USB 3.1 Cable Compliance Test Method of Implementation (MOI) Using Tektronix DSA8300 Series Sampling Oscilloscope

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Index

Revision History

Version	Date	Summary of Change(s)	Contributors
.5	12/17/2014	Initial Document	Steve Bright Tomorrow's Solutions Connected Randy White, Tektronix Mike Tranchemontagne, Tektronix

1. Overview

The cable test for USB 3.1 standards are far different then the testing requirements for any earlier USB cables. This testing requires the use of s-parameters of the cable to calculate integrated values. This test procedure is designed to assist the end user in capturing the required s-parameters and use them in the USB compliance tool to generate the integrated valves and validate that the cable is acceptable for use with the USB 3.1 standard.

The following list summarizes the cable tests required for USB 3.1 compliant cables and adapters.

1. Differential Insertion Loss Fit
2. Integrated Differential Multi-reflections
3. Integrated Differential Crosstalk on SuperSpeed
4. Integrated Return Loss
5. Differential to Common Mode Conversion
6. CC to USB D+/D- Differential Coupling
7. Vbus to SBU_A/SBU_B Single ended
8. SBU_A/SBU_B to D+/D- Differential Coupling

This MOI contains the procedure for testing electrical requirements for Enhanced SuperSpeed USB Cables and adapters as descripted in Universal Serial Bus (USB) 3.1 specifications Revision 1.0 dated July 26, 2013.

2. Test Equipment Requirements

In this MOI, the test are grouped by cable type. Within each cable type there is a sub-section for normative and informative measurements. Each cable type can be performed without any previous cable setups.

2.1. Required Equipment

The following equipment is required for USB 3.1 cable tests

1. 1 ea. Tektronix DSA8300
   - Tektronix Option 80SSPAR, 80SICON, or 80SICMX (IConnect® S-parameters Software)

2. 2 ea. 80E08B, 80E10B, OR 80E04[1] sampling module
3. 1 ea. set of approved text fixture adapters
4. 4 ea. SMA male to male barrel adapters
5. 16 ea. SMA male 50 Ohm terminators
6. USB Analysis software tool (available from USB-IF)
7. 1 ea. SMA cable
8. 1 ea. 5/16 torque wrench
9. 1 ea. 5/16 wrench (optional, highly recommended)
10. 1 each ¼ wrench (optional, useful when torqueing the SMA Male to Male adapter)
11. External Monitor (optional, highly recommended)

2.2. Oscilloscope

This document is developed using the Tektronix sampling oscilloscope, Model# DSA8300 with 80E10B modules. Any Tektronix Sampling oscilloscope capable of supporting the TDR Modules offered by Tektronix and able to support the use of the IConnect S-parameter Wizard will work. This includes the 80E04 TDR modules with some limitations.

2.1. USB 3.1 Test Fixture

For cable testing, a LUXSHARE-ICT set of adapters and four male to male SMA barrel adapters are used.

Figure 1: LUXSHAREICT USB3.1 Test Fixture

[1] The 80E04 has not been tested with this process because of it limited frequency response and reduce accuracy. For this reason the 80E04 is not recommended. However, all tools and process in this document will work with the 80E04. If the 80E04 is used, 18 GHz matched cable will be required.

3. Getting Started

3.1. Equipment Calibration and Fixture setup

Before starting the DSA8300 and associate module needs to have a 20 minute warm-up period for best results. After the warm-up verify that the mainframe and modules do not require compensation. This can be verify by viewing the temp gauge at the lower right side of the gratitude display. If the gauge is yellow or red compensation is required.

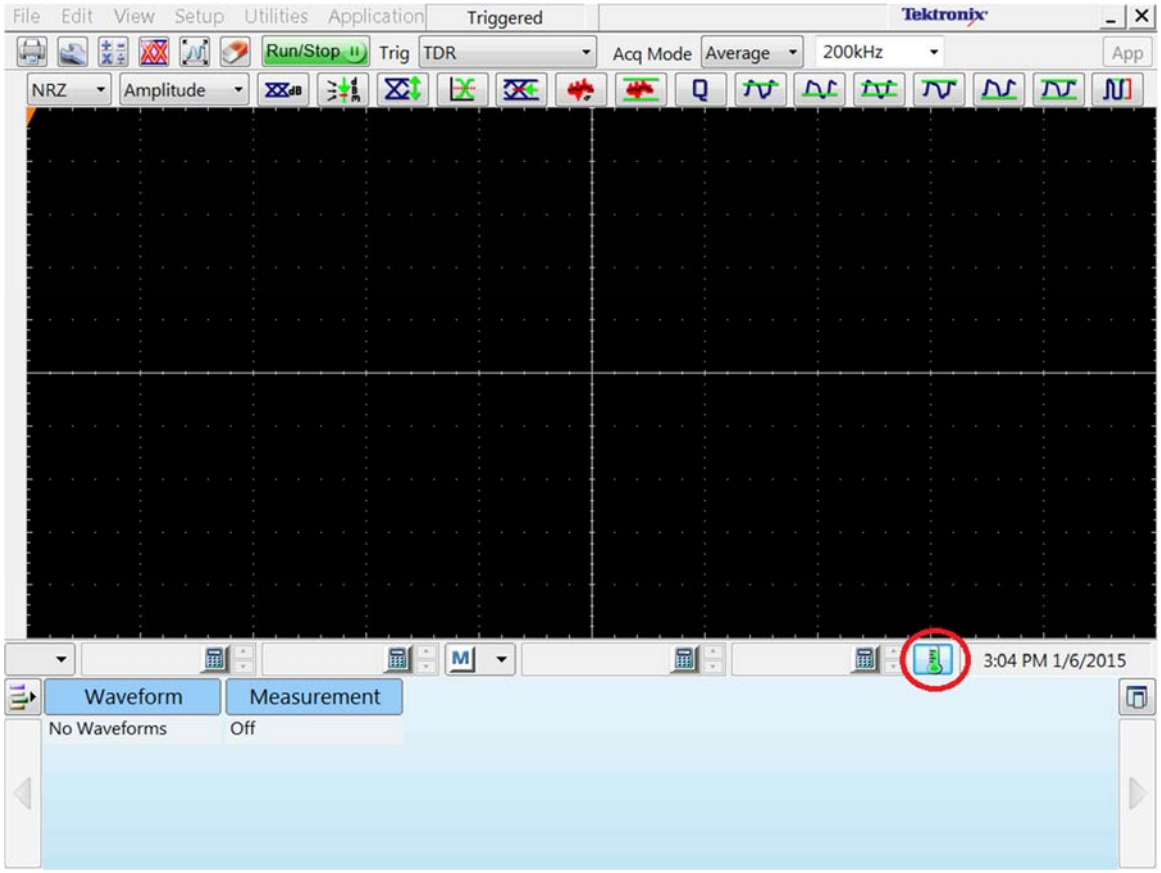

Figure 2 Screen shot of the calibration indicator

To run compensation click on the temp gauge. A menu will appear that will show what the temp drift from the last compensation. The mainframe is compensated separately from the modules. Select either Mainframe or all modules (One module can be compensated but it is recommended to compensate all modules) then click on Execute and follow the prompts on the display. When finished with compensation click on close.

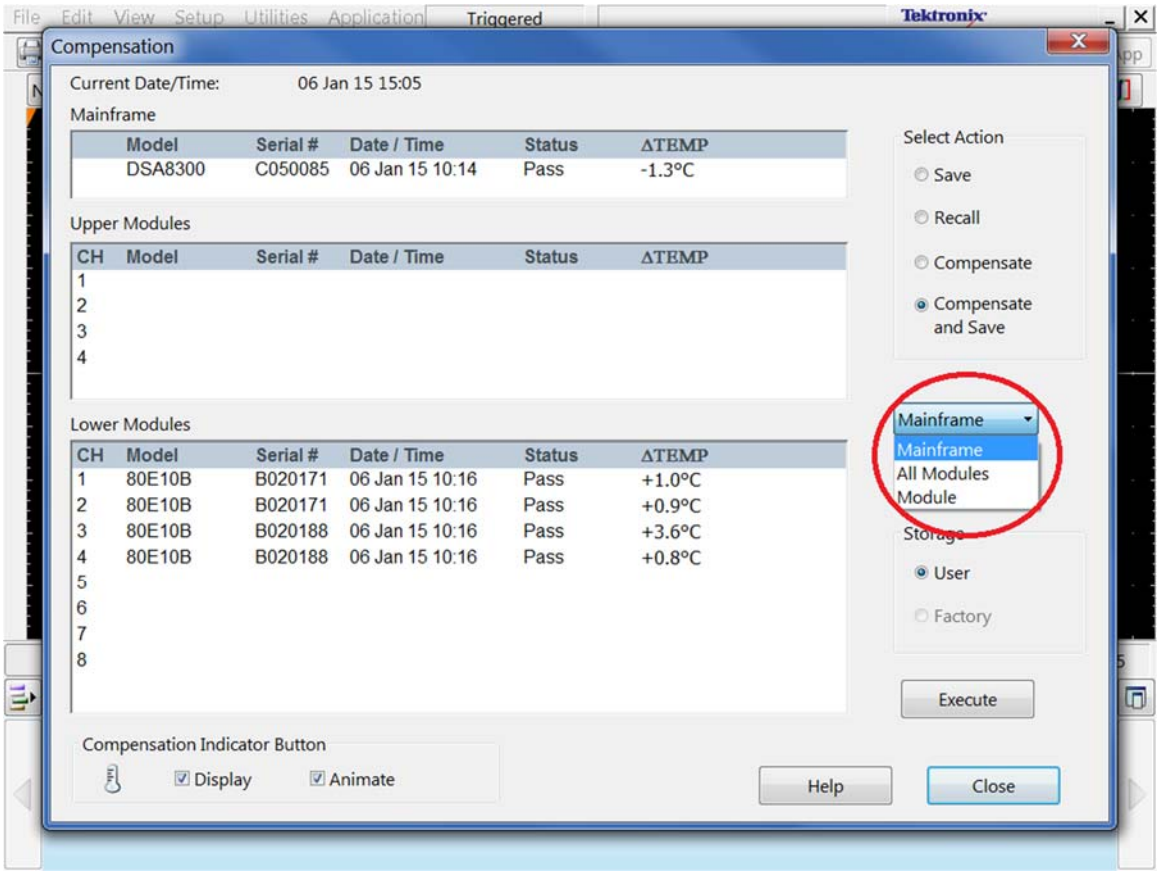

Figure 3 Screen that allows compensation to be run

Note when using the DSA8300 and modules it is very important to always use a grounding strap. When the instrument is not in use make sure that the termination caps are placed on the module inputs.

Next is to identify which side of the cable will be Host and which will be the Device. For Type-C to Type-C cables the user will need to identify and mark each side. In this procedure for Standard A to Type-C legacy cables the Type-C will be referred to as the Device side and the Standard A legacy side will be referred to the Host side. Additionally for Type-C to Type-C cables the end user needs to determine the orientation of the cable as it plugs into the fixture. For this procedure it is assumed that TX1+/- will connect to RX1+/- and the same holds true for TX2 and RX2.

To determine the orientation of the cables with the test fixtures, it is best to associate the USB logo on the top of the cable connector with the fixture that has top side printed on it. Refer to figure 4.

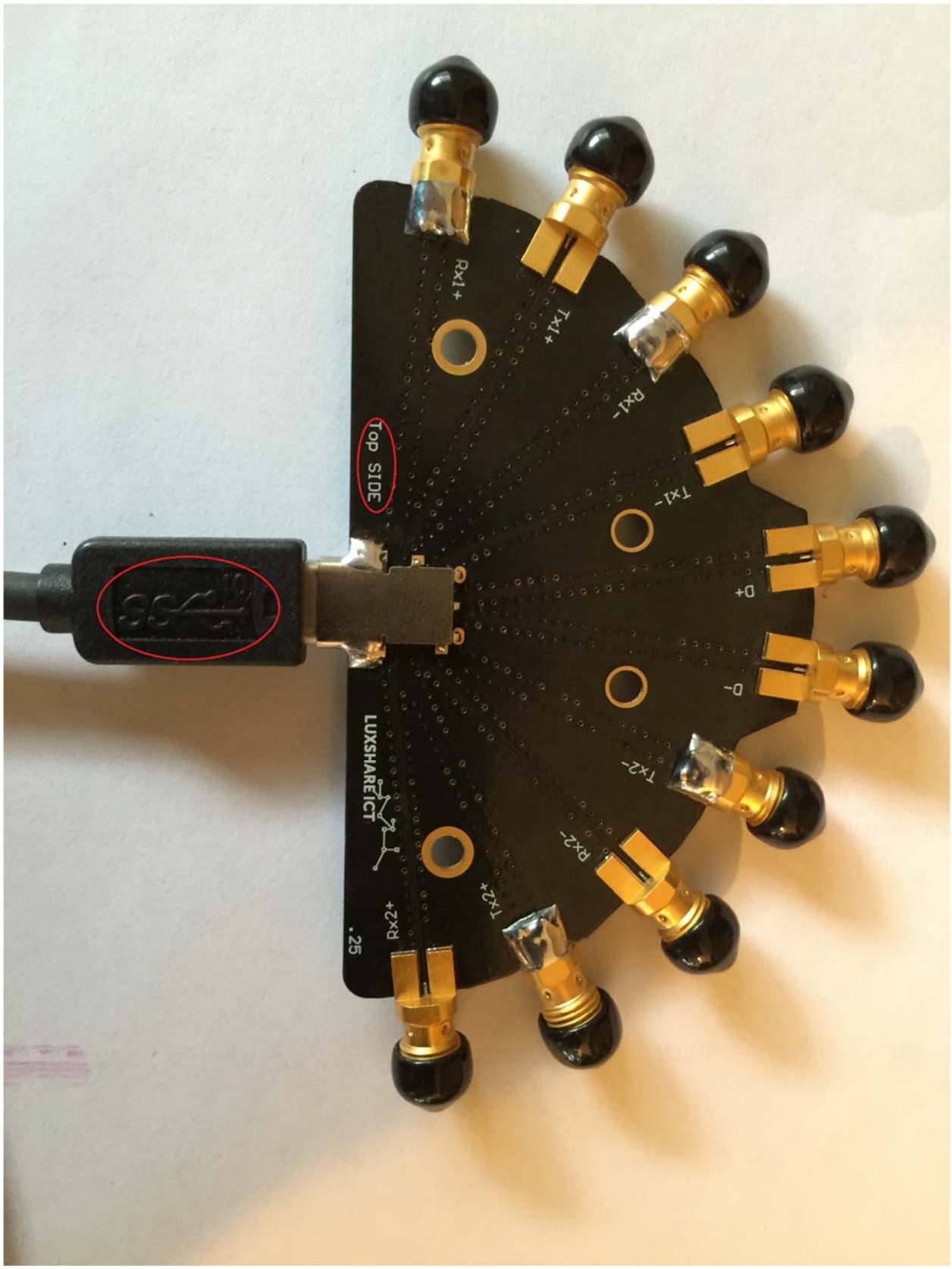

Figure 4: USB Type-C cable associated with USB Fixture

4. USB Type-C to Type-C Cable Assembly

4.1. Normative Measurements

Main Setup:

4.1.1. From the DSA8300 pull down application menu select IConnect S-parameter Wizard. A popup window about resuming measurements will show up click OK.

4.1.2. From the top menu in the Wizard select 4 port Single Ended refer to figure 5

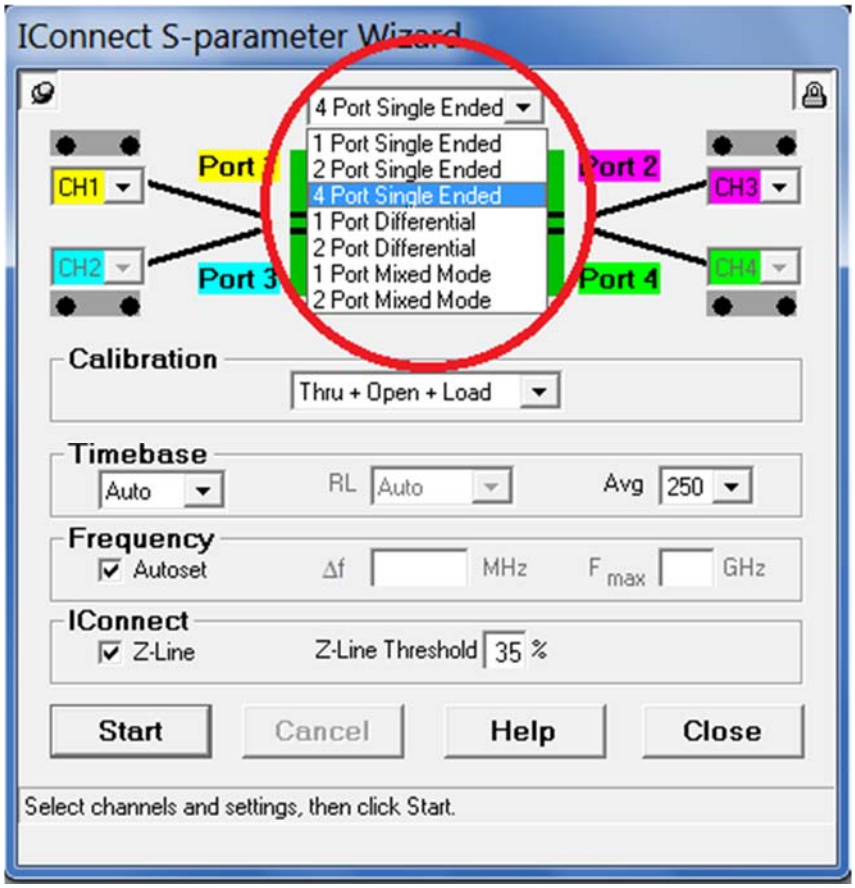

Figure 5: Setting the Wizard for s4p file

4.1.3. In the Wizard Calibration menu select Thru +Open +Load from the pull down. Refer to figure 6.

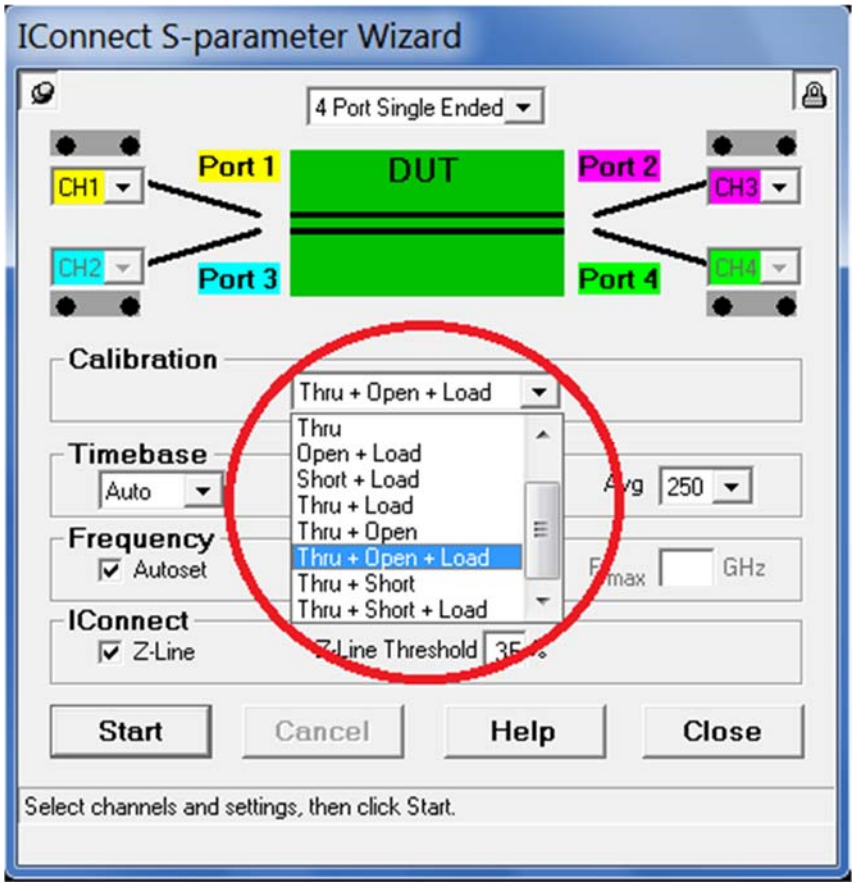

Figure 6: Selecting Calibration Method

4.1.4. In the Frequency menu uncheck the Auto and set the Delta Frequency to 10MHz and the max Frequency to 15 GHz. Refer to Figure 7.

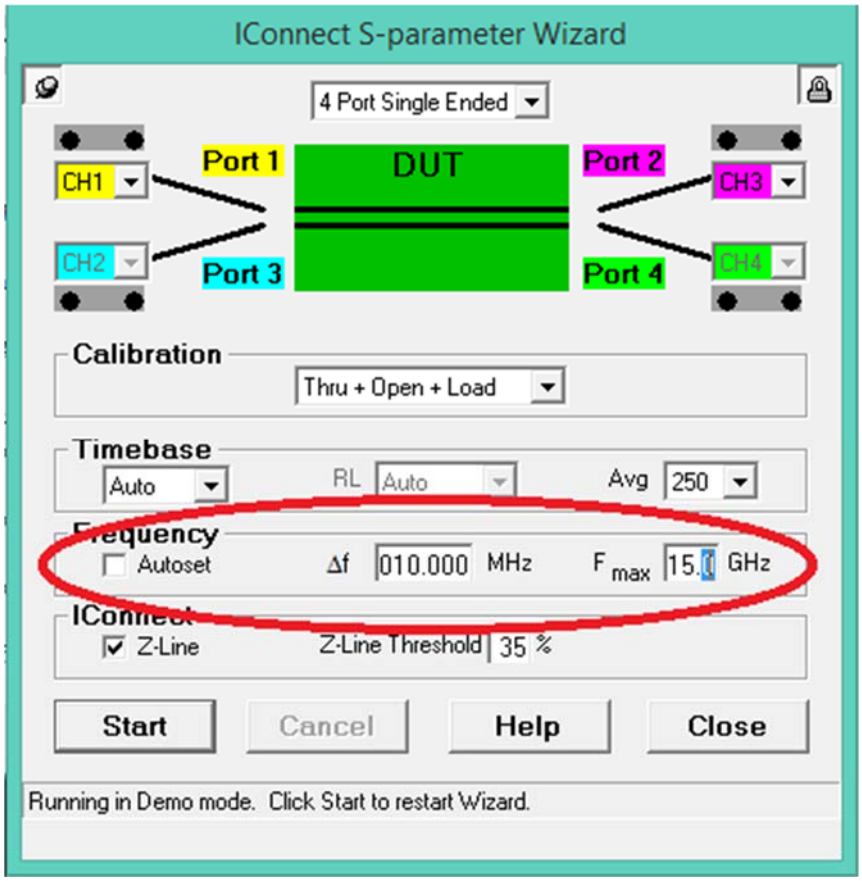

Figure 7: Setting the Delta Frequency and Max Frequency Range

4.1.5. Verify Port setting are as follows: Ch1 = Port 1, Ch2 = Port 3, Ch3 = Port 2, and Ch4 =Port 4 (This is important for the compliance tool set to work correctly).

4.1.6. Click on the Start Button. Next create or select a folder for the measurement data to go to.

Insertion Loss and Return Loss data acquisition:

4.1.7. Input the following file name **ID#_Host_TX1_Thru**. Replace the #with a unique identifier. Then click OK. Refer to Figure 8.

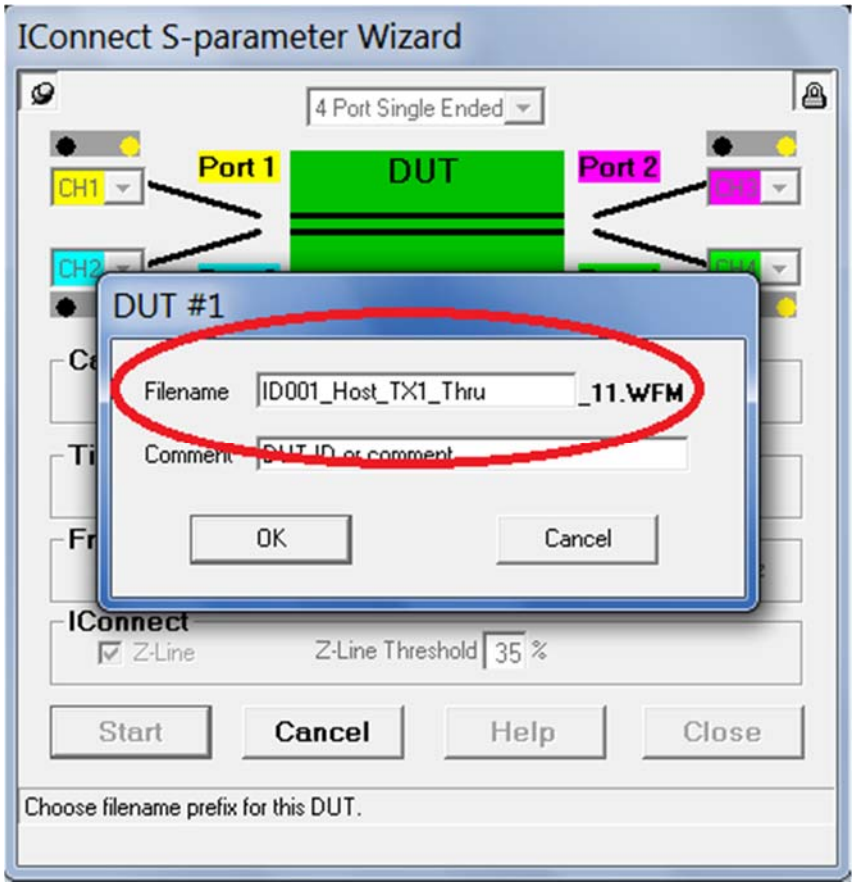

Figure 8: File naming step

4.1.8. If a pop window appears asking to use previous measured Deskews, select No if there has been any change in the setup since the last time testing was performed. Then follow promotes to remove terminators and cables and connect to the TDR clock output.

4.1.9. Make the following connections using the male to male barrel adapters to the USB Fixtures: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Device RX1+, and Ch4 Device to RX1-. Install 50 ohm terminators on all unused connectors. Do not

connect any cables between fixtures. Click OK. Refer to Figure 9 for fixture markings.

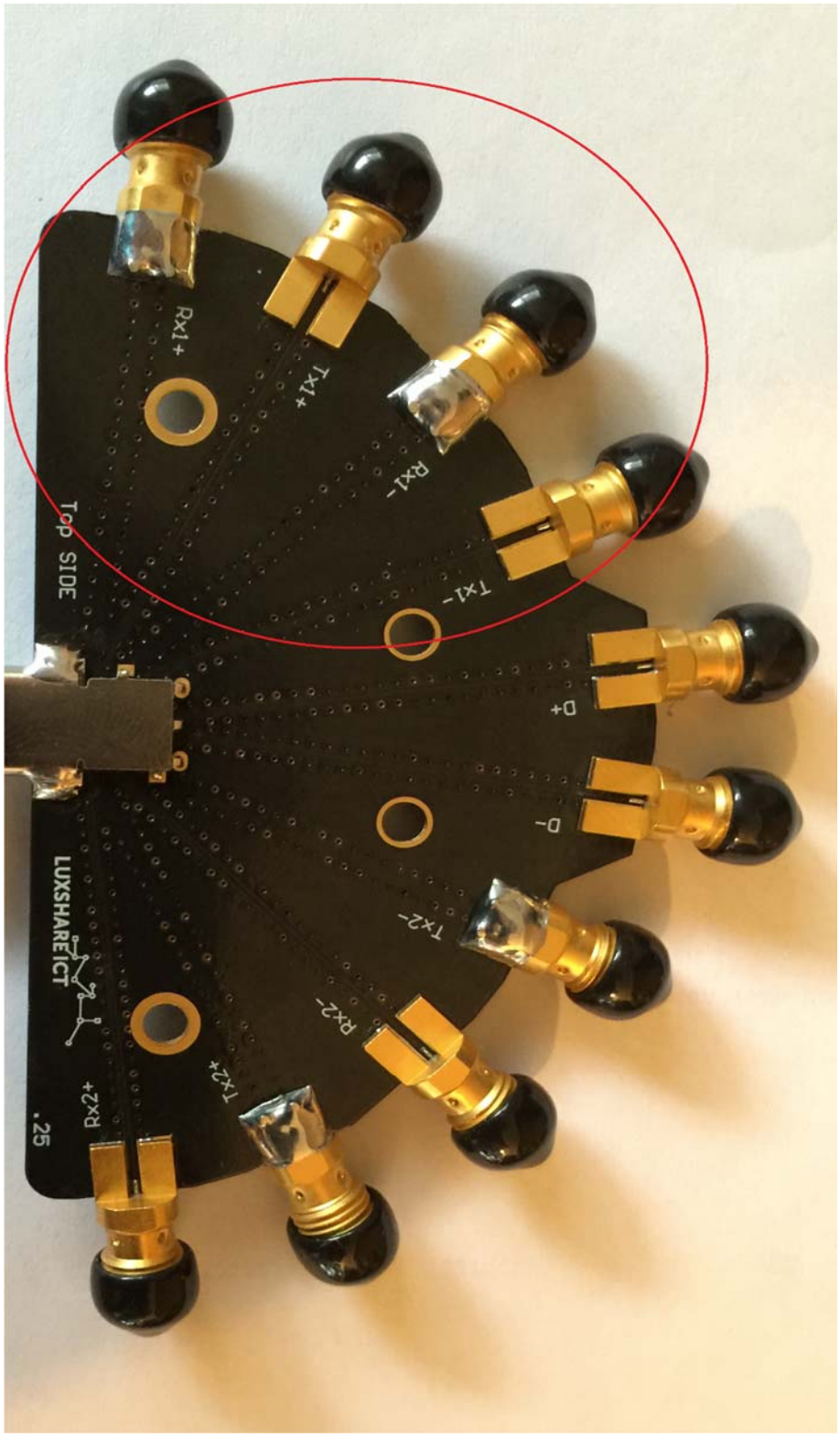

Figure 9: Identifying fixture inputs

4.1.10. Connect the first cable to be tested. Note if more than one cable is being tested start with the longest cable. This will set the time base correctly for test all other cables. Click OK

4.1.11. Disconnect the test fixture from the barrel adapter. Then connect Ch1 to the open reference on the USB calibration test fixture. Then Click OK. Repeat the step for remaining channels.

4.1.12. Connect Ch 1 to one side of the 2X thru on the Calibration test fixture and Ch3 to the other side of the same 2X thru. Click OK. When prompted by the application repeat for the following connections: Ch2 to Ch4, Ch1 to Ch4, Ch3 to Ch2, Ch1 to Ch2, Ch3 to Ch4,.

4.1.13. Connect Ch1 to Load_1 on the calibration test fixture, then click OK. Repeat for the remaining channels when promoted by the application.

4.1.14. Input the following file name **ID#_Host_RX1_Thru**. Replace the # with a unique identifier. Then click OK.

4.1.15. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Device TX1+, and Ch4 to Device TX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.16. Input the following file name **ID#_Host_D+_D-_Thru**. Replace the # with a unique identifier. Then click OK.

4.1.17. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Near End Cross Talk Data acquisitions:

4.1.18. Input the following file name **ID#_Host_TX1RX1_NEXT**. Replace the # with a unique identifier. Then click OK.

4.1.19. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Host RX1+, and Ch4 to Host RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.20. Input the following file name **ID#_Device_TX1RX1_NEXT**. Replace the # with a unique identifier. Then click OK.

4.1.21. Make the following connections using the male to male barrel adapters: Ch1 to Device TX1+, Ch2 to Device TX1-, Ch3 to Device RX1+, and Ch4 to Device RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.22. Input the following file name **ID#_Host_TX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.

4.1.23. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Host D+, and Ch4 to Host D-. Install 50 ohm

terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.24. Input the following file name **ID#_Host_RX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.

4.1.25. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Host D+, and Ch4 to Host D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.26. Input the following file name **ID#_ Device_TX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.

4.1.27. Make the following connections using the male to male barrel adapters: Ch1 to Device TX1+, Ch2 to Device TX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.28. Input the following file name **ID#_ Device_RX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.

4.1.29. Make the following connections using the male to male barrel adapters: Ch1 to Device RX1+, Ch2 to Device RX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Far End Cross Talk data Acquisitions:

4.1.30. Input the following file name **ID#_ HostRX1_DeviceRX1_FEXT**. Replace the # with a unique identifier. Then click OK.

4.1.31. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Device RX1+, and Ch4 to Device RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.32. Input the following file name **ID#_ HostTX1_DeviceTX1_FEXT**. Replace the # with a unique identifier. Then click OK.

4.1.33. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Device TX1+, and Ch4 to Device TX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.34. Input the following file name **ID#_ HostD+D-_DeviceTX1_FEXT**. Replace the # with a unique identifier. Then click OK.

4.1.35. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device TX1+, and Ch4 to Device TX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.36. Input the following file name **ID#_ HostD+D-_DeviceRX1_FEXT**. Replace the # with a unique identifier. Then click OK.

4.1.37. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device RX1, and Ch4 to Device RX1. Install 50

ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.38. Input the following file name **ID#_ HostTX1_DeviceD+D-_FEXT**. Replace the # with a unique identifier. Then click OK.

4.1.39. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

4.1.40. Input the following file name **ID#_ HostRX1_DeviceD+D-_FEXT**. Replace the # with a unique identifier. Then click OK.

4.1.41. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Analyzing the Capture Data with USB Compliance Software Tool

4.1.42. Start the USB Compliance Tool IntePar by Double clicking on C:\IntePar\IntePar_v0p7\IntePar_v0p7_x86.exe (or equivalent application)

4.1.43. Select 4 port VNA

4.1.44. Select Cable Type Type-C to Type-C, Gen 2. Refer to Figure 10.

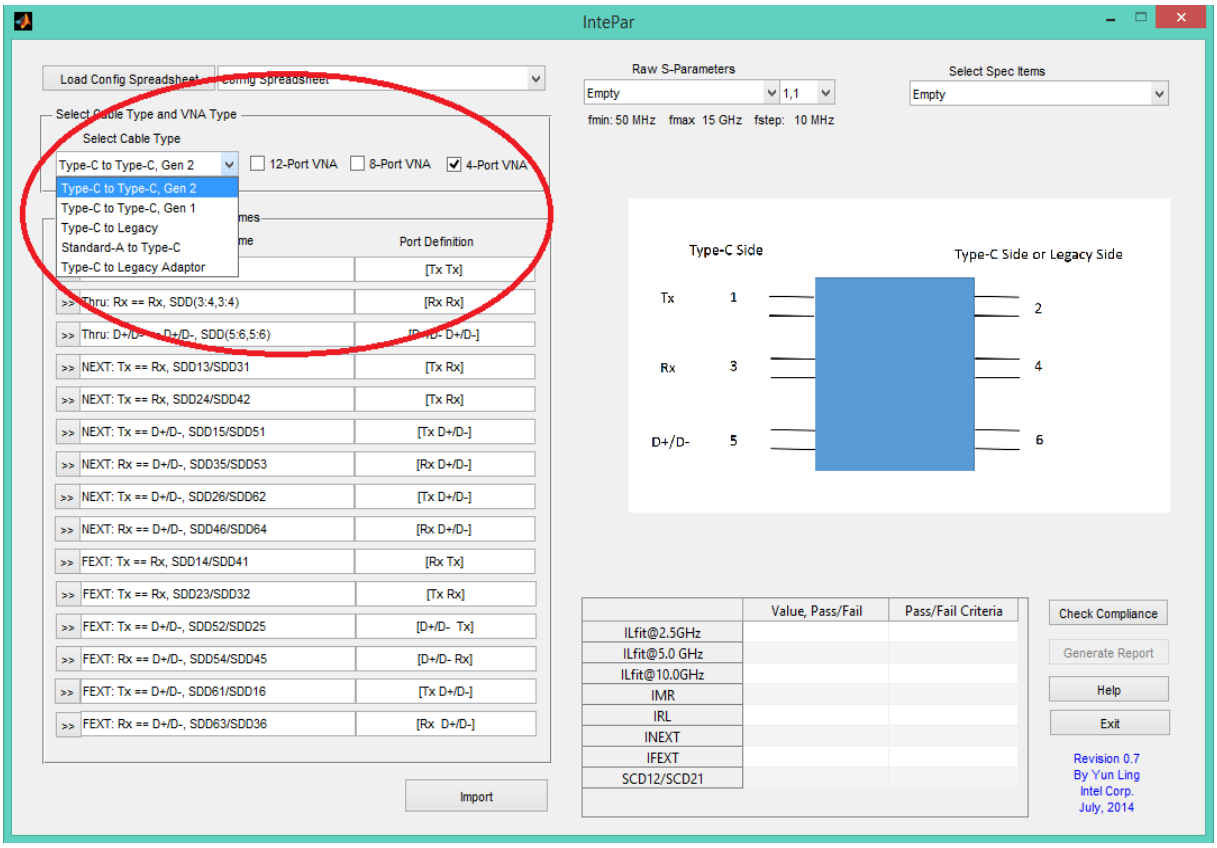

Figure 10: Selecting USB cable Type with s4p files

4.1.45. In the Load/Show S-parameter Files Names select the file to be loaded by clicking beside file name. As shown in figure 11.

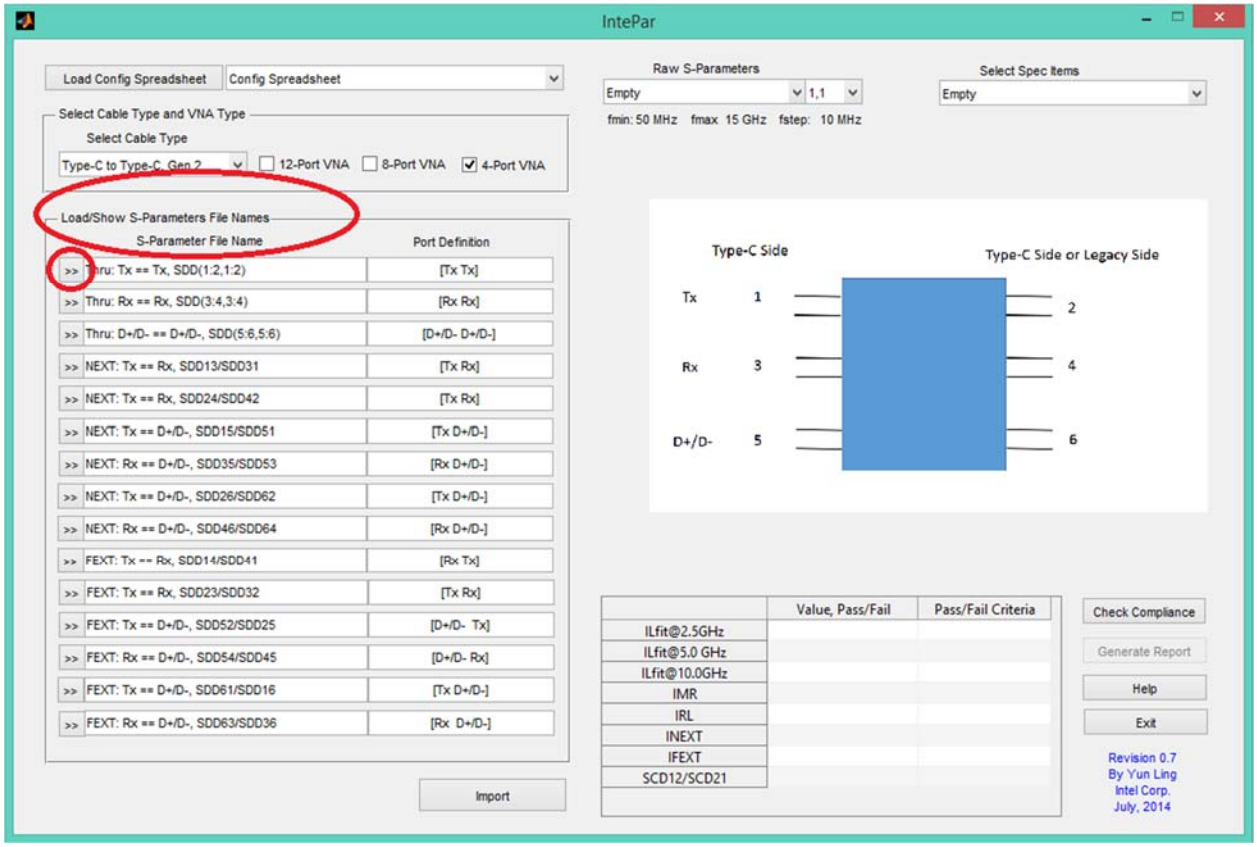

Figure 11: Loading associated s4p files

Load all files as associated in table below:

Thru: Tx==Tx, SDD(1:2, 1:2)	**ID#_Host_TX1_Thru**
Thru: Rx==Rx, SDD(3:4, 3:4)	**ID#_Host_RX1_Thru**
Thru: D+/D-==D+/D-, SDD(5:6, 5:6)	**ID#_Host_D+_D-_Thru**
NEXT: Tx == Rx, SDD13/SDD31	**ID#_Host_TX1RX1_NEXT**
NEXT: Tx == Rx, SDD24/SDD42	**ID#_Device_TX1RX1_NEXT**
NEXT: Tx == D+/D-, SDD15/SDD51	**ID#_Host_TX1D+D-_NEXT**
NEXT: Rx == D+/D-, SDD35/SDD53	**ID#_Host_RX1D+D-_NEXT**

NEXT: Tx == D+/D-, SDD26/SDD62	**ID#_ Device_TX1D+D-_NEXT**
NEXT: Rx == D+/D-, SDD46/SDD64	**ID#_ Device_RX1D+D-_NEXT**
FEXT: Tx == Rx, SDD14/SDD41	**ID#_ HostRX1_DeviceRX1_FEXT**
FEXT: Tx == Rx, SDD23/SDD32	**ID#_ HostTX1_DeviceTX1_FEXT**
FEXT: Tx == D+/D-, SDD52/SDD25	**ID#_ HostD+D-_DeviceTX1_FEXT**
FEXT: Rx == D+/D-, SDD54/SDD45	**ID#_ HostD+D-_DeviceRX1_FEXT**
FEXT: Tx == D+/D-, SDD61/SDD16	**ID#_ HostTX1_DeviceD+D-_FEXT**
FEXT: Rx == D+/D-, SDD63/SDD36	**ID#_ HostRX1_DeviceD+D-_FEXT**

4.1.46. Click on the Import button

4.1.47. Click on the Check Compliance, verify that results are with in Specifications from the generated report. Refer to figure 12.

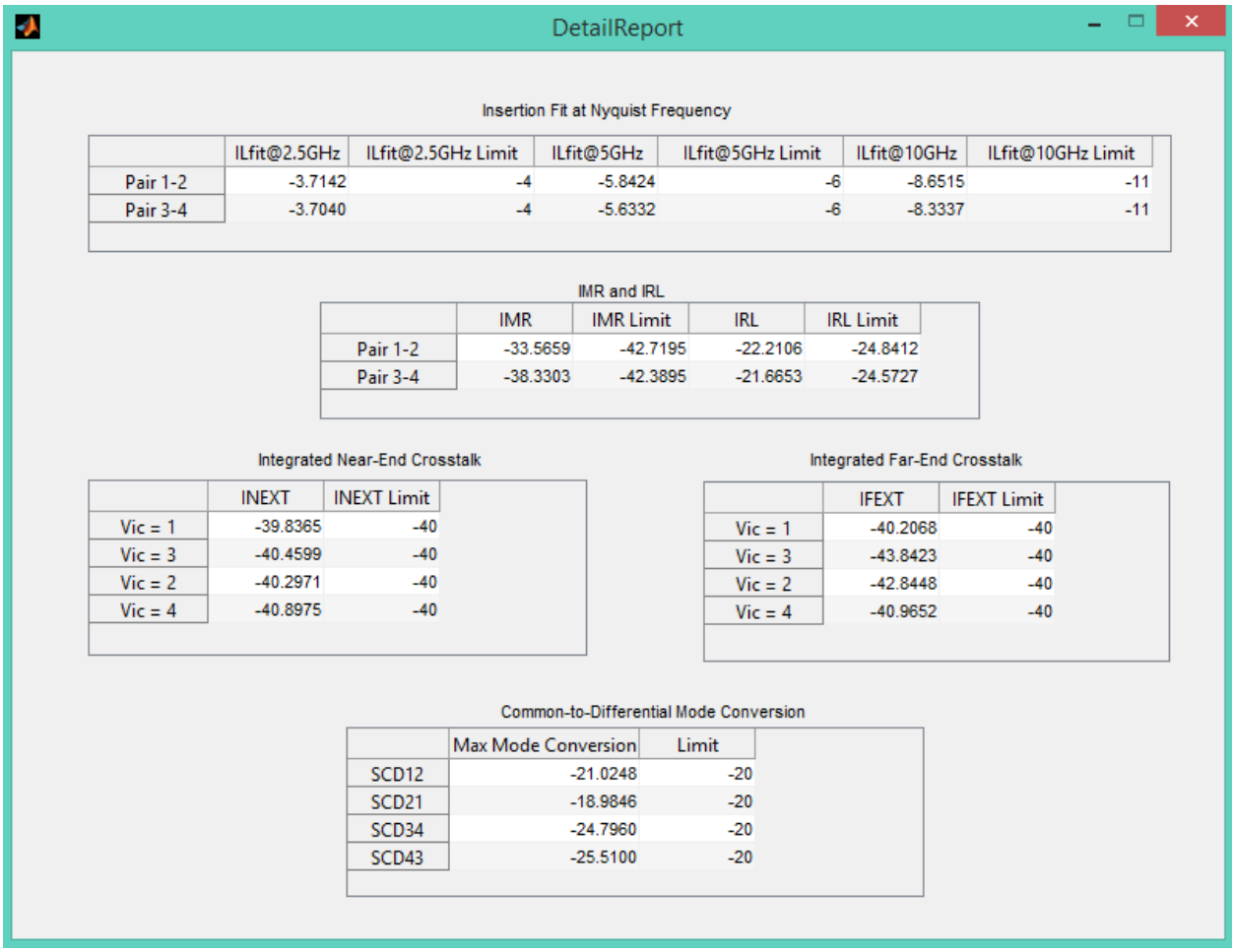

Figure 12: IntePar report

4.1.48. Repeat process for TX2 and RX2.

4.2. Informative Measurements

To be completed in a future revision

5. USB Standard A to Type-C Cable Assembly

5.1. Normative Measurements

Main Setup:

5.1.1. From the DSA8300 pull down application menu select IConnect S-parameter Wizard. A popup window about resuming measurements will show up click OK.

5.1.2. From the top menu in the Wizard select 4 port Single Ended refer to figure13.

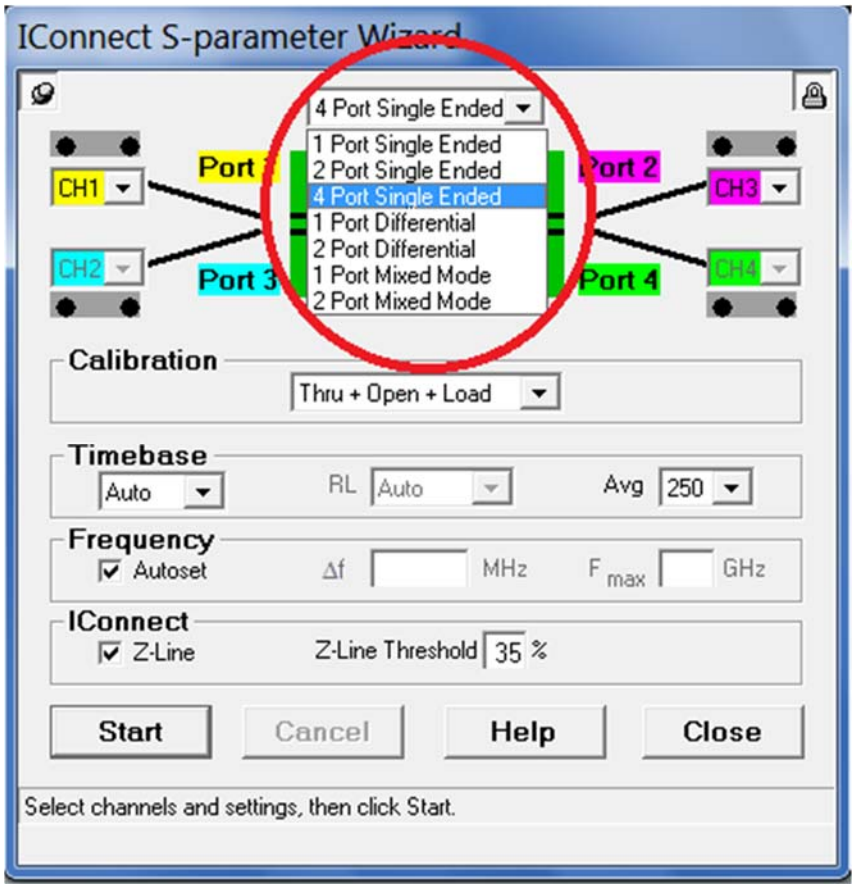

Figure 13: Setting the Wizard for s4p file

5.1.3. In the Wizard Calibration menu select Thru +Open +Load from the pull down. Refer to figure 14.

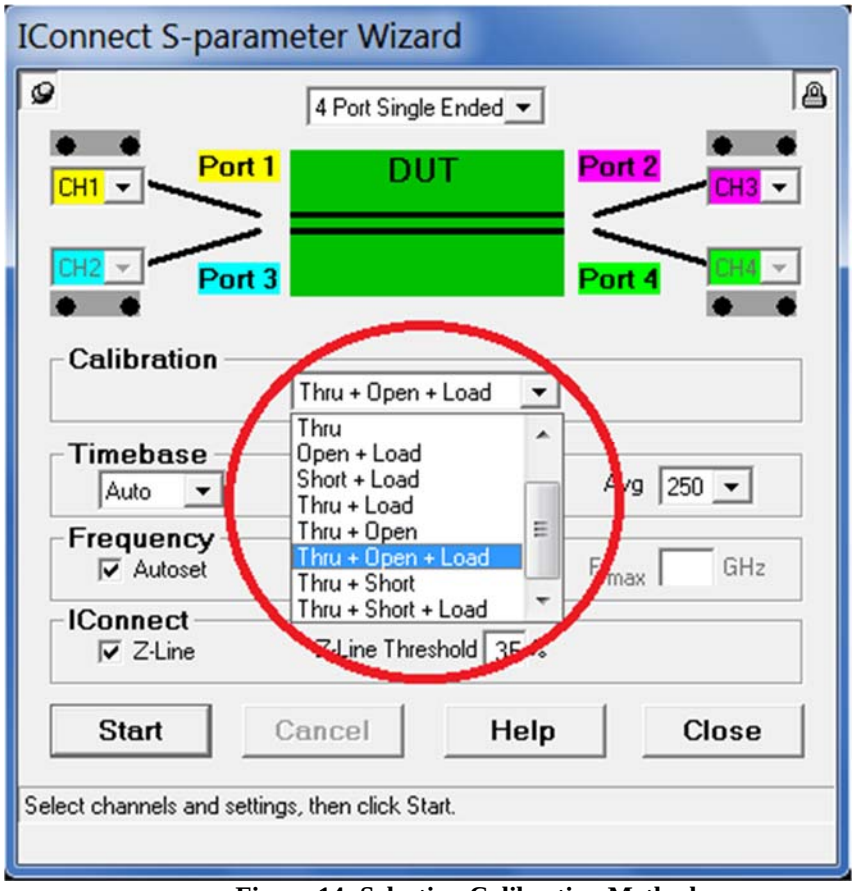

Figure 14: Selecting Calibration Method

5.1.4. In the Frequency menu uncheck the Auto and set the Delta Frequency to 10 MHz and the max Frequency to 15 GHz. Refer to figure 15

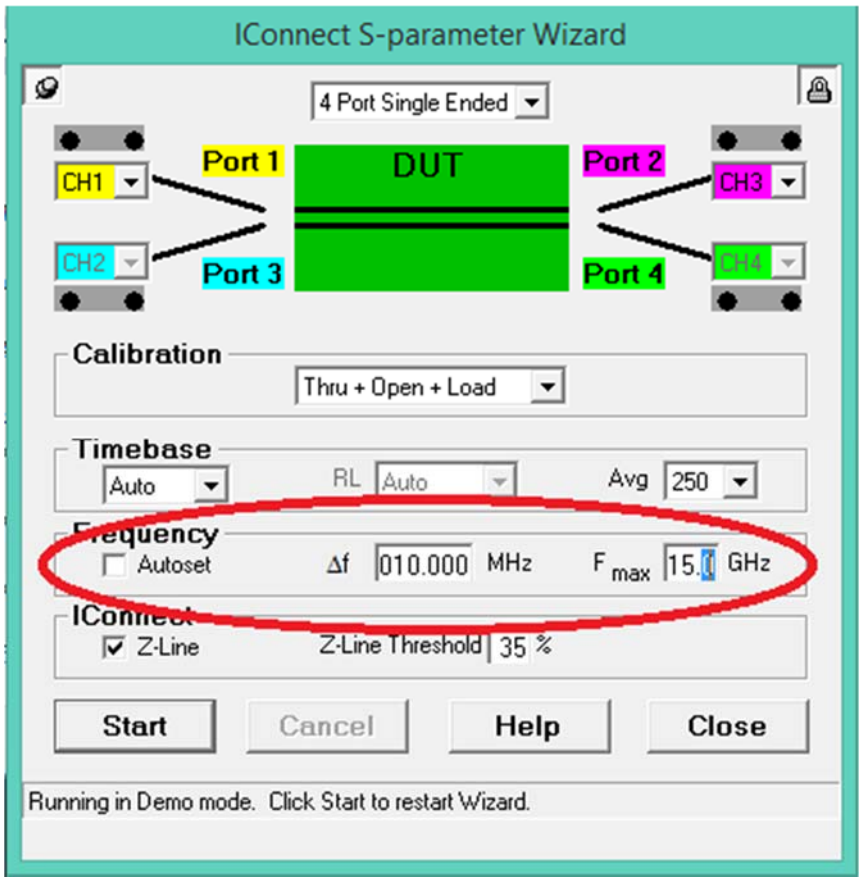

Figure 15: Setting the Delta Frequency and Max Frequency Range

5.1.5. Verify Port setting are as follows: Ch1 = Port 1, Ch2 = Port 3, Ch3 = Port 2, and Ch4 =Port 4 (This is important for the compliance tool set to work correctly).

5.1.6. Click on the Start Button. Next create or select a folder for where the measurement data will be stored.

Insertion Loss and Return Loss data acquisition:

5.1.7. Input the following file name **ID#_Host_TX_Thru**. Replace the # with a unique identifier. Then click OK. Refer to figure 16

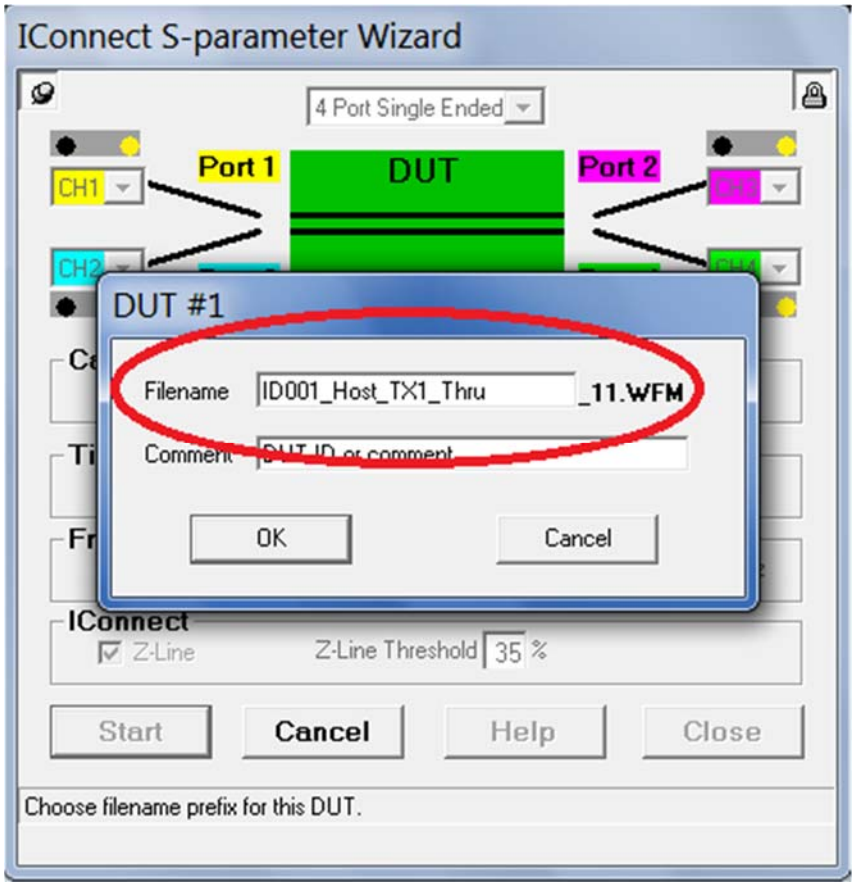

Figure 16: File naming step

5.1.8. If a pop window appears asking to use previous measured Deskews, select No if there has been any change in the setup since the last time testing was performed. Then follow promotes to remove terminators and cables and connect to the TDR clock output.

5.1.9. Make the following connections using the male to male barrel adapters to the Host Standard A fixture and the Device Type-C fixture: Ch1 to Host TX+, Ch2 to Host TX-, Ch3 to Device RX1+, and Ch4 Device to RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.10. Connect the First cable to be tested. Note if more than one cable is being tested start with the longest cable. This will set the time base correctly for test all other cables. Click Okay

5.1.11. Disconnect the test fixture from the barrel adapter. Then connect Ch1 to the open reference on the USB calibration test fixture. Then Click OK. Repeat the step for remaining channels.

5.1.12. Connect Ch 1 to one side of the 2X thru on the Calibration test fixture and Ch3 to the other side of the same 2X thru. Click OK. When prompted by the application repeat for the following connections: Ch2 to Ch4, Ch1 to Ch4, Ch3 to Ch2, Ch1 to Ch2, Ch3 to Ch4,.

5.1.13. Connect Ch1 to Load_1 on the calibration test fixture, then click OK. Repeat for the remaining channels when promoted by the application.

5.1.14. Input the following file name **ID#_Host_RX_Thru**. Replace the # with a unique identifier. Then click OK.

5.1.15. Make the following connections using the male to male barrel adapters: Ch1 to Host RX+, Ch2 to Host RX-, Ch3 to Device TX1+, and Ch4 to Device TX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.16. Input the following file name **ID#_Host_D+D-_Thru**. Replace the # with a unique identifier. Then click OK.

5.1.17. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Near End Cross Talk Data acquisitions:

5.1.18. Input the following file name **ID#_Host_TXRX_NEXT**. Replace the # with a unique identifier. Then click OK.

5.1.19. Make the following connections using the male to male barrel adapters: Ch1 to Host TX+, Ch2 to Host TX-, Ch3 to Host RX+, and Ch4 to Host RX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.20. Input the following file name **ID#_Device_TX1RX1_NEXT**. Replace the # with a unique identifier. Then click OK.

5.1.21. Make the following connections using the male to male barrel adapters: Ch1 to Device TX1+, Ch2 to Device TX1-, Ch3 to Device RX1+, and Ch4 to Device RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.22. Input the following file name **ID#_Host_TXD+D-_NEXT**. Replace the # with a unique identifier. Then click OK.

5.1.23. Make the following connections using the male to male barrel adapters: Ch1 to Host TX+, Ch2 to Host TX-, Ch3 to Host D+, and Ch4 to Host D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.24. Input the following file name **ID#_Host_RXD+D-_NEXT**. Replace the # with a unique identifier. Then click OK.
5.1.25. Make the following connections using the male to male barrel adapters: Ch1 to Host RX+, Ch2 to Host RX-, Ch3 to Host D+, and Ch4 to Host D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
5.1.26. Input the following file name **ID#_ Device_TX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.
5.1.27. Make the following connections using the male to male barrel adapters: Ch1 to Device TX1+, Ch2 to Device TX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
5.1.28. Input the following file name **ID#_ Device_RX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.
5.1.29. Make the following connections using the male to male barrel adapters: Ch1 to Device RX1+, Ch2 to Device RX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Far End Crosstalk data Acquisitions:

5.1.30. Input the following file name **ID#_ HostRX_DeviceRX1_FEXT**. Replace the # with a unique identifier. Then click OK.
5.1.31. Make the following connections using the male to male barrel adapters: Ch1 to Host RX+, Ch2 to Host RX-, Ch3 to Device RX1+, and Ch4 to Device RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
5.1.32. Input the following file name **ID#_ HostTX_DeviceTX1_FEXT**. Replace the # with a unique identifier. Then click OK.
5.1.33. Make the following connections using the male to male barrel adapters: Ch1 to Host TX+, Ch2 to Host TX-, Ch3 to Device TX1+, and Ch4 to Device TX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
5.1.34. Input the following file name **ID#_ HostD+D-_DeviceTX1_FEXT**. Replace the # with a unique identifier. Then click OK.
5.1.35. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device TX1+, and Ch4 to Device TX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
5.1.36. Input the following file name **ID#_ HostD+D-_DeviceRX1_FEXT**. Replace the # with a unique identifier. Then click OK.
5.1.37. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device RX1+, and Ch4 to Device RX1-. Install 50

ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.38. Input the following file name **ID#_ HostTX_DeviceD+D-_FEXT**. Replace the # with a unique identifier. Then click OK.

5.1.39. Make the following connections using the male to male barrel adapters: Ch1 to Host TX+, Ch2 to Host TX-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

5.1.40. Input the following file name **ID#_ HostRX_DeviceD+D-_FEXT**. Replace the # with a unique identifier. Then click OK.

5.1.41. Make the following connections using the male to male barrel adapters: Ch1 to Host RX+, Ch2 to Host RX-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Analyzing the Capture Data with USB Compliance Software Tool

5.1.42. Start the USB Compliance Tool IntePar by Double clicking on C:\IntePar\IntePar_v0p7\IntePar_v0p7_x86.exe (or equivalent application)

5.1.43. Select Cable Type as Standard A to Type-C

5.1.44. Select 4 port VNA. Refer to figure 17

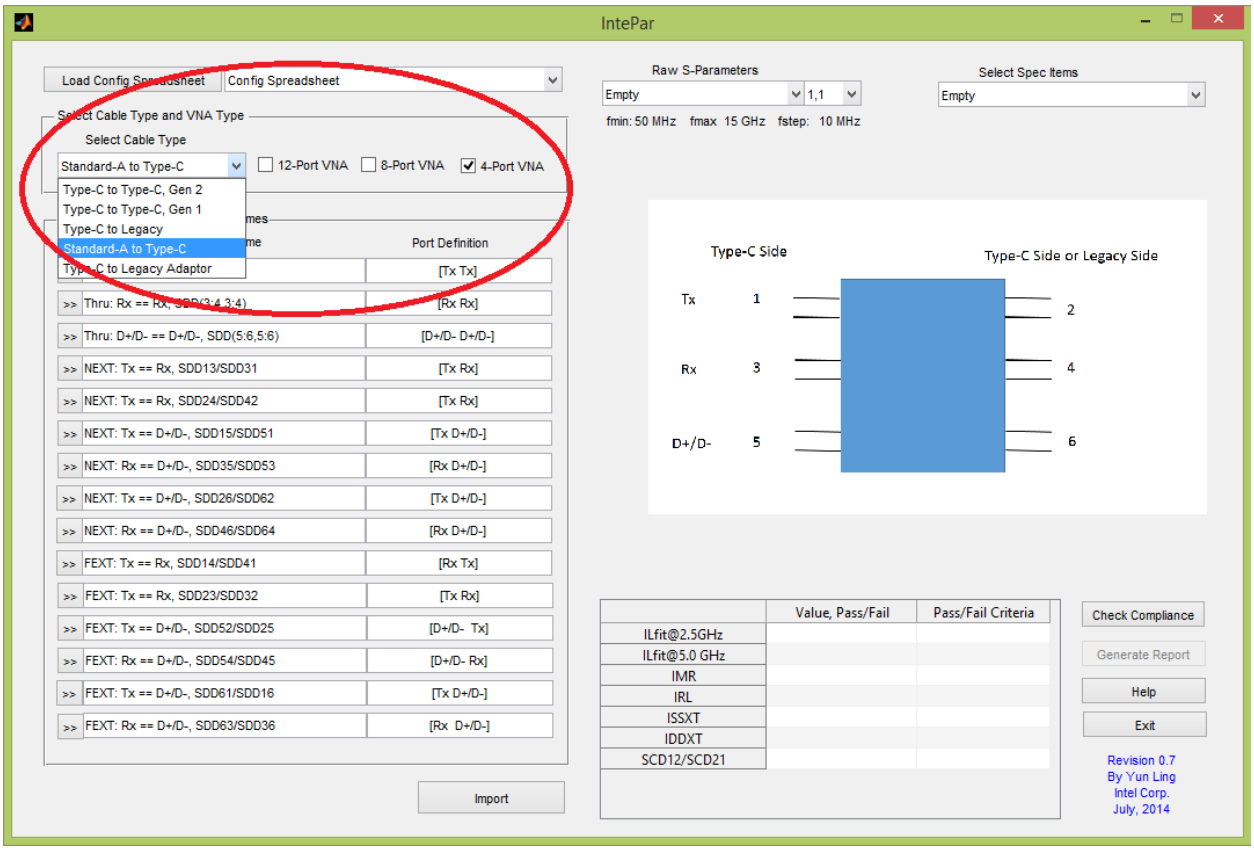

Figure 17: Selecting USB cable Type with s4p files

5.1.45. In the Load/Show S-parameter Files Names select the file to be loaded by clicking beside file name. As show in figure 18

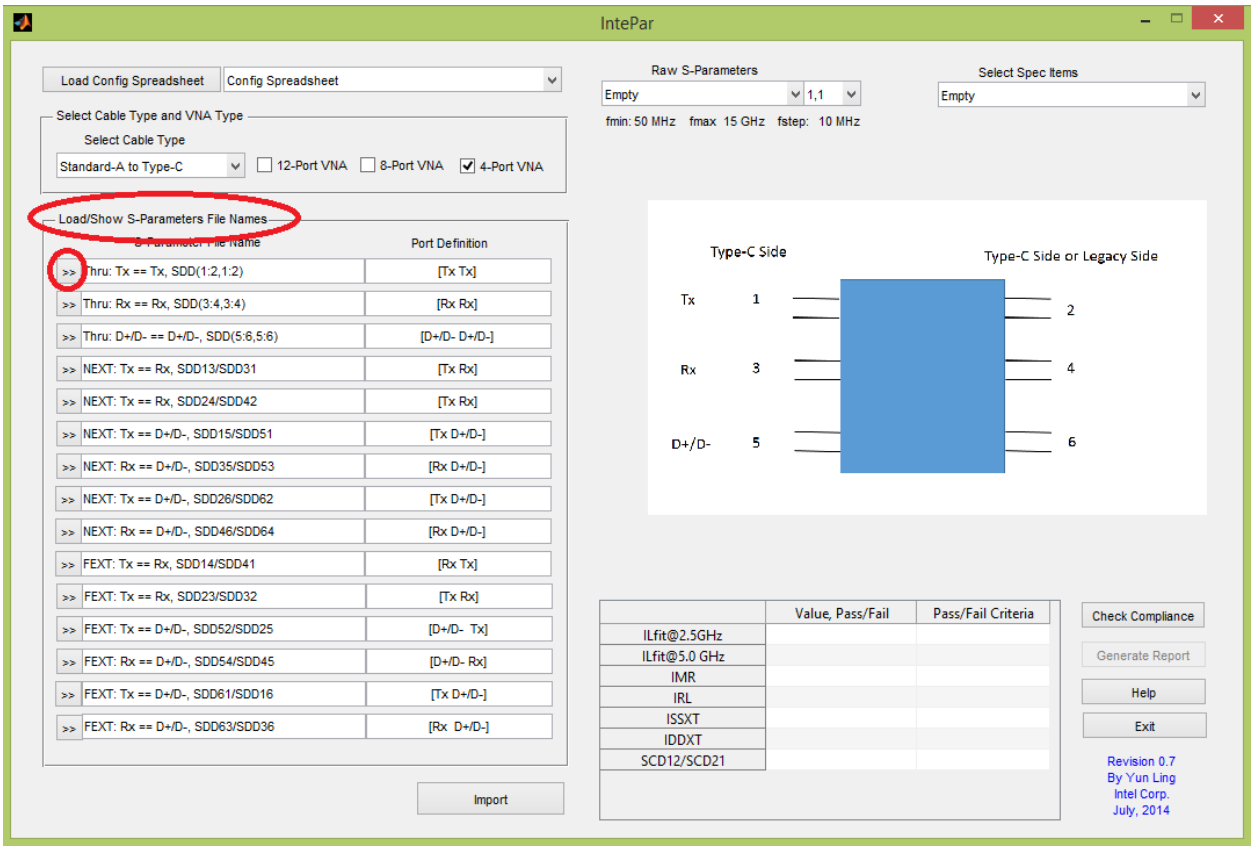

Figure 18: Loading associated s4p files

Load all files as associated in table below:

Thru: Tx==Tx, SDD(1:2, 1:2)	**ID#_Host_TX_Thru**
Thru: Rx==Rx, SDD(3:4, 3:4)	**ID#_Host_RX_Thru**
Thru: D+/D-==D+/D-, SDD(5:6, 5:6)	**ID#_Host_D+D-_Thru**
NEXT: Tx == Rx, SDD13/SDD31	**ID#_Host_TXRX_NEXT**
NEXT: Tx == Rx, SDD24/SDD42	**ID#_Device_TX1RX1_NEXT**
NEXT: Tx == D+/D-, SDD15/SDD51	**ID#_Host_TXD+D-_NEXT**
NEXT: Rx == D+/D-, SDD35/SDD53	**ID#_Host_RXD+D-_NEXT**
NEXT: Tx == D+/D-, SDD26/SDD62	**ID#_ Device_TX1D+D-_NEXT**
NEXT: Rx == D+/D-, SDD46/SDD64	**ID#_ Device_RX1D+D-_NEXT**
FEXT: Tx == Rx, SDD14/SDD41	**ID#_ HostRX_DeviceRX1_FEXT**

FEXT: Tx == Rx, SDD23/SDD32	**ID#_ HostTX_DeviceTX1_FEXT**
FEXT: Tx == D+/D-, SDD52/SDD25	**ID#_ HostD+D-_DeviceTX1_FEXT**
FEXT: Rx == D+/D-, SDD54/SDD45	**ID#_ HostD+D-_DeviceRX1_FEXT**
FEXT: Tx == D+/D-, SDD61/SDD16	**ID#_ HostTX_DeviceD+D-_FEXT**
FEXT: Rx == D+/D-, SDD63/SDD36	**ID#_ HostRX_DeviceD+D-_FEXT**

5.1.46. Click on the Import button

5.1.47. Click on the Check Compliance, verify that results are with in Specifications from the generated report. Refer to figure 19

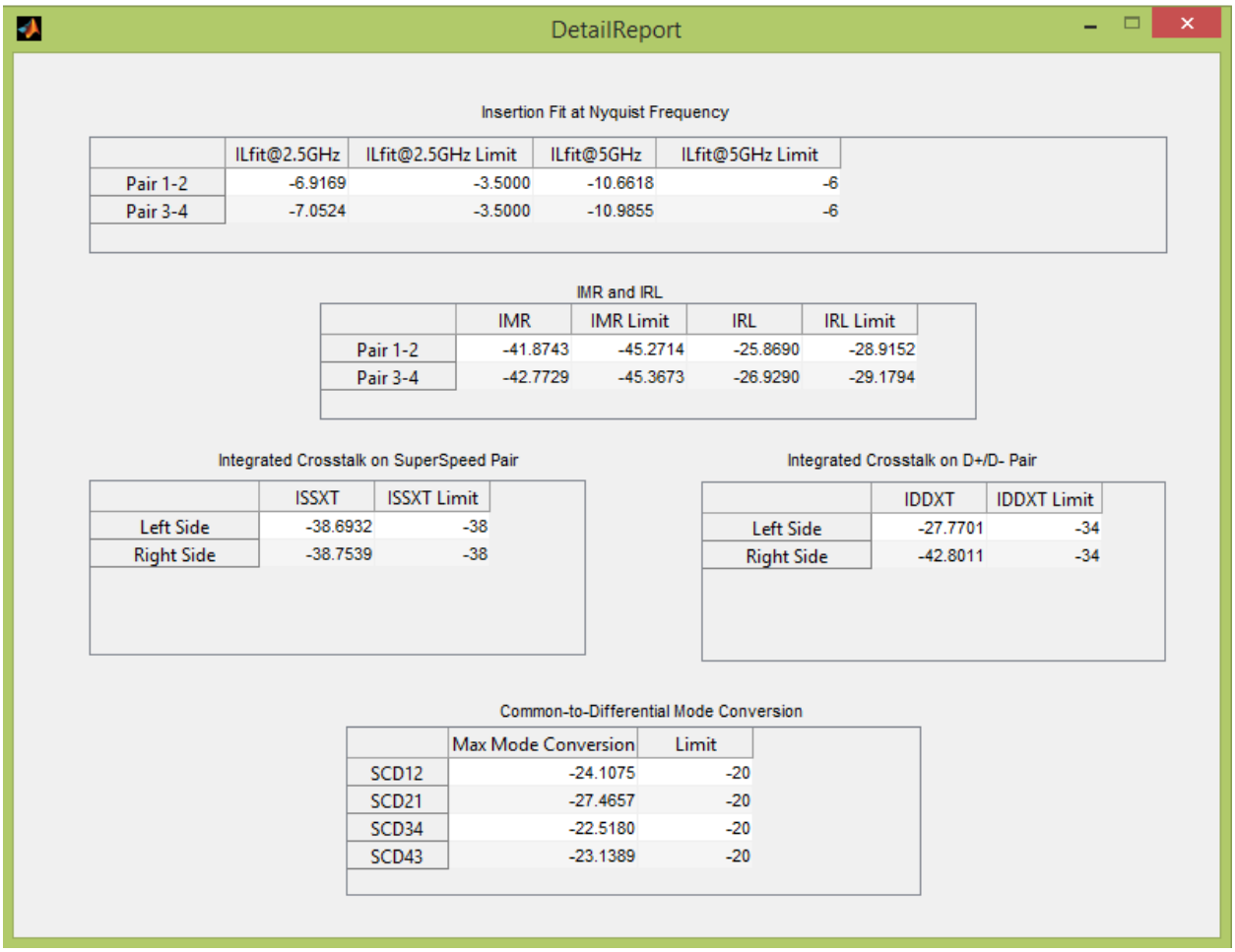

Figure 19: IntePar report

5.1.48. Repeat process for TX2 and RX2 by flipping the Type C connector 180 degrees and plug into the fixture so that the USB logo is associated to the bottom side of the test fixture.

5.2. Informative Measurements

To be completed in a future revision

6. USB Type-C to Legacy Cable Assembly

6.1. Normative Measurements

Main Setup:

6.1.1. From the DSA8300 pull down application menu select IConnect S-parameter Wizard. A popup window about resuming measurements will show up click OK.

6.1.2. From the top menu in the Wizard select 4 port Single Ended refer to figure 20.

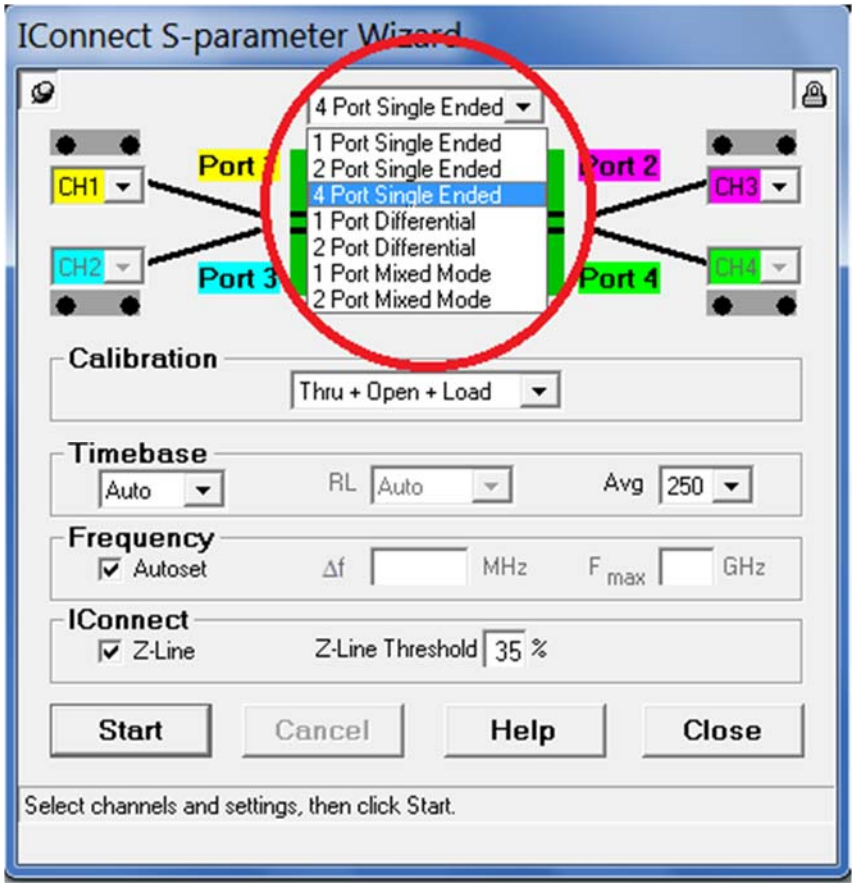

Figure 20: Setting the Wizard for s4p file

6.1.3. In the Wizard Calibration menu select Thru +Open +Load from the pull down. Refer to figure 21.

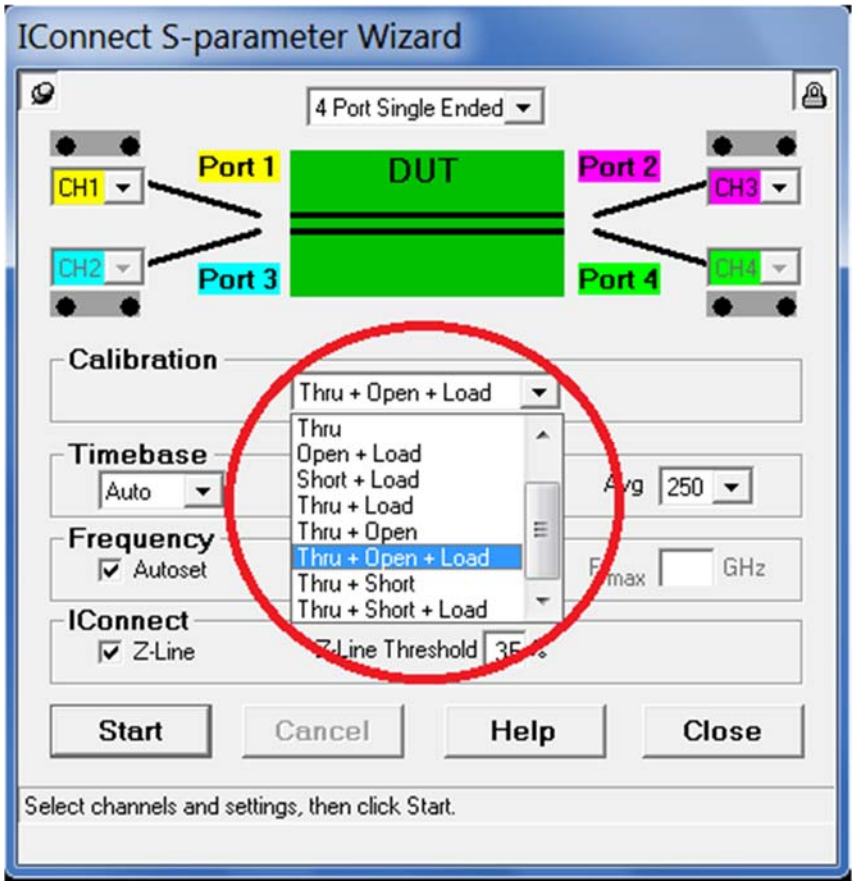

Figure 21: Selecting Calibration Method

6.1.4. In the Frequency menu uncheck the Auto and set the Delta Frequency to 10 MHz and the max Frequency to 15 GHz. Refer to figure 22

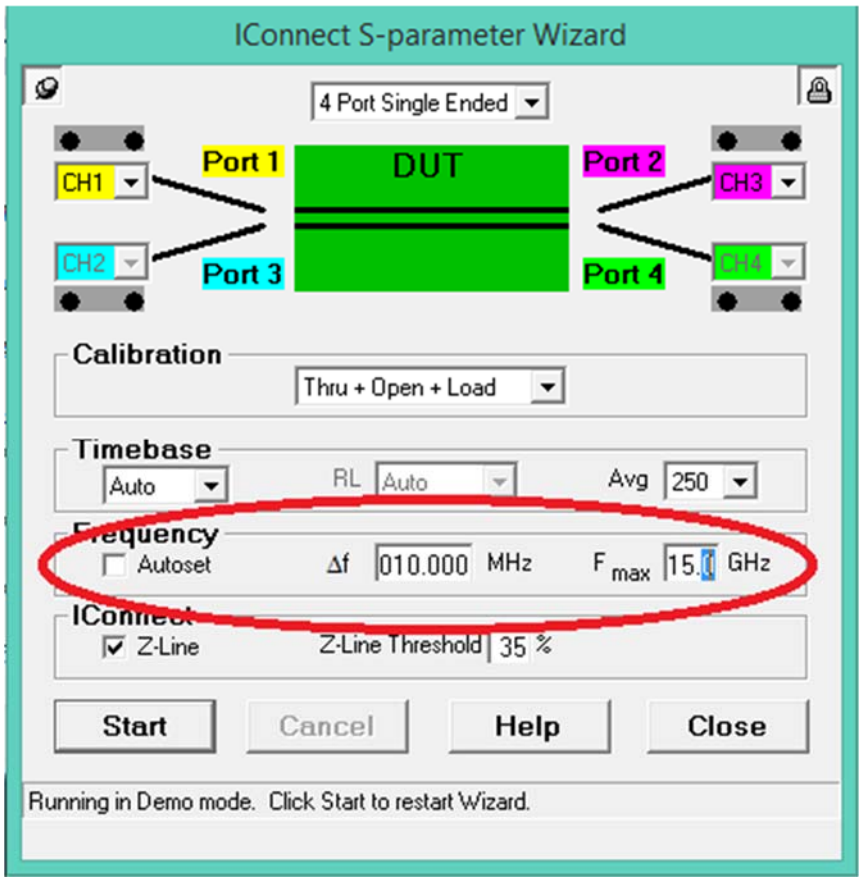

Figure 22: Setting the Delta Frequency and Max Frequency Range

6.1.5. Verify Port setting are as follows: Ch1 = Port 1, Ch2 = Port 3, Ch3 = Port 2, and Ch4 =Port 4 (This is important for the compliance tool set to work correctly).

6.1.6. Click on the Start Button. Next create or select a folder for the measurement data to go to.

Insertion Loss and Return Loss data acquisition:

6.1.7. Input the following file name **ID#_Host_TX1_Thru**. Replace the # with a unique identifier. Then click OK. Refer to figure 23.

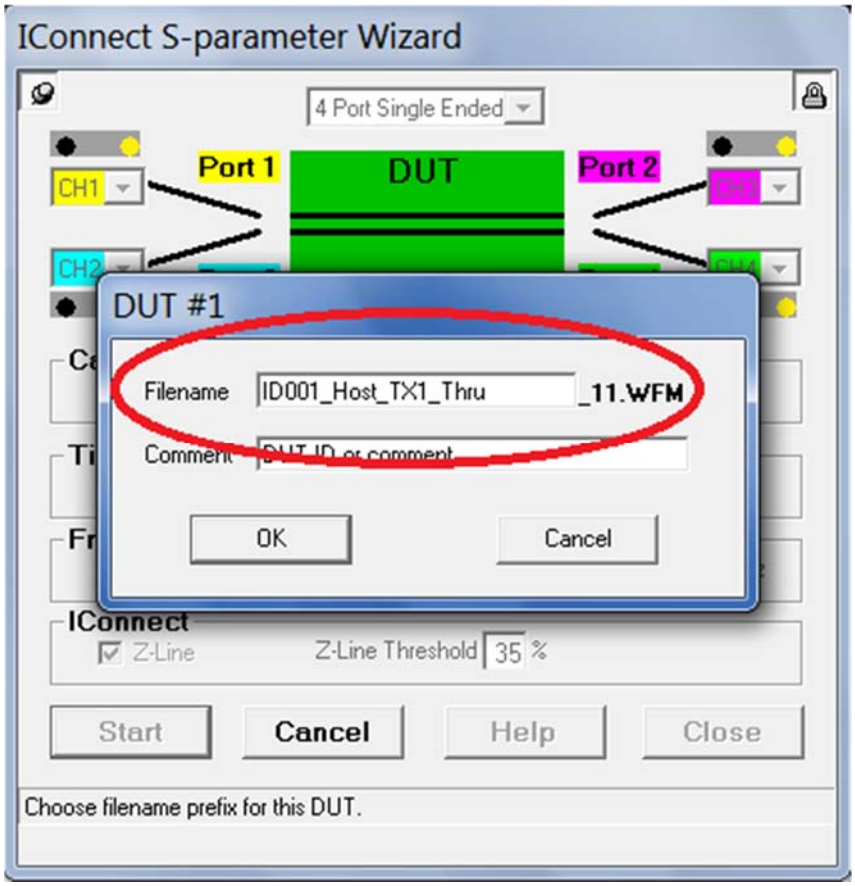

Figure 23: File naming step

6.1.8. If a pop window appears asking to use previous measured Deskews, select No if there has been any change in the setup since the last time testing was performed. Then follow promotes to remove terminators and cables and connect to the TDR clock output.

6.1.9. Make the following connections using the male to male barrel adapters to the Host Type-C fixture and the Device Legacy fixture: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Device RX+, and Ch4 Device to RX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.10. Connect the First cable to be tested. Note if more than one cable is being tested start with the longest cable. This will set the time base correctly for test all other cables. Click Okay

6.1.11. Disconnect the test fixture from the barrel adapter. Then connect Ch1 to the open reference on the USB calibration test fixture. Then Click OK. Repeat the step for remaining channels.

6.1.12. Connect Ch 1 to one side of the 2X thru on the Calibration test fixture and Ch3 to the other side of the same 2X thru. Click OK. When prompted by the application repeat for the following connections: Ch2 to Ch4, Ch1 to Ch4, Ch3 to Ch2, Ch1 to Ch2, Ch3 to Ch4,.

6.1.13. Connect Ch1 to Load_1 on the calibration test fixture, then click OK. Repeat for the remaining channels when promoted by the application.

6.1.14. Input the following file name **ID#_Host_RX1_Thru**. Replace the # with a unique identifier. Then click OK.

6.1.15. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Device TX+, and Ch4 to Device TX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.16. Input the following file name **ID#_Host_D+D-_Thru**. Replace the # with a unique identifier. Then click OK.

6.1.17. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Near End Cross Talk Data acquisitions:

6.1.18. Input the following file name **ID#_Host_TX1RX1_NEXT**. Replace the # with a unique identifier. Then click OK.

6.1.19. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Host RX1+, and Ch4 to Host RX1-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.20. Input the following file name **ID#_Device_TXRX_NEXT**. Replace the # with a unique identifier. Then click OK.

6.1.21. Make the following connections using the male to male barrel adapters: Ch1 to Device TX+, Ch2 to Device TX-, Ch3 to Device RX+, and Ch4 to Device RX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.22. Input the following file name **ID#_Host_TX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.

6.1.23. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Host D+, and Ch4 to Host D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.24. Input the following file name **ID#_Host_RX1D+D-_NEXT**. Replace the # with a unique identifier. Then click OK.
6.1.25. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Host D+, and Ch4 to Host D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
6.1.26. Input the following file name **ID#_ Device_TXD+D-_NEXT**. Replace the # with a unique identifier. Then click OK.
6.1.27. Make the following connections using the male to male barrel adapters: Ch1 to Device TX+, Ch2 to Device TX-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
6.1.28. Input the following file name **ID#_ Device_RXD+D-_NEXT**. Replace the # with a unique identifier. Then click OK.
6.1.29. Make the following connections using the male to male barrel adapters: Ch1 to Device RX+, Ch2 to Device RX-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Far End Crosstalk data Acquisitions:

6.1.30. Input the following file name **ID#_ HostRX1_DeviceRX_FEXT**. Replace the # with a unique identifier. Then click OK.
6.1.31. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Device RX+, and Ch4 to Device RX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
6.1.32. Input the following file name **ID#_ HostTX1_DeviceTX_FEXT**. Replace the # with a unique identifier. Then click OK.
6.1.33. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Device TX+, and Ch4 to Device TX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
6.1.34. Input the following file name **ID#_ HostD+D-_DeviceTX_FEXT**. Replace the # with a unique identifier. Then click OK.
6.1.35. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device TX+, and Ch4 to Device TX-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.
6.1.36. Input the following file name **ID#_ HostD+D-_DeviceRX_FEXT**. Replace the # with a unique identifier. Then click OK.
6.1.37. Make the following connections using the male to male barrel adapters: Ch1 to Host D+, Ch2 to Host D-, Ch3 to Device RX+, and Ch4 to Device RX-. Install 50

ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.38. Input the following file name **ID#_ HostTX1_DeviceD+D-_FEXT**. Replace the # with a unique identifier. Then click OK.

6.1.39. Make the following connections using the male to male barrel adapters: Ch1 to Host TX1+, Ch2 to Host TX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

6.1.40. Input the following file name **ID#_ HostRX1_DeviceD+D-_FEXT**. Replace the # with a unique identifier. Then click OK.

6.1.41. Make the following connections using the male to male barrel adapters: Ch1 to Host RX1+, Ch2 to Host RX1-, Ch3 to Device D+, and Ch4 to Device D-. Install 50 ohm terminators on all unused connectors. Do not connect any cables between fixtures. Click OK.

Analyzing the Capture Data with USB Compliance Software Tool

6.1.42. Start the USB Compliance Tool IntePar by Double clicking on C:\IntePar\IntePar_v0p7\IntePar_v0p7_x86.exe (or equivalent application)

6.1.43. Select Cable Type as Standard A to Type-C

6.1.44. Select 4 port VNA Refer to figure 24.

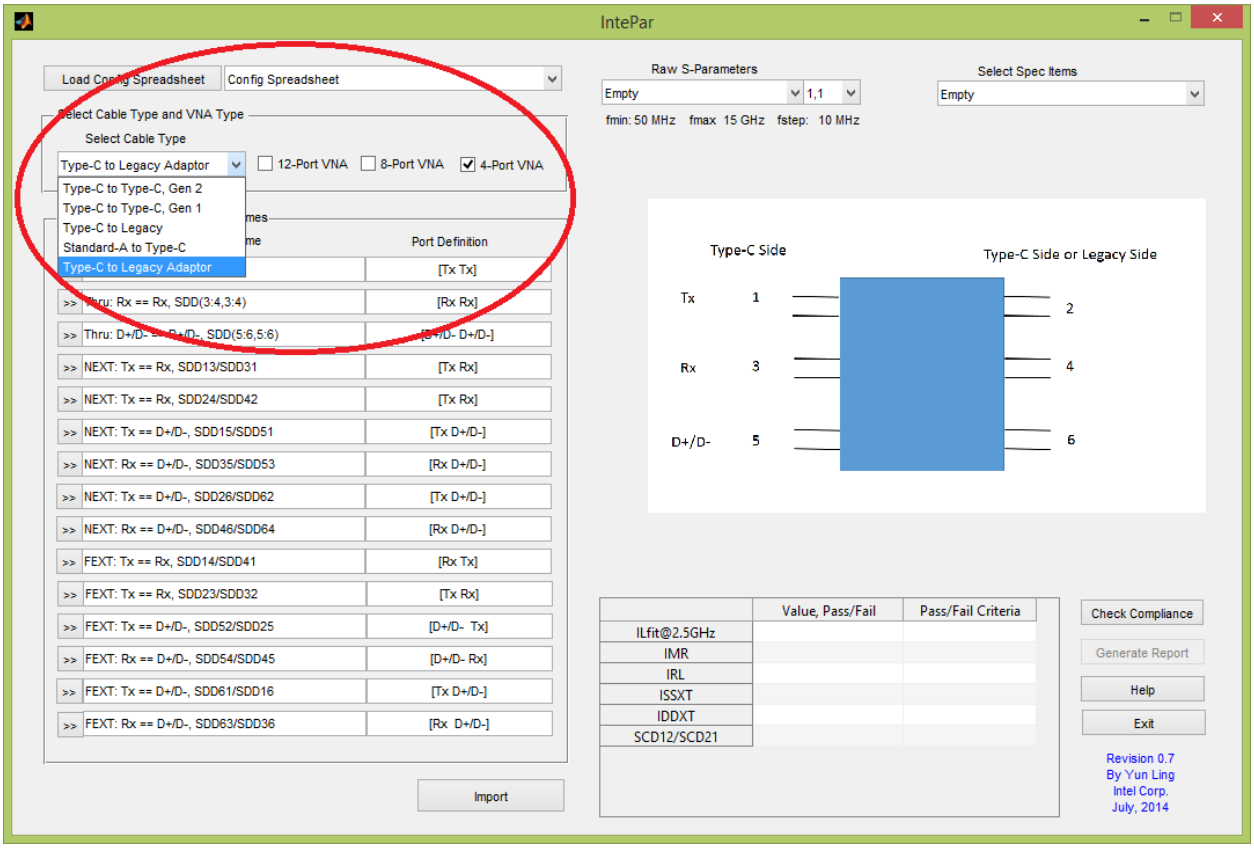

Figure 24: Selecting USB cable Type with s4p files

6.1.45. In the Load/Show S-parameter Files Names select the file to be loaded by clicking beside file name. As shown in figure 25

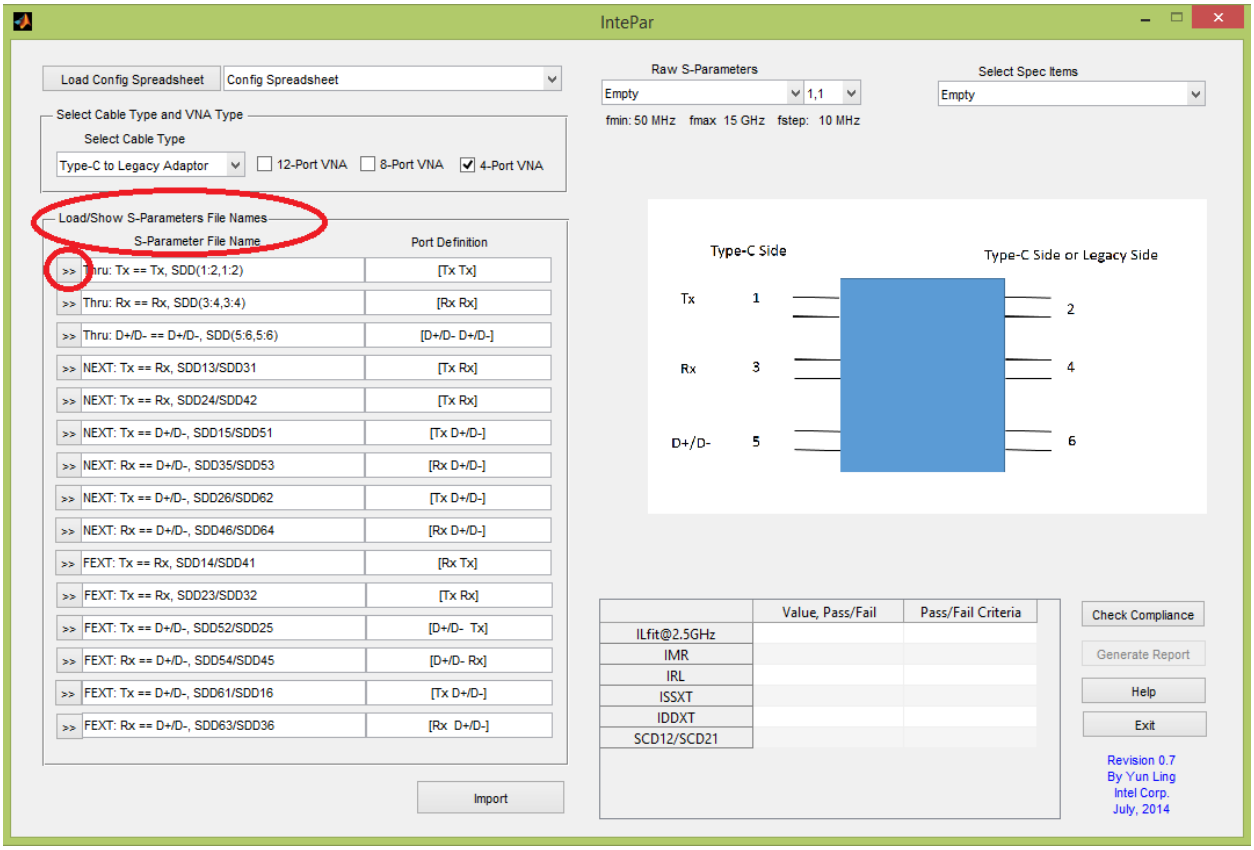

Figure 25: Loading associated s4p files

Load all files as associated in table below:

Thru: Tx==Tx, SDD(1:2, 1:2)	**ID#_Host_TX1_Thru**
Thru: Rx==Rx, SDD(3:4, 3:4)	**ID#_Host_RX1_Thru**
Thru: D+/D-==D+/D-, SDD(5:6, 5:6)	**ID#_Host_D+D-_Thru**
NEXT: Tx == Rx, SDD13/SDD31	**ID#_Host_TX1RX1_NEXT**
NEXT: Tx == Rx, SDD24/SDD42	**ID#_Device_TXRX_NEXT**
NEXT: Tx == D+/D-, SDD15/SDD51	**ID#_Host_TX1D+D-_NEXT**
NEXT: Rx == D+/D-, SDD35/SDD53	**ID#_Host_RX1D+D-_NEXT**
NEXT: Tx == D+/D-, SDD26/SDD62	**ID#_ Device_TXD+D-_NEXT**
NEXT: Rx == D+/D-, SDD46/SDD64	**ID#_ Device_RXD+D-_NEXT**
FEXT: Tx == Rx, SDD14/SDD41	**ID#_ HostRX1_DeviceRX_FEXT**
FEXT: Tx == Rx, SDD23/SDD32	**ID#_ HostTX1_DeviceTX_FEXT**

FEXT: Tx == D+/D-, SDD52/SDD25	**ID#_ HostD+D-_DeviceTX_FEXT**
FEXT: Rx == D+/D-, SDD54/SDD45	**ID#_ HostD+D-_DeviceRX_FEXT**
FEXT: Tx == D+/D-, SDD61/SDD16	**ID#_ HostTX1_DeviceD+D-_FEXT**
FEXT: Rx == D+/D-, SDD63/SDD36	**ID#_ HostRX1_DeviceD+D-_FEXT**

6.1.46. Click on the Import button

6.1.47. Click on the Check Compliance, verify that results are with in Specifications from the generated report. Refer to figure 26

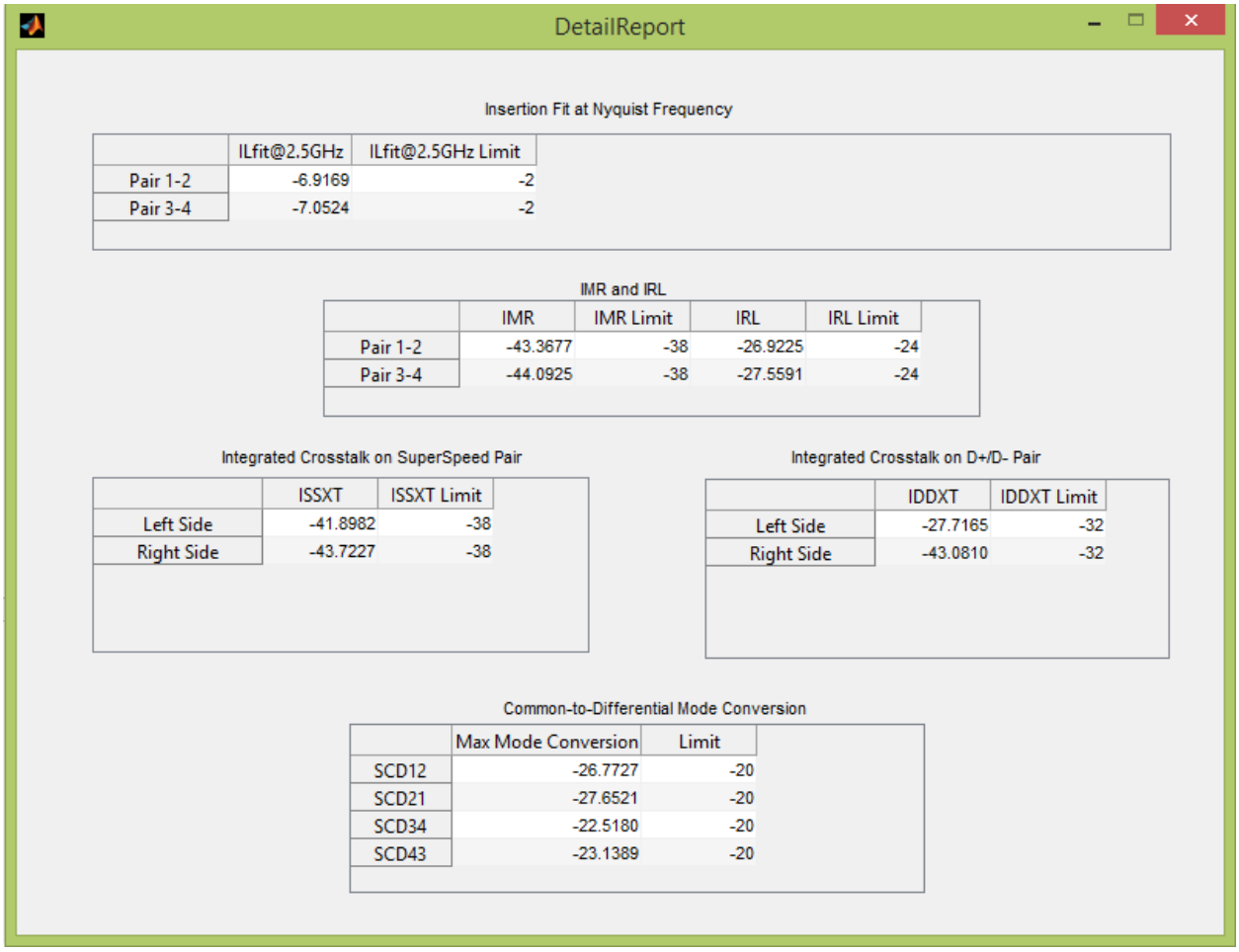

Figure 26: IntePar report

6.1.48. Repeat process for TX2 and RX2 by flipping the Type C connector 180 degrees and plug into the fixture so that the USB logo is associated to the bottom side of the test fixture.

6.2. Informative Measurements

To be completed in a future revision

7. Low Speed Signal

7.1. Single Ended Coupling between Vbus to SBU_A/SBU_B.
To be completed in a future revision

7.2. Single Ended Coupling between Vbus to CC.
To be completed in a future revision

7.3. Single Ended Coupling between SBU_A/SBU_B to CC.
To be completed in a future revision

7.4. Differential Coupling between CC and D+/D-.
To be completed on a Future Revision

7.5. Differential Coupling between Vbus and D+/D-.
To be completed on a future revision

7.6. USB D+/D- Signal Integrity.
To be completed on a future revision

8. Appendix A: Tips to reduce time and connections

8.1. Reducing the number connections made during testing

When testing the Type-C to Type-C cable with a 4 port VNA or TDR type of instrument, there are many files to save as well as may connections that have to be made during the process. This can slow the process greatly and create opportunity for the end user to make errors during the acquisition capturing process. To assist in reducing the number of connections that need to be made during the testing process, there is a simple step that could be added to the process that would allow for the capture of two s-parameter files with one connection instead of a single s-parameter file. After the user has captured the first s-parameter file, they can unplug the cable and rotate it 180 degrees at both ends of the cable, this will associate the USB logo on the cable with the bottom side of the test fixture instead of the top side of the fixture. This will allow the user to capture the data for the second pair of lanes in the cable. The user will need replace the 1 in the file name with a 2, since now the user is capturing data for either TX2 or RX2. For example if the file name for the data is ID001_Host_TX1RX1_NEXT the new file name will be ID001_Host_TX2RX2_NEXT. This process will allow the user to capture all the data require to be used with the USB compliance tool for both pairs of lanes without needing to repeat the data acquisition process. This process also assumes that the test equipment and fixtures have equal performance on all lanes connecting to the USB cable. If the test equipment and fixtures

including cabling to the fixture do not have equal performance then this process is not recommended.

More tips to be added in future revisions of this document.