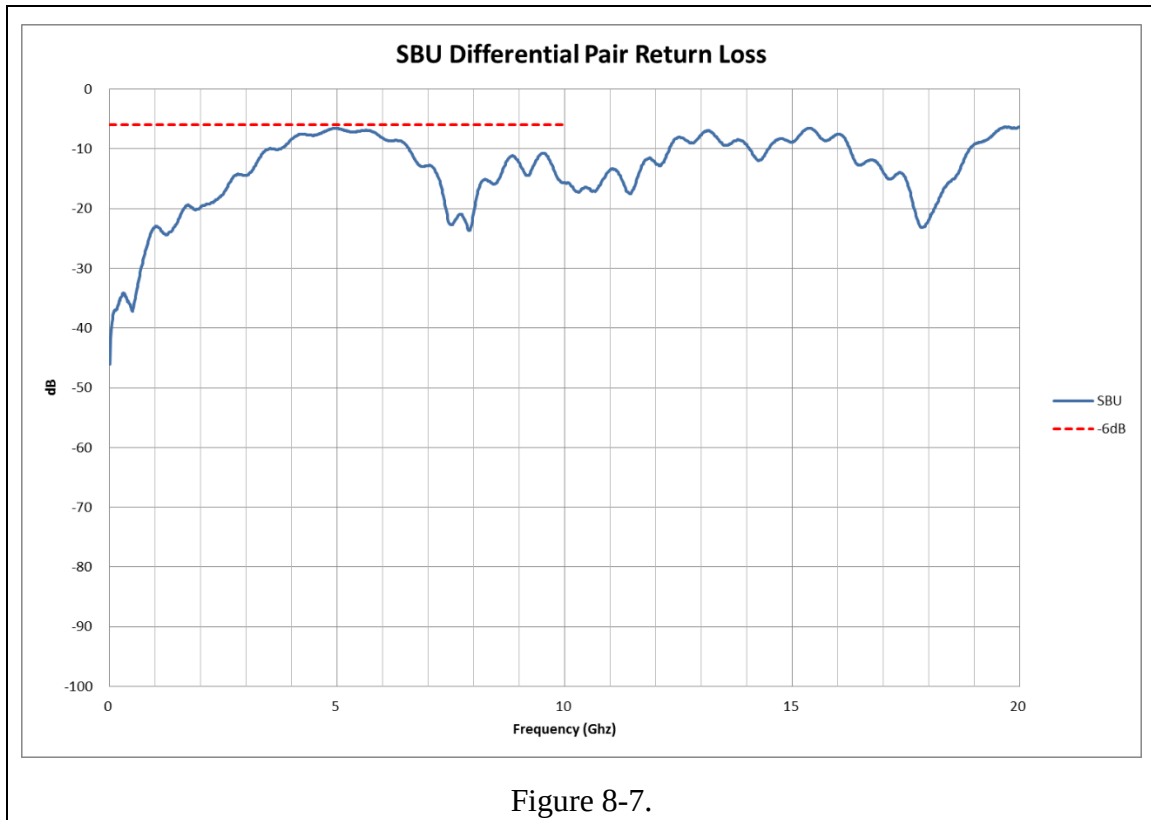
8-1-6. TX and RX Differential Pair Return Loss @ 10GHz

Pair Num	Min	Unit	Figure
RX1	-9.49	dB	16
RX2	-9.59		
TX1	-10.38		
TX2	-9.66		



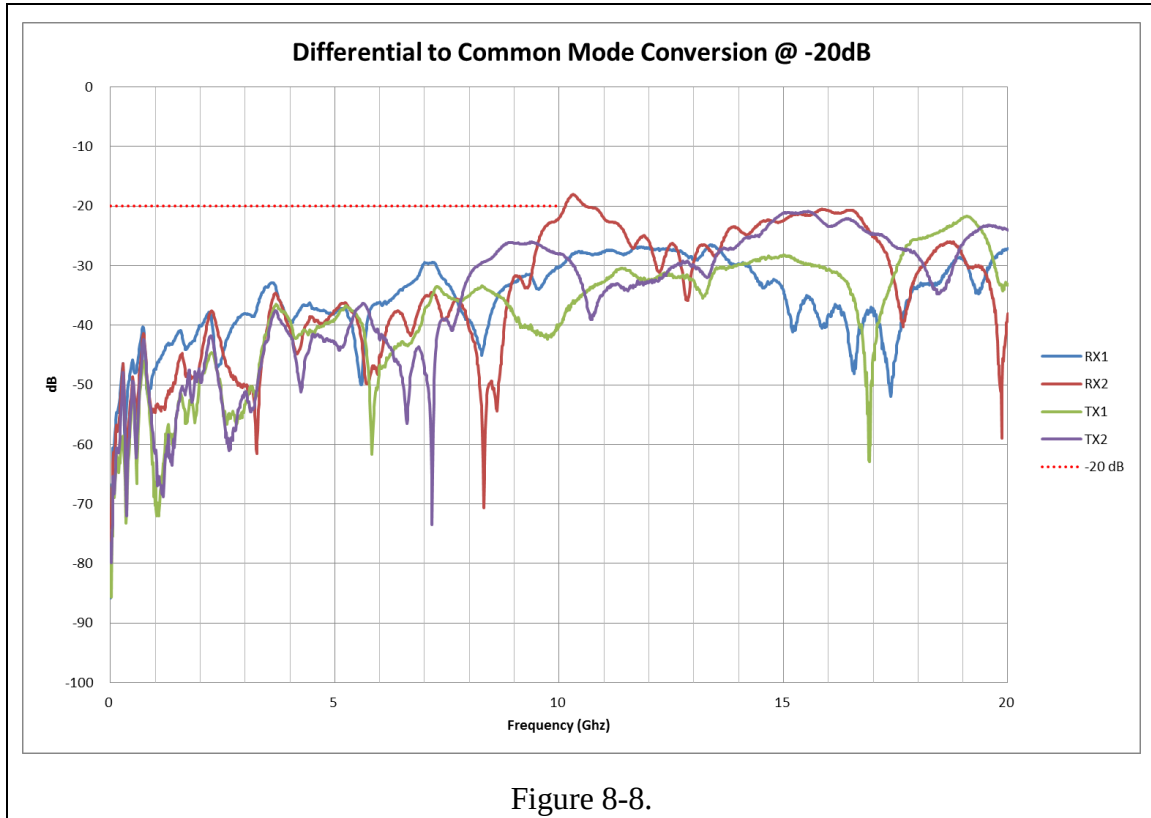
8-1-7. SBU Differential Pair Return Loss

Pair Num	Min	Unit	Figure
SBU	-6.57	dB	17



8-1-8. Differential to Common Mode Conversion @ -20dB

Pair Num	M	Unit	Figure
RX1+	-29.45	dB	18
RX2+	-22.06		
TX1+	-33.34		
TX2+	-26.03		



8-1-9. All Differential Pair Intra Pair Skew

Pair Num		Min	Unit	Figure
TX1+	TX1-	0.67	ps	19
TX2+	TX2-	0.06		20
RX1+	RX1-	2.59		21
RX2+	RX2-	0.05		22

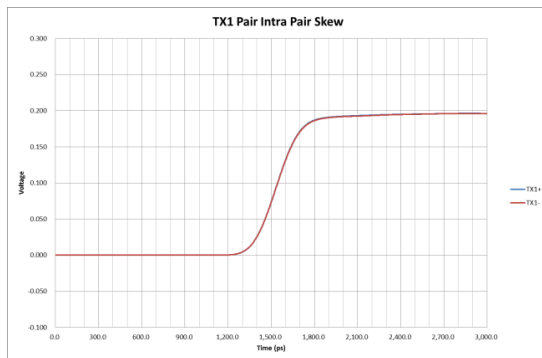


Figure 8-9.

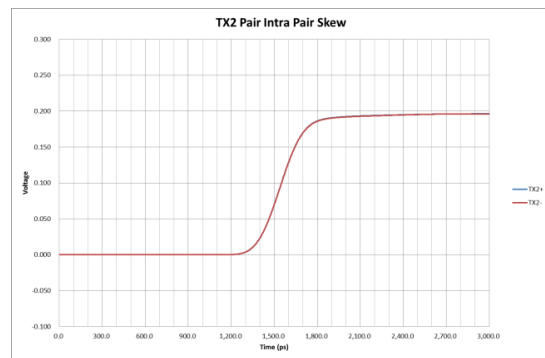


Figure 8-10.

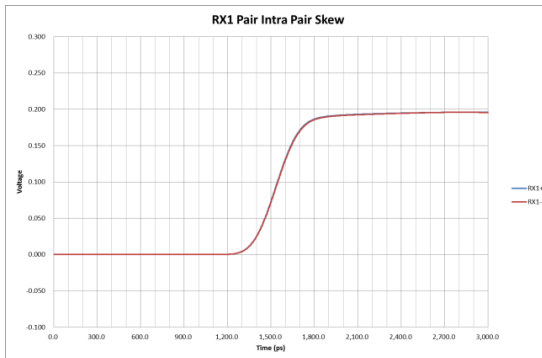


Figure 8-11.

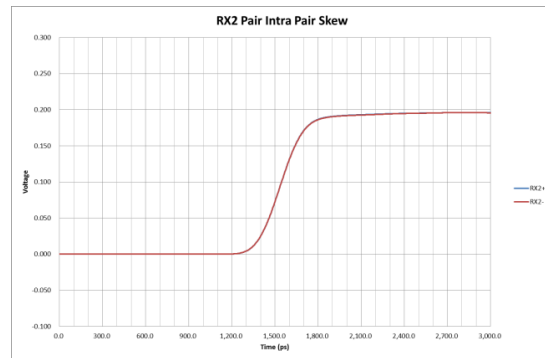
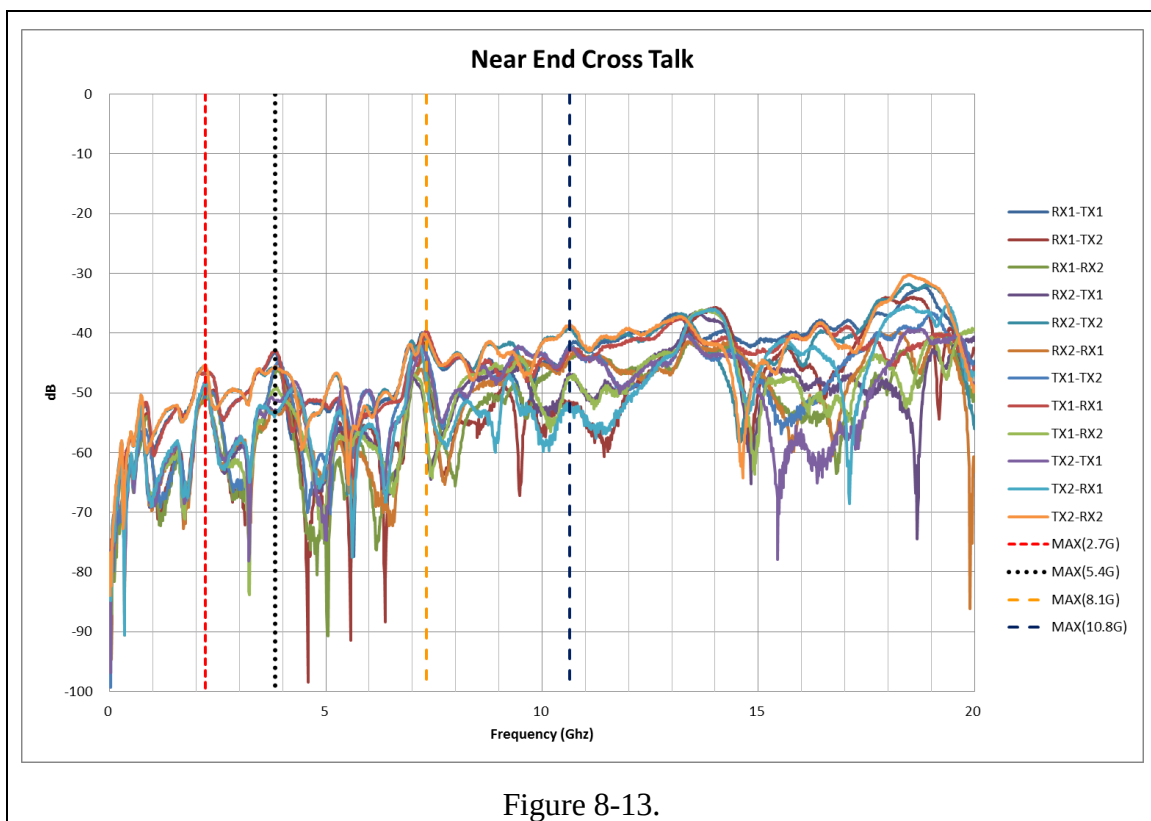


Figure 8-12.

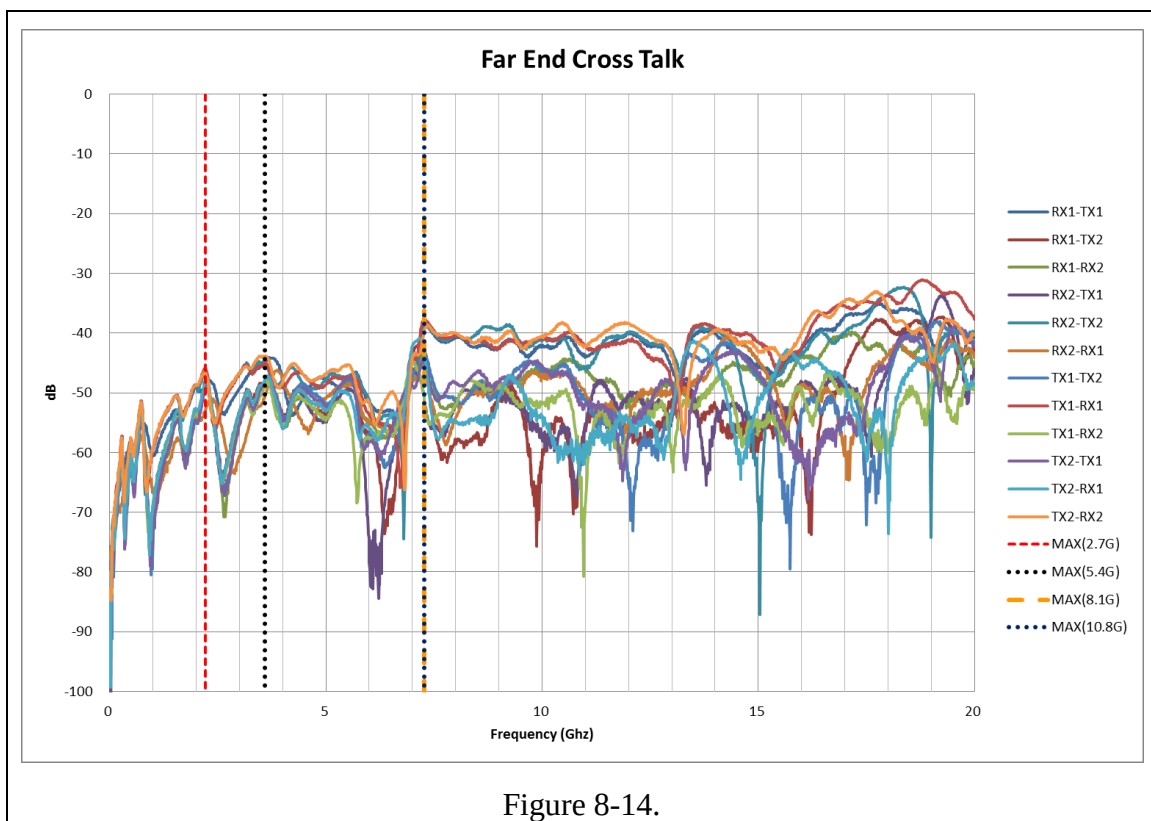
8-1-10. Near End Cross Talk

Pair Num	MAX(2.7G)	MAX(5.4G)	MAX(8.1G)	MAX(10.8G)	Unit	Figure
RX1-TX1	-46.51	-43.32	-39.95	-39.95	dB	23
RX1-TX2	-49.56	-44.83	-41.12	-41.12		
RX1-RX2	-50.06	-46.29	-44.53	-43.44		
RX2-TX1	-48.60	-48.60	-47.44	-45.58		
RX2-TX2	-45.51	-45.51	-40.98	-39.12		
RX2-RX1	-48.74	-48.74	-46.03	-43.12		
TX1-TX2	-49.78	-44.68	-41.72	-41.72		
TX1-RX1	-46.56	-42.96	-39.59	-39.59		
TX1-RX2	-49.66	-49.08	-46.74	-43.93		
TX2-TX1	-47.96	-47.96	-42.27	-42.09		
TX2-RX1	-48.23	-48.23	-42.08	-42.08		
TX2-RX2	-45.38	-45.38	-40.09	-38.72		



8-1-11. Far End Cross Talk

Pair Num	MAX(2.7G)	MAX(5.4G)	MAX(8.1G)	MAX(10.8G)	Unit	Figure
RX1-TX1	-47.94	-44.14	-38.74	-38.74	dB	24
RX1-TX2	-48.11	-48.07	-41.49	-41.49		
RX1-RX2	-48.35	-47.39	-43.23	-43.23		
RX2-TX1	-48.48	-48.15	-45.93	-45.93		
RX2-TX2	-46.94	-44.73	-38.76	-38.55		
RX2-RX1	-50.97	-46.17	-45.49	-45.49		
TX1-TX2	-48.06	-47.78	-42.00	-42.00		
TX1-RX1	-45.94	-45.02	-37.79	-37.79		
TX1-RX2	-48.23	-48.03	-44.70	-44.70		
TX2-TX1	-48.56	-47.09	-44.58	-44.58		
TX2-RX1	-47.45	-47.14	-40.86	-40.86		
TX2-RX2	-46.54	-43.84	-38.69	-38.16		



8-1-12. Typical mated pair 2.7Gb/s Eye Diagram

Level Zero	0.010773
Level One	0.385267
Level Mean	0.19802
Amplitude	0.374493
Height	0.333021
Width	3.65E-10
Opening Factor	0.963085
Signal / Noise	27.08959
Duty Cycle Distortion	1.34E-15
Duty Cycle Distortion (%)	0.000361
Rise Time	6.09E-11
Fall Time	6.00E-11
Jitter (PP)	2.31E-12
Jitter (RMS)	8.25E-13
Cross Point (%)	49.9986

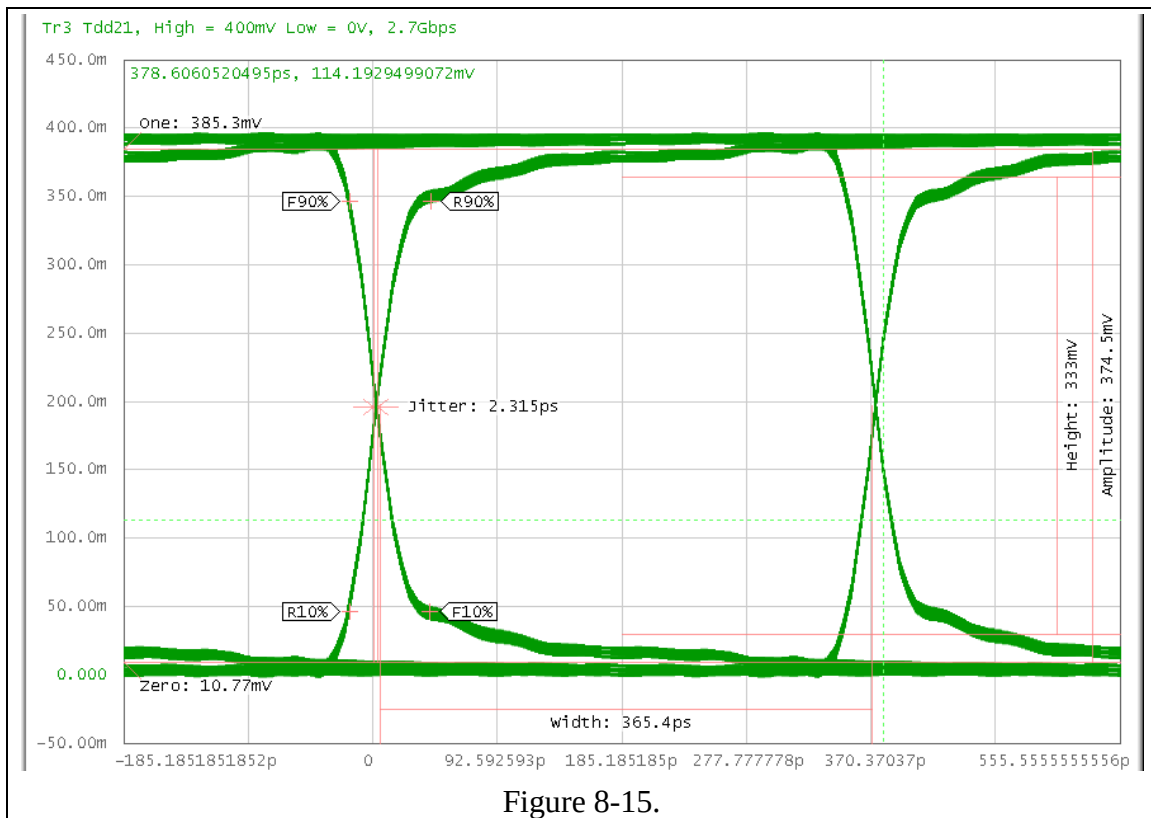
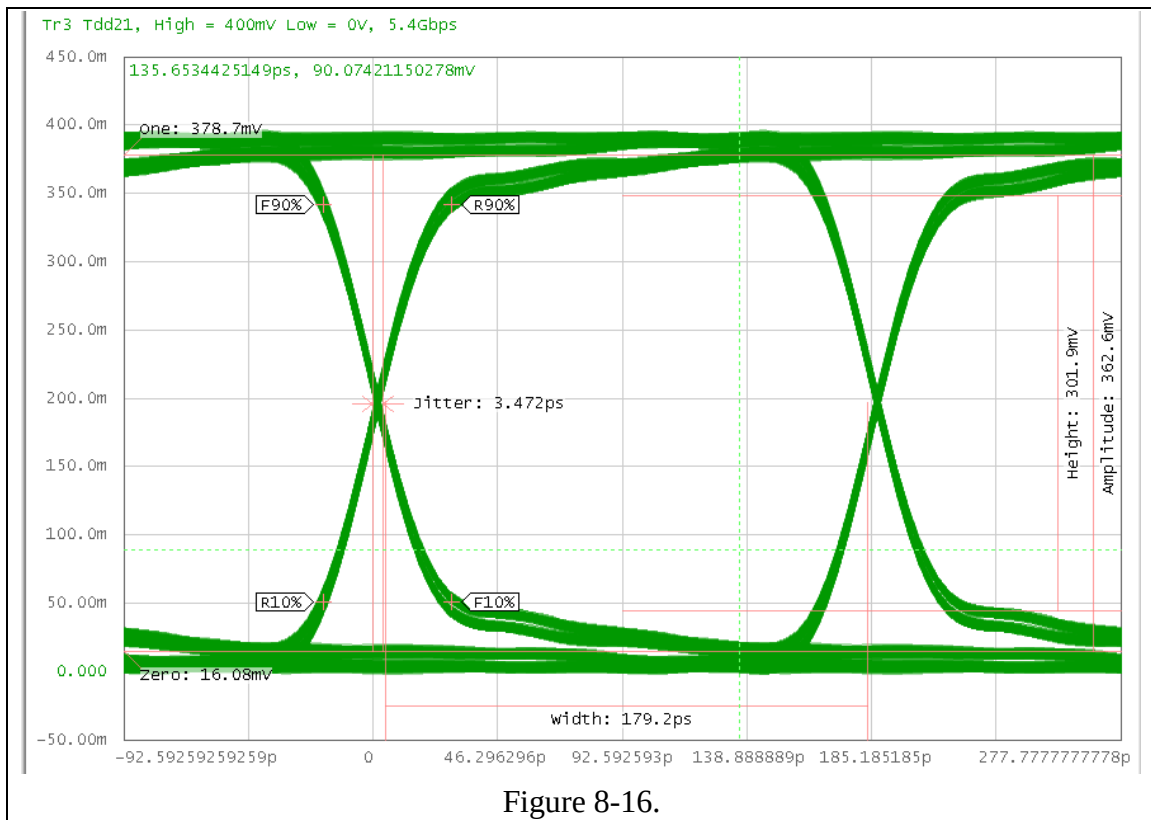


Figure 8-15.

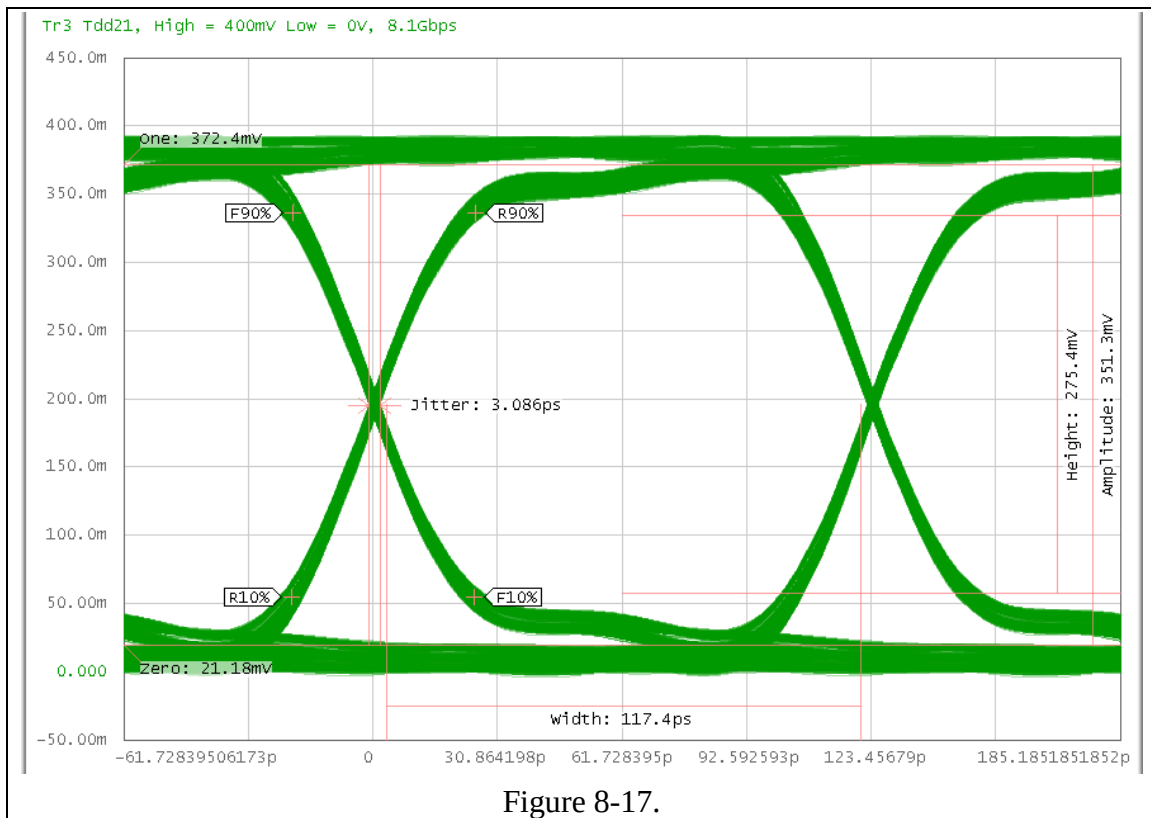
8-1-13. Typical mated pair 5.4Gb/s Eye Diagram

Level Zero	0.016084
Level One	0.378666
Level Mean	0.197375
Amplitude	0.362582
Height	0.301921
Width	1.79E-10
Opening Factor	0.944233
Signal / Noise	17.93169
Duty Cycle Distortion	1.96E-15
Duty Cycle Distortion (%)	0.001057
Rise Time	4.74E-11
Fall Time	4.76E-11
Jitter (PP)	3.47E-12
Jitter (RMS)	9.92E-13
Cross Point (%)	49.99783



8-1-14. Typical mated pair 8.1Gb/s Eye Diagram

Level Zero	0.021178967
Level One	0.372431267
Level Mean	0.196805117
Amplitude	0.3512523
Height	0.275403275
Width	1.17E-10
Opening Factor	0.928020377
Signal / Noise	13.8928207
Duty Cycle Distortion	5.39E-15
Duty Cycle Distortion (%)	0.00436422
Rise Time	4.53E-11
Fall Time	4.50E-11
Jitter (PP)	3.09E-12
Jitter (RMS)	1.01E-12
Cross Point (%)	49.99705588



8-1-15. Typical mated pair 10.8Gb/s Eye Diagram

Level Zero	0.022752149
Level One	0.369790387
Level Mean	0.196271268
Amplitude	0.347038238
Height	0.265170121
Width	8.56E-11
Opening Factor	0.92136494
Signal / Noise	12.71697389
Duty Cycle Distortion	3.11E-15
Duty Cycle Distortion (%)	0.003360744
Rise Time	4.42E-11
Fall Time	4.42E-11
Jitter (PP)	4.05E-12
Jitter (RMS)	1.17E-12
Cross Point (%)	49.99679878

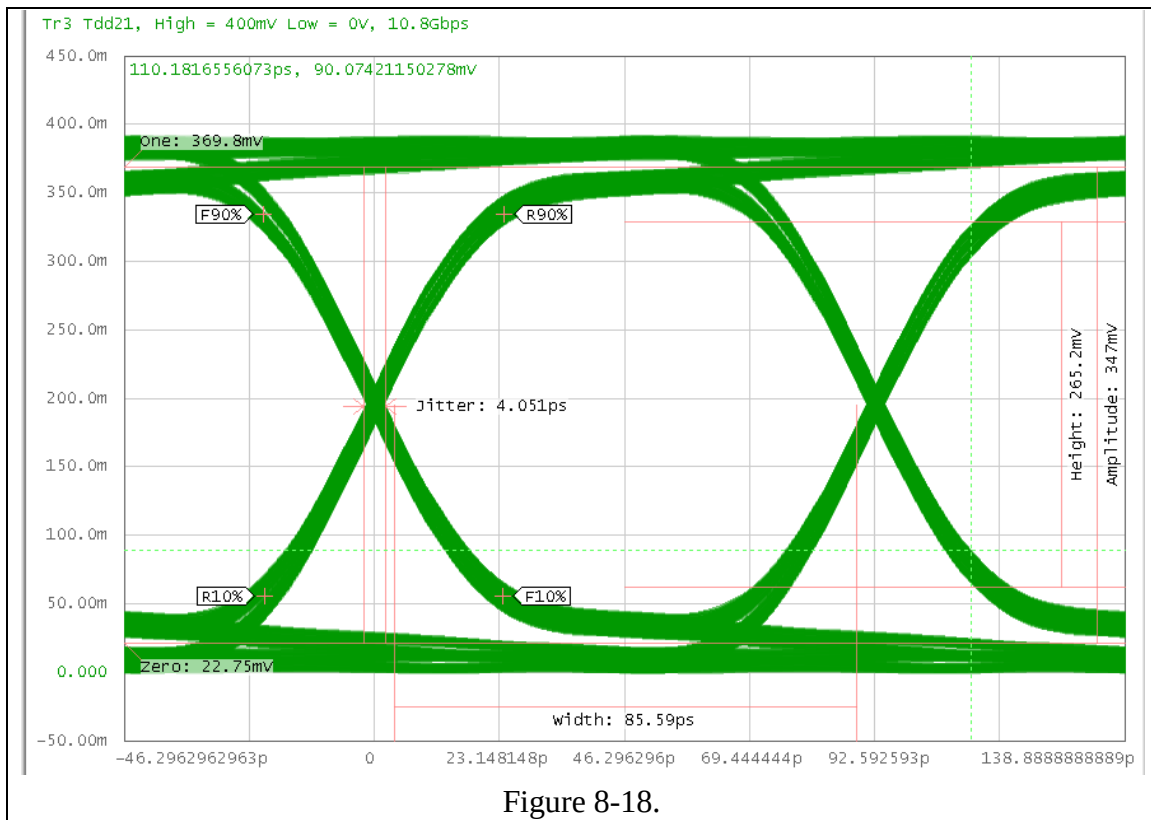


Figure 8-18.

9. Testing Result

9-1. Specification

HDMI1.4b_AltMode_USBTypeC_final20160915a

9-2. Keysight

Method of Implementation (MOI) for HDMI 1.4b Cable Assembly Test

https://www.keysight.com/upload/cmc_upload/All/E5071C-TDR_HDMI_1.4b_MOI_1.12.pdf

USB Type-C Alt-Mode Test Fixture User Manual



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Product Name	Version	Date	Comments
USB Type-C Alt-Mode Test Fixture Series	01	Jan.16,2019	Initial release

1. 簡介

本文介紹 USB Type-C Alt Mode Fixture 的機械規格與電氣規格。

2. 目的

本規範提供了 USB Type-C Alt Mode Fixture 的特性規格與測試結果。

3. 操作方式&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板手(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板手(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

USB Type-C Alt mode 測試適配器是完全無源組件。因此，校準在驅動 USB 的測
試儀器中必須補償損失。創建 S4P 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 Type-C 連接器接口焊盤。

4. 產品檢驗

客戶收到治具，請執行以下檢驗流程。

- 檢查包裹外包裝和產品外觀是否損壞，確認產品內容完整性，不使用治具時請收置於治具泡棉內襯盒內。
- 確認發貨清單，確認產品數量。
- 萬一產品有缺陷或不完整，在”保固期間”聯繫 LUXSHARE-IC 技術支援單位和產品退換貨事宜。

5. 尺寸規格

5-1. 工程圖

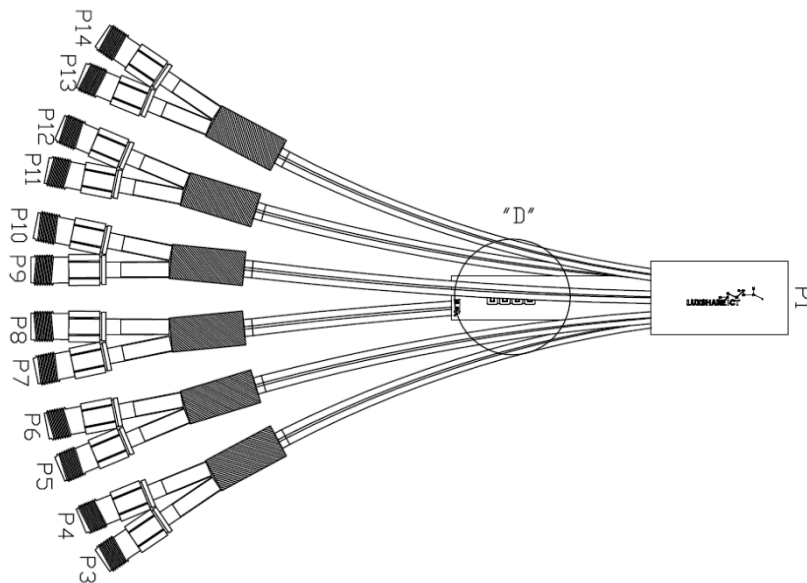


Figure 5-1. USB Type-C Receptacle Alt mode Fixture TF21-189G

P1	Type-C Receptacle		USB	DP		
			Fixture Pinout	Source (DFP)	Sink (UFP)	
A1	GND		GND			P2
A2	TX1+		USB_TX1+	DP_L2+	DP_L3+	P5
A3	TX1-		USB_TX1-	DP_L2-	DP_L3-	P6
A4	VBUS		VBUS			P2
A5	CC		CC1	CC1	CC1	P2
A6	D+		D1+	D1+	D1+	P9
A7	D-		D1-	D1-	D1-	P10
A8	SBU1		SBU1	AUX+	AUX+	P7
A9	VBUS		VBUS			P19
A10	RX2-		USB_RX2-	DP_L0-	DP_L1-	P13
A11	RX2+		USB_RX2+	DP_L0+	DP_L1+	P14
A12	GND		GND			P2
B1	GND		GND			P2
B2	TX2+		USB_TX2+	DP_L1+	DP_L0+	P12
B3	TX2-		USB_TX2-	DP_L1-	DP_L0-	P11
B4	VBUS		VBUS			P2
B5	Vconn		CC2	CC2	CC2	P2
B6						
B7						
B8	SBU2		SBU2	AUX-	AUX-	P8
B9	VBUS		VBUS			P2
B10	RX1-		USB_RX1-	DP_L3-	DP_L2-	P4
B11	RX1+		USB_RX1+	DP_L3+	DP_L2+	P3
B12	GND		GND			P2
SIGNAL GROUND : A1,A12,B1,B12						
SIGNAL VBUS : A5,A9,B5,B9						

Figure 5-2. USB Type-C Receptacle Alt mode Fixture Pin Assignment

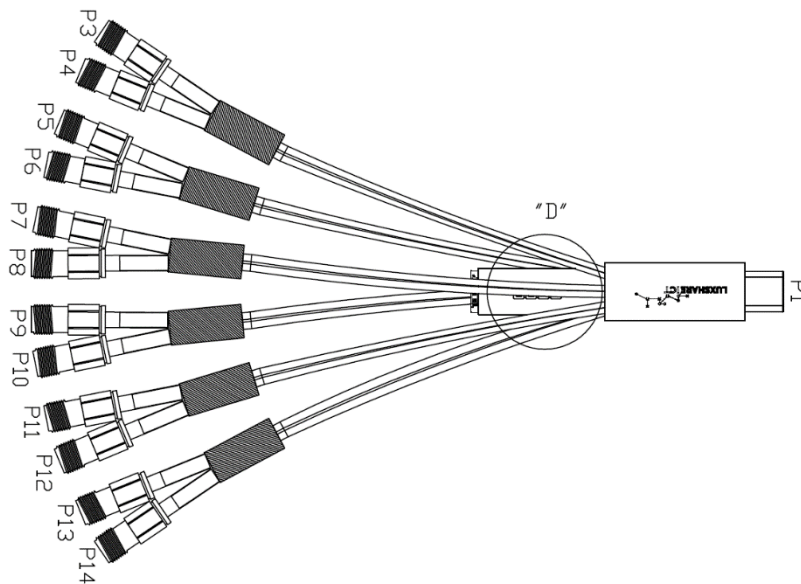


Figure 5-3. USB Type-C Plug Alt mode Fixture TF21-190G

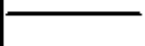
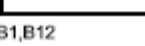
P1	Type-C Plug		USB	DP		
			Fixture Pinout	Source(DFP)	Sink (UFP)	
A1	GND		GND			P2
A2	TX1+		USB_TX1+	DP_L2+	DP_L3+	P3
A3	TX1-		USB_TX1-	DP_L2-	DP_L3-	P4
A4	VBUS		VBUS			P2
A5	CC		CC1	CC1	CC1	P2
A6	D+		D1+	D1+	D1+	P7
A7	D-		D1-	D1-	D1-	P8
A8	SBU1		SBU1	AUX+	AUX+	P9
A9	VBUS		VBUS			P19
A10	RX2-		USB_RX2-	DP_L0-	DP_L1-	P11
A11	RX2+		USB_RX2+	DP_L0+	DP_L1+	P12
A12	GND		GND			P2
B1	GND		GND			P2
B2	TX2+		USB_TX2+	DP_L1+	DP_L0+	P14
B3	TX2-		USB_TX2-	DP_L1-	DP_L0-	P13
B4	VBUS		VBUS			P2
B5	Vconn		CC2	CC2	CC2	P2
B6						
B7						
B8	SBU2		SBU2	AUX-	AUX-	P10
B9	VBUS		VBUS			P2
B10	RX1-		USB_RX1-	DP_L3-	DP_L2-	P6
B11	RX1+		USB_RX1+	DP_L3+	DP_L2+	P5
B12	GND		GND			P2
SIGNAL GROUND : A1,A12,B1,B12						
SIGNAL VBUS : A5,A9,B5,B9						

Figure 5-4. USB Type-C Plug Alt mode Fixture Pin Assignment

TF21-189G



Figure 5-5. USB Type-C Receptacle
Alt mode Fixture

TF21-190G



Figure 5-6. USB Type-C Plug
Alt mode Fixture

TF21-239L



Figure 5-7.1x Calibration Flexible cable
(150mm)

TF21-240L



Figure 5-8. 2x Calibration Flexible cable
(300mm)

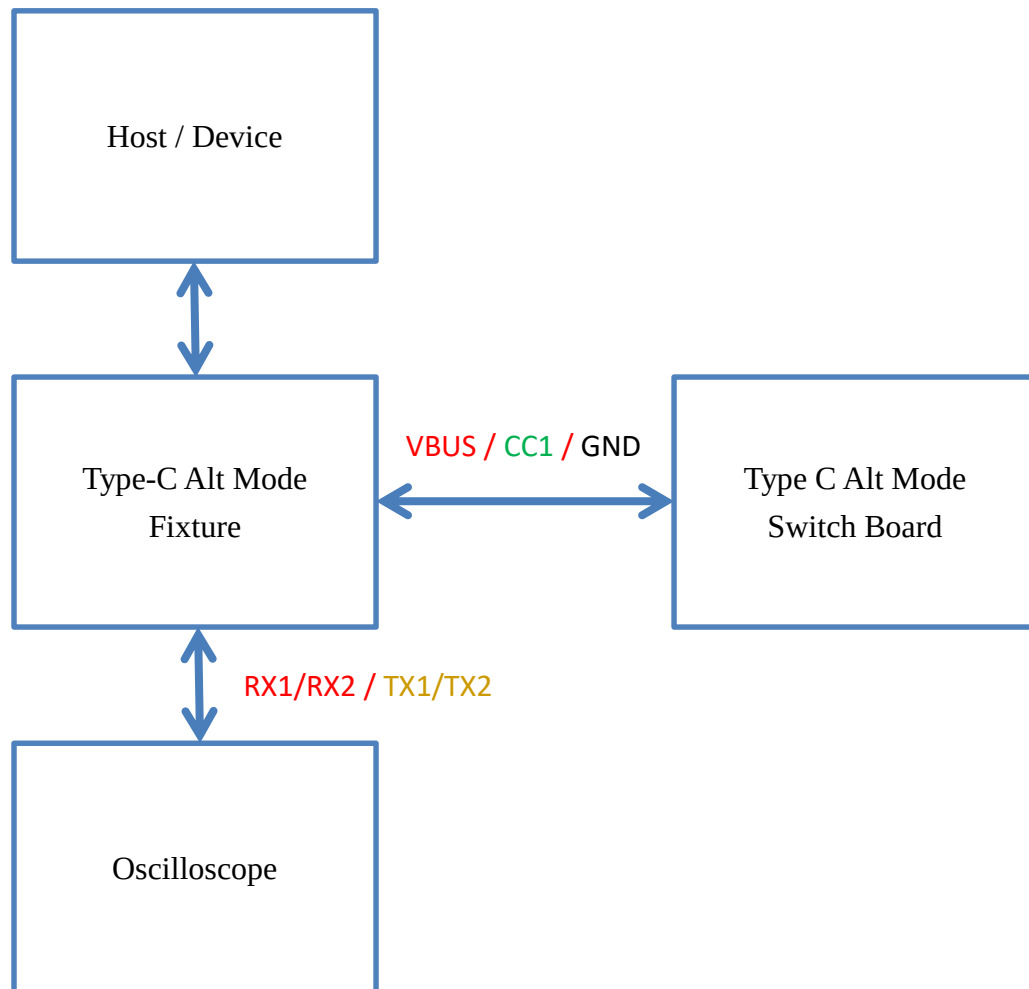
TF21-347G



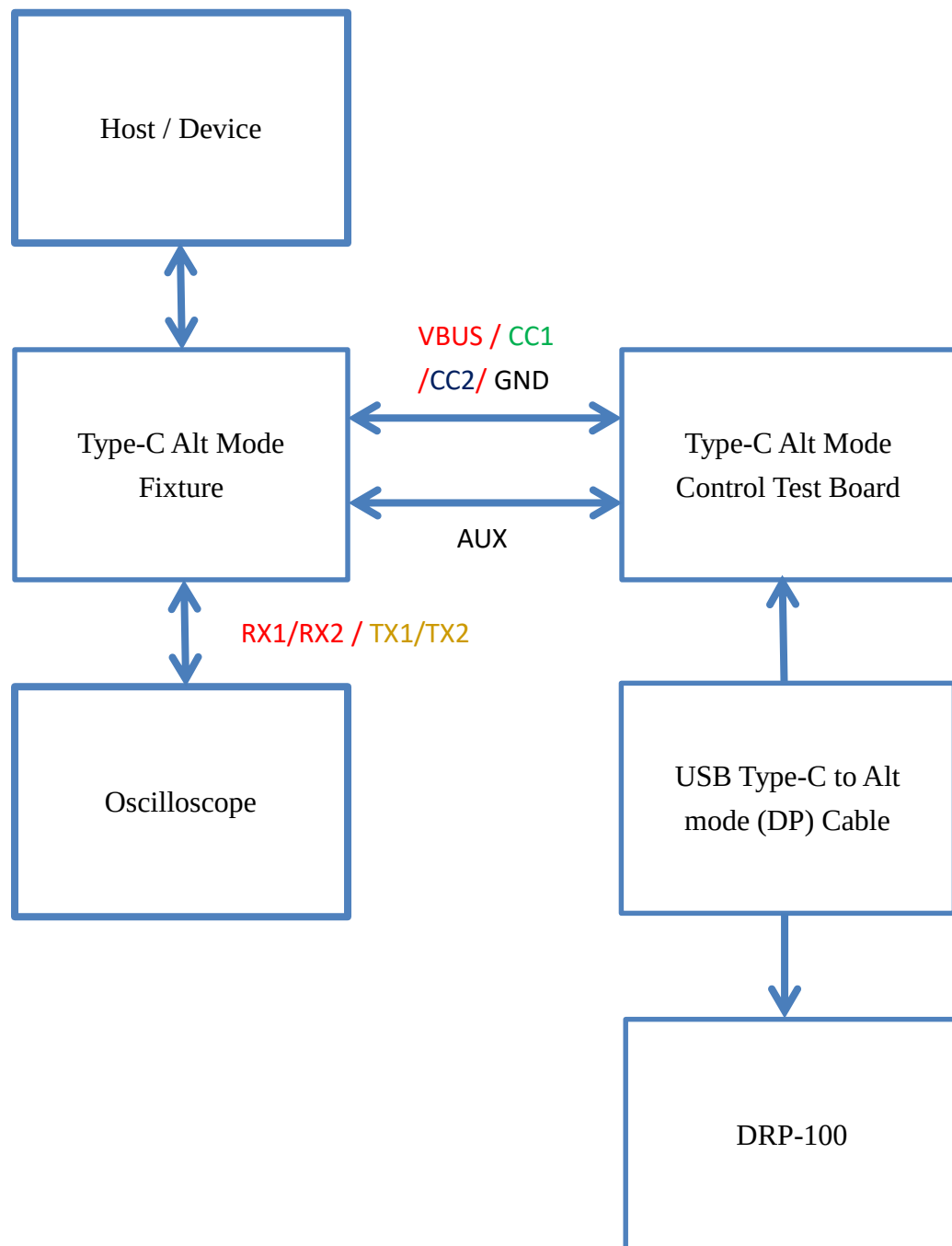
Figure 5-9. USB Type-C Alt Mode Switch
Board

6. 使用模型

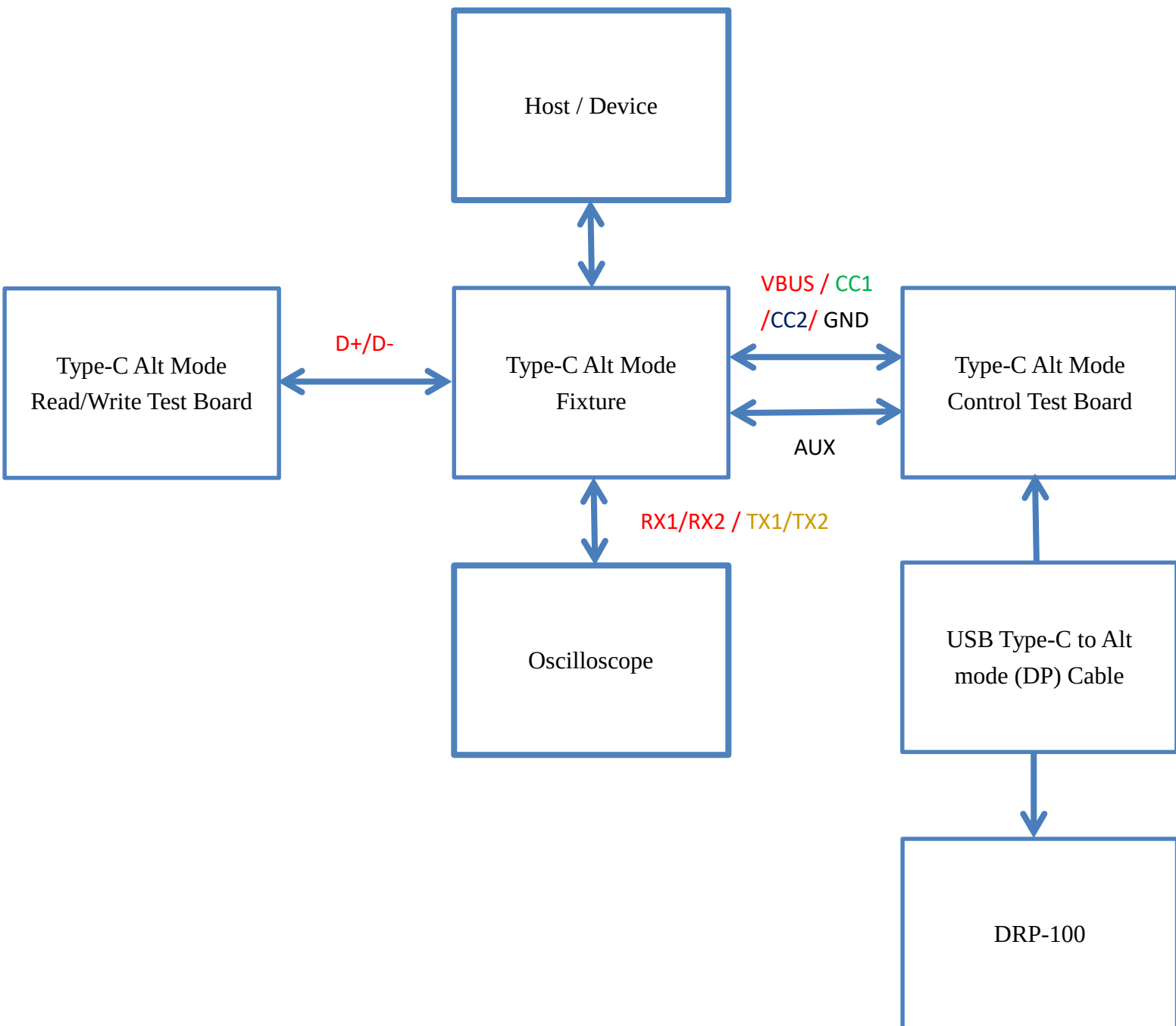
6-1. USB Type-C Mode



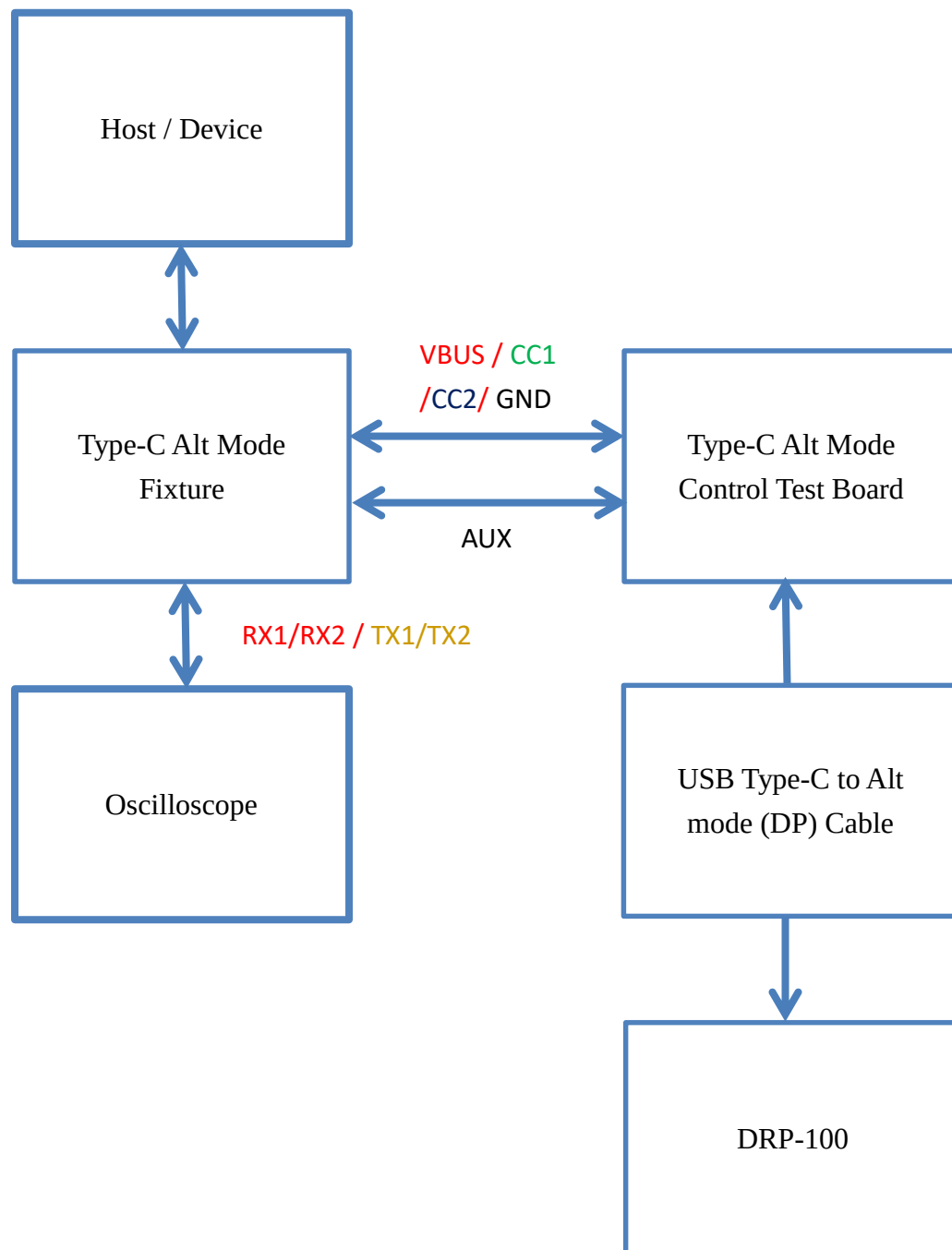
6-2. USB Type-C Alt mode (RX Test) 4-Lane



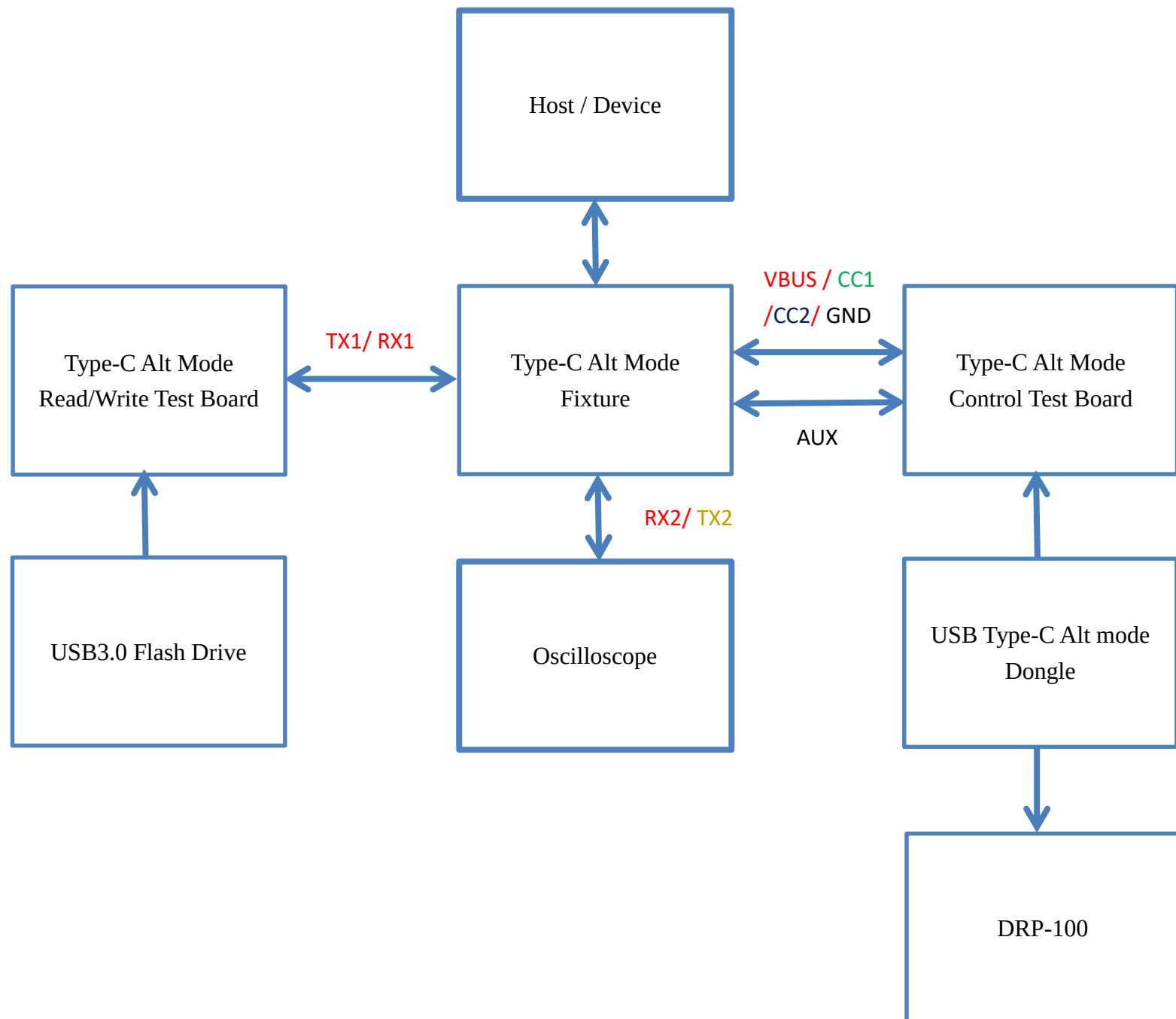
6-3. USB Type-C Alt mode (RX Test) –NEXT USB2.0 Read/Write



6-4. USB Type-C Alt mode (TX Test) 4-Lane



6-5. USB Type-C Alt mode (TX Test) –NEXT USB3.0 Read/Write



7. 電氣規格

Test Item		Fixture PN	Requirements	Description
01	TX and RX Differential Pair Impedance	TF21-189G TF21-190G	$85 \pm 9 \text{ Ohm}$	Mated Connector with Receptacle and Plug , @40ps (20~80%)
02	D+/D- Pair Impedance	TF21-189G TF21-190G	$90 \pm 15 \text{ Ohm}$	Mated Connector with Receptacle and Plug , @200ps (20~80%)
03	TX and RX Differential Pair Insertion Loss @ -3dB	TF21-189G TF21-190G	$> 10 \text{ GHz}$	Mated Receptacle and Plug fixture with Connector and Pads.
04	SBU/AUX Differential Pair Insertion Loss @ -3dB	TF21-189G TF21-190G	$> 4.5 \text{ GHz}$	Mated Receptacle and Plug fixture with Connector and Pads.
05	Insertion Loss (1x/2x Calibration Flexible Cable)	TF21-239L TF21-240L	$> 20 \text{ GHz}$	Only SMA Jack Cable.
06	TX and RX Differential Pair Return Loss @ 10GHz	TF21-189G TF21-190G	$< -9 \text{ dB}$	Mated Receptacle and Plug fixture with Connector and Pads.
07	SBU Differential Pair Return Loss	TF21-189G TF21-190G	$< -6\text{dB}$	Mated Receptacle and Plug fixture with Connector and Pads.
08	Differential to Common Mode Conversion @ -20dB	TF21-189G TF21-190G	$> 10\text{GHz}$	Mated Receptacle and Plug fixture with Connector and Pads.
09	All Differential Pair Intra Pair Skew @200ps (20~80%)	TF21-189G TF21-190G	$< 4 \text{ ps}$	Mated Receptacle and Plug fixture with Connector and Pads,
10	NEXT @ -36dB	TF21-189G TF21-190G	$> 10 \text{ GHz}$	All Differential Pair Mated , Receptacle and Plug fixture
11	FEXT @ -38dB	TF21-189G TF21-190G	$> 10 \text{ GHz}$	All Differential Pair Mated , Receptacle and Plug fixture

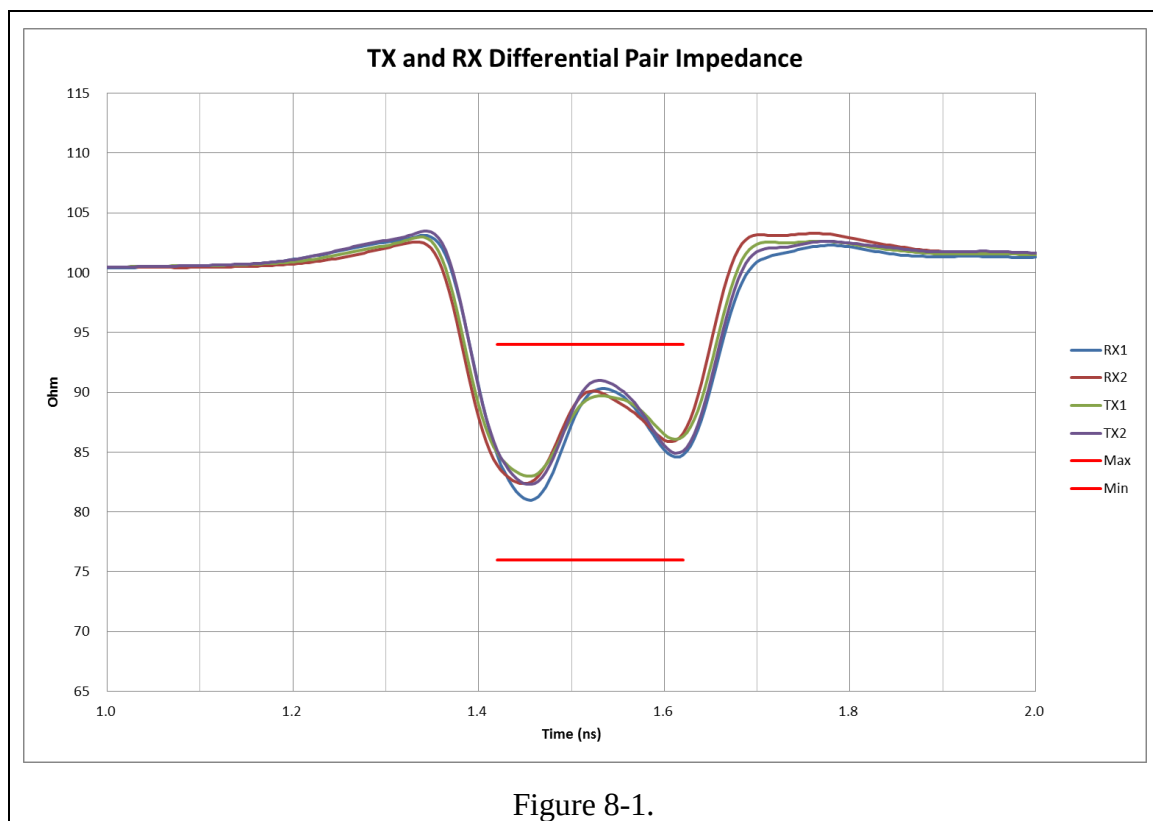
8. 測試結果

8-1. 測試設備

Item	Product Model	Name	Manufacturer
01	E5071C-TDR	300KHz~20GHz ENA Network Analyzer	Agilent
02	N4433A	200KHz~20GHz Electronic Calibration Module	Agilent

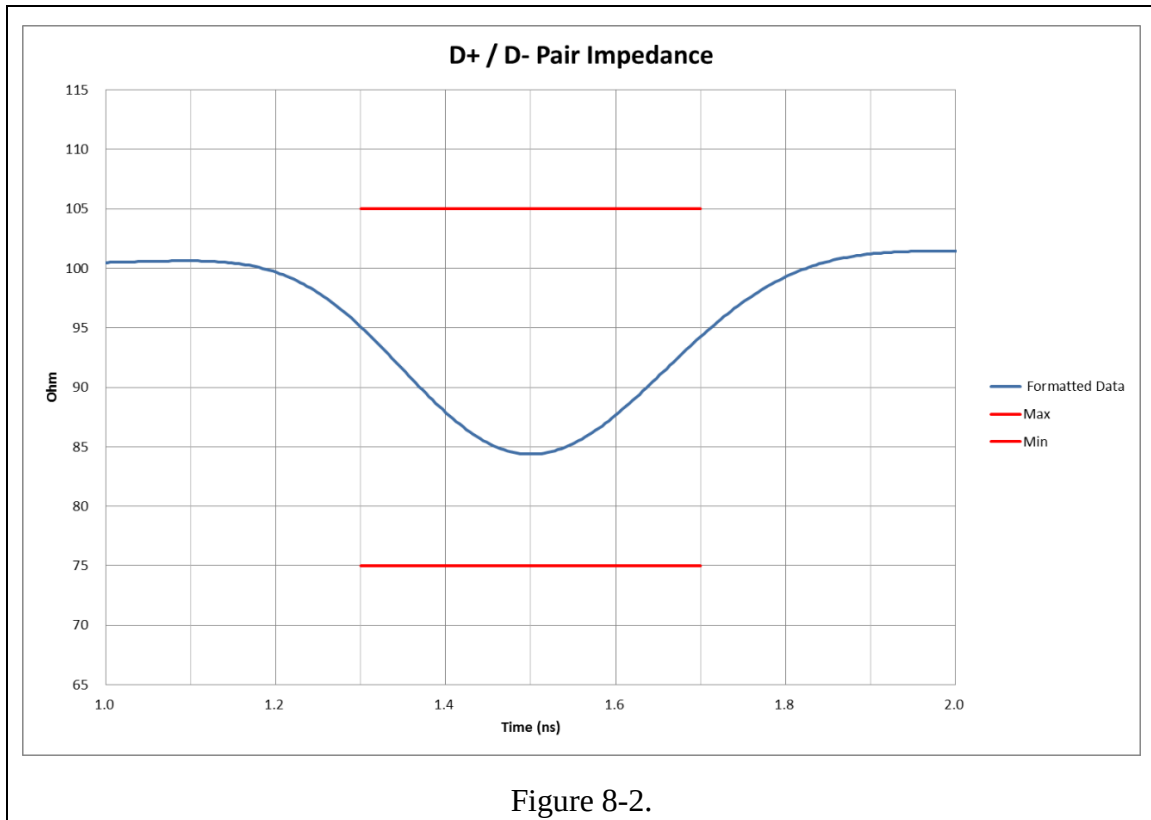
8-1-1. TX and RX Differential Pair Impedance

Pair Num	Maximum	Minimum	Unit	Figure
RX1	90.33	80.97	Ω	11
RX2	90.10	82.35		
TX1	89.68	82.98		
TX2	90.98	82.30		



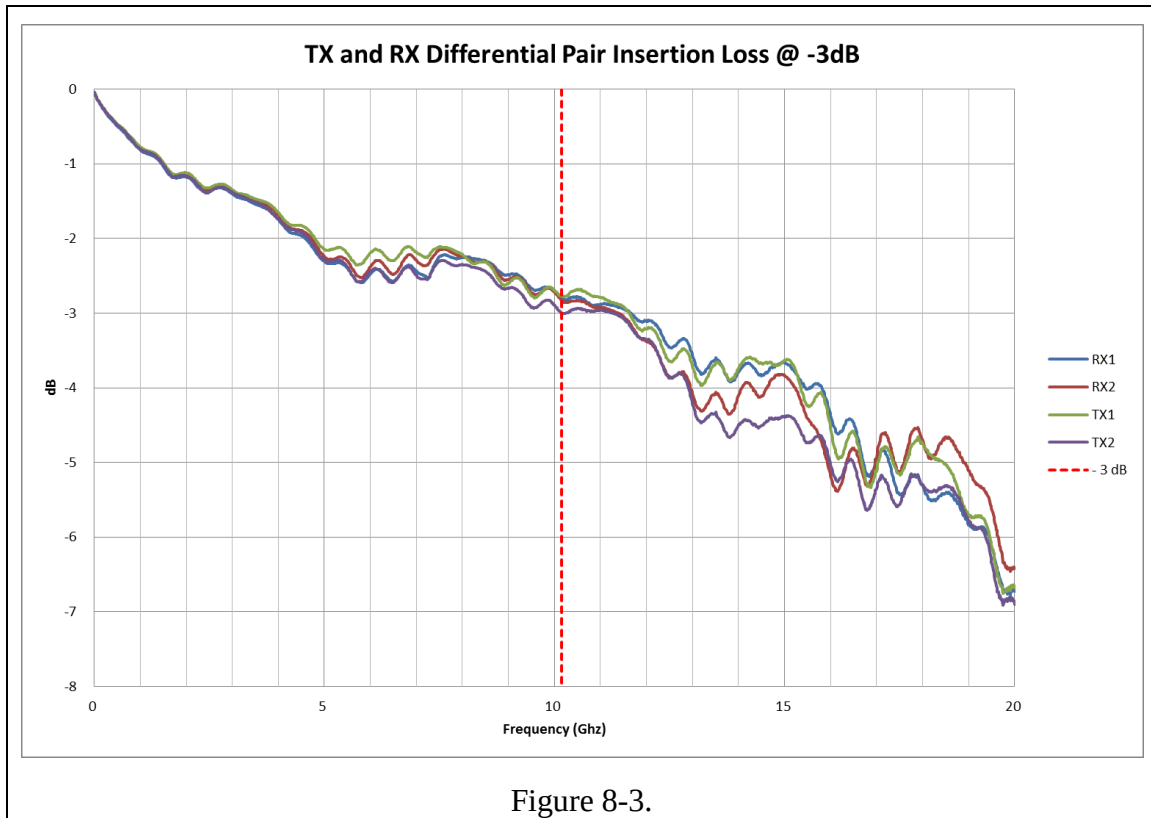
8-1-2. D+/D- Pair Impedance

Pair Num	Maximum	Minimum	Unit	Figure
D	95.32	84.38	Ω	12



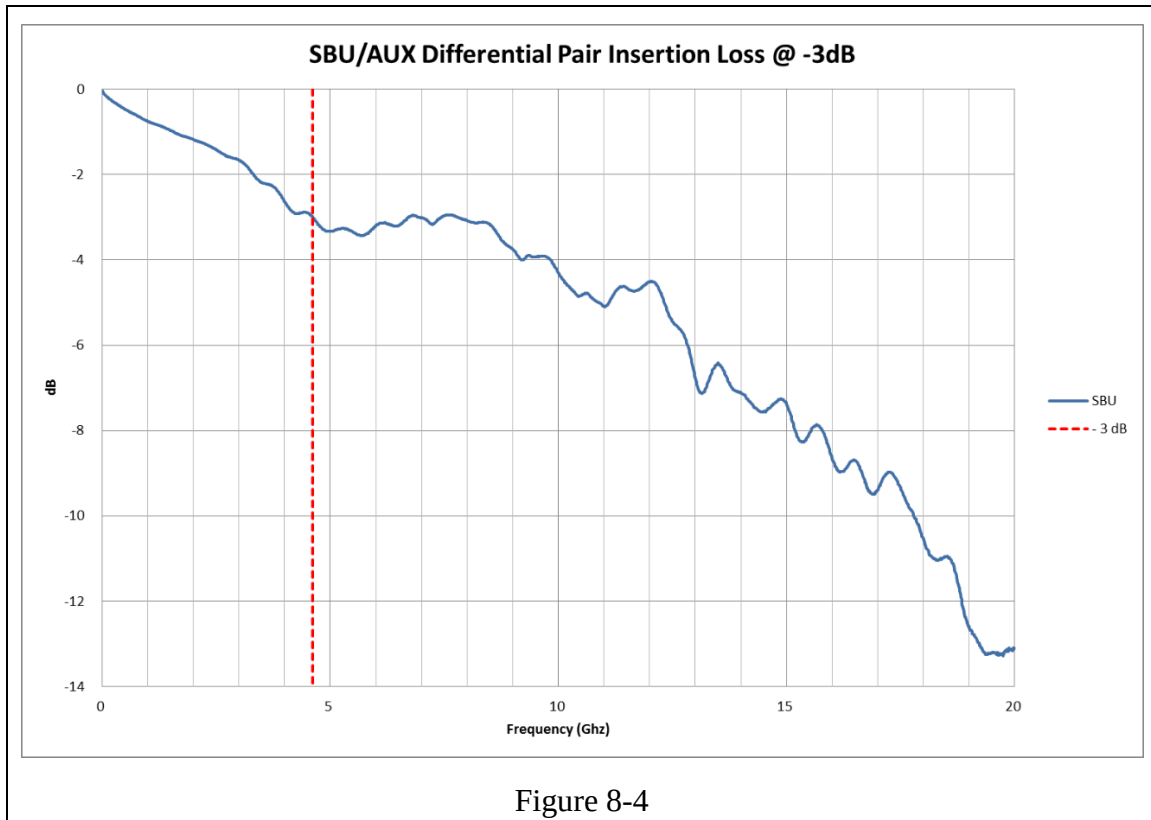
8-1-3. TX and RX Differential Pair Insertion Loss @ -3dB

Pair Num	Min	Unit	Figure
RX1	11.65	GHz	13
RX2	11.38		
TX1	11.63		
TX2	10.15		



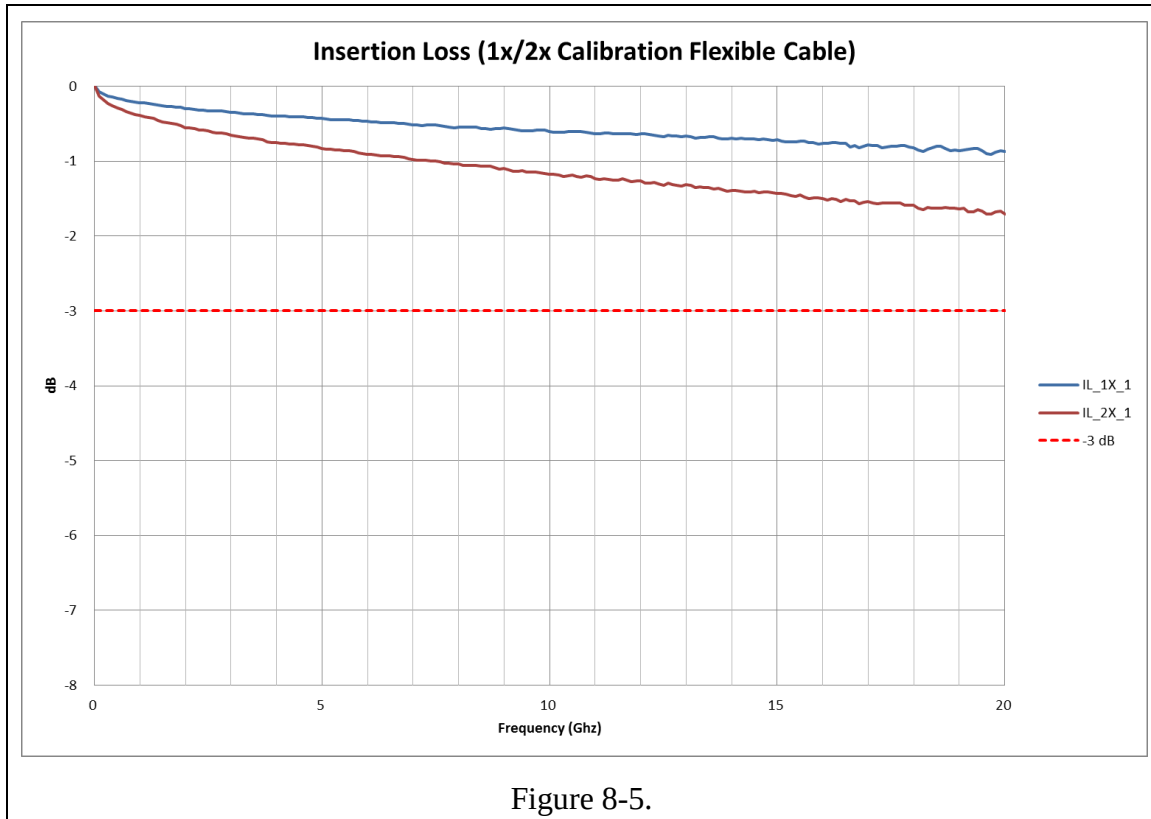
8-1-4. SBU/AUX Differential Pair Insertion Loss @ -3dB

Pair Num		Min	Unit	Figure
SBU	AUX	-4.6	GHz	14



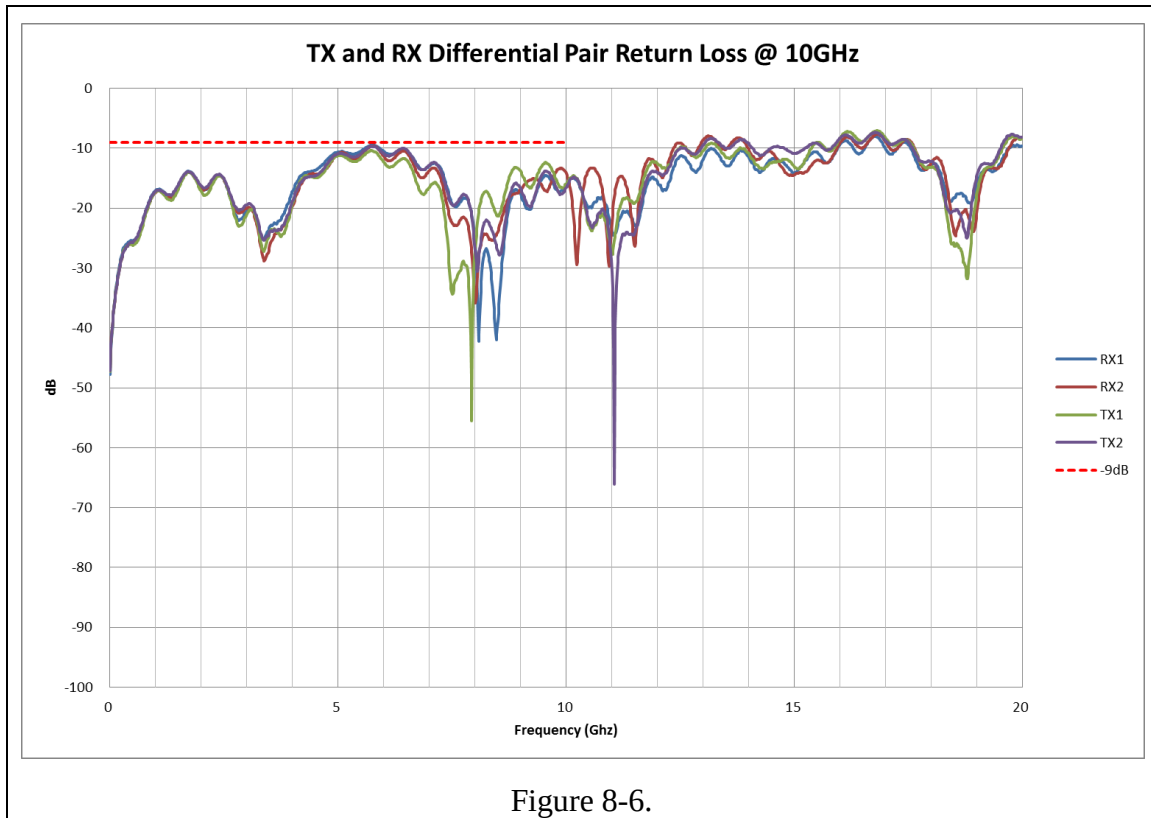
8-1-5. Insertion Loss (1x/2x Calibration Flexible Cable)

Pair Num		Min	Unit	Figure
1X	TF21-239L	-0.91	dB	15
2X	TF21-240L	-1.71		



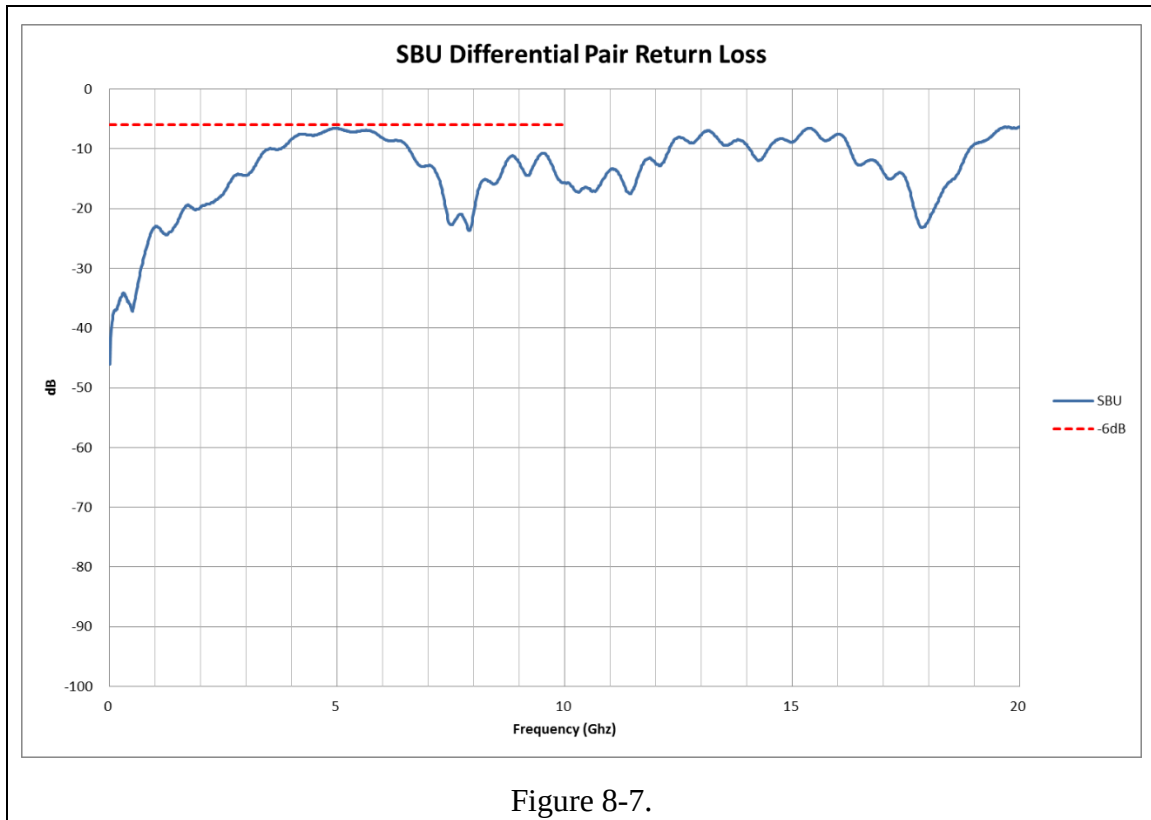
8-1-6. TX and RX Differential Pair Return Loss @ 10GHz

Pair Num	Min	Unit	Figure
RX1	-9.49	dB	16
RX2	-9.59		
TX1	-10.38		
TX2	-9.66		



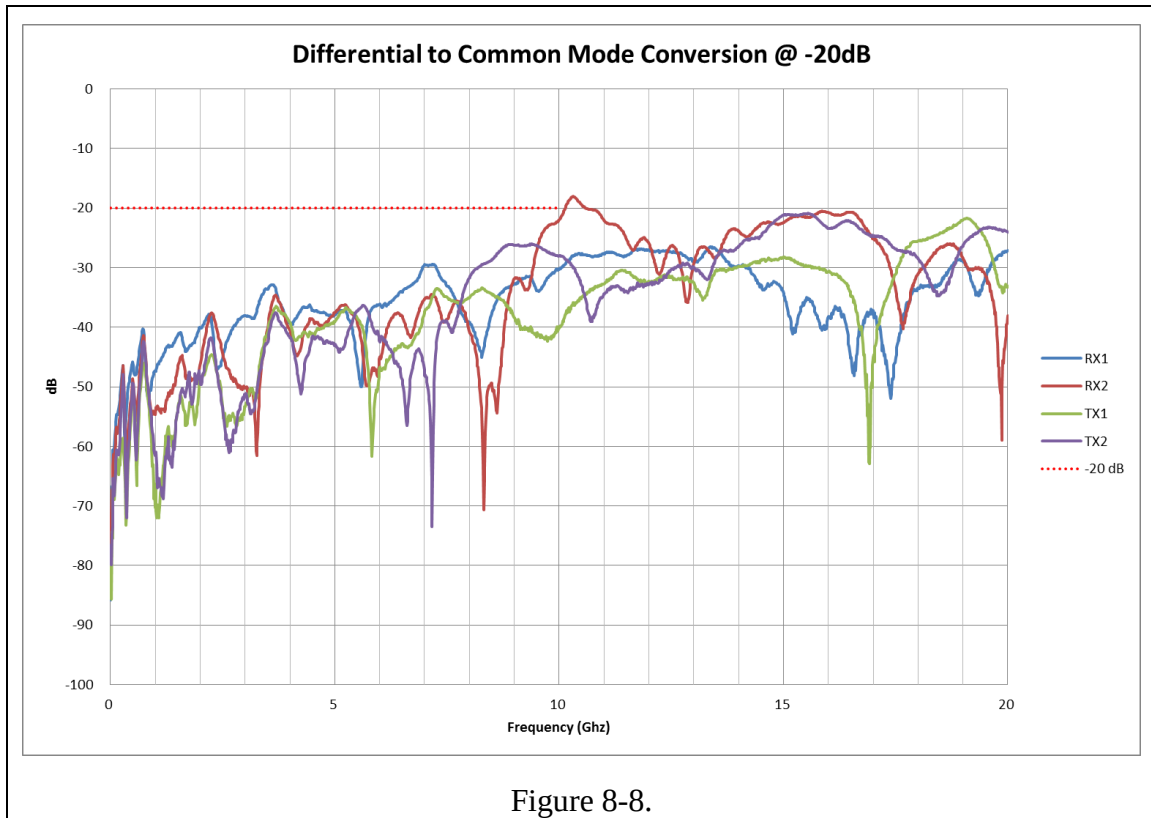
8-1-7. SBU Differential Pair Return Loss

Pair Num	Min	Unit	Figure
SBU	-6.57	dB	17



8-1-8. Differential to Common Mode Conversion @ -20dB

Pair Num	M	Unit	Figure
RX1+	-29.45	dB	18
RX2+	-22.06		
TX1+	-33.34		
TX2+	-26.03		



8-1-9. All Differential Pair Intra Pair Skew

Pair Num		Min	Unit	Figure
TX1+	TX1-	0.67	ps	19
TX2+	TX2-	0.06		20
RX1+	RX1-	2.59		21
RX2+	RX2-	0.05		22

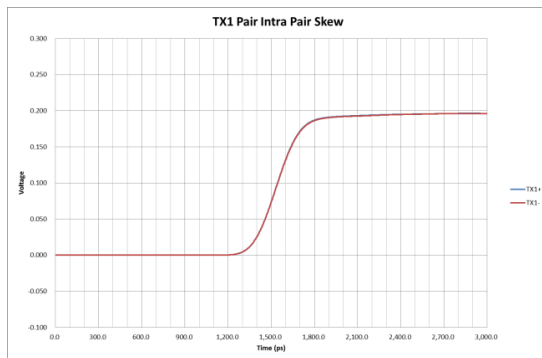


Figure 8-9.

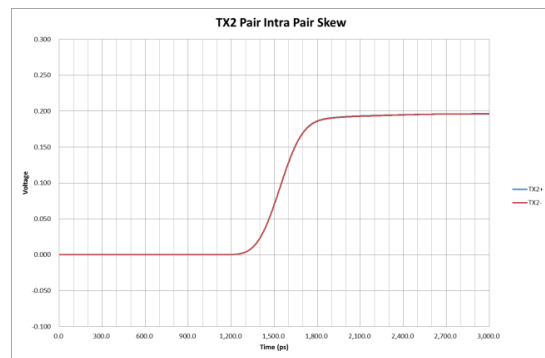


Figure 8-10.

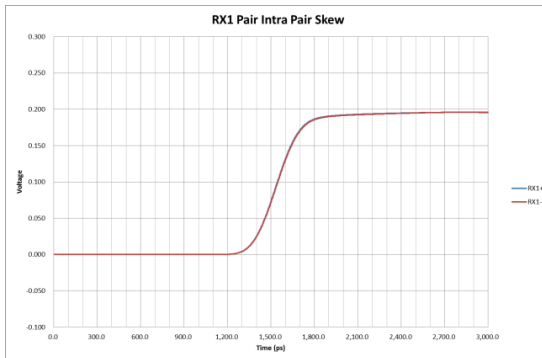


Figure 8-11.

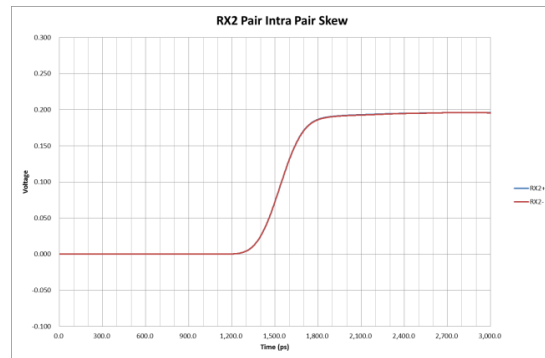
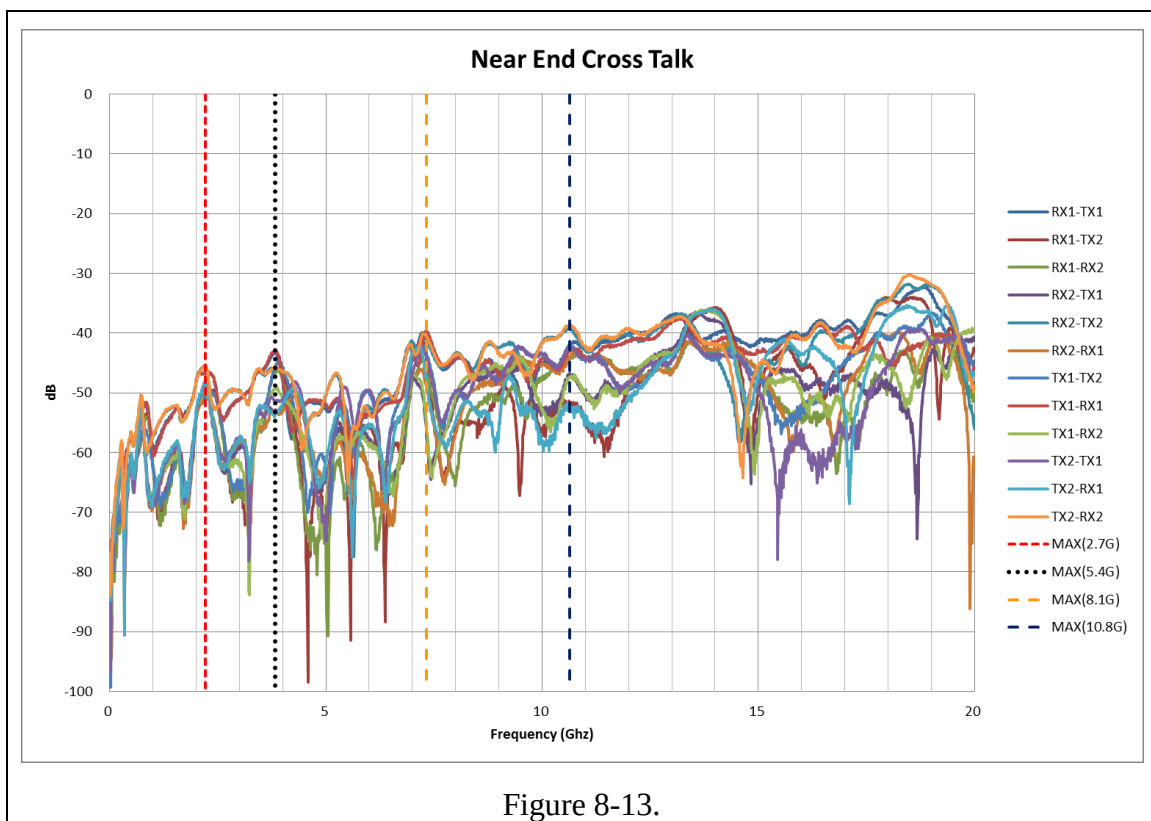


Figure 8-12.

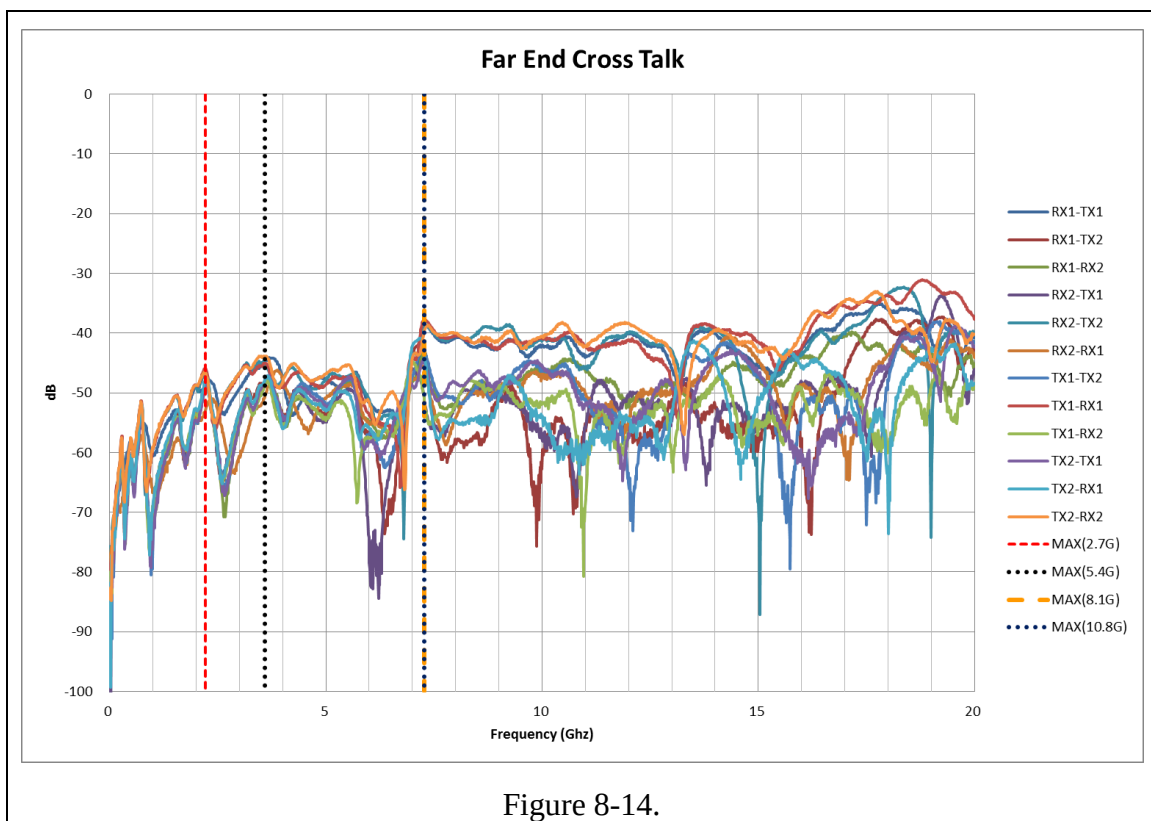
8-1-10. Near End Cross Talk

Pair Num	MAX(2.7G)	MAX(5.4G)	MAX(8.1G)	MAX(10.8G)	Unit	Figure
RX1-TX1	-46.51	-43.32	-39.95	-39.95	dB	23
RX1-TX2	-49.56	-44.83	-41.12	-41.12		
RX1-RX2	-50.06	-46.29	-44.53	-43.44		
RX2-TX1	-48.60	-48.60	-47.44	-45.58		
RX2-TX2	-45.51	-45.51	-40.98	-39.12		
RX2-RX1	-48.74	-48.74	-46.03	-43.12		
TX1-TX2	-49.78	-44.68	-41.72	-41.72		
TX1-RX1	-46.56	-42.96	-39.59	-39.59		
TX1-RX2	-49.66	-49.08	-46.74	-43.93		
TX2-TX1	-47.96	-47.96	-42.27	-42.09		
TX2-RX1	-48.23	-48.23	-42.08	-42.08		
TX2-RX2	-45.38	-45.38	-40.09	-38.72		



8-1-11. Far End Cross Talk

Pair Num	MAX(2.7G)	MAX(5.4G)	MAX(8.1G)	MAX(10.8G)	Unit	Figure
RX1-TX1	-47.94	-44.14	-38.74	-38.74	dB	24
RX1-TX2	-48.11	-48.07	-41.49	-41.49		
RX1-RX2	-48.35	-47.39	-43.23	-43.23		
RX2-TX1	-48.48	-48.15	-45.93	-45.93		
RX2-TX2	-46.94	-44.73	-38.76	-38.55		
RX2-RX1	-50.97	-46.17	-45.49	-45.49		
TX1-TX2	-48.06	-47.78	-42.00	-42.00		
TX1-RX1	-45.94	-45.02	-37.79	-37.79		
TX1-RX2	-48.23	-48.03	-44.70	-44.70		
TX2-TX1	-48.56	-47.09	-44.58	-44.58		
TX2-RX1	-47.45	-47.14	-40.86	-40.86		
TX2-RX2	-46.54	-43.84	-38.69	-38.16		



8-1-12. Typical mated pair 2.7Gb/s Eye Diagram

Level Zero	0.010773
Level One	0.385267
Level Mean	0.19802
Amplitude	0.374493
Height	0.333021
Width	3.65E-10
Opening Factor	0.963085
Signal / Noise	27.08959
Duty Cycle Distortion	1.34E-15
Duty Cycle Distortion (%)	0.000361
Rise Time	6.09E-11
Fall Time	6.00E-11
Jitter (PP)	2.31E-12
Jitter (RMS)	8.25E-13
Cross Point (%)	49.9986

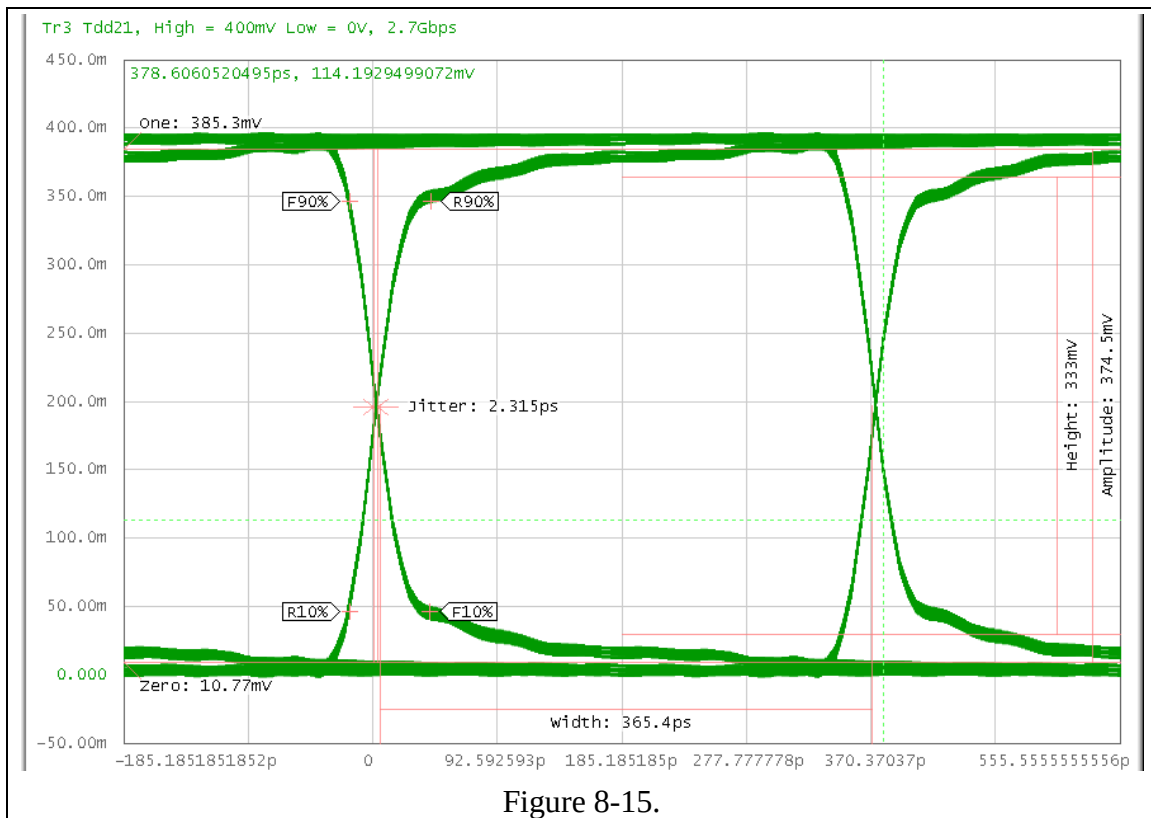
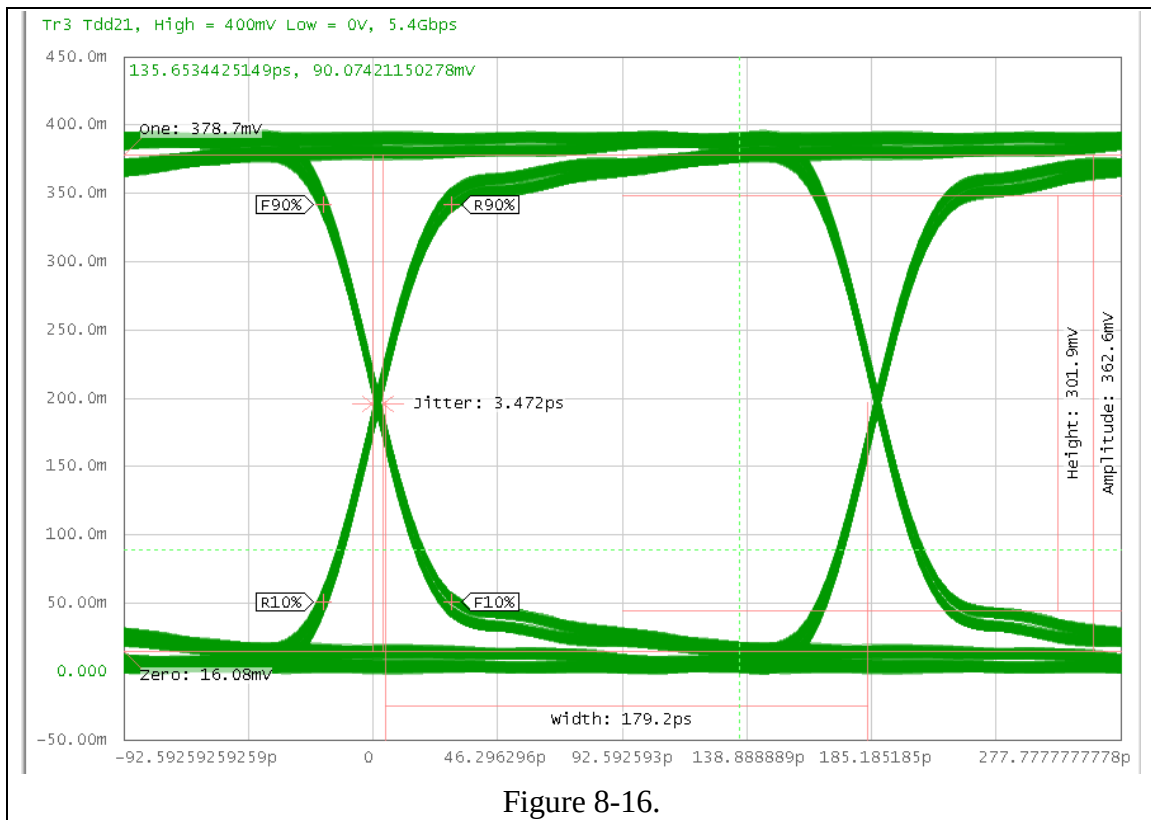


Figure 8-15.

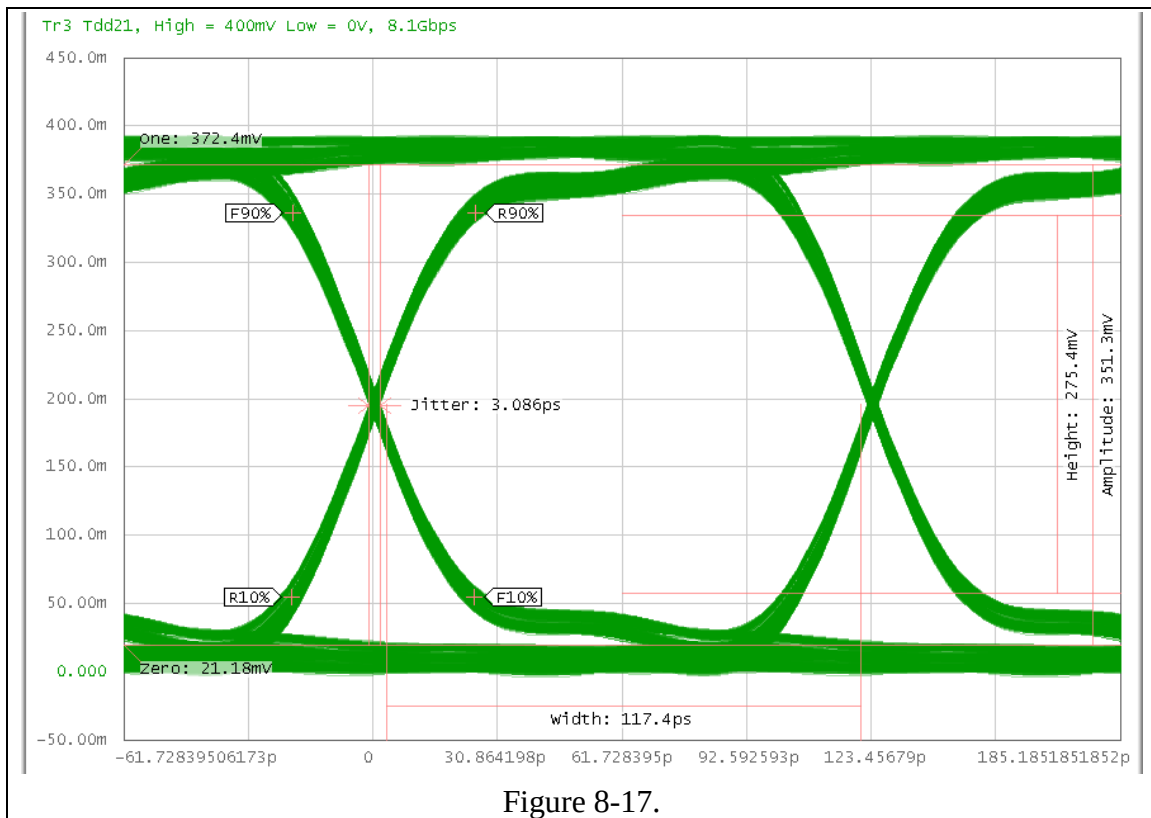
8-1-13. Typical mated pair 5.4Gb/s Eye Diagram

Level Zero	0.016084
Level One	0.378666
Level Mean	0.197375
Amplitude	0.362582
Height	0.301921
Width	1.79E-10
Opening Factor	0.944233
Signal / Noise	17.93169
Duty Cycle Distortion	1.96E-15
Duty Cycle Distortion (%)	0.001057
Rise Time	4.74E-11
Fall Time	4.76E-11
Jitter (PP)	3.47E-12
Jitter (RMS)	9.92E-13
Cross Point (%)	49.99783



8-1-14. Typical mated pair 8.1Gb/s Eye Diagram

Level Zero	0.021178967
Level One	0.372431267
Level Mean	0.196805117
Amplitude	0.3512523
Height	0.275403275
Width	1.17E-10
Opening Factor	0.928020377
Signal / Noise	13.8928207
Duty Cycle Distortion	5.39E-15
Duty Cycle Distortion (%)	0.00436422
Rise Time	4.53E-11
Fall Time	4.50E-11
Jitter (PP)	3.09E-12
Jitter (RMS)	1.01E-12
Cross Point (%)	49.99705588



8-1-15. Typical mated pair 10.8Gb/s Eye Diagram

Level Zero	0.022752149
Level One	0.369790387
Level Mean	0.196271268
Amplitude	0.347038238
Height	0.265170121
Width	8.56E-11
Opening Factor	0.92136494
Signal / Noise	12.71697389
Duty Cycle Distortion	3.11E-15
Duty Cycle Distortion (%)	0.003360744
Rise Time	4.42E-11
Fall Time	4.42E-11
Jitter (PP)	4.05E-12
Jitter (RMS)	1.17E-12
Cross Point (%)	49.99679878

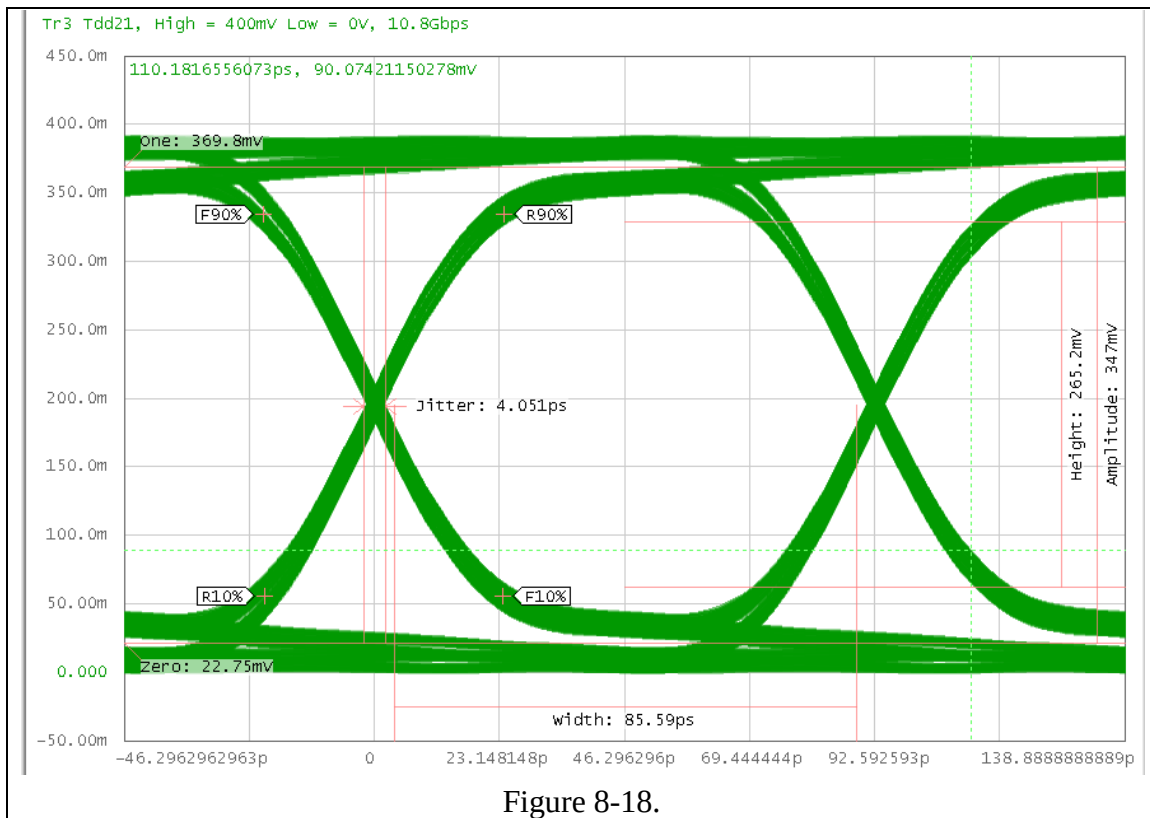


Figure 8-18.

9. 參考資料

9-1. Specification

HDMI1.4b_AltMode_USBTypeC_final20160915a

9-2. Keysight

Method of Implementation (MOI) for HDMI 1.4b Cable Assembly Test

https://www.keysight.com/upload/cmc_upload/All/E5071C-TDR_HDMI_1.4b_MOI_1.12.pdf