

USB 3.1 Test Fixture

User Manual



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Product Name	Version	Date	Comments
USB 3.1 Test Fixture Series	05	Mar.19,2019	Initial release

1. Introduction

This document describes the Dimension and electrical specification for USB Type-C test fixture.

2. Objectives

This specification provides the requirements for test fixture performances and test methods of USB Type-C 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 USB Type-C 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.

TFU-23R2R



Figure 3-1. USB 3.1 Type C Receptacle High Speed Test Fixture

TFU-24R5U



Figure 3-2. USB 3.1 Type C Receptacle Low Speed Test Fixture

TFU-12R4R

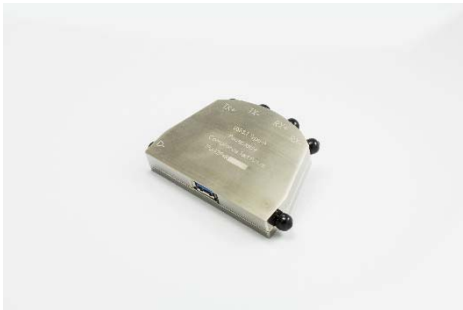


Figure 3-3. USB 3.1 Type-A Receptacle Test Fixture

TFU-12P4R



Figure 3-4. USB 3.1 Type-A Plug Test Fixture

TFU-19R4R



Figure 3-5. USB 3.1 Type-B Receptacle Test Fixture

TFU-14R4R

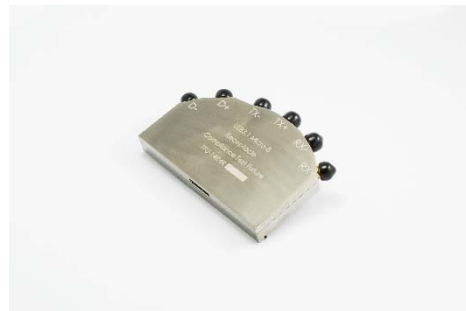




Figure 3-6. USB 3.1 Micro-B Receptacle Test Fixture

<p>TFU-26R4R</p>  <p>Figure 3-7. USB 2.0 Mini-B Receptacle Test Fixture</p>	<p>TFU-25P4R</p>  <p>Figure 3-8. USB 2.0 Micro-B Plug Test Fixture</p>
<p>TFU-31C4R</p>  <p>Figure 3-9. USB 3.1 Calibration Board - Thru</p>	<p>TFU-32C4R</p>  <p>Figure 3-10. USB 3.1 Calibration Board - SOL</p>
<p>TFU-33C4R</p>  <p>Figure 3-11. USB 3.1 Calibration Board - TRL</p>	<p>TFU-31C6U</p>  <p>Figure 3-12. USB 3.1 Type-C Low Speed Calibration Board - Thru</p>

4. Electrical Specification

Test Item		Requirements		Description
01	Single End Impedance (SMA Side)	TFU-23R2R	50± 2.5 Ohm	Rise Time : 40ps (20%~80%)
		TFU-24R5U		
		TFU-12R4R		
		TFU-12P4R		
		TFU-19R4R		
		TFU-14R4R		
		TFU-25P4R		
		TFU-26R4R		
		TFU-31C4R		
		TFU-32C4R		
		TFU-33C4R		
02	Single End Impedance (PCB Side)	TFU-23R2R	50± 2.5 Ohm	Rise Time : 40ps (20%~80%)
		TFU-24R5U		
		TFU-12R4R		
		TFU-12P4R		
		TFU-19R4R		
		TFU-14R4R		
		TFU-25P4R		
		TFU-26R4R		
		TFU-31C4R		
		TFU-32C4R		
		TFU-33C4R		
03	Insertion Loss (Bandwidth)	TFU-31C4R	-3dB > 20GHz	Frequency Range = 10M~20G Number of point =1601 IFBW = 1KHz

4-1. Testing Equipment

Item	Product Model	Name	Manufacturer
01	E5071C-TDR	300KHz~20GHz ENA Network Analyzer	Keysight
02	N4433A	200KHz~20GHz Electronic Calibration Module	Keysight
03	TDS8300+80E04	TDR with TDR and TDT module	Tektronix

5. Mechanical Specification

Test Item	Requirements		Description
Durability Test	TFU-23R2R	NA	maximum rate of 200 cycles/hours
Differential Impedance	TFU-23R2R	90± 9 Ohm	Rise Time : 40ps (20%~80%)
Insertion Loss	TFU-23R2R	NA	Frequency Range = 10M~20G Number of point =1601 IFBW = 1KHz
Return Loss	TFU-23R2R	NA	Frequency Range = 10M~20G Number of point =1601 IFBW = 1KHz

5-1. Testing 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
04	TDS8300+80E04	TDR with TDR and TDT module	Tektronix

5-2. Test Conditions

5-2-1. Differential Impedance

1. Frequency Range = 10M~20G
2. Number of point =1601
3. IFBW = 1KHz

5-2-2. Insertion Loss

1. Frequency Range = 10M~20G
2. Number of point =1601
3. IFBW = 1KHz

5-2-3. Return Loss

1. Frequency Range = 10M~20G
2. Number of point =1601
3. IFBW = 1KHz

6. Testing Result

6-1. Single End (SMA Side) Impedance

6-1-1. USB 3.1 Type-C Receptacle High Speed Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TX1p	51.0	48.4	Ω	41
SS-TX1n	51.0	49.2		
SS-RX1p	50.0	48.7		
SS-RX1n	50.8	49.1		
SS-TX2p	50.7	49.2		
SS-TX2n	50.6	48.8		
SS-RX2p	50.9	48.7		
SS-RX2n	51.5	48.6		
Dp	50.5	49.2		
Dn	50.9	49.3		

6-1-2. USB 3.1 Type-C Receptacle Low Speed Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
Dp	50.5	48.8	Ω	42
Dn	50.8	49.0		
SUB1	51.2	49.5		
SUB2	50.3	49.1		
CC1	50.0	48.9		
VBUS	51.1	49.4		

6-1-3. USB 3.1 Type-A Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	52.1	49.4	Ω	43
SS-TXn	52.2	49.5		
SS-RXp	51.7	49.5		
SS-RXn	51.8	49.1		
Dp	51.1	49.2		
Dn	51.7	50.1		

6-1-4. USB 3.1 Type-A Plug Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	51.6	49.7	Ω	44
SS-TXn	51.2	49.5		
SS-RXp	51.1	49.3		
SS-RXn	51.0	49.2		
Dp	51.3	49.3		
Dn	51.2	49.4		

6-1-5. USB 3.1 Type-B Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	51.5	49.3	Ω	45
SS-TXn	51.6	49.5		
SS-RXp	51.1	48.7		
SS-RXn	51.2	49.0		
Dp	51.2	49.3		
Dn	51.2	49.2		

6-1-6. USB 3.1 Micro-B Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	51.9	48.8	Ω	46
SS-TXn	51.2	48.6		
SS-RXp	51.1	48.6		
SS-RXn	51.2	48.8		
Dp	51.6	48.6		
Dn	51.8	49.0		

6-1-7. USB 2.0 Mini-B Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
Dp	51.0	49.3	Ω	47
Dn	50.7	49.4		

6-1-8. USB 2.0 Micro-B Plug Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
Dp	50.9	49.0	Ω	48
Dn	50.9	49.7		

6-1-9. USB 3.1 Calibration Board				
Pair Num	Maximum	Minimum	Unit	Figure
Thru(1x)_1	49.9	48.3	Ω	49
Thru(1x)_2	49.5	48.4		
Thru(2x)_1	50.0	48.1		
Thru(2x)_2	50.2	47.8		
Short_1	50.1	48.1		
Short_2	50.5	48.2		
Open_1	52.0	48.2		
Open_2	50.8	48.1		
Load_1	51.0	48.4		
Load_2	49.7	48.1		
Line_1	51.2	48.0		
Line_2	49.9	48.1		
Line_3	51.0	48.6		

6-2. USB 3.1 Calibration Board

6-2-1. Bandwidth (1X and 2X calibration semirigid cable)				
Pair Num	Test mode	Value	Unit	Figure
Thru(1x)_1	Single mode S31	-2.1	dB	50
Thru(1x)_2	Single mode S31	-2.1		
Thru(2x)_1	Single mode S31	-3.9		
Thru(2x)_2	Single mode S31	-4.0		

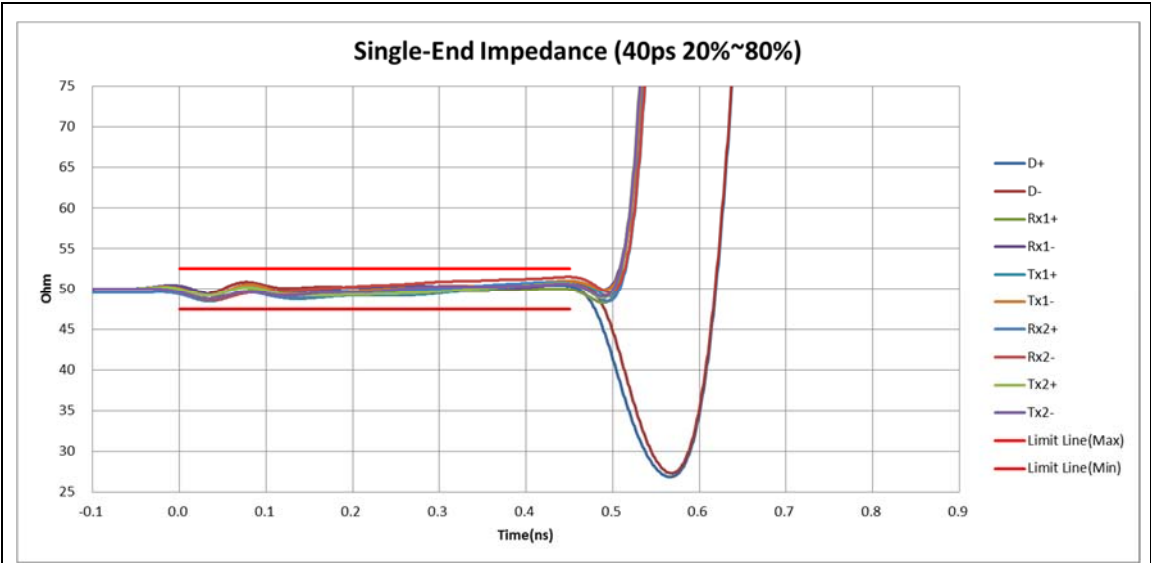


Figure 6-1. USB 3.1 Type-C Receptacle High Speed Test Fixture Impedance

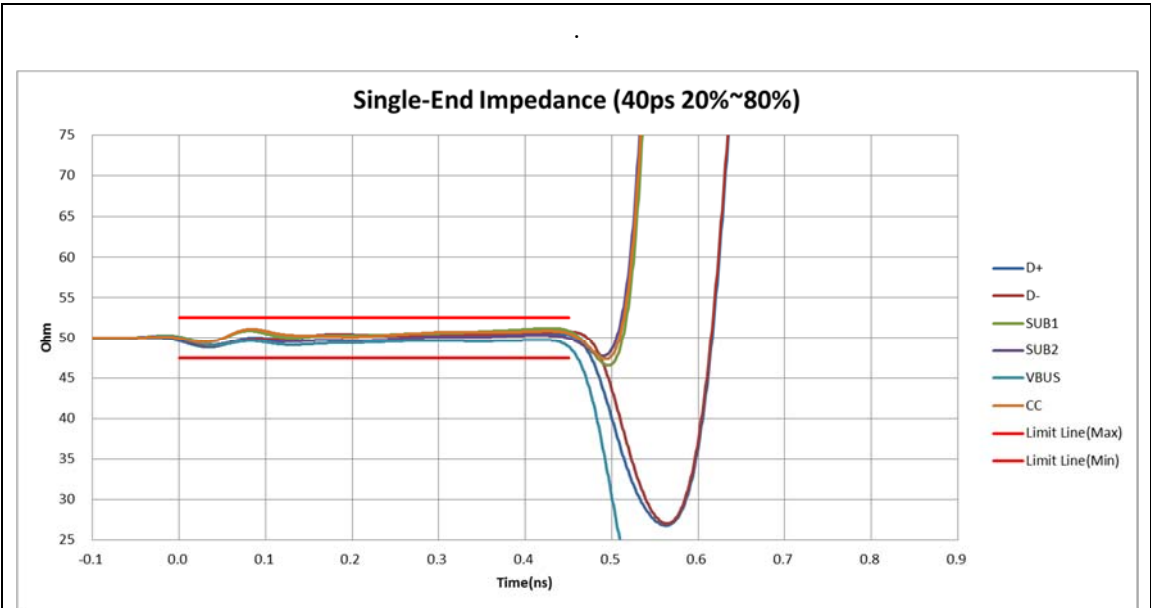


Figure 6-2. USB 3.1 Type-C Receptacle Low Speed Test Fixture Impedance

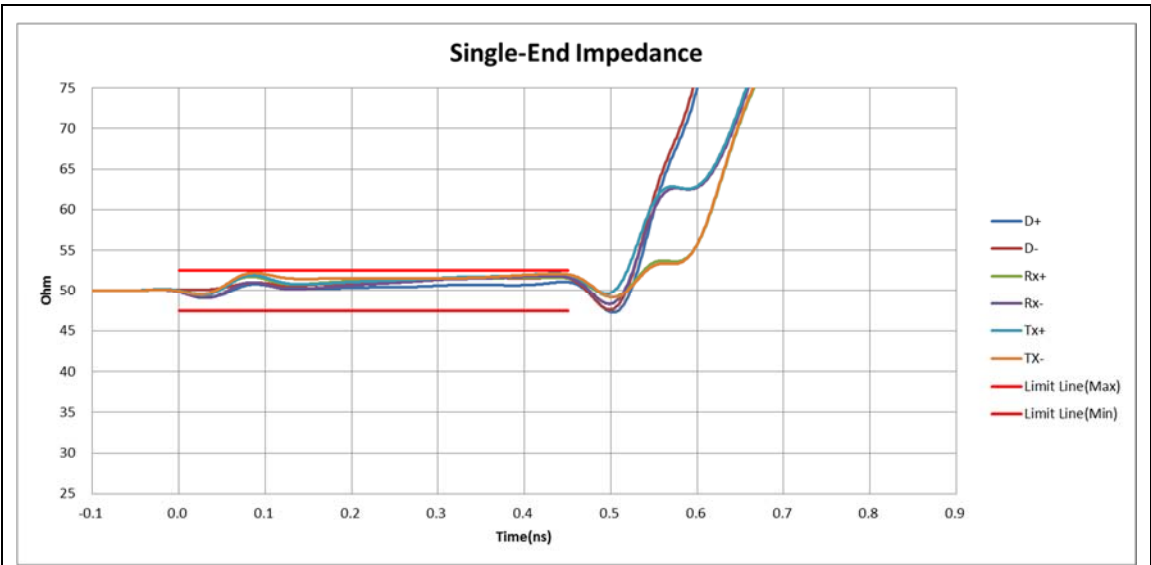


Figure 6-3. USB 3.1 Type-A Receptacle Test Fixture Impedance

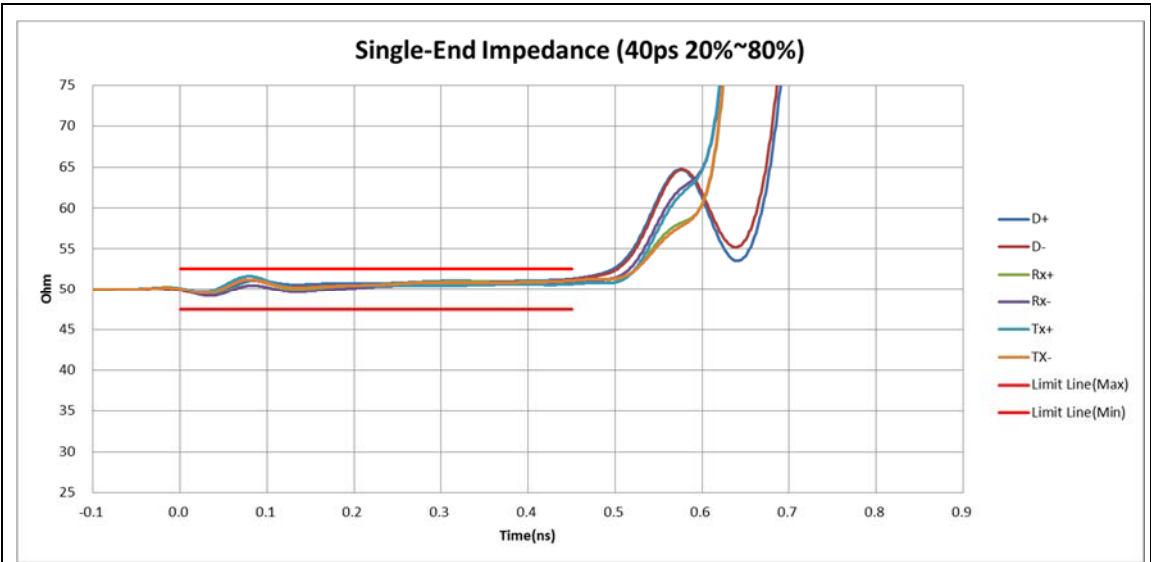


Figure 6-4. USB 3.1 Type-A Plug Test Fixture Impedance

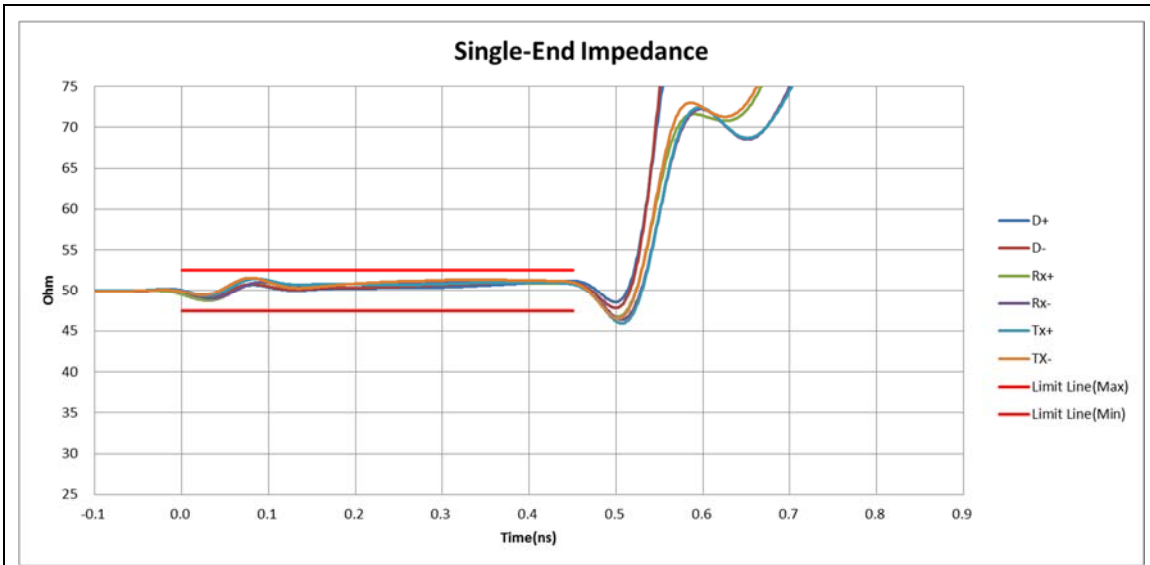


Figure 6-5. USB 3.1 Type-B Receptacle Test Fixture Impedance

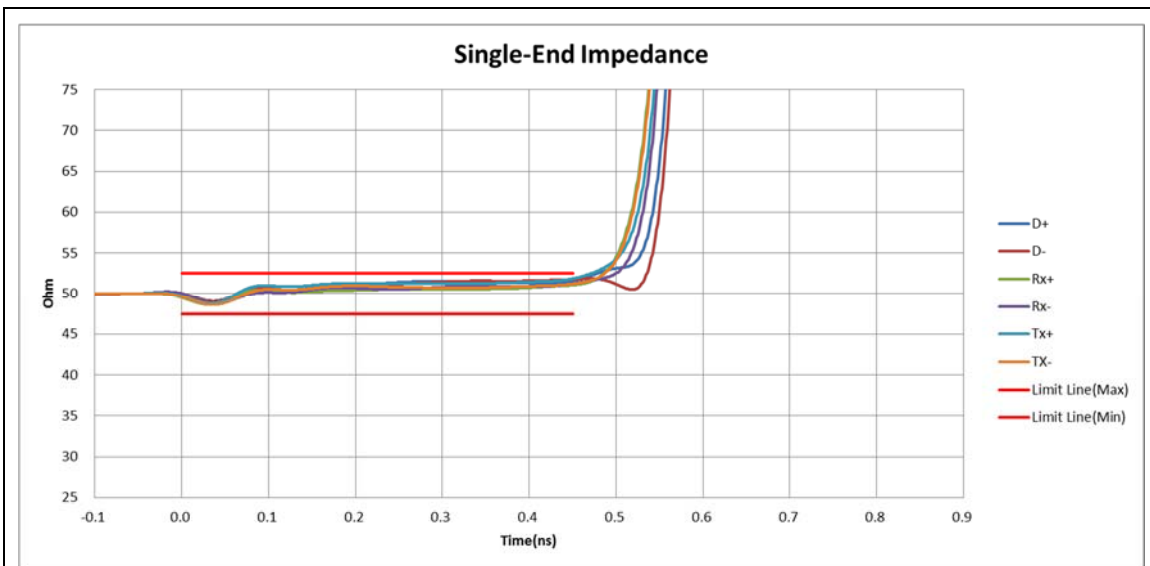


Figure 6-6. USB 3.1 Micro-B Receptacle Test Fixture Impedance

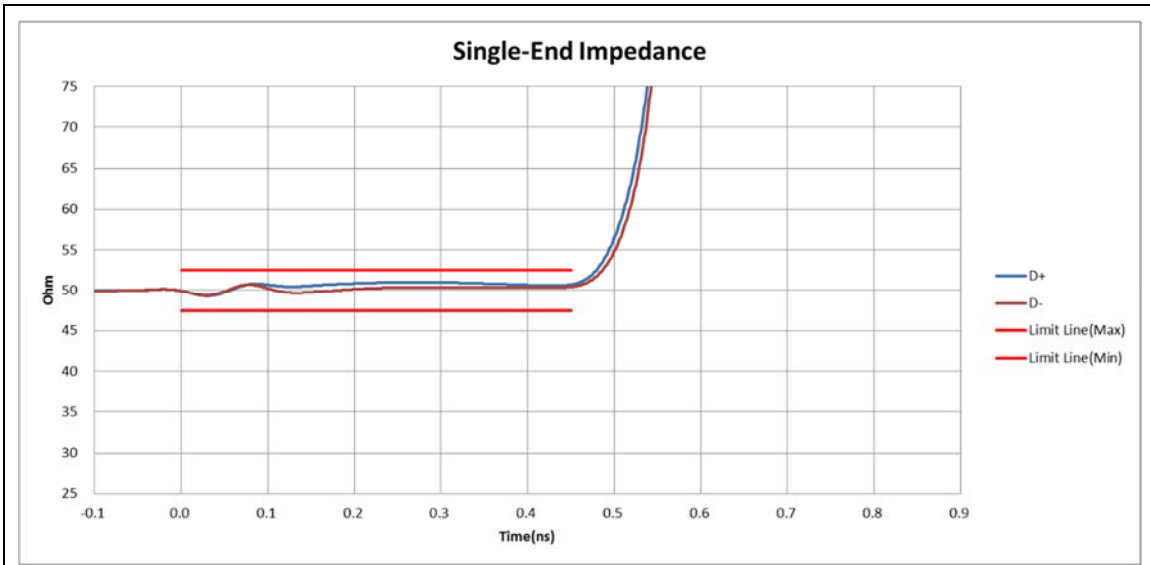


Figure 6-7. USB 2.0 Mini-B Receptacle Test Fixture Impedance

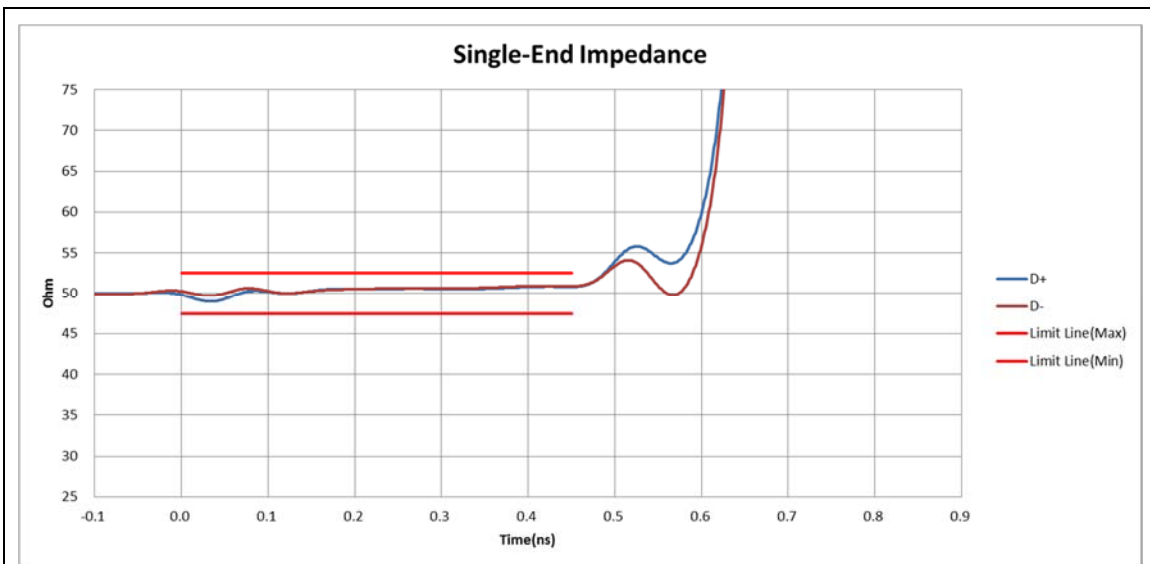
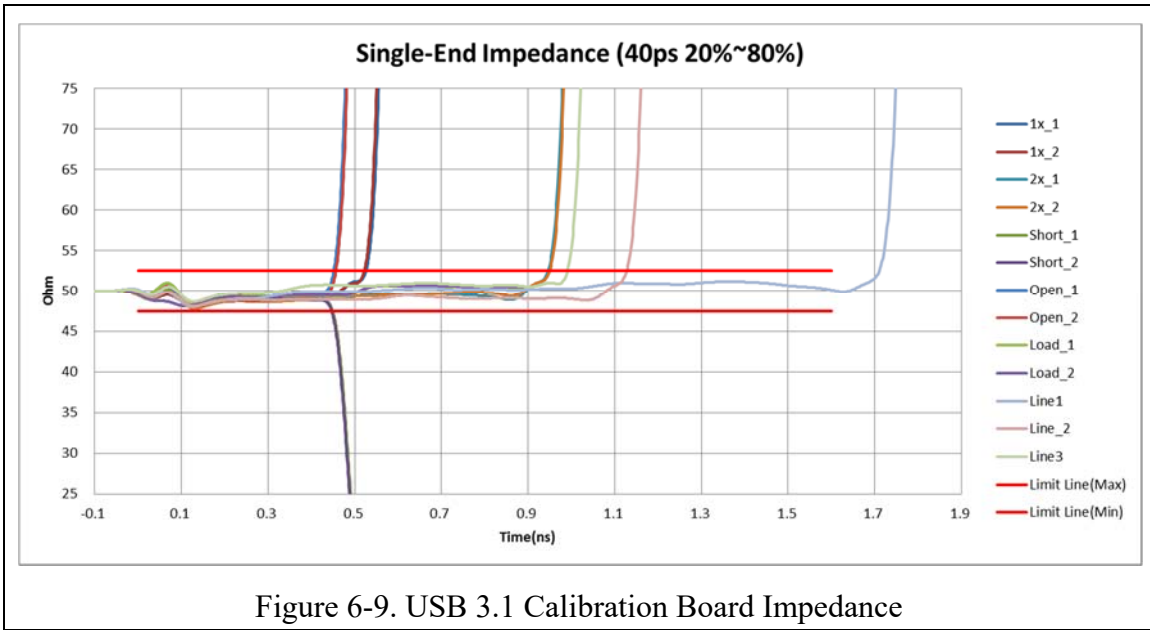


Figure 6-8. USB 2.0 Micro-B Plug Test Fixture Impedance

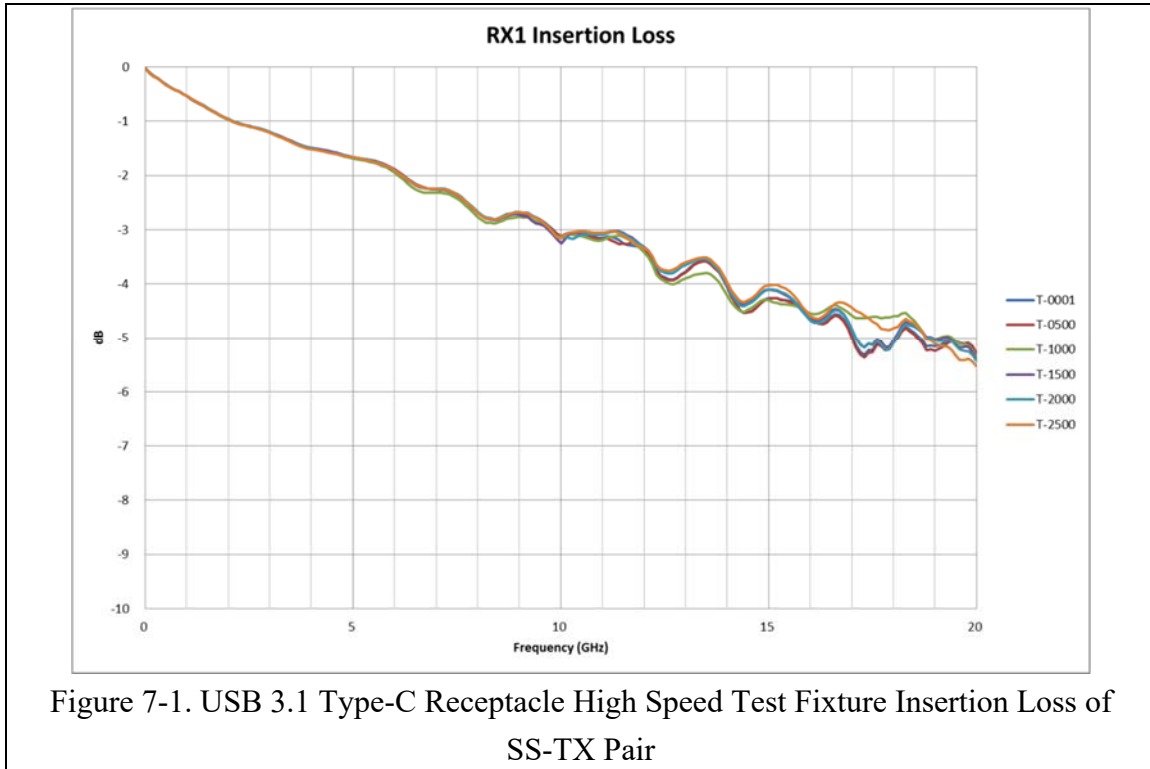


7. Durability Test

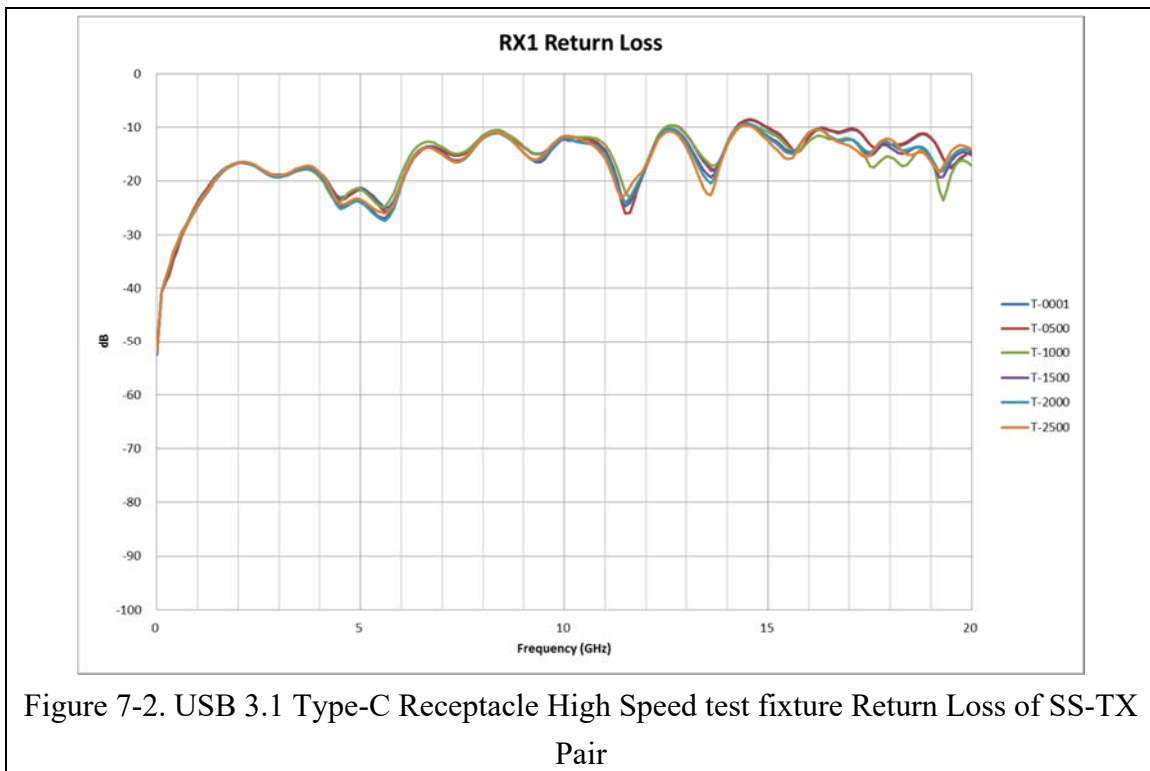
7-1. Differential Impedance

Cycles	Minimum	Unit
1	84.60	Ω
500	84.65	
1000	85.02	
1500	85.24	
2000	86.87	
2500	85.97	

7-2. Insertion Loss



7-3. Return Loss



8. Reference materials

8-1. Keysight

Method of Implementation (MOI) for USB Type-C to Type-C
Cable-Connector Assembly Compliance Test

https://www.keysight.com/upload/cmc_upload/All/E5071C-TDR_USB_Type-C_Type-C_CableTest_MOI_rev01.00.pdf

8-2. Tektronix

USB 3.1 Cable Tests MOI

<https://tw.tek.com/document/method-implementation/usb-31-cable-tests-moi>

USB 3.1 Test Fixture

User Manual



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Product Name	Version	Date	Comments
USB 3.1 Test Fixture Series	05	Mar.19,2019	Initial release

1. 簡介

本文介紹 USB Type-C test fixture 的機械規格與電氣規格。

2. 目的

本規範提供了 USB Type-C test 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 and 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

USB Type-C 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。

TFU-23R2R



Figure 3-1. USB 3.1 Type C Receptacle High Speed Test Fixture

TFU-24R5U



Figure 3-2. USB 3.1 Type C Receptacle Low Speed Test Fixture

TFU-12R4R

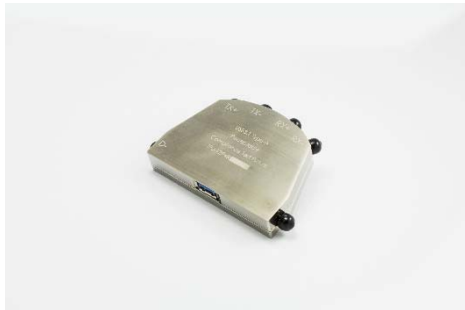


Figure 3-3. USB 3.1 Type-A Receptacle Test Fixture

TFU-12P4R



Figure 3-4. USB 3.1 Type-A Plug Test Fixture

TFU-19R4R



Figure 3-5. USB 3.1 Type-B Receptacle Test Fixture

TFU-14R4R



Figure 3-6. USB 3.1 Micro-B Receptacle Test Fixture

TFU-26R4R



Figure 3-7. USB 2.0 Mini-B Receptacle Test Fixture

TFU-25P4R



Figure 3-8. USB 2.0 Micro-B Plug Test Fixture

TFU-31C4R



Figure 3-9. USB 3.1 Calibration Board - Thru

TFU-32C4R



Figure 3-10. USB 3.1 Calibration Board - SOL

TFU-33C4R



Figure 3-11. USB 3.1 Calibration Board - TRL

TFU-31C6U



Figure 3-12. USB 3.1 Type-C Low Speed Calibration Board - Thru

4. 電氣規格

Test Item		Requirements		Description
01	Single End Impedance (SMA Side)	TFU-23R2R	50± 2.5 Ohm	Rise Time : 40ps (20%~80%)
		TFU-24R5U		
		TFU-12R4R		
		TFU-12P4R		
		TFU-19R4R		
		TFU-14R4R		
		TFU-25P4R		
		TFU-26R4R		
		TFU-31C4R		
		TFU-32C4R		
		TFU-33C4R		
02	Single End Impedance (PCB Side)	TFU-23R2R	50± 2.5 Ohm	Rise Time : 40ps (20%~80%)
		TFU-24R5U		
		TFU-12R4R		
		TFU-12P4R		
		TFU-19R4R		
		TFU-14R4R		
		TFU-25P4R		
		TFU-26R4R		
		TFU-31C4R		
		TFU-32C4R		
		TFU-33C4R		
03	Insertion Loss (Bandwidth)	TFU-31C4R	-3dB > 20GHz	Frequency Range = 10M~20G Number of point =1601 IFBW = 1KHz

4-1. 測試設備

Item	Product Model	Name	Manufacturer
01	E5071C-TDR	300KHz~20GHz ENA Network Analyzer	Keysight
02	N4433A	200KHz~20GHz Electronic Calibration Module	Keysight
03	TDS8300+80E04	TDR with TDR and TDT module	Tektronix

5. 機械規格

Test Item	Requirements		Description
Durability Test	TFU-23R2R	NA	maximum rate of 200 cycles/hours
Differential Impedance	TFU-23R2R	90± 9 Ohm	Rise Time : 40ps (20%~80%)
Insertion Loss	TFU-23R2R	NA	Frequency Range = 10M~20G Number of point =1601 IFBW = 1KHz
Return Loss	TFU-23R2R	NA	Frequency Range = 10M~20G Number of point =1601 IFBW = 1KHz

5-1. 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
04	TDS8300+80E04	TDR with TDR and TDT module	Tektronix

5-2. 校正

5-2-1. Differential Impedance

1. Frequency Range = 10M~20G
2. Number of point =1601
3. IFBW = 1KHz

5-2-2. Insertion Loss

1. Frequency Range = 10M~20G
2. Number of point =1601
3. IFBW = 1KHz

5-2-3. Return Loss

1. Frequency Range = 10M~20G
2. Number of point =1601
3. IFBW = 1KHz

6. 測試條件

6-1. Single End (SMA Side) Impedance

6-1-1. USB 3.1 Type-C Receptacle High Speed Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TX1p	51.0	48.4	Ω	41
SS-TX1n	51.0	49.2		
SS-RX1p	50.0	48.7		
SS-RX1n	50.8	49.1		
SS-TX2p	50.7	49.2		
SS-TX2n	50.6	48.8		
SS-RX2p	50.9	48.7		
SS-RX2n	51.5	48.6		
Dp	50.5	49.2		
Dn	50.9	49.3		

6-1-2. USB 3.1 Type-C Receptacle Low Speed Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
Dp	50.5	48.8	Ω	42
Dn	50.8	49.0		
SUB1	51.2	49.5		
SUB2	50.3	49.1		
CC1	50.0	48.9		
VBUS	51.1	49.4		

6-1-3. USB 3.1 Type-A Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	52.1	49.4	Ω	43
SS-TXn	52.2	49.5		
SS-RXp	51.7	49.5		
SS-RXn	51.8	49.1		
Dp	51.1	49.2		
Dn	51.7	50.1		

6-1-4. USB 3.1 Type-A Plug Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	51.6	49.7	Ω	44
SS-TXn	51.2	49.5		
SS-RXp	51.1	49.3		
SS-RXn	51.0	49.2		
Dp	51.3	49.3		
Dn	51.2	49.4		

6-1-5. USB 3.1 Type-B Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	51.5	49.3	Ω	45
SS-TXn	51.6	49.5		
SS-RXp	51.1	48.7		
SS-RXn	51.2	49.0		
Dp	51.2	49.3		
Dn	51.2	49.2		

6-1-6. USB 3.1 Micro-B Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
SS-TXp	51.9	48.8	Ω	46
SS-TXn	51.2	48.6		
SS-RXp	51.1	48.6		
SS-RXn	51.2	48.8		
Dp	51.6	48.6		
Dn	51.8	49.0		

6-1-7. USB 2.0 Mini-B Receptacle Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
Dp	51.0	49.3	Ω	47
Dn	50.7	49.4		

6-1-8. USB 2.0 Micro-B Plug Test Fixture				
Pair Num	Maximum	Minimum	Unit	Figure
Dp	50.9	49.0	Ω	48
Dn	50.9	49.7		

6-1-9. USB 3.1 Calibration Board				
Pair Num	Maximum	Minimum	Unit	Figure
Thru(1x)_1	49.9	48.3	Ω	49
Thru(1x)_2	49.5	48.4		
Thru(2x)_1	50.0	48.1		
Thru(2x)_2	50.2	47.8		
Short_1	50.1	48.1		
Short_2	50.5	48.2		
Open_1	52.0	48.2		
Open_2	50.8	48.1		
Load_1	51.0	48.4		
Load_2	49.7	48.1		
Line_1	51.2	48.0		
Line_2	49.9	48.1		
Line_3	51.0	48.6		

6-2. USB 3.1 Calibration Board

6-2-1. Bandwidth (1X and 2X calibration semirigid cable)				
Pair Num	Test mode	Value	Unit	Figure
Thru(1x)_1	Single mode S31	-2.1	dB	50
Thru(1x)_2	Single mode S31	-2.1		
Thru(2x)_1	Single mode S31	-3.9		
Thru(2x)_2	Single mode S31	-4.0		

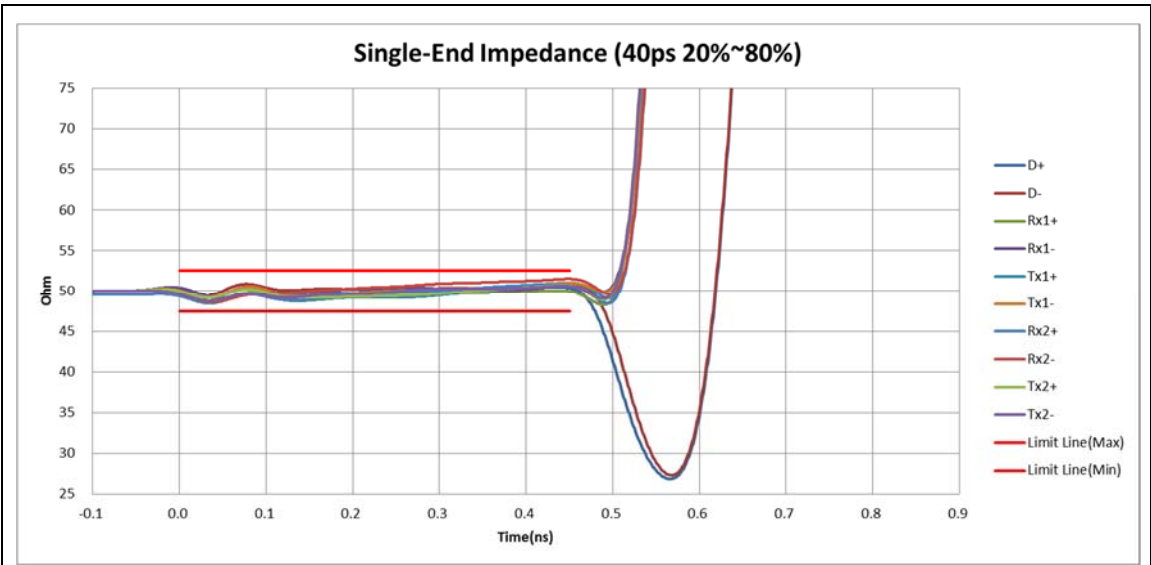


Figure 6-1. USB 3.1 Type-C Receptacle High Speed Test Fixture Impedance

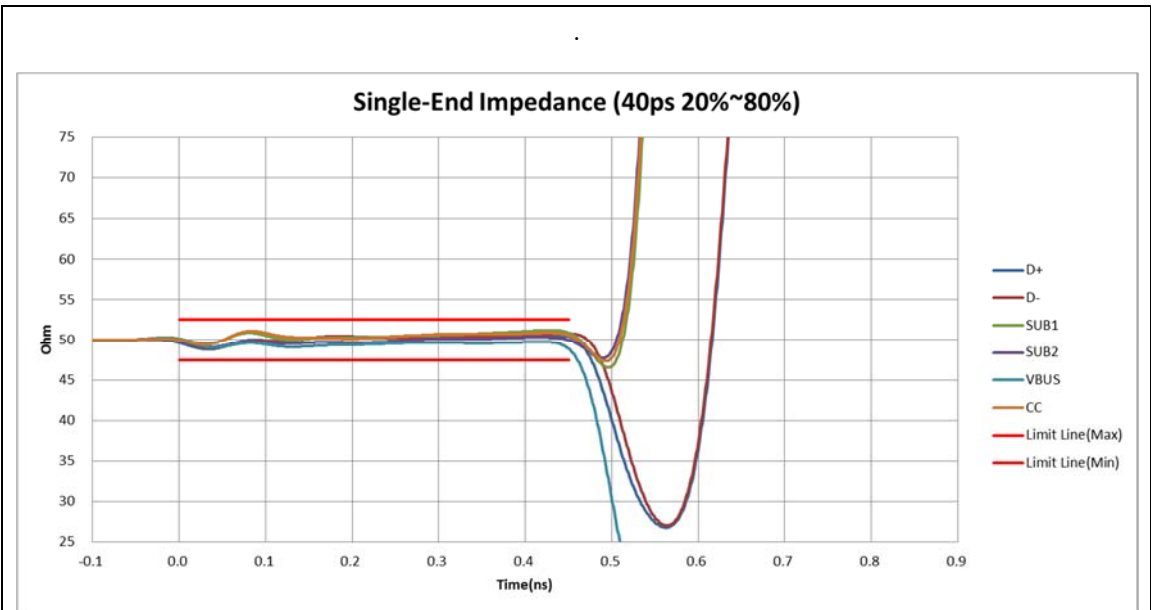


Figure 6-2. USB 3.1 Type-C Receptacle Low Speed Test Fixture Impedance

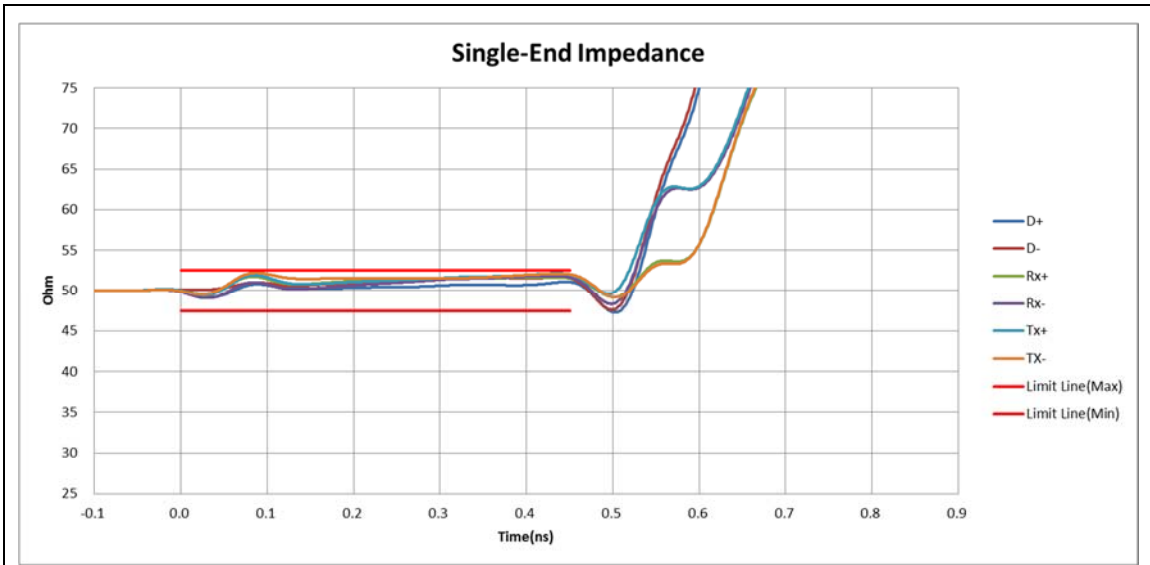


Figure 6-3. USB 3.1 Type-A Receptacle Test Fixture Impedance

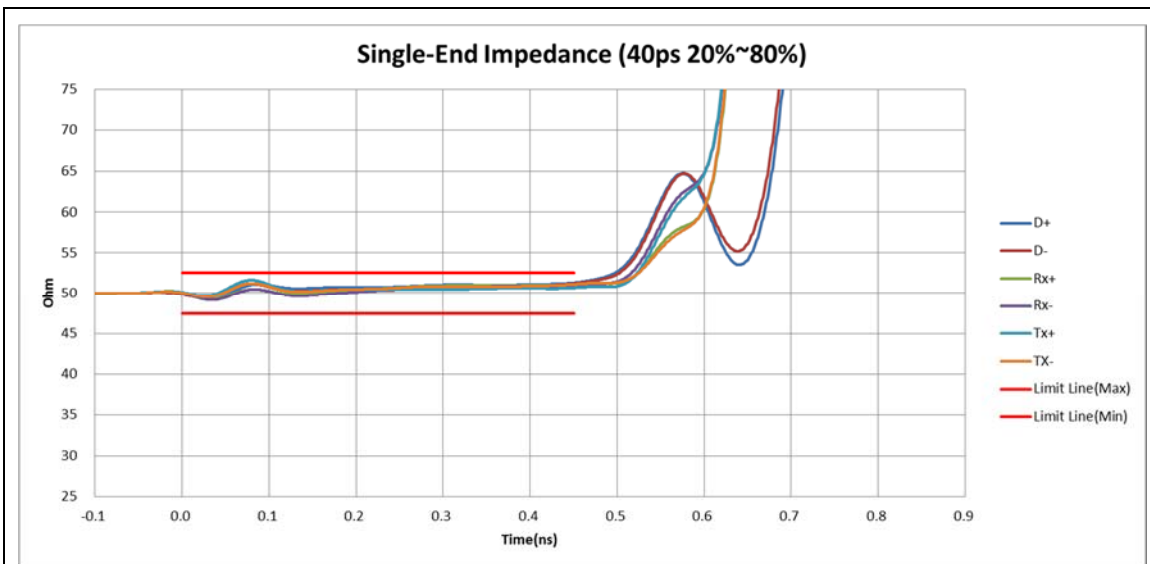


Figure 6-4. USB 3.1 Type-A Plug Test Fixture Impedance

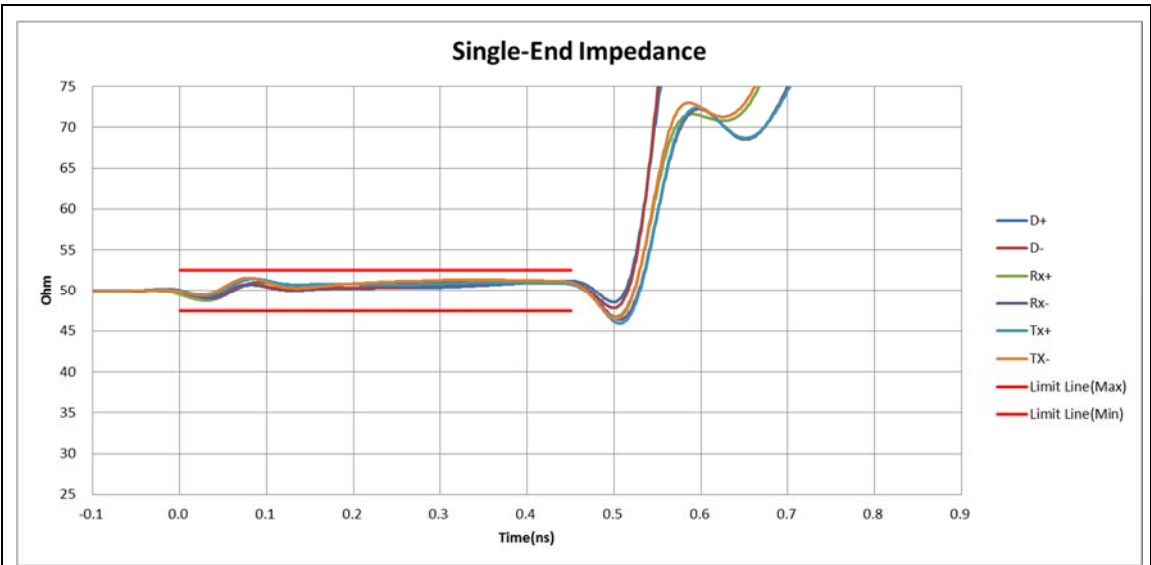


Figure 6-5. USB 3.1 Type-B Receptacle Test Fixture Impedance

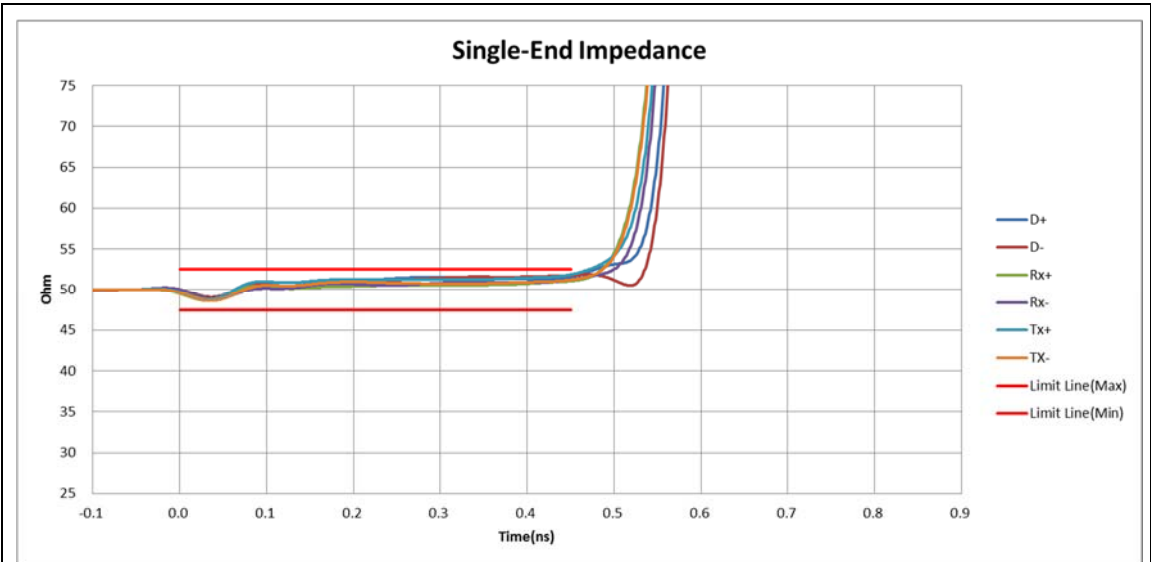


Figure 6-6. USB 3.1 Micro-B Receptacle Test Fixture Impedance

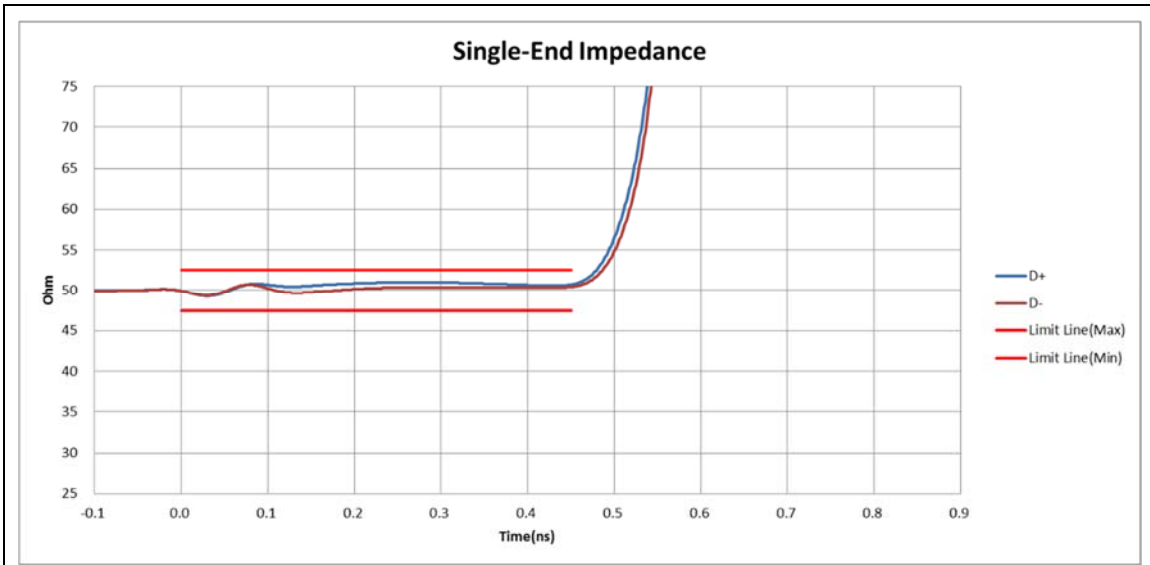


Figure 6-7. USB 2.0 Mini-B Receptacle Test Fixture Impedance

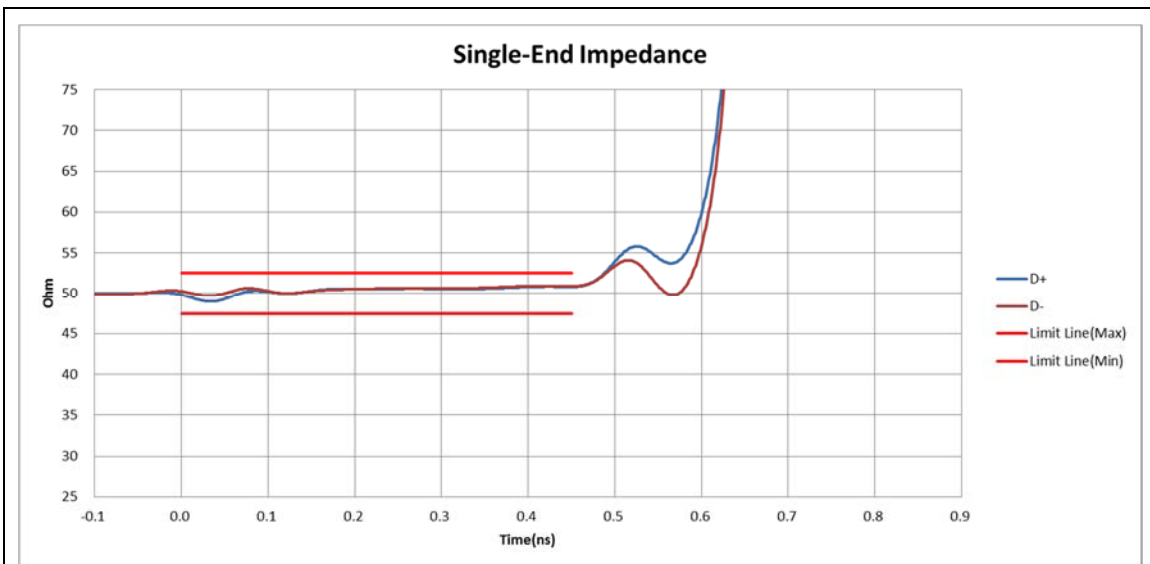
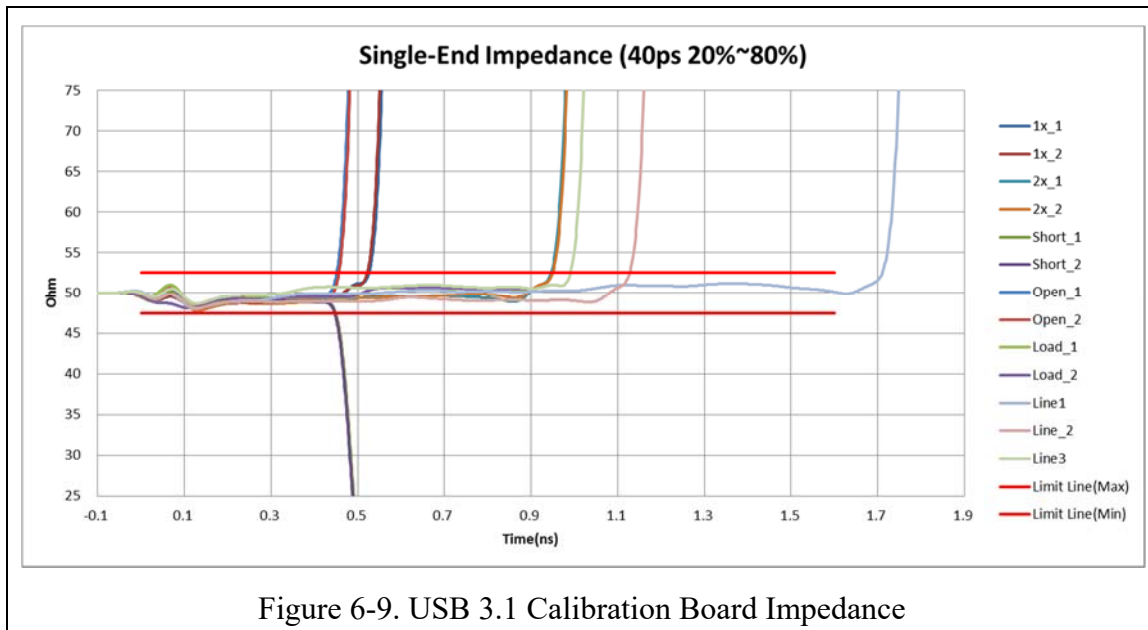


Figure 6-8. USB 2.0 Micro-B Plug Test Fixture Impedance



7. 耐久性試験

7-1. Differential Impedance

Cycles	Minimum	Unit
1	84.60	Ω
500	84.65	
1000	85.02	
1500	85.24	
2000	86.87	
2500	85.97	

7-2. Insertion Loss

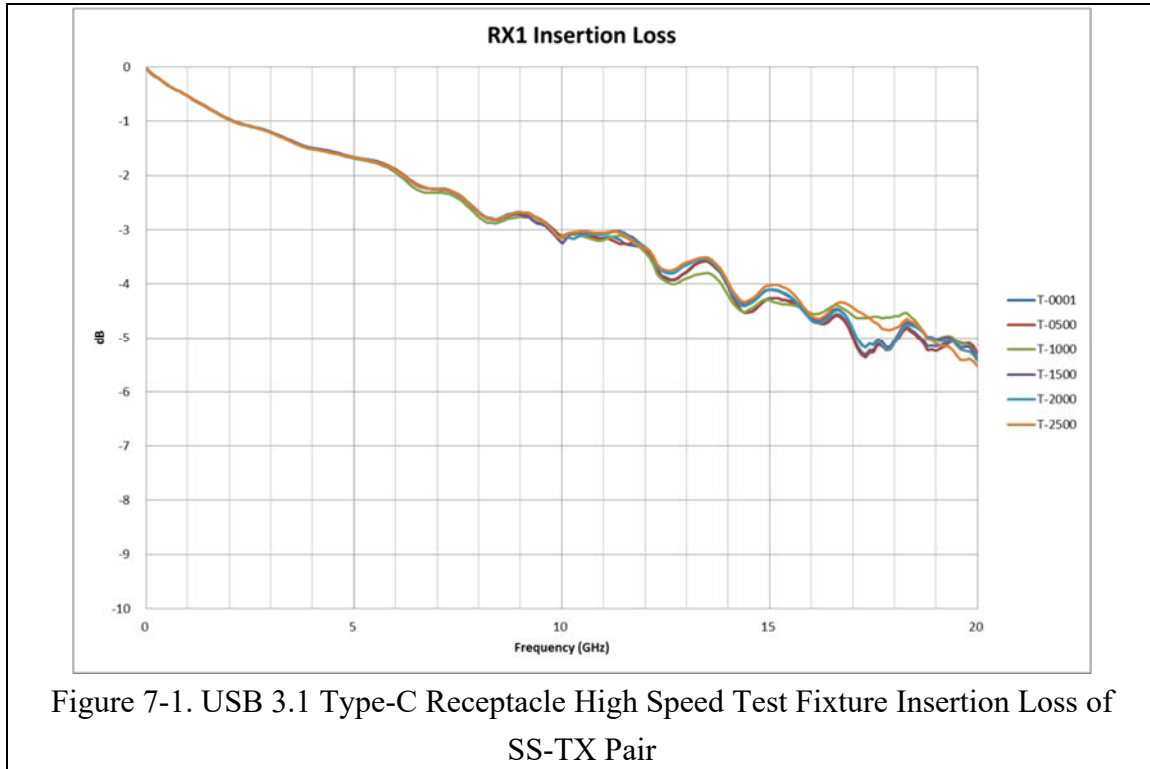


Figure 7-1. USB 3.1 Type-C Receptacle High Speed Test Fixture Insertion Loss of SS-TX Pair

7-3. Return Loss

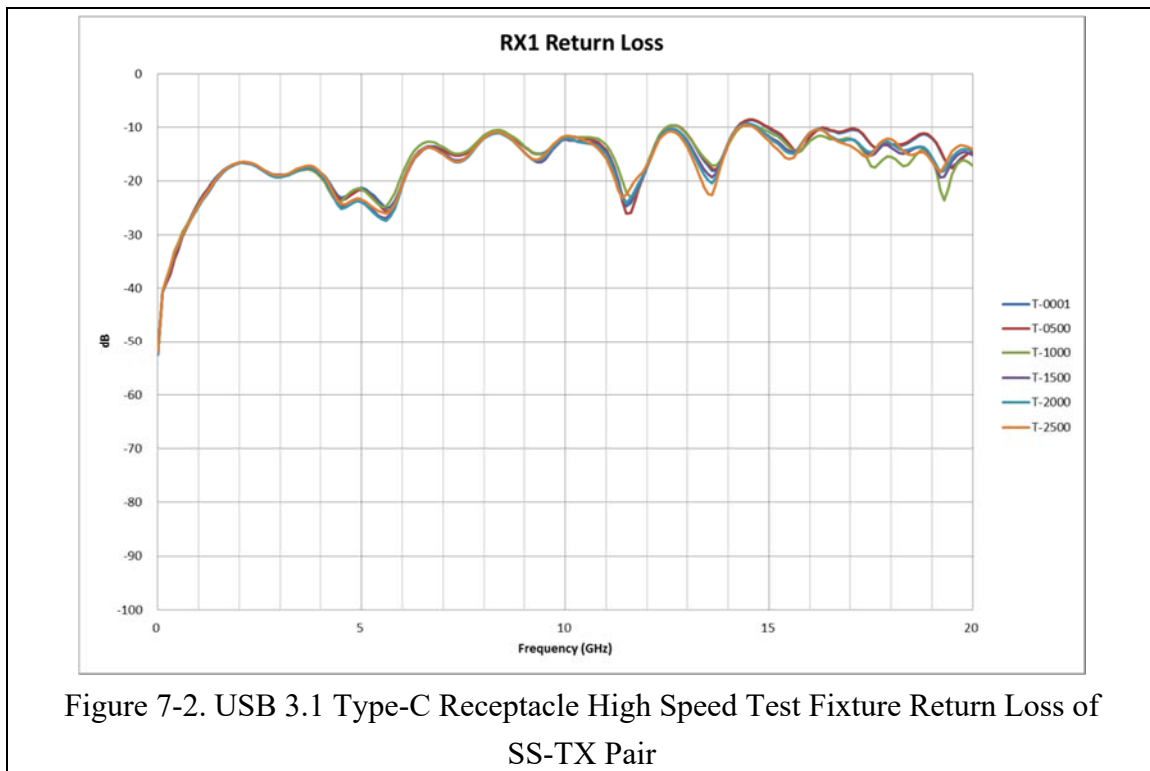


Figure 7-2. USB 3.1 Type-C Receptacle High Speed Test Fixture Return Loss of SS-TX Pair

8. 參考資料

8-1. Keysight

Method of Implementation (MOI) for USB Type-C to Type-C
Cable-Connector Assembly Compliance Test

https://www.keysight.com/upload/cmc_upload/All/E5071C-TDR_USB_Type-C_Type-C_CableTest_MOI_rev01.00.pdf

8-2. Tektronix

USB 3.1 Cable Tests MOI

<https://tw.tek.com/document/method-implementation/usb-31-cable-tests-moi>