

Granite River Labs

USB4® Receiver Test Method of Implementation (MOI) Using Anritsu MP1900A BERT, High Performance Real-time Oscilloscope, and GRL-USB4-RXA Calibration and Test Automation Software

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TABLE OF CONTENTS

1	IN	TRODUCTION	10
2	RE	EFERENCE DOCUMENTS	10
3	RE	ESOURCE REQUIREMENTS	11
	3.1	EQUIPMENT REQUIREMENTS	11
	3.2	Software Requirements	12
4	IN	STALLING AND SETTING UP GRL-USB4-RXA SOFTWARE	14
	4.1 4.1 4.1 4.1	L.2 Launch and Set Up GRL-USB4-RXA Software	16 17
5	RE	ECEIVER CALIBRATION SETUPS	20
	5.1	CONNECTION SETUP FOR ANRITSU MP1900A BERT GENERATOR SET	20
	5.2	CONNECTION SETUP FOR TP3' (CASE 1) CALIBRATION	21
	5.3	CONNECTION SETUP FOR TP3 (CASE 2) CALIBRATION	21
6	CA	ALIBRATING USING GRL-USB4-RXA SOFTWARE	24
	6.1	ENTER CALIBRATION/TEST SESSION INFORMATION	24
	6.2	SET UP CONDITIONS FOR CALIBRATION/TESTING	24
	6.3 6.3	SELECT CALIBRATION	
	6.4	CONFIGURE CALIBRATION/TEST PARAMETERS	27
	6.5	CONFIGURE CALIBRATION TARGET VALUES	32
	6.6	RUN CALIBRATION	33
7	CC	OMPLIANCE TESTING USING GRL-USB4-RXA SOFTWARE	35
	7.1 7.1 7.1		ERT)35
	7.2	SELECT DUT TYPE	38
	7.3 7.3	SELECT DUT Rx TESTS	
	7.4	SET UP USB4 MICROCONTROLLER ENVIRONMENT	40



	7.5	SET UP INTEL'S TENLIRA ENVIRONMENT	41
	7.6	SET UP USB4 ETT ENVIRONMENT	42
	7.7	RUN DUT RX TESTS	43
8	TE 8.1. 8.1. 8.1. 8.1.	.2 Results Summary Table	45 46
	8.2	DELETE TEST RESULTS	49
9	SA	VING AND LOADING TEST SESSIONS	50
10) A	PPENDIX A: MANUAL CALIBRATION & TEST METHODOLOGIES	51
	10.1 10.1 10.1		56
	10.2	TEST RECEIVER AT 10GB/S OR 10.3125GB/S FOR TEST CASE 1 AT TP3'	80
	10.3	CALIBRATE AND SAVE FOR 10GB/S OR 10.3125GB/S RX TEST CASE 2 AT TP3	81
	10.4	TEST RECEIVER AT 10GB/S OR 10.3125GB/S FOR TEST CASE 2 AT TP3	87
	10.5 10.5 10.5		89
	10.6	Test Receiver at 20GB/s or 20.625 GB/s for Rx Test Case 1 at TP3'	92
	10.7	CALIBRATE AND SAVE FOR 20GB/S OR 20.625GB/S RX TEST CASE 2 AT TP3	93
	10.8	TEST RECEIVER AT 20GB/S OR 20.625GB/S FOR TEST CASE 2 AT TP3	99
	10.9	TEST FOR SIGNAL FREQUENCY VARIATION TRAINING (10GB/S OR 10.3125GB/S)	100
	10.10	TEST FOR SIGNAL FREQUENCY VARIATION TRAINING (20GB/S OR 20.625GB/S)	100
11	LA	PPENDIX B: RECEIVER STRESSED EYE CALIBRATION USING SIGTES	T102
	11.1	INSTALL AND RUN SIGTEST	102
	11.2	SET UP SCOPE FOR SAVING WAVEFORMS	102
12	2 A	PPENDIX C: CONNECTING KEYSIGHT OSCILLOSCOPE TO PC	104
13	8 A	PPENDIX D: CONNECTING TEKTRONIX OSCILLOSCOPE TO PC	106
1/	ι Δ	PPENDIX F. CONNECTING TELEDYNE LECROY OSCILLOSCOPE TO P	00108



15APPENDIX F: SMA CABLE TRANSFER FUNCTION SETUP PROCEDURE FOR
CABLE DE-EMBEDDING109

15.1 Se	T UP TRANSFER FUNCTION FOR THE KEYSIGHT SCOPE	
	For SMA Cable De-embedding on Scope Channels 1 & 3	
15.2 Cr	EATE FILTER FILES FOR THE TEKTRONIX SCOPE	
15.2.1	Convert Single-Ended S-Parameter Files to Mixed Mode	114
15.2.2	Create SMA Cable De-embedding Files for Scope Channels 1 & 3	115



List of Figures

Figure 1. Launching GRL Software Framework	14
Figure 2. Launching Anritsu USB4 Rx Test Application	15
Figure 3. License Details	
Figure 4. Installed Application	15
Figure 5. GRL Software Instrument Connection Setup	18
Figure 6. Installed GRLRemoteProxyServer.exe File Directory	18
Figure 7. Verify Proxy Server Connection for Controller PC and Scope	19
Figure 8. Configure GRL Remote Proxy Server Network Settings on GRL Software	
Figure 9. Connection Setup for MP1900A BERT Generator Set Modules	20
Figure 10. Setup for TP3' (Case 1) Calibration	21
Figure 11. Setup for TP3 (Case 2) Calibration at 10G or 10.3125G	22
Figure 12. Setup for TP3 (Case 2) Calibration at 20G or 20.625G	23
Figure 13. Enter Calibration/Test Session Information	24
Figure 14. Select Test Point	24
Figure 15. Select DUT Port and Lane Under Test	25
Figure 16. Select Data Rate	25
Figure 17. Select SJ Frequency	25
Figure 18. Select Calibration	26
Figure 19. Configure Calibration/Test Parameters	28
Figure 20. Overwrite Existing Calibration Targets	32
Figure 21. Run Calibration	33
Figure 22. Connection Setup Diagram Dialog Example	34
Figure 23. Rx BER Test Setup at TP3' (Using USB4 Microcontroller and MP1900A BERT)	35
Figure 24. Setup for TP3 Rx BER Test at 10G or 10.3125G (Using USB4 Microcontroller and MP19	
BERT)	
Figure 25. Setup for TP3 Rx BER Test at 20G or 20.625G (Using USB4 Microcontroller and MP190 BERT)	
Figure 26. Select DUT Type	38
Figure 27. Select DUT Rx Tests to be Run	39
Figure 28. Setup for USB4 Microcontroller Environment	40
Figure 29. Setup for TenLira Environment	41
Figure 30. Setup for ETT Environment	42
Figure 31. Run Tests	43
Figure 32. Report Results Page	44



Figure 33. DUT Information45
Figure 34. Results Summary Table Example45
Figure 35. Compliance Test Results Example47
Figure 36. Calibration/Test Result Details Example48
Figure 37. Delete Individual Calibration/Test Results Example
Figure 38. Delete All Results
Figure 39. Saving and Loading Calibration and Test Sessions50
Figure 40. Jitter Clock Source Setting
Figure 41. PPG Misc2 Settings53
Figure 42. Pattern Setting
Figure 43. PPG Emphasis Setting55
Figure 44. SSC Setup55
Figure 45. DATA+ Amplitude Setting55
Figure 46. CM Setting56
Figure 47. Oscilloscope Vertical and Horizontal Setup57
Figure 48. Oscilloscope Clock Recovery Setup
Figure 49. Oscilloscope Jitter Setup60
Figure 50. ISI Measurement Preset Table61
Figure 51. 4Tap Emphasis CH1 Interface62
Figure 52. Optimized Preset (Minimum DDJpp) Measurement On Keysight Scope64
Figure 53. Optimized Preset (Minimum DDJpp) Measurement On Tektronix Scope64
Figure 54. Calibration to Phase Match On Keysight Scope65
Figure 55. Calibration to Phase Match On Tektronix Scope
Figure 56. Calibrate ACCM
Figure 57. Calibrate ACCM Peak-to-Peak Amplitude68
Figure 58. Jitter Amplitudes69
Figure 59. Calibrate RJ Amplitude #1
Figure 60. Calibrate RJ Amplitude #2 On Keysight Scope71
Figure 61. Calibrate RJ Amplitude #2 On Tektronix Scope71
Figure 62. Calibrate SJ Amplitude #1
Figure 63. Calibrate SJ Amplitude #2 On Keysight Scope74
Figure 64. Calibrate SJ Amplitude #2 On Tektronix Scope74
Figure 65. TJ Measurement On Keysight Scope75
Figure 66. TJ Measurement On Tektronix Scope76
Figure 67. Eye Amplitude



Figure 68.	Eye Mask On Keysight Scope	79
Figure 69.	Eye Mask On Tektronix Scope	79
Figure 70.	DC Gain Setting	82
Figure 71.	DFE Setting	83
Figure 72.	Eye Amplitude	84
Figure 73.	Eye Amplitude Measurements	86
Figure 74.	DC Gain Setting	94
Figure 75.	DFE Setting	95
Figure 76.	Eye Amplitude	96
Figure 77.	Eye Amplitude Measurements	98
Figure 78.	Keysight Connection Expert	
Figure 79.	Oscilloscope's VISA Address	
Figure 80.	OpenChoice Instrument Manager In Start Menu	
Figure 81.	OpenChoice Instrument Manager Menu	
Figure 82.	Utilities Setup Menu	
Figure 83.	Oscilloscope's IP Address	
Figure 84.	SMA Cable Transfer Function– Set Up Scope Channels 1 & 3	
Figure 85.	SMA Cable Transfer Function– Select Setup Wizard on Scope	110
Figure 86.	SMA Cable Transfer Function– Set Up InfiniiSim on Scope #1	110
Figure 87.	SMA Cable Transfer Function– Set Up InfiniiSim on Scope #2	
Figure 88.	SMA Cable Transfer Function– Set Up InfiniiSim on Scope #3	
Figure 89.	SMA Cable Transfer Function– Set Up InfiniiSim on Scope #4	
Figure 90.	SMA Cable Transfer Function – Set Up InfiniiSim on Scope Completed	
Figure 91.	Select and Open Serial Data Link Analysis on Tektronix Scope	114
Figure 92.	Convert to Mixed Mode S-Parameters	114
Figure 93.	Save Converted Mixed Mode S-Parameters	115
Figure 94.	Create SMA Cable De-Embedding Files – #1	115
Figure 95.	Create SMA Cable De-Embedding Files – #2	115
Figure 96.	Create SMA Cable De-Embedding Files – #3	116
Figure 97.	Create SMA Cable De-Embedding Files – #4	116
Figure 98.	Create SMA Cable De-Embedding Files – #5	116
Figure 99.	Create SMA Cable De-Embedding Files – #6	



List of Tables

Table 1. Equipment Requirements – Systems and Accessories	11
Table 2. Equipment Requirements – Connection Cables	12
Table 3. Supported Calibration	26
Table 4. Calibration/Test Parameters Description	28
Table 5. Supported Rx Tests	
Table 6. Oscilloscope Vertical and Horizontal Setup	56
Table 7. Oscilloscope Clock Recovery Setup	57
Table 8. Oscilloscope ACCM Setup	58
Table 9. Oscilloscope Jitter Setup	59
Table 10. Oscilloscope Eye Diagram Vertical Setup	60
Table 11. DC Gain Settings	81
Table 12. Oscilloscope Vertical and Horizontal Setup	89
Table 13. Oscilloscope Clock Recovery Setup	
Table 14. Oscilloscope ACCM Setup	90
Table 15. Oscilloscope Jitter Setup	90
Table 16. Oscilloscope Eye Diagram Vertical Setup	90
Table 17. DC Gain Settings	93



1 Introduction

This MOI & User Guide contains the procedure for testing an electrical receiver for USB4[®] certification using the Anritsu MP1900A BERT, High Performance Real-Time Oscilloscope, and GRL-USB4-RXA Test Automation Software as per USB-IF standards.

The main body of this MOI & User Guide describes how to perform automated Calibration and Testing of USB4 Gen2/Gen3 Hosts and Devices using the GRL-USB4-RXA Software, with an appendix describing the manual calibration process as a technical reference.

The tests in this MOI are the tests carried out by USB Independent Test Labs (ITL's). If performing the tests yourself, it is important for you to follow the MOI's as described in this document before submitting your Device Under Test (DUT) for Certification in order for you to be confident that your device will pass. ITL's also provide pre-compliance test services if your company does not have the equipment or resources to carry out the tests. Contact Granite River Labs @ support@graniteriverlabs.com for USB pre-compliance and compliance test services.

For Devices and Hosts with a USB Type-C[®] Connector, the USB-IF, VESA (DisplayPort over USB Type-C), and Thunderbolt[™] Compliance programs all require USB4 Gen2/Gen3 receiver compliance testing.

The solution in this MOI can also be used for USB4 receiver compliance for USB Type-A, USB Type-B and USB Type-B Micro Hosts and Devices.

In summary, this User Guide & MOI basically describes using the GRL-USB4-RXA software to:

- 1. Calibrate and Test a USB4 Gen2/Gen3 Receiver.
- 2. Generate Test Report for Compliance Reporting.

2 Reference Documents

- [1] Universal Serial Bus 4 (USB Type-C) Router Assembly Electrical Compliance Test Specification, Revision 0.96, January 30, 2020.
- [2] Universal Serial Bus 4 (USB4[®]) Specification Version 1.0, August 2019, and associated ECNs.



3 Resource Requirements

3.1 Equipment Requirements

TABLE 1. EQUIPMENT REQUIREMENTS – SYSTEMS AND ACCESSORIES

System Qty		Description	Key Specification Requirement	
Oscilloscope	1	High Performance Real-time	≥ 21 GHz bandwidth ^[b]	
		Oscilloscope ^[a]	16 GB and above memory RAM	
BERT	1	Anritsu MP1900A Signal Quality Analyzer (SQA)	SQA Software Version 4.00.00 or above	
		MP1900A Signal Quality Analyzer,	with following modules:	
		• MU181000A/B 12.5 GHz Synth	nesizer	
		MU181500B Jitter Modulatior	n Source	
		 MU195020A 32G bit/s SI Pulse 	Pattern Generator	
		MU195050A Noise Generator		
Accessory Qt		Description	Key Specification Requirement	
TP3' Plug Test Fixture	1	Test Point 3' (Case 1) Plug Test Fixture		
TP3 Channel Components	2	Test Point 3 (Case 2) Receptacle Fixture		
TP3 Fixed ISI Trace	1	Test Point 3 (Case 2) Fixed ISI Board		
TP3 Test	1	2m USB Type-C Cable	Insertion Loss -18dB at 5GHz	
Cables	1	0.8m USB Type-C Cable	Insertion Loss -16.5dB at 10GHz	
USB4	1	Wilder-Tech USB4	CG3-TPA-TR, with USB Cable ^[c]	
Controller		Microcontroller	• Optional for some test configurations, see Appendix F.	
Cable Deskew Fixture	1	Anritsu Splitter	K241B	
DC Block	2		Bandwidth of at least 33GHz	
Computer	1	Laptop or Desktop PC	Windows 7+ OS	
			For automation control (running GRL-USB4- RXA software)	

^[a] Oscilloscope with scope software requirements as specified in vendor specific MOI's. For example, when using the Keysight Scope, scope software such as Keysight InfiniiSim / EZ-JIT / Serial Data Analysis / Serial Data Equalization that are required for testing and signal processing must be pre-installed on the Scope.



Similarly, the Tektronix Scope shall be used with DPOJET (Jitter and Eye Analysis Tools) software and the Teledyne LeCroy Scope with SDAIII analysis tool for making measurements.

^[b] Oscilloscope with scope bandwidth as specified in vendor specific MOI's.

^[c] Intel TenLira test scripts loaded on the PC/oscilloscope running GRL-USB4-RXA software. Provides sideband SBU control of the DUT for reading BER values from the DUT Rx registers.

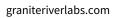
Note: Cable connector type and length requirements may vary according to the lab setup and the dimensions of the DUT board. Table below is a recommended list. Please also refer to the respective manufacturer for detailed cabling recommendations related to USB4.

TABLE 2. EQUIPMENT REQUIREMENTS – CONNECTION CABLES

Connection Cable	Qty.	Key Specification Requirement
MU181000A/B to MU181500B	1	Anritsu J1624A SMA-SMA cable (0.3m)
MU181500B to MU195020A	1	Anritsu J1624A SMA-SMA cable (0.3m)
MU195020A to MU195050A		Anritsu J1746A K-K skew matched pair short semirigid cable
Matched Cable Pairs	3	Phase Matched ±5° at 40GHz Insertion Loss 1dB maximum in 10GHz
RPC-2.92 Jack to SMP Jack	4	Rosenberger 02K119-K00E3
JTAG Ribbon Cable	1	For connecting USB4 microcontroller and test fixture
USB Type-C Cable	1	For connecting controller PC to DUT

3.2 Software Requirements

Source		
Granite River Labs USB4 Receiver Calibration and Test Automation Software – <u>www.graniteriverlabs.com</u> (Support > Download Center) Includes test setup and pattern files for USB4 Rx testing Included with Node Locked License to single oscilloscope or PC OS		
VISA Software is required to be installed on the controller PC running GRL- USB4-RXA software. GRL's software framework has been tested to work with all three versions of VISA available on the Market:		
1. NI-VISA: <u>http://www.ni.com/download/ni-visa-17.0/6646/en/</u>		
 Keysight IO Libraries: <u>www.keysight.com</u> (Search on IO Libraries) Tektronix TekVISA: <u>www.tek.com</u> (Downloads > Software > TekVisa) 		





Software	Source			
MX190000A	Anritsu High-Speed Serial Data Test Software – Mainframe MX190000A SQA Control Software (Version 4.00.00 or above). This software is located on the BERT.			
SigTest Application	Downloadable from USB-IF's website. (Note: Approval and NDA as a USB-IF Adopter is required to gain access to USB-IF products.)			
USB4 Electrical Test Tool (ETT)	Downloadable from USB-IF's website. See Section 4.1.1 for more details.			
Intel TenLira Test Scripts (For Thunderbolt 3 DUT's)	Downloadable from Intel Corporation IBL's website.			
ActiveTcl	Version 8.5.18.0 or above (downloadable from ActiveState's website: <u>http://www.activestate.com/activetcl/downloads</u>).			
(For Thunderbolt 3 DUT's)	Refer to ActiveState's website for specific system requirements and other information for installing the Tcl installation package. Also see the documentation available on the website for installation instructions.			



4 Installing and Setting Up GRL-USB4-RXA Software

This section provides the procedure for installing, configuring and verifying the operation of the GRL-USB4-RXA software. It also helps you familiarize yourself with the basic operation of the software.

The software installer automatically creates shortcuts in the Desktop and Start Menu.

To open the software application, follow the procedure in the following section.

4.1 Download and Set Up GRL-USB4-RXA Software

Install, launch and set up the GRL-USB4-RXA software on a PC or an oscilloscope (where GRL-USB4-RXA is referred to as 'Controller PC' or 'Scope' respectively in this MOI & User Guide):

- 1. Install VISA (Virtual Instrument Software Architecture) on to the PC/Scope where GRL-USB4-RXA is to be used (see Section 3.2).
- 2. Download the GRL-USB4-RXA ZIP file package from the Granite River Labs support site.
- 3. The ZIP file contains:
 - a) **USB4RxANPatternFilesInstallation00xxxxxxSetup.exe** Run this on the Anritsu Signal Quality Analyzer to install the test pattern setup files.
 - b) **USB4RxANTestApplication00xxxxxxSetup.exe** Run this on the controller PC or scope to install the GRL-USB4-RXA application.
 - c) **USB4RxANTestScopeSetupFilesInstallation00xxxxxxx.exe** Run this on the scope to install the scope setup files.
- 4. Launch and set up the software as follows:
 - a) Open the **GRL** folder from the Windows Start Menu. Click on **GRL Automated Test Solutions** within the GRL folder to launch the GRL software framework.

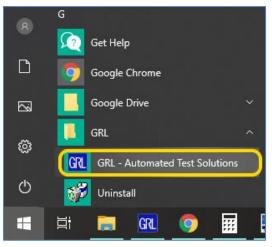


FIGURE 1. LAUNCHING GRL SOFTWARE FRAMEWORK





b) From the Application → Rx Test Solution drop-down menu, select Anritsu USB4 Rx Test. If the selection is grayed out, it means that your license has expired.

🕅 Anritsu USB4 Rx Test						
Application	Options	License	Windows	Help		
Framew	ork Test Sol	ution 🕨				
Rx Test Solution 🔹 🕨			Anrite	su USB4 Rx Test		

FIGURE 2. LAUNCHING ANRITSU USB4 RX TEST APPLICATION

i) To enable license, go to **License** → **License Details**.

🕅 GRL - Automated Test S	olution		
Application Options	License	Windows	Help
→ > → > →	Lice	nse Details	

FIGURE 3. LICENSE DETAILS

ii) Review the installed application.

RL Framework License
Granite River Labs
Framework License Details
Installed Products:
Anritsu USB4 Rx Test - Permanent
Host ID (For enquiries or license request please send this information):
QqEx06bSTAGvNJXI9MZ1IPUpODrJkTEKNwze1r2sC7xLY3KAe+p kT4cslo1WorbZe6E+E9ykt7/Nhmg++AEImiXCTuNcJ5y3cVn6JDbr 4qGqAFZ77aBQgQnRz2vte7CRCrBlYiyWg6wTKRRub8SUC+jAT4s QMWBqD9uool9nGYtxQmITalkJ0
For license enquiries send the Host ID to <u>support@GraniteRiverLabs.com</u>
Activation Key Received:
Activation License File Received: Browse Activate
Close

FIGURE 4. INSTALLED APPLICATION

- iii) Activate a License:
- [1] If you have an Activation Key, enter it in the box provided, and select **Activate**.



[2] If you do not have an Activation Key, select **Close** to use the software for 10 days free of charge.

Note: Once the 10-day trial times out, you will need to request an Activation Key for future usage on the same computer or oscilloscope. The demo software is also limited in its capability, in that it will only calibrate the maximum frequency for each data rate. Thus, the demo version cannot be used to full calibrate and test a device.

For Demo and Beta Customer License Keys, please request an Activation Key by contacting support@graniteriverlabs.com.

4.1.1 Download and Install USB4 Electrical Test Tools (ETT)

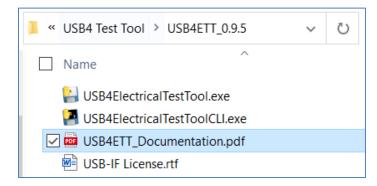
For USB4 Rx measurements, the Host/Device's CIO PHY must be in an active state during testing. Its transmitters shall be transmitting PRBS31 into the analyzer measurement channel during testing and its receivers shall have their terminations enabled during testing. Thus, a PHY microcontroller must be used to put the DUT into the right state for USB4 Rx testing.

Download ETT:

Visit the USB-IF official website and download "USB4 Electrical Test Tool" (ETT) at <u>https://www.usb.org/usb4tools</u>.

Install ETT:

Before running ETT, configure the Control PC's environment using the instructions in **USB4ETT_Documentation.pdf** from the ETT package downloaded from USB-IF.



For USB4 Host Testing:

 The ETT can be loaded on the Control PC with the GRL-USB4-RXA software. In this case, the Wilder-Tech μController is required. The DUT is controlled using a 0.8m USB Type-C cable from the Wilder-Tech μController to the USB4 Test Fixture.

For USB4 Device Testing:

Upstream Facing Port (UFP): The ETT can be loaded on the Control PC with the GRL-USB4-RXA software. In this case, the Wilder-Tech μController is required. The DUT is controlled using a 0.8m USB Type-C cable from the Wilder-Tech μController to the USB4 Test Fixture.



• **Downstream Facing Port (DFP):** Connect the DUT's UFP to any USB4 Host via the USB4 Type-C cable. The ETT tools can be loaded on the Control PC with the GRL-USB4-RXA software. In this case, the Wilder-Tech µController is required. The DUT is controlled using a 0.8m USB Type-C cable from the Wilder-Tech µController to the USB4 Test Fixture. *Take note for the device DUT, if the port under test is a Downstream Facing Port (DFP), a USB4 Host will be required to connect to the DUT's Upwards Facing Port* (*UFP*).

4.1.2 Launch and Set Up GRL-USB4-RXA Software

4.1.2.1 On the Scope or Controller PC

- 1. Launch GRL Host Application from **Start Menu** -> **GRL** -> **GRL Automated Test Solutions**.
- 2. Select Application -> Rx Test Solution -> Anritsu USB4 Rx Test.
- 3. Select the Equipment Setup icon icon for the GRL-Anritsu USB4 Rx Test Application menu.
- 4. Connect the Anritsu MP1900A BERT via LAN to the GRL automation control enabled Scope or PC. The BERT and MX190000A software can be connected using connection string formats similar to the following examples:
 - BERT: "TCPIP0::192.168.0.14::5001::SOCKET" or "192.168.0.14:5001"
 - MX190000A: "TCPIP0::192.168.0.14::5000::SOCKET" or "192.168.0.14:5000"

Note the IP addresses listed above are only examples and should be changed according to the actual network connection being used.

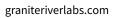
- 5. On the Scope or controller PC, obtain the network addresses for all the connected instruments from the device settings. Note these addresses as they will be used to connect the instruments to the GRL automation software.
- 6. On the Equipment Setup page of the GRL-Anritsu USB4 Rx Test Application, type in the address of each connected instrument into the 'Address' field.
- 7. (Note: If the GRL software is installed on the **Tektronix Scope**, ensure the Scope is connected via GPIB and type in the GPIB network address, for example "GPIB8::1::INSTR".)

(Note: If the GRL software is installed on the **Keysight Scope**, type in the Scope IP address, for example "TCPIP0::127.0.0.1::inst0::INSTR".)

If the GRL software is installed on the PC to control the Scope, type in the Scope IP address, for example "TCPIP0::192.168.0.35::inst0::INSTR". Note to *omit* the Port number from the address.

(Note: If the GRL software is installed on the **Keysight Scope**, and if there is error in connection, type in the Scope IP address as "TCPIP0::192.168.0.35::5025::SOCKET".)

- 8. If the GRL software is installed on the PC to control the Scope, set up the Remote File Server as described in Section 4.1.3.
- 9. Then select the "lightning" button (🗲) for each connected instrument.





The "lightning" button should turn green (\checkmark) once the software has successfully established connection with each instrument.

1	÷ 🔅	* ◎ → ►	→ 📄			
Name	ID	Address	Туре	Vendor	Lib	
Scope	Scope	TCPIP0::localhost::ii	Oscilloscope	Agilent 🗸	AgilentScope 🗸	9 🔳
BERT	BERT	TCPIP0::192.168.0.	BERT	Anritsu 🗸	Anritsu1900Bei 🗸	4
ASG	ASG1	192.168.0.205	BERT	Anritsu 🗸	AnritsuBert 🗸	9 🔳

FIGURE 5. GRL SOFTWARE INSTRUMENT CONNECTION SETUP

Note: Additional information for connecting supported vendor oscilloscopes (Keysight, Tektronix and Teledyne LeCroy) to the controller PC is provided in the Appendix of this document.

4.1.3 Set Up Remote File Server

 The GRLRemoteProxyServer.exe will also be installed along with the USB4RxANTestScopeSetupFilesInstallation0xxxxxxSetup.exe on the Scope. The GRLRemoteProxyServer.exe is installed under the "C:\GRL\GRLRemoteProxyServer" directory.

Local Dis	:k (C:) ▶ GRL ▶ GI	RLRemot	eProxyServer
rary 🔻	Share with 🔻	Burn	New folder
Name	^		1
🚳 Ap	pFrameWork.dll		
📄 GR	LIPAddress		(
💷 GR	LRemoteProxyServe	er	

FIGURE 6. INSTALLED GRLREMOTEPROXYSERVER.EXE FILE DIRECTORY

- 2. If the GRL software is installed on the PC to control the Scope and SigTest is selected as the test method to be used (refer Section 6.4), the GRLRemoteProxyServer.exe must be run on the Scope to move large waveform files back to the controller PC. The GRL software will then perform post-processing and analysis of these waveforms using SigTest.
- 3. When running the GRLRemoteProxyServer.exe, make sure that the controller PC and Scope are connected to the same network, using IP addresses as in following example:
 - Controller PC IP address: 192.168.100.8
 - Scope IP address: 192.168.100.35



Status Log				23	
TCP/IP Server Start TCP/IP Server started PortNo: 53320					
GRL Remote Proxy Server					
Proxy Server Address:	192.168.100.35	Port No:	53320		

FIGURE 7. VERIFY PROXY SERVER CONNECTION FOR CONTROLLER PC AND SCOPE

4. On the GRL USB4 Rx Test Application, configure the "Remote File Server IP Address" and

"Remote File Server Port Number" parameters on the Configurations Z page to match the network settings of the GRL Remote Proxy Server as shown in the example below:

¢	1	
		SigTest Version: 0.5
		SigtestPath: C:\USB4Sigtest
		Sigtest Max Thread Count: 1
		Remote File Server IP Address: 192.168.100.35
	ŀ	Remote File Server Port Number: 53320
		Rx Tests

FIGURE 8. CONFIGURE GRL REMOTE PROXY SERVER NETWORK SETTINGS ON GRL SOFTWARE

Refer Section 6.4 for more details on parameters available on the Configurations page.



5 Receiver Calibration Setups

The following sections show the setup connection diagrams for the Anritsu MP1900A BERT Calibration. The fixtures and channels used for USB4 Compliance testing are available from the USB-IF.

5.1 Connection Setup for Anritsu MP1900A BERT Generator Set

Figure 9 shows the connection setup between each module of the Anritsu MP1900A BERT Generator Set.

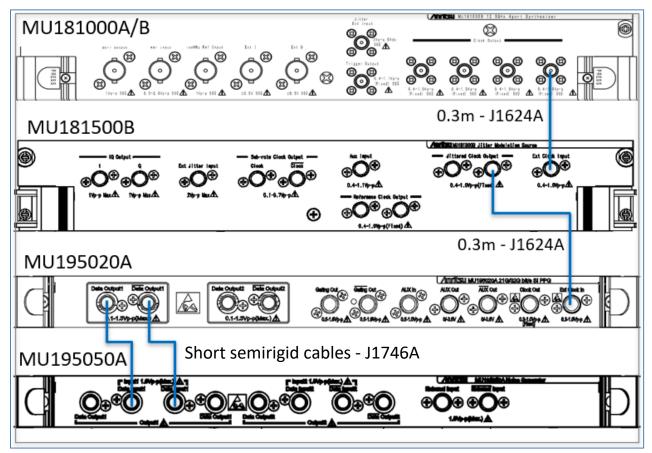


FIGURE 9. CONNECTION SETUP FOR MP1900A BERT GENERATOR SET MODULES

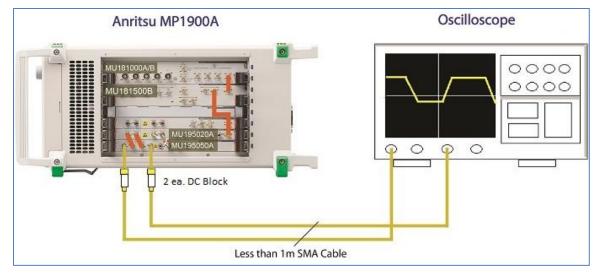
Connection Steps:

- 1. Using the J1624A SMA-SMA (0.3m) cable, connect the Clock Output of the MU181000A/B Synthesizer to the Ext Clock Input of the MU181500B Jitter Modulator.
- 2. Using the J1624A SMA-SMA (0.3m) cable, connect the Jittered Clock Output of the MU181500B Jitter Modulator to the Ext Clock Input of the MU195020A Pulse Pattern Generator.
- 3. Using the J1746A K-K skew matched pair short semirigid cable, connect the MU195020A Data Outputs to the MU195050A Data Inputs.



5.2 Connection Setup for TP3' (Case 1) Calibration

Figure 10 shows the calibration setup diagram for TP3' (Test Point 3') using the Anritsu MP1900A BERT. TP3' (Case 1) is a physical test point for calibration without the effect of a channel.



Note: Cables connecting the signal to the Scope should be < 1m.

FIGURE 10. SETUP FOR TP3' (CASE 1) CALIBRATION

Connection Step:

Using the MP1900A BERT setup connections (Section 5.1), connect the MU195050A data outputs through DC blocks to Channels 1 and 3 on the scope using phase matched K-K coaxial cables.

5.3 Connection Setup for TP3 (Case 2) Calibration

Figure 11 and Figure 12 show the calibration setup diagrams for TP3 (Test Point 3) using the Anritsu MP1900A BERT. TP3 (Case 2) is a physical test point that will affect the eye opening due to the sum of a fixed channel length (representing the fixed ISI on the transmitter side of a host or device) and a physical USB Type-C Cable.

For USB4 Gen2 speed (10Gb/s) or Thunderbolt 3 compatible Gen2 speed (10.3125Gb/s), the total Insertion Loss is -18dB at 5GHz, which uses a 2M USB Type-C cable.

For USB4 Gen3 speed (20Gb/s) or Thunderbolt 3 compatible Gen3 speed (20.625Gb/s), the total Insertion Loss is -16.5dB at 10GHz, which uses a 0.8M USB Type-C cable. The cable's downstream plug connector is connected to a calibration fixture to measure the signal with the scope. The scope uses software equalization to open the eye for calibration.

Note: Cables connecting the signal to the Scope should be de-embedded and $\leq 1m$.



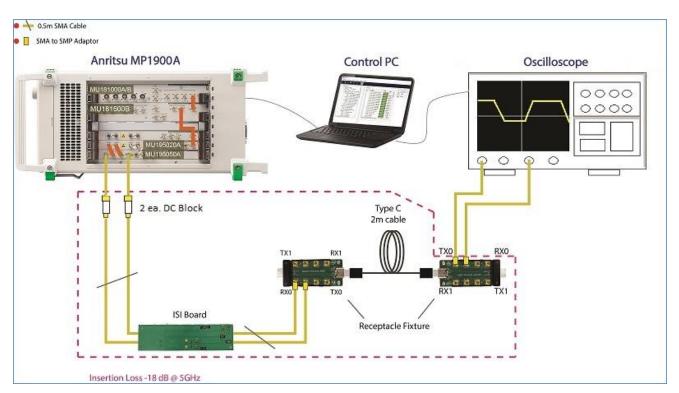


FIGURE 11. SETUP FOR TP3 (CASE 2) CALIBRATION AT 10G OR 10.3125G

Connection Steps:

- 1. Continuing from the MP1900A BERT TP3' (Case 1) calibration setup (Section 5.1), disconnect the MU195050A data outputs from the scope channels.
- 2. Connect the MU195050A data outputs through DC blocks to ISI channels (for 10Gb/s or 10.3125Gb/s) and then to the test fixtures with a 2M USB Type-C cable, and then to Channels 1 and 3 on the scope.



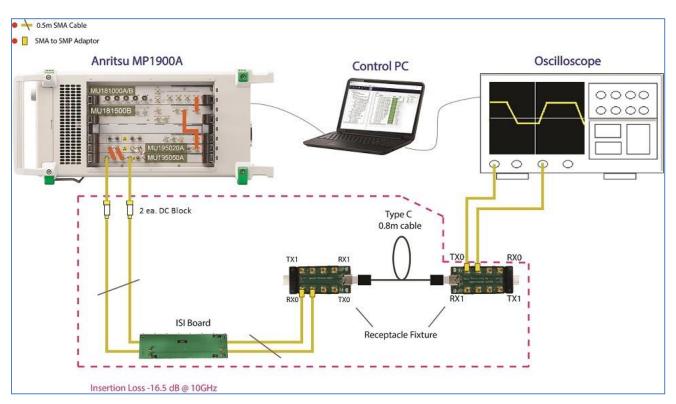
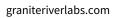


FIGURE 12. SETUP FOR TP3 (CASE 2) CALIBRATION AT 20G OR 20.625G

Connection Steps:

- 1. Continuing from the MP1900A BERT TP3' (Case 1) calibration setup (Section 5.1), disconnect the MU195050A data outputs from the scope channels.
- Connect the MU195050A data outputs through DC blocks to ISI channels (for 20Gb/s or 20.625Gb/s) and then to the test fixtures with a 0.8M USB Type-C cable, and then to Channels 1 and 3 on the scope.





6 Calibrating Using GRL-USB4-RXA Software

6.1 Enter Calibration/Test Session Information

Select from the software menu to access the **Session Info** page. Enter the information as required for the calibration/test session that is currently being run. The information provided will be included in the test report generated by the software once calibration/tests are completed.

- The fields under **DUT Info** and **Test Info** are defined by the user.
- The **Software Info** field is automatically populated by the software.

↓ 🕡 🛧 🐵 ≯ ► → 🛙	
DUT Info Test Info Softwar	e Info
DUT Manufacturer: GRL	Comments
DUT Model Number: USB4_AX001	
DUT Serial Number: 1000888ABC	

FIGURE 13. ENTER CALIBRATION/TEST SESSION INFORMATION

6.2 Set Up Conditions for Calibration/Testing

Select from the software menu to access the Conditions page.

In this section, conditions for Testing and Calibration will need to be set.

1. Select the Test Point(s). [Note: Case 1 calibration (Total Jitter & Eye Height @ TP3') must be performed first prior to Case 2 calibration (Optimized EQ Lookup, Eye Height & Eye Width @ TP3).]

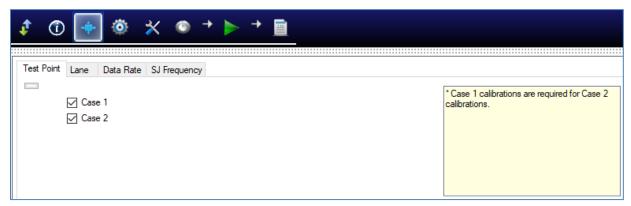


FIGURE 14. SELECT TEST POINT



2. Select the test Port(s) and Lane(s) for the DUT. (*Note: This is only applicable for DUT compliance test and NOT for calibration.*)

1	+	٢	☆	٢	→	+			
Test Point	Lane	Data Rate	SJ Fr	equenc	y				
	Port/	A LO							*This tab is for test only and not applicable to calibrations
	Port/	AL1							
	✓ PortE	3 LO							
	✓ PortE	3 L 1							
	Port(CLO							
	Port(CL1							
	Port[D L0							
	Port[D L1							

FIGURE 15. SELECT DUT PORT AND LANE UNDER TEST

 Select the Data Rate(s) of USB4 Gen2 speed (10Gb/s), USB4 Gen3 speed (20Gb/s), Thunderbolt 3 compatible Gen2 speed (10.3125Gbps) and Thunderbolt 3 compatible Gen3 speed (20.625Gbps).

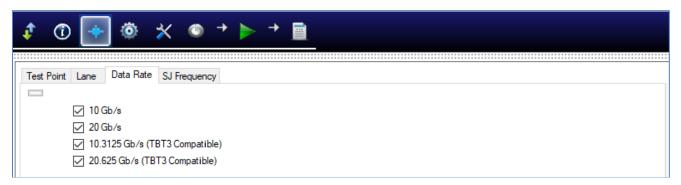


FIGURE 16. SELECT DATA RATE

4. Select the SJ Frequency.

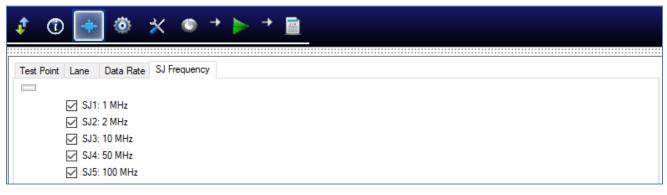


FIGURE 17. SELECT SJ FREQUENCY



6.3 Select Calibration

The test selection page allows calibration/tests that need to be performed to be selected. Initially when starting for the first time or changing anything in the setup, it is suggested to run Calibration first. If the calibration is not completed, the Rx Tests will throw an error message.

The GRL-USB4-RXA software automatically runs the selected calibration when initiated. See Section 6.6 on running the calibration.

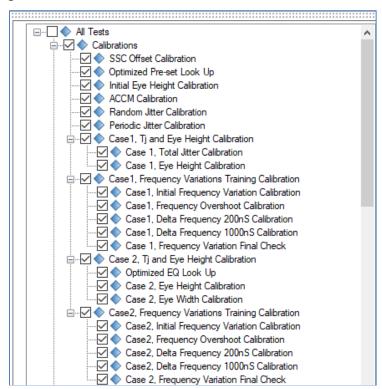


FIGURE 18. SELECT CALIBRATION

Note: The marking shown on the left of each test parameter indicates the status of the calibration/test result of the parameter. In the above example, <> indicates that calibration/testing has not been run for the specific calibration/test parameter. When calibration/testing has been run and completed successfully for the specific calibration/test parameter with a Pass result, this will be indicated with </

6.3.1 Calibrations Group

Select the main Calibrations checkbox to perform all USB4 Rx calibration supported by the GRL-USB4-RXA software.

TABLE 3. SUPPORTED CALIBRATION

Calibration	Description
SSC Offset	Calibrates the frequency offset to achieve the start of the Spread Spectrum Clock



	(SSC) deviation as required by USB4 Specs.
Optimized Pre-set Look Up	Searches for the optimized preset out of 15 possible presets defined in the USB4 Specs. Optimized preset is defined as the preset which yields the lowest number of DDJ.
Initial Eye Height	Calibrates the initial eye height to requirement by USB4 Specs.
ACCM	Calibrates the ACCM as required by USB4 Specs.
Random Jitter	Calibrates random jitter of the BERT using the PRBS15 pattern.
Periodic Jitter	Calibrates sinusoidal jitter of all five of the frequencies as required by the USB4 Specs, and forms a linear curve fit for each SJ frequency.
Case 1, Total Jitter and Eye Height	Calibrates all total jitter and eye height for Case 1 setup at TP3'.
Case 1 & Case 2, Frequency Variations Training	Applies transmitter frequency variation and verifies that the DUT does not lose lock and record errors for Case 1 setup at TP3' and Case 2 setup at TP3 respectively.
Optimized EQ Look Up	Searches for the optimized equalization for the TP3_EQ test point. Note: This option will only be enabled if "Other" is selected as the Calibration method from the Configurations page.
Case 2, Eye Height and Eye Width	Calibrates eye height and eye width for Case 2 setup at TP3.

6.4 Configure Calibration/Test Parameters

After selecting the desired calibration, select if from the software menu to access the Configurations page. Set the required parameters for calibration and tests as described below.

To return all parameters to their default values, select the 'Set Default' button.





			Set Default
⊒ All Tests			Set Delaul
PG Delay: A	to ~		
Overwrite PG Delay:	False	\sim	
PG Delay Value:	0		
ACCM Channel:	Both ~		
Manual ACCM:	False ~		
Enable DeEmbedding:	False	~	
Cable DeEmbedding File:	DoNothing		
Custom Preset Table:	False	~	
Enable Test Characterizatio	Mode: False	~	
EQ DC Gain 20G:	Default ~	1	
EQ DC Gain 10G:	Default ~	i l	
Calibrations		-	
Tek Scope Channel+ Sl	ew(ps):		

FIGURE 19. CONFIGURE CALIBRATION/TEST PARAMETERS

Parameter	Description
PG Delay	Set input Data and Clock delay of the Pulse Pattern Generator (PPG) if used. "Auto" is usually the case. Select "Manual" only if you are sure that the PPG does not require any calibration.
Overwrite PG Delay	"False" is usually the case. If you change this to "True", then you will need to provide a value in the "PG Delay Value" field.
PG Delay Value	If the "Overwrite PG Delay" field is set to "True", enter the Delay value of the PPG.
ACCM Channel	Select "Both" or single channel (splitter required) as the AC Common Mode (ACCM) source if used.
Manual ACCM	Set to "True" to manually set the ACCM source or "False" to apply calibrated values from ACCM calibration.
Enable DeEmbedding	Set to "True" to de-embed cable while calibrating.
Cable DeEmbedding File	Define the cable transfer function file. Applicable only when the "Enable

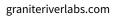


	DeEmbedding" field is set to "True".
Custom Preset Table	Set to "True" to use the list of user-defined measurement preset values for calibration.
Enable Test Characterization Mode	Set to "True" to run eye diagram tests to determine worst-case margins.
EQ DC Gain (20G & 10G)	Select the DC Gain setting index for the 10G and 20G TP3_EQ systems.
Tek Scope Channel+ & Channel- Skew	If the Tektronix ATI based Scope is to be used for measurements, enter the channel skew or timing to perform alignment of the Scope channels.
Rj Bandwidth	Select to use "Narrow" or "Wide" band for jitter decomposition algorithm to separate random jitter.
Fit Rj From Calibration	Set to "True" to fit random jitter value from calibration when running total jitter calibration.
Rj Sampling Method	Select the method to be used to perform random jitter sampling.
Fine Stepping	Set to "True" to enable fine stepping for the eye mask.
Tj Sampling Method	Select the method to be used to perform total jitter sampling.
10G & 20G Damping Factor	Define the 10G and 20G damping factor rates to use for calibration.
Tj Adjust Param	Select whether to use "Rj" or "Sj" for total jitter calibration for both <100 MHz and 100 MHz cases.
Eye Width Tuning	Select "Retune" to repeat the tuning cycle or "Retry" the current tuning procedure when measuring eye width.
Align Eye Mask Delay	Set to "True" to perform alignment for the delay in between validating the eye mask.
Maximum Retry	Enter the number of times to repeat calibration for pass/fail condition.
Calibration Method	Select the method to be used to perform post processing waveform analysis for Rx stressed eye calibration. The SigTest signal quality test method will be used by default or select "Other" to use other supported vendor specific method (Keysight, Tektronix or Teledyne LeCroy Scope measurement tools).
	Note: The vendor specific method option will eventually be obsolete and replaced with SigTest instead.
	Note: Selecting "Other" will enable the "Optimized EQ Look Up" calibration option under the Case 2, TJ and Eye Height Calibration group. See Table 3Table 3. Supported Calibration.
	SigTest allows waveforms captured with the oscilloscope to be analyzed and checked against the specified pass/fail criteria. <i>Refer to Appendix of this</i> <i>document for additional information on SigTest requirements.</i>
SigTest Version	Enter the Version number of the SigTest signal quality test to be run during





	calibration to ensure waveform compliance. Make sure that the SigTest application is already installed in the test controller system.									
SigTest Path	Enter the full path of the SigTest location in the test controller system.									
SigTest Max Thread Count	Set the maximum process threads to generate for checking the Rx device functionality when running SigTest.									
Remote File Server IP Address	Enter the IP address for the GRL Remote Proxy Server. See Section 4.1.3 on how to set up the remote file server.									
Remote File Server Port Number	Enter the Port number for the GRL Remote Proxy Server. See Section 4.1.3 on how to set up the remote file server.									
Perform Link Training	Select the option to run or disable link training for Rx test.									
BER Automation	Select the method to be used to run Rx BER tests.									
Save BERT Setup Only	"False" is usually the case. Set to "True" if you are sure that you only want to save the BERT test setup in the Rx test.									
Prompt Before Link Training	"False" is usually the case. Set to "True" if you want to be prompted prior to start running link training. Ensure that the "Always" or "Once" run option is selected in the "Perform Link Training" field.									
Skip DUT Reset	"False" is usually the case. Set to "True" if you want to reset the DUT when performing tests.									
Script Version	Select the version of the TenLira test script ("ver 0.8.3" or above) or the ETT test script ["ETT(v0.9.4)" or "ETT(v0.9.5)"] to be used.									
DUT Platform	Select the platform/processor as supported by the DUT for running test scripts.									
DUT with Re-timer	If the ETT test script is selected in the "Script Version" field, set to "True" if the DUT has additional re-timer.									
ETT Test Port Mapping	If the ETT test script is selected in the "Script Version" field, specify the test connector lanes to validate the port mapping of the DUT connectors.									
Set Swap Lane with ETT	If the ETT test script is selected in the "Script Version" field, select the router and/or re-timer setup to perform lane switching for the DUT.									
Preset Negotiation Interval(s)	Set the time interval in seconds between preset negotiations.									
Ridge	If the Tenlira test script is selected in the "Script Version" field, select the number of ports to be tested for the ridge DUT.									
DUT Chipset (When Using Tenlira Only)	If the Tenlira test script is selected in the "Script Version" field, select the Titan Ridge "TR" or Alpine Ridge "AR" processor as supported by the DUT.									
Remote/Local Working Directory	Set the working directory to the path where the test script is installed in the host PC.									





Remote IP Address	Enter the IP address of the remote host of the test script.								
Remote Port Number	Enter the port number of the remote host of the test script.								
Remote Script	Enter the name of the remote test script.								
Remote Script Arguments	Set the arguments for executing the remote test script.								
Run Post Test Script	Select the option to run the remote test script in the post-test stage.								
Post Test Remote Script	Enter the name of the remote test script for post-test.								
Post Test Remote Script Directory	Set the working directory to the path where the post-test script is installed in the host PC.								
Short Test Link Training Cycle	Define the number of times to perform link training for short BER loopback.								
Maximum Error	Define the maximum error count for error checking during Rx test.								
Prompt When BER Overflow	"False" is usually the case. Set to "True" if you want to be prompted if there is buffer overflow during BER testing.								
Case 1 Preset Mapping	Select "Active" or "Passive" mapping for presets for Case 1 setup at TP3'.								
Load User Calibration Data	"False" is usually the case. Set to "True" if you want to recall and use a saved calibrated setup in the Rx test.								
10G & 20G Compliance Test Duration	Set how long it would take (in seconds) to test the DUT for 10G or 20G compliance.								
Frequency Variation Test Trials	Set the number of times to run the Rx signal frequency variations training test for each DUT lane.								
Frequency Variation Test with SSC Profile	"True" is usually the case. Set to "False" if SSC is not supported by the DUT when running the Rx signal frequency variations training test.								
Use Calibrated SSC Profile	"True" is usually the case. Set to "False" if you do not want to use a saved calibrated SSC profile setup when running the Rx signal frequency variations training test.								
Margin Step Size (%)	Set the step size for stepping through SJ or amplitude margins when running the optional margin search tests.								
Maximum Margin Test Error	Define the maximum error count for error checking during margin search tests.								
Maximum Steps	Define the maximum number of steps to step through margins.								
10G & 20G Margin Test Duration(s)	Set how long it would take (in seconds) to run full margin search tests for the 10G and 20G data rates.								
Short Margin Test Duration	Set the duration in seconds to run a brief margin search test.								
Quick Margin Search Scan	Set to "True" to perform a quick scan for worst-case margins during margin search tests.								



Margin Limit Line	Select the option to use a limit based on calibrated or specification values for margin search tests.								
Final Eye Preset	Select the option to use a preset from calibration or link training for final eye measurements.								
CTLE DC Gain	Select the DC Gain value to be used based on the CTLE model to measure eye heights for TP3_EQ tests.								
10G & 20G User Defined CTLE Gain	If "User Defined" is selected in the "TP3 CTLE DC Gain" field, select the optimized CTLE Gain setting index for the 10G and 20G TP3_EQ systems.								

6.5 Configure Calibration Target Values

Select in the main software menu to access the Calibration Target page. User may change the calibration target value for any of the calibration items. By default, the target values are those defined in the specification. Change the values only when debugging.

To change the values, un-select the Use Default Value checkbox. Also at any point in time if the default values are required, just select the checkbox and the default values will replace all the current values.

Note: The PID Control setting is used to adjust the step width for steps calculation if the target measurement cannot be met with the current step. To adjust, use a lower PID Control value to reduce the subsequent step or increase the control value to make the subsequent step bigger.

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	V V	lse Defau	ılt Value	3															
	Case1, I	Initial Free	quency	Variati	on Calibration	Cas	e 1, Fre	quency	Oversh	noot Calibration	n Case1, De	lta Frequer	ncy 200n S Calibra	ation	Case 1, Delta Frequ	ency 10	100nS Calibrat	tion	
	Case 2,	Eye Heig	ght Calib	bration	Case 2, Eye	e Widti	h Calibr	ation	Case2,	Initial Frequer	ncy Variation C	alibration	Case2, Frequen	ncy Ove	vershoot Calibration	Case2,	, Delta Freque	ency 200	nS Calibration
	Case2, [Delta Fre	quency	1000r	nS Calibration														
	SSC Offe	set Calibr	ration	Initial I	Eye Height Ca	alibratic	on AC	CM Ca	libration	Random Jit	ter Calibration	Periodic	Jitter Calibration	Case	e 1, Total Jitter Calibr	ration (Case 1, Eye H	leight Ca	libration
	Rat	te_10G	Rate_	20G	Rate_10p312	25G	Rate_2	0p6250	3										
	Ini	itial Cal			300		ppm												
	Ta	arget Valu	le:		99.96		ps												
	Mi	in Limit:			99.96		ps												
	Ma	ax Limit:			99.98		ps												
	Pli	D Contro	d.		30														





6.6 Run Calibration

Select in the main software menu to access the Run Tests page.

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		ikip Test	t If Result									Run Tests	

FIGURE 21. RUN CALIBRATION

Select the Run Option before clicking the "Run Tests" button to start selected calibration:

- **Skip Test if Result Exists.** If previous calibration results exist, then the software will *skip* the calibration steps that have existing reports.
- **Replace if Result Exists.** If previous calibration results exist, then the software will *replace* each step in the calibration with new results.

When calibration is running, the connection setup diagram of the respective calibration will initially appear as a guide for the user to make sure all connections are proper before calibration is performed.



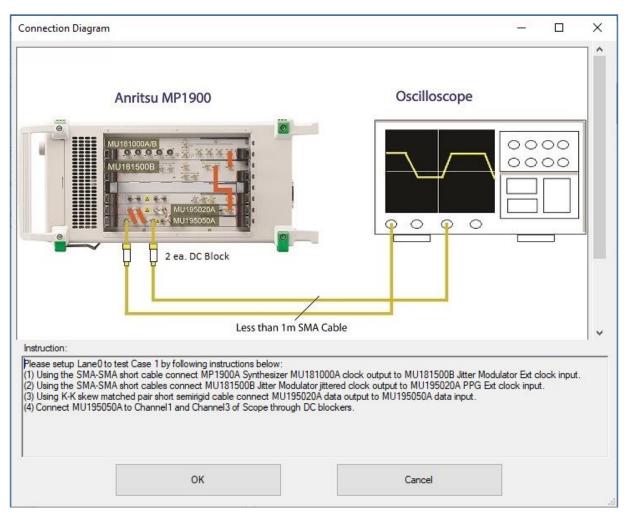


FIGURE 22. CONNECTION SETUP DIAGRAM DIALOG EXAMPLE

If you need to re-run only certain calibration on certain conditions, delete the calibration results from the Report tab and Run with **Skip Test if Result Exists.** The GRL software will keep track of the missing calibration results in the report and perform those calibration only. See Section 8.2, Delete Test Results for details.



7 Compliance Testing Using GRL-USB4-RXA Software

After calibration has completed successfully, receiver BER (Bit Error Rate) compliance and optional margin testing can then be performed on the device under test (DUT). The GRL-USB4-RXA software automates the Gen2 & 3 receiver compliance testing for BER tolerance, at the specdefined or user-defined jitter frequency steps. The receiver will also undergo signal frequency variations during Link training for the Case 2 setup, before obtaining steady state.

If desired, optional receiver margin testing can be additionally performed via the GRL-USB4-RXA software to search for SJ and amplitude margins.

When testing is completed, the results will be logged in an aggregated test report which can be generated into PDF format.

7.1 Connection Setups for BER Testing

This section describes the test setups for the host/device DUT using the USB4 microcontroller and MP1900A BERT. Test scripts as listed in Section 3.2 are required to run the automation tests. Also refer to Section 4.1.1 or Appendix F for options on how to configure the test setup.

7.1.1 BER Test Setup for TP3' (Using USB4 Microcontroller Method and MP1900A BERT)

Figure 23 shows the USB4 host/device DUT test setup diagram for TP3' (Test Point 3', Case 1) using the USB4 microcontroller method and the MP1900A BERT. The calibrated stressed signal is attached to a plug style test fixture and crosstalk is added to the fixture from the DUT which generates crosstalk signals. The microcontroller is used to directly control the DUT by executing microcontroller test scripts.

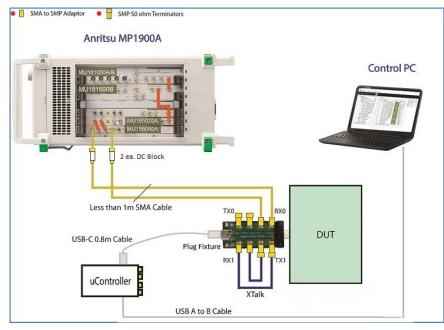


FIGURE 23. RX BER TEST SETUP AT TP3' (USING USB4 MICROCONTROLLER AND MP1900A BERT)



Connection Steps:

- 1. Attach the USB Type-C connector of the plug fixture to the DUT receptacle.
- 2. Using the MP1900A BERT TP3' (Case 1) calibration setup (Section 5.2), disconnect the MU195050A data outputs from the scope channels.
- 3. Connect the MU195050A data outputs through DC blocks to Rx Lane0/Lane1 of the DUT through the plug fixture.
- 4. Connect the USB4 microcontroller to power supply and to the controller PC.
- 5. Connect a 0.8M USB Type-C cable between the microcontroller and plug fixture.
- 6. Connect Tx Lane0/Lane1 of the plug fixture to the Rx lanes of the plug fixture that are not under test to inject crosstalk.
- 7. Terminate the Tx lanes of the plug fixture that are not under test with 50Ω termination.
- 8. Run the microcontroller test scripts to control the DUT.

7.1.2 BER Test Setup for TP3 (Using USB4 Microcontroller Method and MP1900A BERT)

Figure 24 shows the USB4 host/device DUT test setup diagram for TP3 (Test Point 3, Case 2) at 10G using the USB4 microcontroller method and the MP1900A BERT. The USB Type-C cable is disconnected from the calibration fixture and connected to the host/device DUT's USB Type-C receptacle connector. The microcontroller is used to directly control the host/device DUT by executing microcontroller test scripts.

For USB4 Gen2 speed (10Gb/s) or Thunderbolt 3 compatible Gen2 speed (10.3125Gb/s), the setup uses a 2M USB Type-C cable.

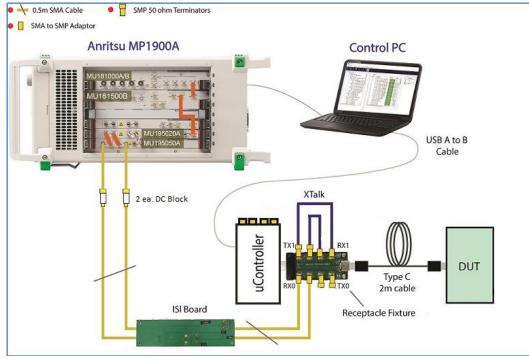


FIGURE 24. SETUP FOR TP3 RX BER TEST AT 10G OR 10.3125G (USING USB4 MICROCONTROLLER AND MP1900A BERT)



Connection Steps:

- 1. Using the MP1900A BERT TP3 (Case 2) calibration setup (Section 5.3), disconnect the test fixture that connects to the scope.
- 2. Attach the 2M USB Type-C cable to the DUT receptacle.
- 3. Connect the ISI channels to Rx Lane0/Lane1 of the test fixture.
- 4. Connect the USB4 microcontroller to power supply and to the controller PC.
- 5. Attach the microcontroller to the test fixture.
- 6. Connect Tx Lane0/Lane1 of the test fixture to the Rx lanes of the test fixture that are not under test to inject crosstalk.
- 7. Terminate the Tx lanes of the test fixture that are not under test with 50Ω termination.
- 8. Run the microcontroller test scripts to control the DUT.

Figure 25 shows the USB4 host/device DUT test setup diagram for TP3 (Test Point 3, Case 2) at 20G using the USB4 microcontroller method and the MP1900A BERT. The USB Type-C cable is disconnected from the calibration fixture and connected to the host/device DUT's USB Type-C receptacle connector. The microcontroller is used to directly control the host/device DUT by executing microcontroller test scripts.

For USB4 Gen3 speed (20Gb/s) or Thunderbolt 3 compatible Gen3 speed (20.625Gb/s), the setup uses a 0.8M USB Type-C cable.

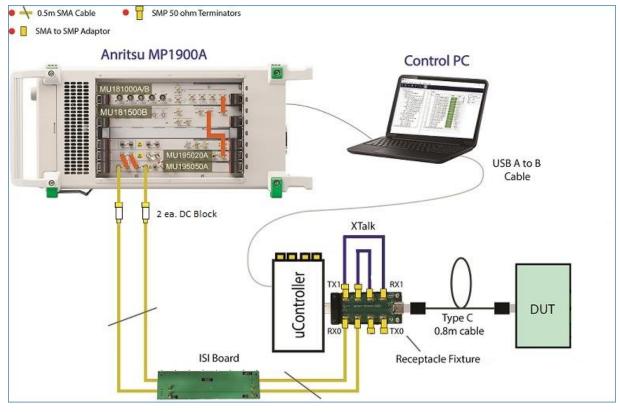
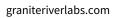


FIGURE 25. SETUP FOR TP3 Rx BER TEST AT 20G OR 20.625G (USING USB4 MICROCONTROLLER AND MP1900A BERT)





Connection Steps:

- 1. Using the MP1900A BERT TP3 (Case 2) calibration setup (Section 5.3), disconnect the test fixture that connects to the scope.
- 2. Attach the 0.8M USB Type-C cable to the DUT receptacle.
- 3. Connect the ISI channels to Rx Lane0/Lane1 of the test fixture.
- 4. Connect the USB4 microcontroller to power supply and to the controller PC.
- 5. Attach the microcontroller to the test fixture.
- 6. Connect Tx Lane0/Lane1 of the test fixture to the Rx lanes of the test fixture that are not under test to inject crosstalk.
- 7. Terminate the Tx lanes of the test fixture that are not under test with 50Ω termination.
- 8. Run the microcontroller test scripts to control the DUT.

7.2 Select DUT Type

Select 🧐 from the software menu to access the Setup Configuration page.

Select either a USB4 Host or Device to be tested.

¢	1	+	Ö	☆	٢	+		→	
	* * * * * * * * * * * * * *			* * * * * * * * * * * *					
	DUT C	Configura	tion						
		OUT Typ	e.	Ho	ot		~		
		501 190	.	Ho					
•					vice				

FIGURE 26. SELECT DUT TYPE



7.3 Select DUT Rx Tests

On the test selection page, deselect all Calibration selections as they were completed in the previous section. Scroll down to access the Rx Test selections. Select the check boxes of the respective tests to be run.

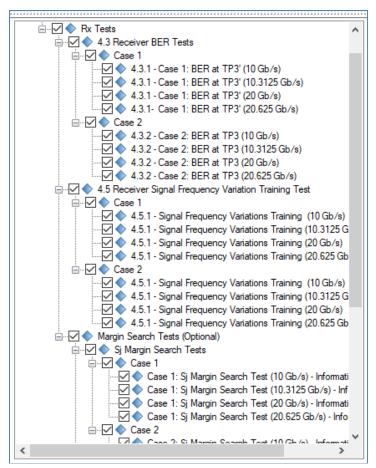


FIGURE 27. SELECT DUT RX TESTS TO BE RUN

7.3.1 Receiver Test Group

Select the main Rx Tests checkbox to perform all USB4 Rx tests for the DUT supported by the GRL software with parameters from the calibration steps.

Rx Test	Description
Receiver BER Tests	Runs all BER compliance tests as required by the USB4 Specs.
Receiver Signal Frequency Variation Training Tests	Applies transmitter frequency variations during link training before obtaining steady state.
Sj Margin Search Tests	Runs Optional tests to search for SJ Margin (for information purpose



	only)
Amplitude Margin Search Tests	Runs Optional tests to search for Amplitude Margin (for information purpose only)

7.4 Set Up USB4 Microcontroller Environment

Select Kircle from the software menu to access the Configurations page.

The fields for setting up the USB4 microcontroller environment are as shown below:

¢	1	+ @ 🔀 © → ⊳ → 🖻
		BER Automation:
		Save BERT Setup Only: False ~
		Prompt Before Link Training:
		Skip DUT Reset:
		Script Version: ETT(v0.9.5)
		DUT Platform: V
		DUT with Re-timer:
	ļ	ETT Test Port Mapping: 1,3,5,7
		Set Swap Lane with ETT: None V
		Preset Negotiation Interval(s): 0.5
		Ridge: 1
		DUT Object (Marco United Tables Only)
		Remote/Local Working Directory: C:\uController

FIGURE 28. SETUP FOR USB4 MICROCONTROLLER ENVIRONMENT

To set up the software to call the microcontroller script from a controller PC:

- 1. Set the **BER Automation** field to "uController".
- 2. Set the **Remote/Local Working Directory** field to the path where the microcontroller script is installed in the controller PC.



7.5 Set Up Intel's TenLira Environment

Select from the software menu to access the Configurations page.

The fields for setting up the TenLira environment are as shown below:

¢	٦	+ 💿 🗙 👁	→ ▶ → ■
		BER Automation:	Tenlira 🗸
		Save BERT Setup Only:	False 🗸
		Prompt Before Link Training:	False ~
		Skip DUT Reset:	False ~
		Script Version:	ver 0.8.3 ~
		DUT Platform: C	Other ~
		DUT with Re-timer:	True \lor
		ETT Test Port Mapping:	1.3.5.7
		Set Swap Lane with ETT:	None \checkmark
		Preset Negotiation Interval(s):	0.5
		Ridge: 1	Ý
	-	DUT Chipset (When Using Ten	nlira Only): VR
		Remote/Local Working Directo	ory: C:\Tenlira\
		Remote IP Address:	192.168.0.2
		Remote Port Number:	53397
		Remote Script:	python ErrorDector.py

FIGURE 29. SETUP FOR TENLIRA ENVIRONMENT

To set up the software to call the TenLira script from a remote host:

- 1. Set the **BER Automation** field to "Tenlira".
- 2. Select the **TenLira Script Version** to be used.
- 3. Select the number of ports for the **Ridge** DUT.
- 4. Select the supported **DUT Chipset**.
- 5. Set the **Remote/Local Working Directory** field to the path where the TenLira script is installed in the host PC.
- 6. Provide the **Remote IP Address** and **Remote Port Number** of the remote host.
- 7. Enter the name of the **Remote Script** to be used.



7.6 Set Up USB4 ETT Environment

Select from the software menu to access the Configurations page.

The fields for setting up the ETT environment are as shown below:

🦸 🛈 🤫	+ 🐵 🔀 ⊙ → ⊳ → 🖻
	BER Automation:
	Save BERT Setup Only: False
	Prompt Before Link Training: False ~
	Skip DUT Reset: False V
- (Script Version: ETT(v0.9.4)
	DUT Platform: Tiger Lake ~
	DUT with Re-timer:
	ETT Test Port Mapping: 1,3,5,7
	Set Swap Lane with ETT: Router
	Preset Negotiation Interval(s): 0.5
	Ridge: 1
	DUT Chipset (When Using Tenlira Only):
- (Remote/Local Working Directory: C:\USB4 Electrical\uController
	Remote IP Address: 192.168.0.2
	Remote Port Number: 53397
	Remote Script: USB4_Host_Rx_10G.tbc

FIGURE 30. SETUP FOR ETT ENVIRONMENT

To set up the software to call the ETT script from a remote host:

- 1. Set the **BER Automation** field to "uController".
- 2. Select the ETT Script Version to be used.
- 3. Select the **DUT Platform** as supported by the DUT.
- 4. Select "True" if to use the **DUT with Re-timer**.
- 5. Specify the test connector lanes of the DUT to validate for **ETT Test Port Mapping**.
- 6. To perform lane switching for the DUT, select the router and/or re-timer setup in the **Set Swap Lane with ETT** field.
- 7. Set the **Remote/Local Working Directory** field to the path where the ETT script is installed in the host PC.



- 8. Provide the **Remote IP Address** and **Remote Port Number** of the remote host.
- 9. Enter the name of the **Remote Script** to be used.

7.7 Run DUT Rx Tests

Select **I** from the software menu to access the Run Tests page. Select the Run Option as desired before clicking the Run Tests button to start testing the DUT. (*This is similar to Section 6.6;* refer for more details.)

\$ Ū	+	٥	☆	۲	→ <mark>></mark> -	•	_					
	škip Test	i If Result If Result I								Run Te	sts	

FIGURE 31. RUN TESTS





8 Test Results and Reports Using GRL-USB4-RXA Software

The **Report** page has all the results from all the test runs displayed. If some of the results are not desired, they can be individually deleted by using the **Delete** button. Also for a PDF report, select the **Generate report** button. To have the calibration data plotted in the report, make sure the **Plot Calibration Data** box is checked.

lesult					
No	TestName	Result	Limits	Val 🔺	Generate report
1	SSC Offset Calibration	PASS	N/A	N/	Delete
2	Initial Eye Height Calibration	PASS	N/A	N/	
3	Initial Eye Height Calibration	PASS	N/A	N/ =	S Delete All
4	Initial Eye Height Calibration	PASS	N/A	N/	
5	Initial Eye Height Calibration	PASS	N/A	N/	
6	Optimized Pre-set Look Up	PASS	N/A	N/	
7	Optimized Pre-set Look Up	PASS	N/A	N/	
8	Optimized Pre-set Look Up	PASS	N/A	N/	
9	Optimized Pre-set Look Up	PASS	N/A	N/	
10	ACCM Calibration	PASS	N/A	N/	
11	ACCM Calibration	PASS	N/A	N/	
12	ACCM Calibration	PASS	N/A	N/	
13	ACCM Calibration	PASS	N/A	N/	
14	Random Jitter Calibration	PASS	N/A	N/	
15	Random Jitter Calibration	PASS	N/A	N/	
16	Random Jitter Calibration	PASS	N/A	N/	
17	Random Jitter Calibration	PASS	N/A	N/	
18	Sinusoidal Jitter Calibration	PASS	N/A	N/	
19	Sinusoidal Jitter Calibration	PASS	N/A	N/	
20	Sinusoidal Jitter Calibration	PASS	N/A	N/	
21	Sinusoidal Jitter Calibration	PASS	N/A	N/	
22	Sinusoidal Jitter Calibration	PASS	N/A	NZ	
23	Sinusoidal Jitter Calibration	PASS	N/A	N/	
24	Sinusoidal Jitter Calibration	PASS	N/A	N/	

FIGURE 32. REPORT RESULTS PAGE



8.1.1 DUT Information

This portion is populated from the information in the DUT tab from the **Session Info** tab.

	Anritsu USB4 Rx Test Report
DUT Information	
DUT Manufacturer	: GRL
DUT Model Number	: USB4_AX001
DUT Serial Number	: 1000888ABC
DUT Comments	:
Test Information	
Test Lab	: Granite River Labs
Test Operator	: John
Test Date	: April 1, 2020
Software Version	
Software Revision	: 0.00.43

FIGURE 33. DUT INFORMATION

8.1.2 Results Summary Table

This portion is populated from the calibration and tests performed with their respective results. This gives an overall view of all the results and test conditions.

No	TestName	Limits	Value	Results	Test Point	Lane	Data Rate	SJ Frequency
1	SSC Offset Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	N/A
2	SSC Offset Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	N/A
3	SSC Offset Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	N/A
4	SSC Offset Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20p625G	N/A
5	Initial Eye Height Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	N/A
6	Initial Eye Height Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	N/A
7	Initial Eye Height Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	N/A
8	Initial Eye Height Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20p625G	N/A
9	Optimized Pre-set Look Up	N/A	N/A	Pass	N/A	N/A	Rate_10G	N/A
10	Optimized Pre-set Look Up	N/A	N/A	Pass	N/A	N/A	Rate_20G	N/A
11	Optimized Pre-set Look Up	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	N/A
12	Optimized Pre-set Look Up	N/A	N/A	Pass	N/A	N/A	Rate_20p625G	N/A
13	ACCM Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	N/A
14	ACCM Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	N/A
15	ACCM Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	N/A
16	ACCM Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20p625G	N/A
17	Random Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	N/A
18	Random Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	N/A
19	Random Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	N/A
20	Random Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20p625G	N/A
21	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	SJ1
22	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	SJ2
23	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	SJ3
24	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	SJ4
25	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10G	SJ5
26	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	SJ1
27	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	SJ2
28	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	SJ3
29	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	SJ4
30	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_20G	SJ5
31	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	SJ1
32	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	SJ2
33	Periodic Jitter Calibration	N/A	N/A	Pass	N/A	N/A	Rate_10p3125G	SJ3

FIGURE 34. RESULTS SUMMARY TABLE EXAMPLE



8.1.3 Compliance Test Results

This portion is populated from the results of all Rx compliance tests performed.

	G BER at TP				
j Frequency	SJ1	SJ2	SJ3	SJ4	SJ5
ane0	-	-	-	-	-
ane1	-	-	-	-	-
.ane2	-	-	-	-	-
.ane3	-	-	-	-	-
se1 20G BEF	at TP3'				
ij Frequency	SJ1	SJ2	SJ3	SJ4	SJ5
ane0	-	-	-	-	-
.ane1	-	-	-	-	-
.ane2	-	-	-	-	-
	BED at TD3	-	-	-	-
se1 20p625G	BER at TP3				
<mark>se1 20p625G</mark> 6j Frequency	BER at TP3	SJ2	SJ3	SJ4	\$J5
se1 20p625G 6j Frequency .ane0	BER at TP3	SJ2 -	SJ3 -	SJ4 -	\$J5 -
sel 20p625G bj Frequency ane0 ane1	BER at TP3	SJ2 - -	SJ3 - -	SJ4 - -	SJ5 - -
sel 20p625G bj Frequency ane0 ane1 ane2	BER at TP3	SJ2 - - - -	SJ3 - - -	SJ4 - - -	SJ5 - - -
sel 20p625G 6j Frequency ane0 ane1 ane2	BER at TP3	SJ2 - -	SJ3 - -	SJ4 - -	SJ5 - -
sel 20p625G 5j Frequency ane0 ane1 ane2 ane3	BER at TP3	SJ2 - - - -	SJ3 - - -	SJ4 - - -	SJ5 - - -
sel 20p625G j Frequency ane0 ane1 ane2 ane3 se2 10G BEF	BER at TP3	SJ2 - - - -	SJ3 - - -	SJ4 - - -	SJ5 - - -
sel 20p625G bj Frequency ane0 ane1 ane2 ane3 se2 10G BEF bj Frequency	BER at TP3	SJ2 - - - - -	SJ3 - - - - -	SJ4 - - - -	SJ5 - - - -
sel 20p625G bj Frequency ane0 ane1 ane2 ane3 se2 10G BEF bj Frequency ane0	BER at TP3	SJ2 - - - - - - - - - - - - - - - - - - -	SJ3 - - - - - - - - - - -	SJ4 - - - - - - - - - - - -	SJ5 - - - - - - - SJ5
Lane3 ase1 20p625G Sj Frequency Lane0 Lane1 Lane2 Lane3 Sj Frequency Lane0 Lane0 Lane0 Lane1 Lane2 Lane1 Lane2	BER at TP3	SJ2 - - - - - - - - - - - - - - - - - - -	SJ3 - - - - - - - - - - - - - - - - - - -	SJ4 - - - - - - - - - - - - - - - - - - -	SJ5 - - - - - - - - - - - - - - - - - - -



Case2 10p3125G BER at TP3

Sj Frequency	SJ1	SJ2	SJ3	SJ4	S J5
Lane0	-	-	-	-	-
Lane1	-	-	-	-	-
Lane2	-	-	-	-	-
Lane3	-	-	-	-	-
Sj Frequency	SJ1	\$J2	\$J3	SJ4	\$J5
	SJ1	SJZ	S J3	SJ4	SJ5
Lane0	-	-	-	-	-
Lane1	-	-	-	-	-
Lane2	-	-	-	-	-
Lane3	-	-	-	-	-
ase2 20p625G	BER at TP3	SJ2	SJ3	SJ4	\$J5
Sj Frequency					
Lane0	-	-	-	-	-
Lane1	-	-	-	-	-
Lane2	-	-	-	-	-
Lane3					

FIGURE 35. COMPLIANCE TEST RESULTS EXAMPLE

8.1.4 Calibration & Test Result Details

This portion is populated with results from each of the calibration and test runs. Here the results are explained in depth with supporting data points and screenshots. If the Plot Calibration Data checkbox is selected, then the plots are also displayed.

102. Case 2, Eye Width Calibratio	n [C	Case2,Rate_20p625G,SJ5]
Pass/Fail Stats	:	Pass
Cal Parameter	:	Eye_Width_Rate_20p625GCase2SJ5
Settings Parameter	:	SJ (p-p)
Settings	:	120.0000 mUI(p-p)
Measured Parameter	:	Compliance TJ
Measured Value	:	537.2145 mUI(p-p)
Tj Adjust Parameter	:	Sj
Sj Frequency	:	100.0000 MHz
Test completed time	:	30 September 2020 5:33:44 AM





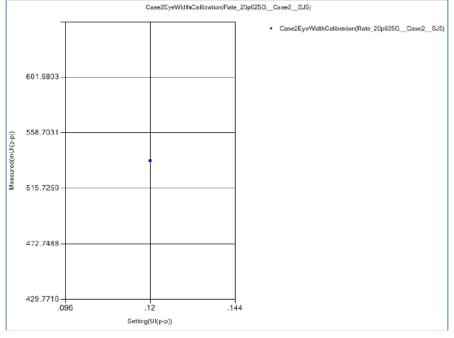


FIGURE 36. CALIBRATION/TEST RESULT DETAILS EXAMPLE



8.2 Delete Test Results

If some of the results are not desired, they can be individually deleted by selecting the **Delete** button.

Result					
No	TestName	Result	Limits	Va 🔺	Generate report
1	SSC Offset Calibration	PASS	N/A	N/	S Delete
2	Initial Eye Height Calibration	PASS	N/A	N/	
3	Initial Eye Height Calibration	PASS	N/A	N/	O Delete All
4	Initial Eye Height Calibration	PASS	N/A	N/ =	(=)
5	Initial Eye Height Calibration	PASS	N/A	N/	
6	Optimized Pre-set Look Up	PASS	N/A	N/	
7	Optimized Pre-set Look Up	PASS	N/A	N/	
8	Optimized Pre-set Look Up	PASS	N/A	N/	
9	Optimized Pre-set Look Up	PASS	N/A	N/	
10	ACCM Calibration	PASS	N/A	N	
11	ACCM Calibration	PASS	N/A	N/	
12	ACCM Calibration	PASS	N/A	N/	
13	ACCM Calibration	PASS	N/A	N/	
14	Random Jitter Calibration	PASS	N/A	N/	
15	Random Jitter Calibration	PASS	N/A	N/	
16	Random Jitter Calibration	PASS	N/A	N/	
17	Random Jitter Calibration	PASS	N/A	N/	
18	Sinusoidal Jitter Calibration	PASS	N/A	N/	
19	Sinusoidal Jitter Calibration	PASS	N/A	N/	
20	Sinusoidal Jitter Calibration	PASS	N/A	N/	
21	Sinusoidal Jitter Calibration	PASS	N/A	N/	
22	Sinusoidal Jitter Calibration	PASS	N/A	N/	
23	Sinusoidal Jitter Calibration	PASS	N/A	N/	
24	Sinusoidal Jitter Calibration	PASS	N/A	N/	Plot Calibration Data

FIGURE 37. DELETE INDIVIDUAL CALIBRATION/TEST RESULTS EXAMPLE

To remove all results, select the **Delete All** button.

/	Result]				Generate report
	No	TestName	Result	Limits	¥	Delete
						Delete All

FIGURE 38. DELETE ALL RESULTS





9 Saving and Loading Test Sessions

The GRL-USB4-RXA software enables Calibration and Test Results to be created and maintained as a 'Live Session' in the application. This allows you to quit the application and return later to continue where you left off.

Save and Load Sessions are used to Save a Test Session that you may want to recall later. You can 'switch' between different sessions by Saving and Loading them when needed.

To save a session, with all of the parameter information, the test results, and any waveforms, use the "Options" command on the menu bar, then the "Save Session" command.

To load a session back into the software, including the saved parameter settings, use the "Options" command on the menu bar, then the "Load Session" command.

To create a New session and return the application back to a default configuration, use "Options" command on the menu bar, then the "New Session" command.

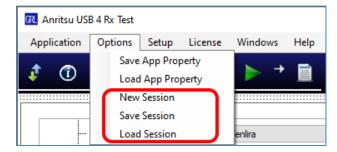


FIGURE 39. SAVING AND LOADING CALIBRATION AND TEST SESSIONS

The configuration and session results are saved in a file with the extension '.ses', which is a compressed zip-style file, containing a variety of information.



10 Appendix A: Manual Calibration & Test Methodologies

Note the MP1900A BERT is used in the following calibration and test methodologies.

10.1 Calibrate Receiver Stressed Eye for 10Gb/s or 10.3125Gb/s Test Case 1 at TP3'

- 1. Set up the physical equipment connections without the ISI channel, as per Figure 10.
- 2. Set up the MP1900A BERT as follows:
 - a) Go to Menu Bar \rightarrow File \rightarrow Initialize.
 - b) Go to Jitter tab and set Clock Source to "Unit1:Slot2:MU181000B". See Figure 40.
 - c) Go to PPG \rightarrow Misc2.
 - d) Set Clock Source to "Unit1:Slot4:MU181500B". See Figure 46.
 - e) Set Bit Rate to 10Gbit/s or 10.3125Gbit/s. See Figure 46.
 - f) Set Offset (ppm) to 300ppm for rounded rate (10G) and 400ppm for legacy rate (10.3125G). See Figure 46.
 - g) Set Output Clock Rate to "Fullrate". See Figure 46.
 - h) Set Test Pattern on PPG to "PRBS" and Length to "2^15-1" bits. See Figure 42.
 - i) Turn on PPG Data Output.
 - j) Go to PPG → Emphasis tab and turn on "Manual Setting". See Figure 43.
 - k) Turn on "SSC", with settings of 32kHz (for 10G) or 36kHz (for 10.3125G) with 5600ppm (for 10G) and 5800ppm (for 10.3125G) triangle down spread. (SSC will remain on for all of the following steps.) See Figure 44.
 - l) Set DATA+ amplitude to 620mV. A differential amplitude just over the 700mV EH should show as an initial value. (See the lower left in Figure 45.)
 - m) Set initial CM frequency to 400MHz. See Figure 46.
 - n) Turn the CM output to "Off" until the CM Calibration Step.



[4] Jitter Modulation Sourc	e				
SJ1 Off SJ2 10 Hz 0.000 Ulp-p 0.	Off 10 Hz .000 Ulp-p		BUJ Off 0.000 Ulp-p	RJ 0.000	Off Ext Of Ulp-p
Clock Source Unit1:Slot2:MU181 12 500 00		&,		rate (MU 000 Gbit	t/s
AUX Input Clock		. - [Sub-rate Cloo	00 000 k	/8
Clock Source Unit1:Slot2	2:MU18100	0B			
Center Frequency			12 50	0 000	kHz
Offset				0	opm
	Internal			0 1	opm
	Internal			0 t	
Reference Clock	Internal			0 t	
Reference Clock	Internal			0 t	
Reference Clock	Internal			0 t	

FIGURE 40. JITTER CLOCK SOURCE SETTING



] 21G/32G SI PPG	
_Clock Setting Clock Source	Unit1:Slot4:MU181500B
CIOCK SOURCE	
Bit Rate	Variable To.312 500 Gbit/s
Output Clock Rat	te Fullrate 💌 Offset 400 ppm
Reference Clock	Internal
_Noise Setting	
Noise Generator	Not use
Offset	0.000 dB

FIGURE 41. PPG MISC2 SETTINGS



Menu 🖕 🧧	NOFF Output	Err.	JIII Single Err. Addition		Applica
[7] 21G/32G SI PP	G Datal 🔻	C OFF			
© Output ©	Emphasis	🛙 Pattern	Error Addition	Miscl Misc2	
Test Pattern (PRBS	▼ 1	ogic C POS	Bit Shift	lbit 💌
Length 🖻	2^15-1	▼ bit			
Mark Ratio 🖾	1/2				

FIGURE 42. PATTERN SETTING

7] 21G/32G SI PPG Data1 🔻 📴 OFF
Output E Emphasis Pattern Error Addition Misc1 Misc2
$\begin{array}{c c c c c c c c c c c c c c c c c c c $
Manual Setting
File Operation Recall Store Initialize
Standard/Preset 🛛 USER 🛛 🗨 - Coefficient 🔍 - Preset0 🔍
Amplitude 0.620 Vpp
Output Monitor
Coefficient Simulated Pulse[Vpp]
C-3 0.000 000 Cursor dB
C-2 0.000 000 Post1 0.000
C-1 0.000 000 Post2 0.000
C0 1.000 000 Post3 0.000
C1 0.000 000 Post4 0.000
C2 0.000 000 Post5 0.000 Va Vb Vc Vd Ve Vf Vg Vh Vi Vj
C3 0.000 000 Va 0.620 Vf 0.620
C4 0.000 Vb (0.620) Vg (0.620)
C5 0.000 Pre2 0.000 Vc 0.620 Vh 0.620 C5 0.000 Pre2 0.000 Vd 0.620 Vi 0.620
C6 0,000 000 Pre1 0.000 Va (0.620 Vi (0.620) Ve (0.620 Vj (0.620)



FIGURE 43. PPG EMPHASIS SETTING

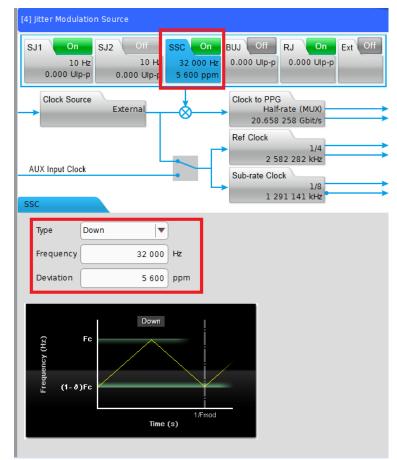


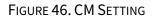
FIGURE 44. SSC SETUP



FIGURE 45. DATA+ AMPLITUDE SETTING



[8] Noise Gene	erator	
Data Input 1		Data Output 1
Data Input 1	Ext Off	Data Output 1
External Input	→•	
External Input		
	CM Off	
	10 mVpp	
	400 MHz	
	DM Off	
	4 mVpp	
	2.000 GHz	
	WN Off	
	0.200 mVrms	
Data Input 2		Data Output 2
Data Input 2		Data Output 2
	(I)_(I)	
Common mode	e noise	
Presets	Manual 🔻	
	Amplitude Frequency Band	
	10 mVpp 400 MHz Low 🔻	



10.1.1 Set Up Oscilloscope

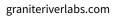
10.1.1.1 Oscilloscope Vertical and Horizontal Setup

Set up the Scope as listed in Table 6.

TABLE 6. OSCILLOSCOPE VERTICAL AND HORIZONTAL SETUP

Setting	Setup
Vertical	Ch1-Ch3 (using the full range of the Scope's D/A)
Record Length	40M in a single acquisition
Sample Rate	80Gs/s





Setting	Setup
Averaging	OFF
Sample Mode	Real Time
Bandwidth	16GHz (which allows for 3 rd harmonic capture at 10.3125Gb/s)
Vertical Scale	Set to full screen without clipping
Sin x/x	OFF

e Control Setup Display	Trigger Measure Mat		and the second se	nos Help		440	KEYSIGHT	العارد
Acquisition		* ?		$\sim\sim\sim$	$\sim \sim \sim \int$	33.0 GHz	T 0.0 V	
Sampling Mode ———	Acquisition Mo	de ———						
Real Time	🔵 Normal							
Segmented	Peak Detec		÷					800
Roll Mode	🔵 High Resolu	ition				وارد تا وتعادد أورد تعر وجرو		600
RealEdge	Automatic		v 1					400
On								200
	Frequency Res							0.
Sin(x)/x Interpolation —	Flat Mag, Line	ar Phase						-200
Off	Bandwidth Lir	nit ———						-400
Averaging —	Automatic							-600
Enabled	32.95 GHz		0 5	2.00 µs	4.00 µs	6.00 µs	8.00 µs	-800 10.0 µs
# of Averages	Standard Band		-	2.00 µ3	400 μs	0.00 µs	0.00 µ3	800
16	Display Status							600
Sampling Rate	Enabled				State of the state			400
🔘 Automatic 🔵 Manual						11 3		200
80.0 GSa/s					- Ma	A Street and the		0.
			t t			All a		-200
Memory Depth						In the second		-400
Automatic Manual								-600 -800
2.00000 Mpts	<u> </u>		.0 s	18 ps	36 ps	54 ps	72 ps	90 ps
H 2.00 μs/ 0.0 s								
er/Noise								
Results (Measure All Data)			*****					
Source Channel 1 -		1.53 ps		DDJpp	1.23 ps		Direction Both	
RJ Method Spectral	DJδδ	1.71 ps		DCD	1.23 ps	Measu	irement TIE (P	hase)
Data Rate 5.5000039 G		1.374965 M 220 fs		ISIpp Dominic	0.0 s			
Pattern Length Clock	PJrms	and the second se		DDPWS	1.23 ps			
TJ(1E-12) 23.59 ps	ΡΙδδ	940 fs		Clock Recovery	Constant Freq			

FIGURE 47. OSCILLOSCOPE VERTICAL AND HORIZONTAL SETUP

10.1.1.2 Oscilloscope Clock Recovery Setup

Enter the Clock Recovery menu and set up the Scope as listed in Table 7.

TABLE 7. OSCILLOSCOPE CLOCK RECOVERY SETUP

Setting	Setup
Nominal Data Rate	10Gb/s (Rounded), 10.3125Gb/s (Thunderbolt 3 Legacy)
Clock Recovery Method	Second Order PLL
PLL Specification	OJTF Loop Bandwidth: 5.000MHz Damping factor: 0.94



Clock Recovery	🔹 <mark>?</mark> 🗙
Clock recovery applies to proto analysis, Rj/Dj, and TIE jitter n	col decode, real time eye, serial data neasurements.
Clock Recovery Applies To —	
All Waveforms	ck Recovery Source
Individual Waveforms	
Preset	Damping
Custom	
Clock Recovery Method	
Second Order PLL	
	Frequency
Nominal Data Rate	
10.312500000 Gb/s V A	
PLL Specification	
● JTF	OJTF
Loop Bandwidth	Loop Bandwidth
8.373 MHz	5.000 MHz
Loop Bandwidth Divisor	Loop Bandwidth Divisor
1.23164 k	2.06250 k
Peaking	Damping Factor
1.37 dB	0.940
Transition Density Depende	ent
Adv	vanced

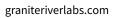
FIGURE 48. OSCILLOSCOPE CLOCK RECOVERY SETUP

10.1.1.3 Oscilloscope AC Common Mode (ACCM) Setup

Set up the Scope as listed in Table 8.

TABLE 8. OSCILLOSCOPE ACCM SETUP

Setting	Setup
Sample Rate	≥ 80Gs/s
Record Length	40Mpts per channel
Bandwidth	16GHz
Vertical Scale	20mV/div
CDR	OFF
Averaging	OFF
Sin x/x	OFF





10.1.1.4 Jitter Setup

Enter the Jitter menu and set up the Scope as listed in Table 9.

TABLE 9. OSCILLOSCOPE JITTER SETUP

Setting	Setup
Units	Unit Interval
Jitter Method	Spectral
Source for Jitter & Eye Diagram	Channel 1-3
BER Level	1E-12
Pattern	Periodic, Repeating Pattern (2 ¹⁵ -1 = 32,767 bits)

	Measure Math Analyze Utilities Dem	os Help		TECHNO	GHT	X
Witherform Window 1 Witherform Window 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Markers QuickMeas Add Measurement Edit Measurement Delete Measurement Delete All Measurements.			~Ĵ (1) 0.0 \		
s ve	Jitter/Noise (EZJIT Complete)					1.00 V
	Measure PAM					0.0 V
H H	Limit Test & Search					-1.00 V -2.00 V
leas	Setup Thresholds					-3.00 V
-500 ms -400 ms -300 ms	Clock Recovery	100 mi	200 mi	300 ns 40	0 ms 500 r	-4.00 V
100 ns/ 0.0 s	Level Qualification					
	••••••••••••••••••••••••••••••••••••••					
Jitter/Noise						0
Type 🔽 RJ PJ Histogram	Graphs 1 VA 0	_				
Course of the second	Graphs I TA A	m				



ile Control Setup Display Trigger M Atter / Noise Setup		Utilities Demos Help			
Setup Wizard 7			~~~~~	J 🕡 0.0 V	
Hitter Noise Advanced					
TIE (Phase) Period	idges X Both V J Bandwidth Narrow (Pink)	V			4.00 3.00 1.00 1.00 1.00 1.00 -1.00 -2.00
Number of UI 2 Display Units RJ Method		0.0 s 300 m	200 m. 10	Ons Click a graticu the sca	ertical Scale waveform in the de or right-click le to change the el displayed.
 Second Spectral Only Unit Interval Spectral & Tail 	Fit	23 Histogram			
Common Source Channel 1-3 BER Level 1E-12	ngth c • Arbitrary				
Results (Measure All Edgos) Measurement Current © Frequency(1+3) Incomplete In	Mean Mi complete Incomplet		Channel 1R - 3R 	Rims,narrow DJ55 Transitions Pires	Incomplete Incomplete

FIGURE 49. OSCILLOSCOPE JITTER SETUP

10.1.1.5 Eye Diagram Vertical Setup

Set up the Scope as listed in Table 10.

TABLE 10. OSCILLOSCOPE EYE DIAGRAM VERTICAL SETUP

Setting	Setup
Vertical Scale	200 mV/div
Horizontal Scale	2 UI's
Eye Mask Height	700 mV (for final Eye Height Calibration)
Eye Mask Width	650 mUI





10.1.2 Record ISI Measurements

 Step through Pre-set coefficients 0 to 14 and use a Preset which gives minimum DDJ Measurement. Although these are not calibrated values, record ISI measurement as part of the measurement table.

Preset Number	Pre-shoot [dB]	De-emphasis [dB]	Informative Filter Coefficients			
Number	Number	[ub]	C-1	Co	C1	
0	0	0	0	1	0	
1	0	-1.9	0	0.90	-0.10	
2	0	-3.6	0	0.83	-0.17	
3	0	-5.0	0	0.78	-0.22	
4	0	-8.4	0	0.69	-0.31	
5	0.9	0	-0.05	0.95	0	
6	1.1	-1.9	-0.05	0.86	-0.09	
7	1.4	-3.8	-0.05	0.79	-0.16	
8	1.7	-5.8	-0.05	0.73	-0.22	
9	2.1	-8.0	-0.05	0.68	-0.27	
10	1.7	0	-0.09	0.91	0	
11	2.2	-2.2	-0.09	0.82	-0.09	
12	2.5	-3.6	-0.09	0.77	-0.14	
13	3.4	-6.7	-0.09	0.69	-0.22	
14	3.6	0	-0.17	0.83	0	
15	1.7	-1.7	-0.05	0.55	-0.05	

FIGURE 50. ISI MEASUREMENT PRESET TABLE

2. In 4Tap Emphasis Ch1 Menu, create 15 Presets with coefficients which match the Table in the Thunderbolt Interconnect Specification. See Figure 51 below.



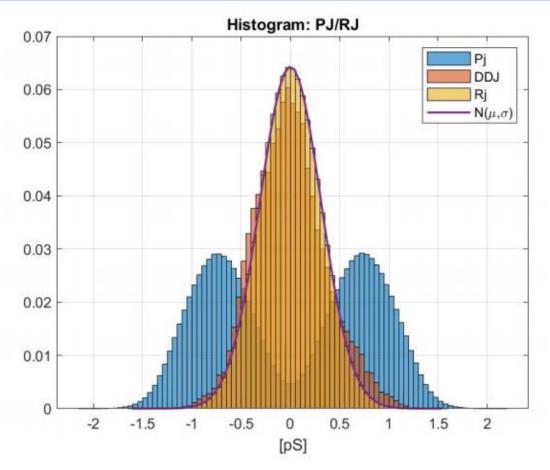
Menu -	Output Addition Addition Addition
[7] 21G/32G SI PPG	Datal 🔽 📴: OFF
G Output G En	nphasis 🖸 Pattern Error Addition Miscl Misc2
Manual Setting	On Channel Off ISI Off
Manual Setting	
File Operation	Recall Store Initialize
Standard/Preset 🖻	USER - Coefficient - Preset0 -
Amplitude	0.620 Vpp
Coefficient 🗉	Output Monitor
	Simulated Pulse [Vpp]
	Cursor dB
C-2 0.000 000	Post1 0.000
C-1 0.000 000 F	Post2 0.000
C0 1.000 000	Post3 0.000
C1 0.000 000	Post4 0.000
C2 0.000 000	Post5 0.000 Va Vb Vc Vd Ve Vf Vg Vh Vi Vj
	Post6 0.000
	0.000 Va 0.620 Vf 0.620
C4 0.000 000	Pre3 0.000 Vb 0.620 Vg 0.620 Vc 0.620 Vh 0.620
C5 0.000 000	Pre2 0.000 Vd 0.620 Vi 0.620
C6 0.000 000	Prel 0.000 Ve 0.620 Vj 0.620

FIGURE 51. 4TAP EMPHASIS CH1 INTERFACE

- 3. Step through all 15 Presets. The Preset with the minimum DDJpp measurement is the optimized preset.
- 4. For SigTest measurement, use the following template:
 - Test Point: tp3_prime
 - CTS Test Template: jitter
- 5. Retrieve DDJ measurement.



Electrical Compliance Test Specification for gen2_rounded	357 207 1215			
Date:	21-Oct-20			
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\				
File: TP3_Prime_Gen2_Rounded.bin				
Total Jitter (BER=1e-12) Measurement UIp-p:	Tj	0.363443		
PJ Jitter Measurement mUI:	PJ-rms	58.981258		
RJ Jitter Measurement mUI:	RJ-rms	12.812331	100	
DDJ Measurement Ulp-p:	DDJ jitter Ulp-p	0.038398	1	
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.974974 Drift [PPM]	-2502.56





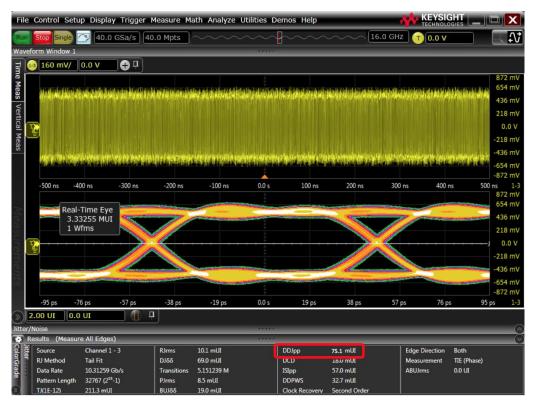


FIGURE 52. OPTIMIZED PRESET (MINIMUM DDJPP) MEASUREMENT ON KEYSIGHT SCOPE

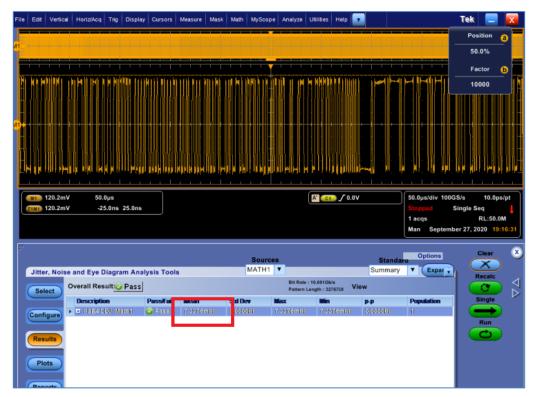
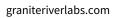


FIGURE 53. OPTIMIZED PRESET (MINIMUM DDJPP) MEASUREMENT ON TEKTRONIX SCOPE





- 6. Set up the scope so that Channel 1 and Channel 3 scale to 80% of screen.
- 7. Turn on function 1 of scope to do subtraction of Channel 1 and Channel 3.
- 8. Measure VPP on Function1.
- 9. For SigTest measurement, use the following template:
 - Test Point: tp3_prime
 - CTS Test Template: ac_common_mode
- 10. Retrieve AC CM measurement.



FIGURE 54. CALIBRATION TO PHASE MATCH ON KEYSIGHT SCOPE







FIGURE 55. CALIBRATION TO PHASE MATCH ON TEKTRONIX SCOPE

- 11. Calibrate ACCM to be 100mVpp at 400MHz Clock, using ACCM Scope Setup. Then return CM Amplitude to zero.
 - a) Turn On SSC and turn Off all jitter components on the MP1900A Generator. Change the test pattern to PRBS31 and transmit the PRBS31 pattern from the MP1900A.
 - b) Set the frequency to 400MHz on the MP1900A CM Generator.



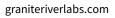
Menu Union Output	Applicati	ion Selector	Start Stop Auto Auto Auto Auto Auto Auto Auto	
[4] Jitter Modulation Source		[8] Noise Gener	rator	
SJ1 Off SJ2 Off SSC On BUJ Off RJ Off Ext 100 000 000 Hz 10 Hz 33 000 Hz 0.000 Ulp-p 0.232 Ulp-p 0.232 Ulp-p 0.100 Ulp-p 5 400 ppm 5 400 ppm 0.000 Ulp-p 0.000 Ulp-p	Off	Data Input 1 Data Input 1 External Input	Ext Off	Output 1 Output 1
Clock Source Unit1:Slot2:MU181000B 8 000 000 kHz Ref Clock	⇒	External Input	CM On 10 mVpp 400 MHz	3
AUX Input Clock 1/1 AUX Input Clock Sub-rate Clock 1/8 1000 000 kHz			DM Off 53 mVpp 2.100 GHz	4 Jitter
SSC 1000 000 KH2			0.200 mVrms	
Type Down 💌		Data Input 2 Data Input 2	Data	Output 2 Output 2
Frequency 33 000 Hz		Common mode	noise	
Deviation 5 400 ppm		Presets	Manual	7 SIPPG
C Fc	Ì		Amplitude Frequency Band	8 Noise
(Te) Fe fourments (1-0)Fe				4
1/Fmod Time (s)				
B Divide & Module Aarm	BERT	AUTO MEAS	EZ SCPI 🗵 🗖 📢 Anrits	SU 00 52

FIGURE 56. CALIBRATE ACCM

c) Measure Ch1 and Ch3 Signals on the scope to have an amplitude of a Mean Peak-to-Peak measurement of 100mVpp.

 $V_{AC-CM} = (V_{TX-P} + V_{TX-N})/2$

d) Turn Off the CM output.





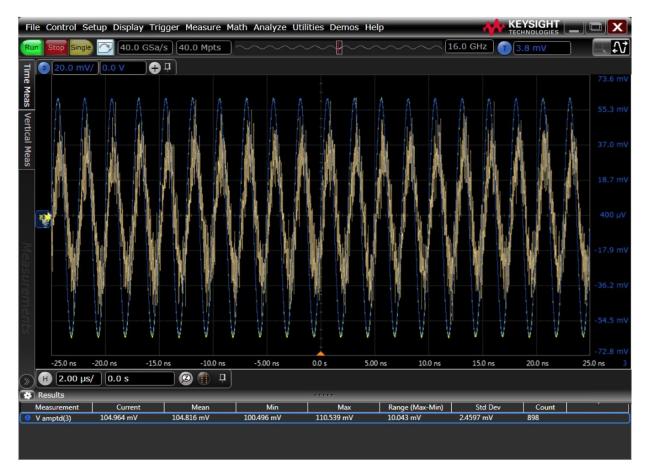


FIGURE 57. CALIBRATE ACCM PEAK-TO-PEAK AMPLITUDE

12. Turn on all remaining Jitter terms (RJ-Filtered (User); HPF (10MHz); SJ@100MHz); and set all jitter amplitudes to zero.



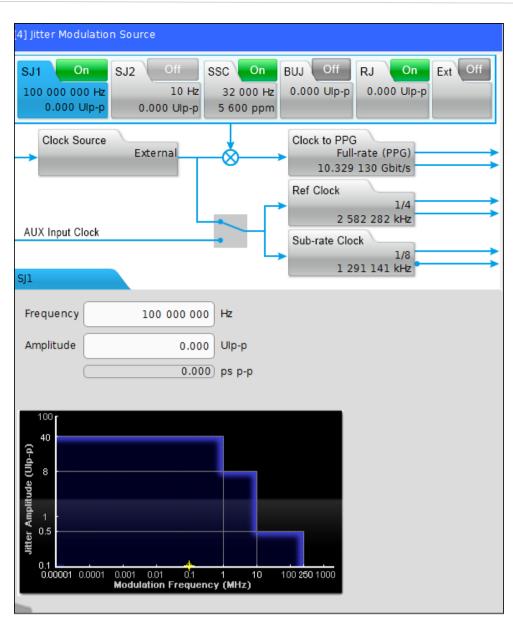


FIGURE 58. JITTER AMPLITUDES

- 13. Return the Scope setup to the jitter setup.
- 14. Set the PRBS15 pattern on the MP1900A.
- 15. Calibrate RJ amplitude to 140mUI peak-to-peak or 10mUI RMS.
- 16. For SigTest measurement, use the following template:
 - Test Point: tp3_prime
 - CTS Test Template: jitter
- 17. Retrieve RJ measurement.





Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_US84_CTS\Waveforms\TP3_Prime\					
File: TP3_Prime_Gen2_Rounded.bin					
Total Jitter (BER=1e-12) Measurement Ulp-p:	Tj	0.363443			
PJ Jitter Measurement mUI:	PJ-rms	58.981258			
RJ Jitter Measurement mUI:	RJ-rms	12.812331			
DDJ Measurement Ulp-p:	DDJ jitter Ulp-p	0.038398			
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.974974	Drift [PPM]	-2502.56

18. Return amplitude to zero.

19. Capture a screen shot.

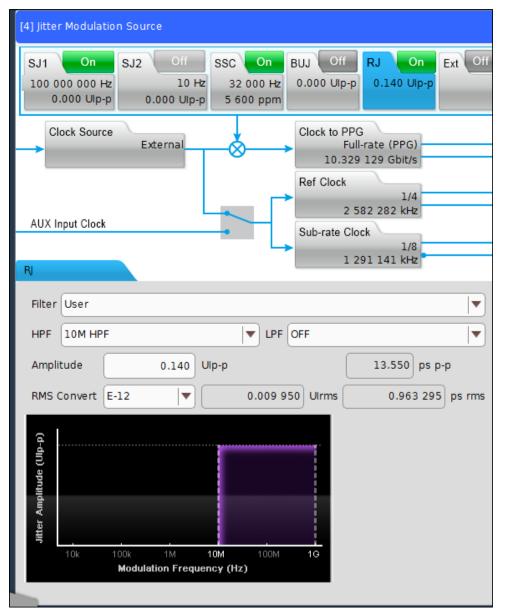


FIGURE 59. CALIBRATE RJ AMPLITUDE #1



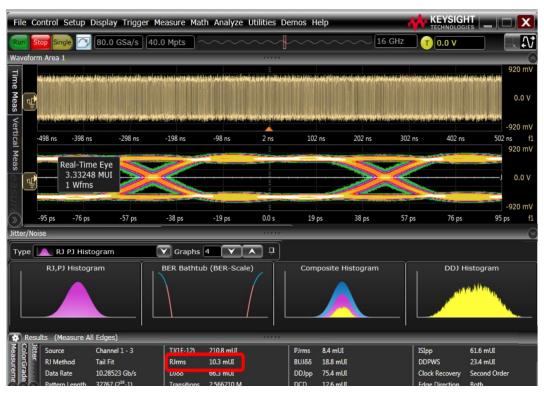


FIGURE 60. CALIBRATE RJ AMPLITUDE #2 ON KEYSIGHT SCOPE



FIGURE 61. CALIBRATE RJ AMPLITUDE #2 ON TEKTRONIX SCOPE



20. Calibrate SJ amplitude to 170mUI peak-to-peak at 100MHz, where "peak-to-peak" is 170mUI.21. For SigTest measurement, use the following template:

- Test Point: tp3_prime
- CTS Test Template: jitter
- 22. Retrieve PJ measurement in RMS. Convert to peak-to-peak by multiplying PJ-rms with a factor of 2.82.

Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\					
File: TP3_Prime_Gen2_Rounded.bin					
Total Jitter (BER=1e-12) Measurement Ulp-p:	Tj	0.363443			
PJ Jitter Measurement mUI:	PJ-rms	58.981258			
RJ Jitter Measurement mUI:	RJ-rms	12.812331	22		
DDJ Measurement Ulp-p:	DDJ jitter Ulp-p	0.038398			
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.974974	Drift [PPM]	-2502.56

23. Capture screen shot.



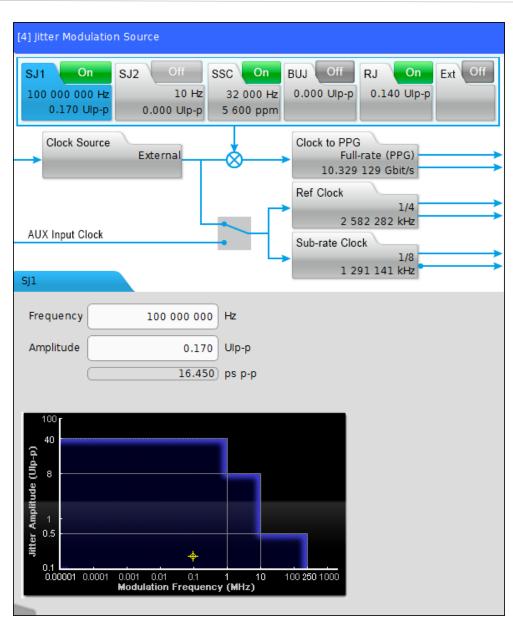


FIGURE 62. CALIBRATE SJ AMPLITUDE #1



19 8				Ulaken			de Las Alacias de	3	623 463 313 154
	0 ns -300 ns	-200 ns	-100 ns	0.0	s 100 ns	200 ns	300 ns 400	-3 Ang an Internet Ang an Internet	150 311 461 621
100 ps/	0.0 5	0	<u>л » п</u>						
H 100 ns/	0.0 s	0) > 7						
ults (Measure All Edg			<u>) ≫ </u>	() - 0	Jitter Results				
ilts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Jitter Results Source	Channel 1 - 3	DCD	(23 mUl	
lts (Measure All Edge surements Measurement	es)				Contraction of the second second	Spectral	ISIpp		C
lts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source	Spectral 10.28673 Gb/s		2.3 mUI	e
lts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source RJ Method	Spectral 10.28673 Gb/s 32767 (2 ¹⁸ -1)	ISIpp	23 mUI 51.2 mUI	C
lts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source RJ Method Data Rate	Spectral 10.28673 Gb/s	ISIpp DDPWS	23 mUI 51.2 mUI 11.4 mUI	C
lts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source RJ Method Data Rate Pattern Length	Spectral 10.28673 Gb/s 32767 (2 ¹⁸ -1)	ISIpp DDPWS F/2 (Even/Odd)	2.3 mUI 51.2 mUI 11.4 mUI 100 µUI	•
lts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source RJ Method Data Rate Pattern Length TJ(1E-12)	Spectral 10.28673 Gb/s 32767 (2 ¹⁸ -1) 274.6 mUl	ISIpp DDPWS F/2 (Even/Odd) Clock Recovery	2.3 mUI 51.2 mUI 11.4 mUI 100 µUI Second Order	
lts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source RJ Method Data Rate Pattern Length TJ(1E-12) RJrms,narrow	Spectral 10.28673 Gb/s 32767 (2 ¹³ -1) 274.6 mUI 4.5 mUI	ISIpp DDPWS F/2 (Even/Odd) Clock Recovery Edge Direction	23 mUI 51.2 mUI 11.4 mUI 100 µUI Second Order Both	
llts (Measure All Edge surements Measurement	es)	Mean	Min	T M	Source RJ Method Data Rate Pattern Length TJ(1E-12) RJms,narrow DJSS	Spectral 10.28673 Gb/s 32767 (2 ¹³ -1) 274.6 mUl 4.5 mUl 210.6 mUl	ISIpp DDPWS F/2 (Even/Odd) Clock Recovery Edge Direction	23 mUI 51.2 mUI 11.4 mUI 100 µUI Second Order Both	
ults (Measure All Edge isurements	es)	Mean	Min	T M	Source RJ Method Data Rate Pattern Length TJ(1E-12) RJms, narrow DJ& Transitions	Spectral 10.28673 Gb/s 32767 (2 ³³ -1) 274.6 mUl 4.5 mUl 210.6 mUl 2.566583 M	ISIpp DDPWS F/2 (Even/Odd) Clock Recovery Edge Direction	23 mUI 51.2 mUI 11.4 mUI 100 µUI Second Order Both	3

FIGURE 63. CALIBRATE SJ AMPLITUDE #2 ON KEYSIGHT SCOPE



FIGURE 64. CALIBRATE SJ AMPLITUDE #2 ON TEKTRONIX SCOPE



- 24. Return all remaining impairment sources (CM, RJ, SJ) to their calibrated values.
- 25. Calibrate the TJ measurement to 350mUI ± 12.5mUI, using the SJ Amplitude control (for SJ frequency of 100MHz) and RJ Amplitude control (for SJ frequencies of less than 100MHz) as an adjustment on the BERT.
- 26. Capture screen shot.

=	1-3	100			~								
ne		1	Infini	ium ha:	s saved y	our setup to	file Case1TjC	alibration_	_Case1_Lane(0_Rate_10G_SJ1.s	et.	.	661
Me								ł					661 m
as		hand dive	No.	Section of the last	MARCHINE.	and the first law made the	a Man Annual State of the		and the state of the state		A SALAR PROPERTY AND A SALAR PROPERTY AND	And Buildings	496 m
Ime Meas Vertical Meas												reich deben	330 m
Ical												s life light	165 m
Mea:	T												0.0
S	P.												
\geq													-165 m
6												-	-330 m ¹
52		-Linkin	ALC: NO	a state	in allaland	And the party local data in the	ALMAN CONTRACTOR	and and and a	and the second second	A ROLL OF THE A ROLL OF THE ADDRESS	And the providence of the second	of the other designation of the	496 m
2								Ī					-661 m
5	-50.	0	40	.0 µs	-30.0 µs	s -20.0 µs	-10.0 µs	0.0	s 10.0	us 20.0 µs	30.0 µs 40.	0 µs 50.0	
2	H	10.0) µs/	0.0	s	0) ≫ ঢ়						
		Measure nents	All Edg	es)				(] - 0	Jitter Results				
		easurem	ent		urrent	Mean	Min	T M	Source	Channel 1 - 3	DCD	2.2 mUI	
0 1		a(1-3)			94 mV	517.94 mV	517.94 mV	517.94		Spectral	ISIpp	44.6 mUI	
									Data Rate	9.975024 Gb/s	DDPWS	12.8 mUI	
									Dattern Lenath	22767 (2 ¹⁸ .1)	F/2 (Even/Odd)	600 µUI	
									TJ(1E-12)	339.1 mUI	Clock Recovery	Second Order	
									TUTITI DATE OF	1000 III04	Edge Direction	Both	
									DJ55	189.8 mUI	Measurement	TIE (Phase)	
									Transitions	2,488798 M			
									PJrms	60.1 mUI			
									PJ&S	171.3 mUI			
									DDJpp	44.6 mUI			

FIGURE 65. TJ MEASUREMENT ON KEYSIGHT SCOPE





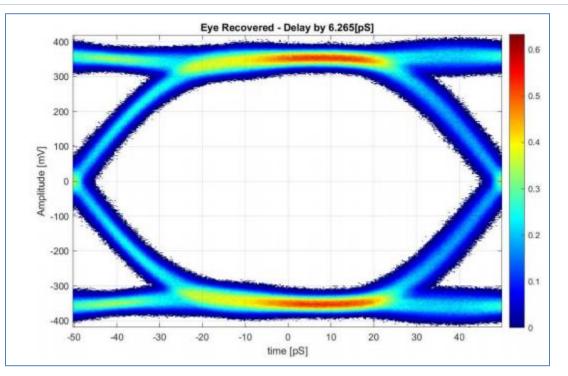


FIGURE 66. TJ MEASUREMENT ON TEKTRONIX SCOPE

- 27. Adjust the memory depth to capture 1,000,000 (1E6) bits.
- 28. Change the Pattern on the MP1900A BERT to PRBS31.
- 29. Calibrate Inner Eye Height to 700mV (top and bottom of the triangle eye mask are V:700mV, H:650mUI).
- 30. For SigTest measurement, use the following template:
 - Test Point: tp3_prime
 - CTS Test Template: ui_ssc_eye
- 31. Retrieve Eye Height measurement.



Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\					
File: TP3_Prime_Gen2_Rounded_prbs31.bin					
Eye Diagram Measurement:	EyeWidth [pS]	89.281492	EyeHeight[mV]	593.984184	
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.975472	Drift [PPM]	-2452.82



32. Capture screen shot.





[7] 21G/32G SI PPG Data1 🔻 🖙 OFF	
Output Emphasis Pattern Error Addition Misc1 Misc2	
$\begin{array}{c} \text{Manual Setting} \\ \hline \\ \text{Setting} \\ \hline \\ \text{Setting} \\ \hline \\ \text{Setting} \\ \hline \\ \text{Setting} \\ \hline \\ \text{Setting} \\ \hline \\ \text{Setting} \\ \hline \\ \hline \\ \ \\ \text{Setting} \\ \hline \\ \hline \\ \ \\ \ \\ \ \\ \ \\ \ \\ \ \\ \ \\ \$	a, -
Manual Setting	
File Operation Recall Store Initialize	
Standard/Preset 🛛 USER 🛛 🔻 - Coefficient 🔍 - Preset0	
Amplitude 0.620 Vpp	
Output Monitor Coefficient © Simulated Pulse[Vpp]	
C-3 0.000 000 Cursor dB	
C-2 0.000 000 Post1 0.000	
C-1 0.000 000 Post2 0.000	
C0 1.000 000 Post3 0.000	
C1 0.000 000 Post4 0.000	
C2 0.000 000 Post5 0.000 Va Vb Vc Vd Ve Vf Vg Vh Vi Vj	
C3 0.000 000 Post6 0.000 V5 (0.620) Vf (0.620)	
0.000 Va 0.520 Vi 0.620 Vb 0.620 Vg 0.620	
Pre3 0.000 Vc 0.620 Vh 0.620	
Prez 0.000 Va 0.620 Vi 0.620	
C6 0.000 000 Pre1 0.000 Ve 0.820 Vj 0.820	

FIGURE 67. EYE AMPLITUDE



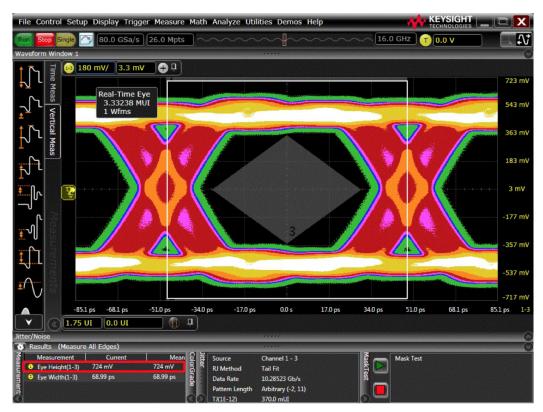


FIGURE 68. EYE MASK ON KEYSIGHT SCOPE

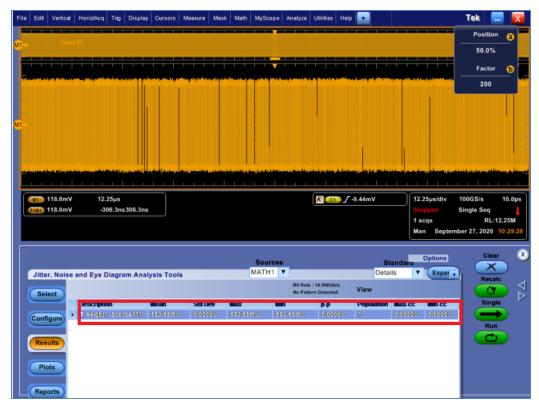


FIGURE 69. EYE MASK ON TEKTRONIX SCOPE



- 33. Save the BERT setup to "10G_TC1_100MHz".
- 34. Return CM, RJ and PJ sources to zero amplitude.
- 35. Repeat step 8-21 for 1MHz, 2MHz, 10MHz and 50MHz PJ frequencies, saving the setups after each frequency as "10G_TC1_1MHz", "10G_TC1_2MHz", "10G_TC1_10MHz" and "10G_TC1_50MHz" respectively.

10.2 Test Receiver at 10Gb/s or 10.3125Gb/s for Test Case 1 at TP3'

After completing the calibration in Section 10.1, proceed to perform the test.

- 1. Set up the physical equipment connections, as per Figure 23.
- 2. Use TenLira scripts on the PC to ensure that the crosstalk generator is sending PRBS31 signals at 800mV to 10Gb/s or 10.3125Gb/s.
- 3. Connect the test fixture to Port A of the DUT.
- 4. Recall the BERT test setup for 10G_TC1_100MHz (as saved in Section 10.1.2).
- 5. Configure the DUT transmitter to output PRBS31 on all lanes with SSC turned ON.
- 6. Initiate negotiation with the preset chosen in calibration.
- 7. Change the preset in the BERT according to the newly acquired preset.
- 8. Configure the DUT for the next negotiation step with the new preset.
- 9. Change the preset in the BERT according to the newly requested preset.
- 10. Configure the DUT for the next negotiation step with the new preset.
- 11. If needed, change the preset in the BERT according to the newly requested preset.
- 12. Run the 10Gb/s or 10.3125Gb/s test script for Rx testing to determine the BER measured by the Receiver and record the error count for 10 seconds.

Note the error checking procedure is different between Host or Device types:

- a) For Windows Host testing, TenLira scripts are run on the Host Under Test, to determine the error count. Refer to the release notes of the scripts for details on how to run the scripts.
- b) For Non-Windows Host testing, proprietary methods are used for error count.
- c) For Device testing, TenLira scripts are run on a separate controller PC that is connected to the device under test if TenLira is not installed. For details on how to run the test scripts to determine the error count, refer to the release notes of the scripts.
- 13. Repeat steps #4 to #12 three more times and record the error count for 10 seconds for each cycle.
- 14. Again, repeat steps #4 to #12 and then record the error count for 400 seconds.
- 15. Record the BER in the test results for 10G_TC1_100MHz.
- 16. If the error count equals to 0 then PASS.
- 17. If the error count is more than 0 then run steps #4 to #12 and then record the error count for 700 seconds.
- 18. If the error count is more than 1 then FAIL.





- 19. Repeat all the steps above for each of the four TC1 frequencies.
- 20. Swap Data and Crosstalk signals, applying Data to Lane1 and Crosstalk to Lane0.
- 21. Repeat all the steps above for Lane1 of the same port if the DUT is a 2-lane Device.
- 22. Repeat all the steps above on Port B if the DUT is a multi-port Device.
- 23. Include the Eye Diagram for 10G_TC1_100MHz in the Compliance Test Report.

10.3 Calibrate and Save for 10Gb/s or 10.3125Gb/s Rx Test Case 2 at TP3

For this test case, the total ISI of a channel should be around 17.5~18.5dB @ 5GHz. The test fixture should have 1 to 1.5dB per mated pair.

- 1. Recall the BERT setup from 10G_TC1_100MHz.
- 2. Connect the physical setup with ISI Channel, as per Figure 11, as follows:
 - a) Output of MU195050A connected to 40GHz K Cable
 - b) -3.5dB Fixed Channel Board connected to 40GHz K Cable
 - c) SMP USB Type-C Receptacle Fixture connected to -12dB Characterized 2 meter USB Type-C Cable
 - d) SMP USB Type-C Receptacle Fixture connected to short 40GHz Cables into Ch1 and Ch3 of Scope
- 3. Search for the optimized DC Gain starting from DC Gain of 1 in Oscilloscope Equalization Setup, adjust the DC Gain to obtain the largest Eye Height with cable de-embedding. *Note: This step is not required if the SigTest method is used.*
 - a) Set up the Scope as follows for CTLE:
 - i) Number of Poles set to USB 3.1
 - ii) DC Gain set to 1.00
 - iii) AC Gain set to 1.41
 - iv) Pole #1 Frequency set to 1.50 GHz
 - v) Pole #2 Frequency set to 5.00 GHz
 - b) Use the DC Gain Setting in Table 11 which yields the largest Eye Height.

Index	DC Gain Setting	Index	DC Gain Setting
0	1.000	-5	0.562
-1	0.891	-6	0.501
-2	0.794	-7	0.446
-3	0.708	-8	0.398
-4	0.630	-9	0.354

TABLE 11. DC GAIN SETTINGS



Equaliz	zation
Set	up Wizard 🏑 🍥 🗌 Show Eq settings table Real-Time Eye Analysis Diagram
Eq 1	Source Copy settings to Equalize in place
Eq 2	O Display as function
Eq 3	
<u> </u>	CTLE
Eq 4	Nominal Data Rate Preset 10.00000000 Gb/s Image: Custom
	/ # of Poles Linear Bandwidth
	2 Pole, AC Gain 🝸 Track Source Bandwidth
	Equation Graph 16.0000 GHz
	$\mathbf{H}(s) = \mathbf{A}_{ac} \cdot \boldsymbol{\omega}_{p2} \cdot \frac{s + \frac{\mathbf{A}_{dc}}{\mathbf{A}_{ac}} \cdot \boldsymbol{\omega}_{p1}}{(s + \boldsymbol{\omega}_{p1}) \cdot (s + \boldsymbol{\omega}_{p2})}$
	DC Gain Pole 1 Frequency
	708 m 1.500 GHz
	AC Gain Pole 2 Frequency
	1.410 5.000 GHz

FIGURE 70. DC GAIN SETTING

- c) Set up the DFE:
 - i) Set Max Tap to 50mV.
 - ii) Run Auto DFE.



qualization		
Setup Wizard 🏑	陵 🗌 Show E	q settings table Real-Time Eye Analysis Diagram.
Eq 1	Source Channel 1 - 3	Copy settings to Equalize in place Equalization Auto Tap Setup
	E 🚹	Lane
Eq 4 Eq 4 # of Taps 1	Auto Set	Eq 1 Eye Width 0.0 UI Tap Sett Max Tap Value 50 mV
		Min Tap Value 0.0 V Normalize DC Gain
2.00 UI 0.0 UI		Run Auto Set
s (Measure All Edges) Jrements		Auto Tap Status Configure the setup and press the Run Auto Set button

FIGURE 71. DFE SETTING

- d) Change the BERT Data pattern to PRBS31.
- e) Adjust the memory depth to capture 1,000,000 (1E6) bits with 5 acquisitions (100,000 UIs per Acquisition).
- f) For each acquisition, measure the Eye Width and Eye Height. Calculate the average of the five measurements and compute the Eye area via *Eye Width * Eye Height*.
- g) Measure the Eye area by iterating through each CTLE gain. The CTLE gain with the biggest eye area is used for the following measurements.
- 4. By adjusting data amplitude, calibrate the Inner Eye Height to 120 ± 10mV diff p-p (top and bottom of the triangle eye mask) using the PRBS31 pattern.

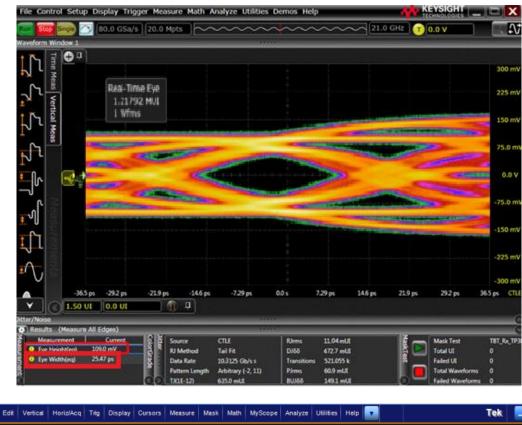


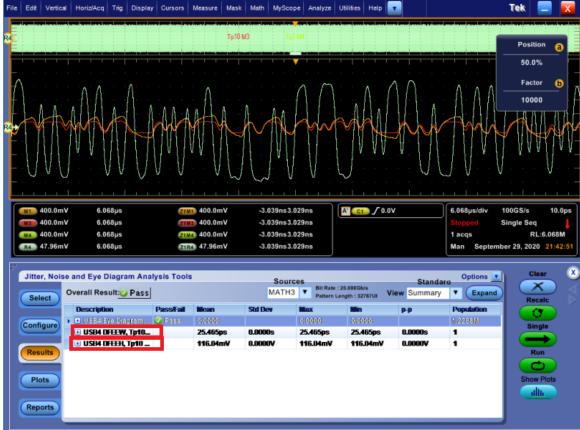
[7] 21G/32G SI PPG	Datal 💌 📴 OFF
G Output G	Emphasis 🕒 Pattern Error Addition Miscl Misc2
Manual Setting → -+Z=+1 1 2	On Channel Off $Z \rightarrow Z \rightarrow$
Manual Setting	
File Operation	Recall Store Initialize
Standard/Preset (USER 🛛 VSER 🖉 - Coefficient 🔷 - Preset0
Amplitude	0.620 Vpp _Output Monitor
Coefficient 🖻	Simulated Pulse[Vpp]
C-3 0.000 000	Cursor dB
C-2 0.000 000	Post1 0.000
C-1 0.000 000	Post2 0.000
C0 1.000 000	Post3 0.000
C1 0.000 000	Post4 0.000
C2 0.000 000	Post5 0.000 Va Vb Vc Vd Ve Vf Vg Vh Vi Vj
C3 0.000 000	Post6 0.000
C4 0.000 000	0.000 Va 0.620 Vf 0.620 Vg 0.620 Vb 0.620 Vg 0.620
	Pre3 0.000 Vc 0.620 Vh 0.620
	Pre2 0.000 Vd 0.620 Vi 0.620 Pre1 0.000 Ve 0.620 Vj 0.620
C6 0.000 000	Pre1 0.000 Ve 0.620 Vj 0.620

FIGURE 72. EYE AMPLITUDE











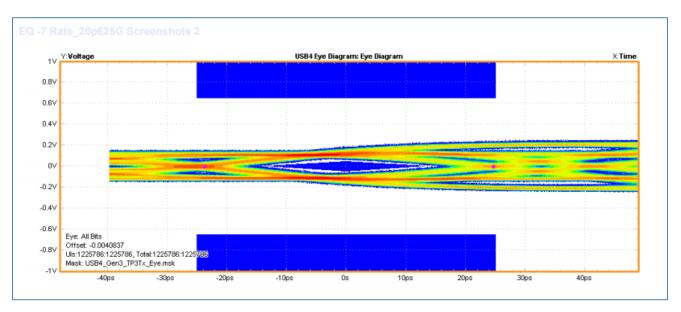
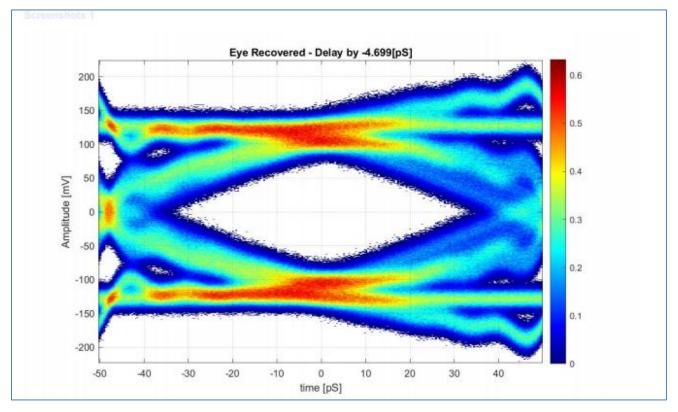


FIGURE 73. EYE AMPLITUDE MEASUREMENTS

- 5. For SigTest measurement, use the following template:
 - Test Point: tp3
 - CTS Test Template: tp3
- 6. Retrieve Eye Height measurement.





Electrical Compliance Test Specification for gen2_rounded															
Date:	25-Oct-20														
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3\Rx\															
File: tp3.bin				_											
Eye Diagram Measurement:	EyeWidth [pS]	81.841387	EyeHeight[mV]	207.027864											
informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.975465	Drift [PPM]	-2453.53										
CTLE-Adc[dB]	CTLE-DC Gain[dB]	DFE[mV]	Eye Height[mV]	EVE Width[p5]	Eye Height[mV]	EYE Width[p5]	Eye Height[mV]	EVE Width[p5]	Eye Height[mV]	EVE Width[pS]	Eye Height[mV]	EVE Width[pS]	Avg. Height[mV]	Avg. Width[p5]	Area[mV*p5]
1	C	50	1.409	0.783	0.285	1.175	0.318	1.175	1.457	0.785	0.313	0.783	0.76	0.94	0.6
0.891	1	48.2	142.647	62 262	129,546	59.129	140.216	63.437	141.373	61.479	136.547	61.479	138.07	61.557	8504.5
0.794	2	43	170.9	71.269	162.341	70.877	172.953	70.485	172.992	70.485	168.59	70.485	169.56	70.72	11990.6
0.708	3	36.7	197.61	78.317	191.643	77.925	199.418	79.883	198.652	80.275	194,414	79.1	196.35	79.1	15533.0
0.631	. 4	32	208.352	82.233	205.568	80.667	206.991	81.058	208.858	82.233	205.37	83.016	207.03	81.841	16943.6
0.562	5	27.8	196.69	80.275	195.141	82.233	197.331	83.016	199.43	82.625	194.586	81.45	196.64	81.92	16108.9
0.501		24	185.353	76.751	182.983	76.359	185.388	79.883	185.091	79.492	181.683	74.01	184.1	77.299	14233.4
0.447	7	20.7	170.463	70.877	168.146	72,443	172.005	72,443	171.527	71.269	168.334	72.052	170.09	71.817	12215.3
0.398	8	17.8	154.847	66.57	153.365	67.744	156.741	67.744	156,386	67.744	154.618	67.744	155.19	67.509	10476.9
0.355	9	15.2	138.71	62 262	139.772	61.87	142,915	63.045	140.059	63.828	140.079	63.045	140.51	62.81	8813.0
Optimal CTLE: 4															

- 7. If the Eye width is not within the 580 ± 25mUI p-p specification, tune RJ (if the SJ frequency is below 100MHz) or tune SJ (if the SJ frequency is 100MHz) so that the eye width is within specification.
- 8. For SigTest measurement, use the following template:
 - Test Point: tp3
 - CTS Test Template: tp3

9. Retrieve Eye Width measurement.

Date:	-25-Oct-20														
DIR:C:\Desktop\SigTest_USB4_CT5\Waveforms\TP3\Rx\															
File: tp3.bin		_													
Eye Diagram Measurement:	EyeWidth [pS]	81.841387	reHeight[mV]	207.027864											
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.975465	Drift [PPM]	-2453.53										
CTLE-Adc[d8]	CTLE-DC Gain[dB]	DFE[mV]	Eye Height[mV]	EYE Width[p5]	Eye Height[mV]	EYE Width[p5]	Eye Height[mV]	EVE Width[p5]	Eye Height[mV]	EYE Width[p5]	Eye Height[mV]	EVE Width[pS]	Avg. Height[mV]	Avg. Width[p5]	Area[mV*p5]
1	0	50	1.409	0.783	0.285	1.175	0.318	1.175	1.457	0.783	0.313	0.783	0.76	0.94	0.6
0.891	1	48.2	142.647	62.262	129.546	59.129	140.216	63.437	141.373	61.479	136.547	61.479	138.07	61.557	8504.5
0.794	2	42	170.9	71.269	162.341	70.877	172.953	70.485	172.992	70.485	168.59	70.485	169.56	70.72	11990.6
0.708	3	36.7	197.61	78.317	191.643	77.925	199.418	79.883	198.652	80.275	194.414	79.1	196.35	79.1	15533.0
0.631		32	208.352	82.233	205.568	80.667	206.991	81.058	208.858	82.233	205.37	83.016	207.03	81.841	16943.6
0.562	5	27.8	196.69	80.275	195.141	82.233	197.331	83.016	199.43	82.625	194.586	81.45	196.64	81.92	16108.9
0.501	6	24		76.751	182.983	76.359	185.388	79.883	185.091	79.492	181.683	74.01	184.1	77.299	14233.4
0.447	7	20.7	170.465	70.877	168.146	72.443	172.005	72.443	171.527	71.269	168.334	72.052	170.09	71.817	12215.3
0.398		17.8			153.365						154.618				
0.355	9	15.2	138.71	62.262	139.772	61.87	142.913	63.045	140.059	63.828	140.079	63.045	140.31	62.81	8813.0

- 10. Save the BERT Setup to "10G_TC2_100MHz".
- 11. Repeat steps #1 to #10 for 1MHz, 2MHz, 10MHz and 50MHz PJ frequencies, saving each setup as 10G_TC2_1MHz, 10G_TC2_2MHz, 10G_TC2_10MHz and 10G_TC2_50MHz respectively.

10.4 Test Receiver at 10Gb/s or 10.3125Gb/s for Test Case 2 at TP3

- 1. Set up the physical equipment connections, as per Figure 24.
- 2. Use TenLira scripts on the PC to ensure that the crosstalk generator is sending PRBS31 signals at 800mV to 10Gb/s or 10.3125Gb/s.
- 3. Connect the test fixture to Port A of the DUT through the 2M USB Type-C cable.
- 4. Recall the BERT test setup for 10G_TC2_100MHz (as saved in Section 10.3).
- 5. Configure the DUT transmitter to output PRBS31 on all lanes with SSC turned ON.
- 6. Initiate negotiation with the preset chosen in calibration.
- 7. Change the preset in the BERT according to the newly acquired preset.
- 8. Configure the DUT for the next negotiation step with the new preset.
- 9. Change the preset in the BERT according to the newly requested preset.
- 10. Configure the DUT for the next negotiation step with the new preset.
- 11. If needed, change the preset in the BERT according to the newly requested preset.



12. Run the 10Gb/s or 10.3125Gb/s test script for Rx testing to determine the BER measured by the Receiver and record the error count for 10 seconds.

Note the error checking procedure is different between Host or Device types:

- a) For Windows Host testing, TenLira scripts are run on the Host Under Test, to determine the error count. Refer to the release notes of the scripts for details on how to run the scripts.
- b) For Non-Windows Host testing, proprietary methods are used for error count.
- c) For Device testing, TenLira scripts are run on a separate controller PC that is connected to the device under test if TenLira is not installed. For details on how to run the test scripts to determine the error count, refer to the release notes of the scripts.
- 13. Repeat steps #4 to #12 three more times and record the error count for 10 seconds for each cycle.
- 14. Again, repeat steps #4 to #12 and then record the error count for 400 seconds.
- 15. Record the BER in the test results for 10G_TC2_100MHz.
- 16. If the error count equals to 0 then PASS.
- 17. If the error count is more than 0 then run steps #4 to #12 and then record the error count for 700 seconds.
- 18. If the error count is more than 1 then FAIL.
- 19. Repeat all the steps above for each of the four TC2 frequencies.
- 20. Swap Data and Crosstalk signals, applying Data to Lane1 and Crosstalk to Lane0.
- 21. Repeat all the steps above for Lane1 of the same port if the DUT is a 2-lane Device.
- 22. Repeat all the steps above on Port B if the DUT is a multi-port Device.
- 23. Include the Eye Diagram for 10G_TC2_100MHz in the Compliance Test Report.

10.5 Calibrate and Save for 20Gb/s or 20.625Gb/s Rx Test Case 1 at TP3'

The initial setups for the BERT and Scope are the same as defined for the 10Gb/s or 10.3215Gb/s section above, except for the settings highlighted in **bold** below.

- 1. Set up the physical equipment connections without ISI Channel, as per Figure 10.
- 2. Set up the BERT as follows:
 - a) Set the Data Rate to **20Gb/s** or **20.625Gb/s**.
 - b) Set the Pattern to PRBS15.
 - c) Turn on "SSC", with settings of 32kHz (for 20G) or 36kHz (for 20.625G) with 5600ppm (for 20G) and 5800ppm (for 20.625G) triangle down spread. (SSC will remain on for all of the following steps.)
 - d) Set DATA+/DATA- Launch Amplitude to 750mV. This should set the differential amplitude just above the 700mV Eye Height target value as an initial value.
 - e) Set the initial CM interference amplitude to 0mV.



10.5.1 Set Up Oscilloscope

10.5.1.1Oscilloscope Vertical and Horizontal Setup

Set up the Scope as listed in Table 12.

TABLE 12. OSCILLOSCOPE VERTICAL AND HORIZONTAL SETUP

Setting	Setup
Vertical	Ch1-Ch3 (using the full range of the Scope's D/A)
Horizontal	20Gb/s or 20.625Gb/s
Record Length	40M
Sample Rate	80Gs/s
Averaging	OFF
Sample Mode	Real Time
Bandwidth	21GHz (The Calibration Bandwidth is limited to the Bit Rate of the signal, which is 2 * 1 st harmonic. This is done intentionally to be on the order of a Thunderbolt Receiver's Bandwidth. This is essentially acting as an "Electrical Reference Receiver", used for calibration. It reduces the noise measured by the Scope which a real Receiver will never perceive.)
Vertical Scale	Set to full screen without clipping
Sin x/x	OFF

10.5.1.2 Oscilloscope Clock Recovery Setup

Enter the Clock Recovery menu and set up the Scope as listed in Table 13.

TABLE 13. OSCILLOSCOPE CLOCK RECOVERY SETUP

Setting	Setup
Nominal Data Rate	20Gb/s or 20.625Gb/s
Clock Recovery Method	Second Order PLL
PLL Specification	OJTF Loop Bandwidth: 5.000 MHz Damping factor: 0.94

10.5.1.3 Oscilloscope AC Common Mode (ACCM) Setup

Set up the Scope as listed in Table 14.



TABLE 14. OSCILLOSCOPE ACCM SETUP

Setting	Setup
Sample Rate	≥ 80Gs/s
Record Length	27Mpts per channel
Bandwidth	21GHz
Vertical Scale	20mV/div
CDR	OFF
Averaging	OFF
Sin x/x	OFF

10.5.1.4 Jitter Setup

Enter the Jitter menu and set up the Scope as listed in Table 15.

TABLE 15. OSCILLOSCOPE JITTER SETUP

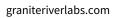
Setting	Setup
Units	Unit Interval
Jitter Method	Spectral
Source for Jitter & Eye Diagram	Channel 1-3
BER Level	1E-12
Pattern	Periodic, Repeating Pattern (2 ¹⁵ -1 = 32,767 bits)

10.5.1.5Eye Diagram Vertical Setup

Set up the Scope as listed in Table 16.

TABLE 16. OSCILLOSCOPE EYE DIAGRAM VERTICAL SETUP

Setting	Setup
Vertical Scale	200 mV/div
Horizontal Scale	2 UI's
Eye Mask Height	700 mV (for final Eye Height Calibration)
Eye Mask Width	620 mUI





10.5.2 Record ISI Measurements

- 1. Step through the Preset Coefficients 0-15 and use the Preset which yields the minimum DDJ Measurement. Although this is not a Calibrated value, record this ISI Measurement as part of the measurements table.
- 2. Change the pattern on the BERT to PRBS31. Calibrate ACCM to be 100mVpp at 400MHz Clock, using the ACCM Scope Setup.
- 3. Return CM Amplitude to zero.
- 4. Turn on all remaining Jitter terms (RJ-Filtered [10MHz HPF] and SJ at 100MHz).
- 5. Set all jitter amplitudes to zero.
- 6. Return the Scope setup to the setup in Section 10.5.1.
- 7. Change the pattern on the BERT to PRBS15.
- 8. Calibrate RJ Amplitude to 140mUI peak-to-peak (10mUI RMS).
- 9. Return amplitude to zero.
- 10. Capture screen shot.
- 11. Calibrate SJ Amplitude to 170mUI peak-to-peak at 100MHz.
- 12. Capture screen shot.
- 13. Return all remaining impairment sources (CM, RJ, SJ) to their calibrated values.
- 14. Calibrate the TJ measurement to 380mUI ± 25mUI using SJ Amplitude control (for SJ Frequency of 100MHz) and RJ Amplitude control (for SJ Frequencies of less than 100 MHz) as an adjustment on the BERT.
- 15. Capture screen shot.
- 16. Change the pattern on the BERT to PRBS31.
- 17. Calibrate Inner Eye Height to 700mV (top and bottom of triangle eye mask, with V:700mV; H:620mUI).
- 18. Capture screen shot.
- 19. Save BERT Setup to "20G_TC1_100MHz".
- 20. Repeat steps #1 to #18 for 1MHz, 2MHz, 10MHz and 50MHz PJ frequencies, saving each BERT Setup as 20G_TC1_1MHz, 20G_TC1_2MHz, 20G_TC1_10MHz and 20G_TC1_50MHz.



10.6 Test Receiver at 20Gb/s or 20.625 Gb/s for Rx Test Case 1 at TP3'

- 1. Set up the physical equipment connections, as per Figure 23.
- 2. Use TenLira scripts on the PC to ensure that the crosstalk generator is sending PRBS31 (800mV) signals at 20Gb/s or 20.625Gb/s.
- 3. Connect the test fixture to Port A of the DUT.
- 4. Recall the BERT test setup for 20G_TC1_100MHz.
- 5. Configure the DUT transmitter to output PRBS31 on all lanes with SSC turned on.
- 6. Initiate negotiation with the preset chosen in calibration.
- 7. Change the preset in the BERT according to the newly acquired preset.
- 8. Configure the DUT for the next negotiation step with the new preset.
- 9. Change the preset in the BERT according to the newly requested preset.
- 10. Configure the DUT for the next negotiation step with the new preset.
- 11. If needed, change the preset in the BERT according to the newly requested preset.
- 12. Run the 20Gb/s or 20.625Gb/s test script for Rx testing to determine the BER measured by the Receiver and record the error count for 10 seconds.

Note the error checking procedure is different between Host or Device types:

- a) For Windows Host testing, TenLira scripts are run on the Host Under Test, to determine the error count. Refer to the release notes of the scripts for details on how to run the scripts.
- b) For Non-Windows Host testing, proprietary methods are used for error count.
- c) For Device testing, TenLira scripts are run on a separate controller PC that is connected to the device under test if TenLira is not installed. For details on how to run the test scripts to determine the error count, refer to the release notes of the scripts.
- 13. Repeat steps #4 to #12 three more times and record the error count for 10 seconds for each cycle.
- 14. Again, repeat steps #4 to #12 and then record the error count for 200 seconds.
- 15. Record the BER in the test results for 20G_TC1_100MHz.
- 16. If the error count equals to 0 then PASS.
- 17. If the error count is more than 0 then run steps #4 to #12 and then record the error count for 350 seconds.
- 18. If the error count is more than 1 then FAIL.
- 19. Repeat all the steps above for each of the four TC1 frequencies.
- 20. Swap Data and Crosstalk signals, applying Data to Lane1 and Crosstalk to Lane0.
- 21. Repeat all the steps above for Lane1 of the same port if the DUT is a 2-lane Device.
- 22. Repeat all the steps above on Port B if the DUT is a multi-port Device.
- 23. Include the Eye Diagram for 20G_TC1_100MHz in the Compliance Test Report.



10.7 Calibrate and Save for 20Gb/s or 20.625Gb/s Rx Test Case 2 at TP3

For this test case, the total ISI of a channel should be around -16.5dB@10GHz. The test fixture should have 1 to 1.5dB per mated pair.

- 1. Recall the BERT setup from 20G_TC1_100MHz.
- 2. Connect the physical setup with ISI Channel, as per Figure 12, as follows:
 - a) Output of MU195050A connected to 40GHz K Cable
 - b) -3.5dB Fixed Channel Board connected to 40GHz K Cable
 - c) SMP USB Type-C Receptacle Fixture connected to -12dB Characterized 0.8 meter USB Type-C Cable
 - d) SMP USB Type-C Receptacle Fixture connected to short 40GHz Cables into Ch1 and Ch3 of Scope
- 3. Search for Optimized DC Gain starting from DC Gain of 1 in Oscilloscope Equalization Setup, adjust the DC Gain to obtain the largest Eye Height with cable de-embedding. *Note: This step is not required if the SigTest method is used.*
 - a) Set up the Scope as follows for CTLE:
 - i) Number of Poles set to USB 3.1
 - ii) DC Gain set to 1.00
 - iii) AC Gain set to 1.41
 - iv) Pole #1 Frequency set to 5 GHz
 - v) Pole #2 Frequency set to 10 GHz
 - b) Use the DC Gain Setting in Table 17 which yields the largest Eye Height.

TABLE 17. DC GAIN SETTINGS

Index	DC Gain Setting	Index	DC Gain Setting
0	1.000	-5	0.562
-1	0.891	-6	0.501
-2	0.794	-7	0.446
-3	0.708	-8	0.398
-4	0.630	-9	0.354



Equaliz	alization	2 <mark>X</mark>
Set	Setup Wizard 🏑 🌺 📃 Show Eq settings table Real-Time Eye Analysis Di	iagram
Eq 1	1 Source Copy settings to Equalize in place	e
Eq 2		tion
Eq 3	CTLE FFE DFE A	
<u> </u>	Enable CTLE	
Eq 4	Nominal Data Rate	
	20.00000000 Gb/s Custom	
	# of Poles Linear Bandwidth	
	2 Pole, AC Gain 🔽 Track Source Bandwidth	
	Equation Graph 21.0000 GHz	
	$\mathbf{H}(s) = \mathbf{A}_{ac} \cdot \boldsymbol{\omega}_{p2} \cdot \frac{\mathbf{s} + \frac{\mathbf{A}_{dc}}{\mathbf{A}_{ac}} \cdot \boldsymbol{\omega}_{p1}}{\left(\mathbf{s} + \boldsymbol{\omega}_{p1}\right) \cdot \left(\mathbf{s} + \boldsymbol{\omega}_{p2}\right)}$	
	DC Gain Pole 1 Frequency	
	446 m 5.000 GHz YA	
	AC Gain Pole 2 Frequency	
	1.410 10.000 GHz	

FIGURE 74. DC GAIN SETTING

- c) Set up the DFE:
 - i) Set Max Tap to 50mV.
 - ii) Run Auto DFE.





Equalization	🌲 ? 🗙
Setup Wizard 🏑 🍥 🗌 Show Eq set	tings table Real-Time Eye Analysis Diagram
Eq 1 Source	Copy settings to Equalize in place
Eq 2 Eq 3 Eq 3	Equalization Auto Tap Setup 🔅 ? 🗙 Lane Eq 2
Eq 4 Taps # of Taps	Eye Width 0.0 UI
1 ▲ Auto Set Tap S	50 mV Min Tap Value
-1.00 ns -800 ps -600 ps	0.0 V Normalize DC Gain -4(
	Auto Tap Status
Its (Measure All Edges) surements Measurement Current Mean	Configure the setup and press the Run Auto Set button

FIGURE 75. DFE SETTING

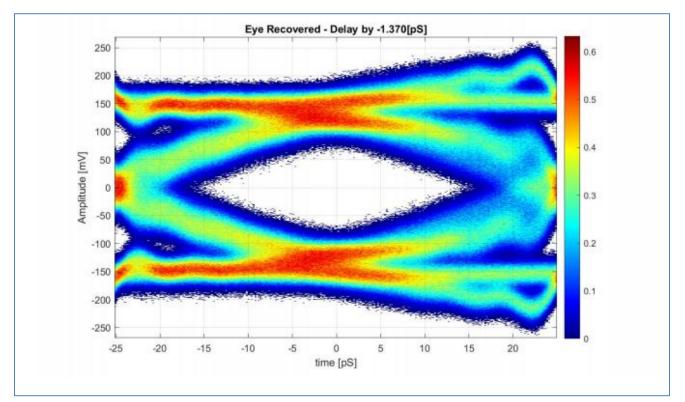
- d) Adjust the memory depth to capture 1,000,000 (1E6) bits with 5 acquisitions (100,000 UI's per Acquisition).
- e) For each acquisition, measure the Eye Width and Eye Height. Calculate the average of the five measurements and compute the Eye area via *Eye Width * Eye Height*.
- f) Measure the Eye area by iterating through each CTLE gain. The CTLE gain with the biggest Eye area is used for the following measurements.
- 4. Calibrate the Inner Eye Height to 98 ± 10mV diff p-p (top and bottom of the triangle eye mask) using the PRBS31 pattern.



🖸 Outp	ut 🖸 Er	nphasis 🖸) Patter	n Error A	ddition Mi	scl Misc2		
Manu Setti	ng T <mark>ZTTZ</mark>	On	Chann Emulat		Off			ff 2=1 -10↓ • ● +
Manual S	Setting							
File Oper	ation	Recall		Store	Initializ	e		
Standard	d/Preset 🖻	USER		- De-Emp	hasis	 Pres 	et0	
Amplitud	e	0.62	0 Vpp					
Pre	dB 🖸	Output	Monitor_					
Cursor3	0.000		/pp (Simulated	Pulse (Vpp)		
Cursor2	0.000	_	.620					
Cursorl	0.000		.620					
Post		Vc 0	.620			1		
Cursorl	0.000	Vd 0	.620					
Cursor2	0.000	Ve 0	.620	/a Vb Vc Vd Ve	Vf Vg Vh Vi Vj			
Cursor3	0.000		.620					
Cursor4	0.000		.620					
Cursor5	0.000		.620					
			.020					

FIGURE 76. EYE AMPLITUDE







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FIGURE 77. EYE AMPLITUDE MEASUREMENTS

- 5. For SigTest measurement, use the following template:
 - Test Point: tp3
 - CTS Test Template: tp3
- 6. Retrieve Eye Height measurement.
- If the Eye Width is not within the 540 ± 50mUI p-p specification, tune RJ (if the SJ frequency is below 100MHz) or tune SJ (if the SJ frequency is 100MHz) so that the Eye Width is within specification.
- 8. For SigTest measurement, use the following template:
 - Test Point: tp3
 - CTS Test Template: tp3
- 9. Retrieve Eye Width measurement.
- 10. Capture screen shot.
- 11. Save BERT Setup to "20G_TC2_100MHz".
- 12. Repeat steps #1 to #11 for 1MHz, 2MHz, 10MHz and 50MHz PJ frequencies, saving each setup as 20G_TC2_1MHz, 20G_TC2_2MHz, 20G_TC2_10MHz and 20G_TC2_50MHz respectively.



10.8 Test Receiver at 20Gb/s or 20.625Gb/s for Test Case 2 at TP3

- 1. Set up the physical equipment connections, as per Figure 25.
- 2. Use TenLira scripts on the PC to ensure that the crosstalk generator is sending PRBS31 signals at 800mV to 20Gb/s or 20.625Gb/s.
- 3. Connect the test fixture to Port A of the DUT through the 0.8M USB Type-C cable.
- 4. Recall the BERT test setup for 20G_TC2_100MHz (as saved in Section 10.7).
- 5. Configure the DUT transmitter to output PRBS31 on all lanes with SSC turned ON.
- 6. Initiate negotiation with the preset chosen in calibration.
- 7. Change the preset in the BERT according to the newly acquired preset.
- 8. Configure the DUT for the next negotiation step with the new preset.
- 9. Change the preset in the BERT according to the newly requested preset.
- 10. Configure the DUT for the next negotiation step with the new preset.
- 11. If needed, change the preset in the BERT according to the newly requested preset.
- 12. Run the 20Gb/s or 20.625Gb/s test script for Rx testing to determine the BER measured by the Receiver and record the error count for 10 seconds.

Note the error checking procedure is different between Host or Device types:

- a) For Windows Host testing, TenLira scripts are run on the Host Under Test, to determine the error count. Refer to the release notes of the scripts for details on how to run the scripts.
- b) For Non-Windows Host testing, proprietary methods are used for error count.
- c) For Device testing, TenLira scripts are run on a separate controller PC that is connected to the device under test if TenLira is not installed. For details on how to run the test scripts to determine the error count, refer to the release notes of the scripts.
- 13. Repeat steps #4 to #12 three more times and record the error count for 10 seconds for each cycle.
- 14. Again, repeat steps #4 to #12 and then record the error count for 200 seconds.
- 15. Record the BER in the test results for 20G_TC2_100MHz.
- 16. If the error count equals to 0 then PASS.
- 17. If the error count is more than 0 then run steps #4 to #12 and then record the error count for 350 seconds.
- 18. If the error count is more than 1 then FAIL.
- 19. Repeat all the steps above for each of the four TC2 frequencies.
- 20. Swap Data and Crosstalk signals, applying Data to Lane1 and Crosstalk to Lane0.
- 21. Repeat all the steps above for Lane1 of the same port if the DUT is a 2-lane Device.
- 22. Repeat all the steps above on Port B if the DUT is a multi-port Device.
- 23. Include the Eye Diagram for 20G_TC2_100MHz in the Compliance Test Report.



10.9 Test for Signal Frequency Variation Training (10Gb/s or 10.3125Gb/s)

- 1. Recall the BERT Test Setup for 10G_TC2_1MHz. Turn Off SSC.
- 2. Set SJ Frequency to 400 kHz.
- 3. Set SJ Amplitude to 22.4UI.
- 4. Configure the DUT transmitter to output PRBS15 on all lanes with SSC turned ON.
- 5. Initiate negotiation with the preset chosen in calibration.
- 6. Change the preset in the BERT according to the newly acquired preset.
- 7. Configure the DUT for the next negotiation step with the new preset.
- 8. Change the preset in the BERT according to the newly requested preset.
- 9. Configure the DUT for the next negotiation step with the new preset.
- 10. If needed, change the preset in the BERT according to the newly requested preset.
- 11. Run the 10Gb/s or 10.3125Gb/s test script for Rx testing to determine the BER measured by the Receiver and record the error count for 10 seconds.

Note the error checking procedure is different between Host or Device types:

- a) For Windows Host testing, TenLira scripts are run on the Host Under Test, to determine the error count. Refer to the release notes of the scripts for details on how to run the scripts.
- b) For Non-Windows Host testing, proprietary methods are used for error count.
- c) For Device testing, TenLira scripts are run on a separate controller PC that is connected to the device under test if TenLira is not installed. For details on how to run the test scripts to determine the error count, refer to the release notes of the scripts.
- 12. If the BER is \leq 1E-6, the test is considered passed, otherwise the test has failed.
- 13. Repeat all the above steps 20 times for each lane.

10.10 Test for Signal Frequency Variation Training (20Gb/s or 20.625Gb/s)

- 1. Recall the BERT Test Setup for 20G_TC2_1MHz. Turn Off SSC.
- 2. Set SJ Frequency to 400 kHz.
- 3. Set SJ Amplitude to 44.8UI.
- 4. Configure the DUT transmitter to output PRBS15 on all lanes with SSC turned ON.
- 5. Initiate negotiation with the preset chosen in calibration.
- 6. Change the preset in the BERT according to the newly acquired preset.
- 7. Configure the DUT for the next negotiation step with the new preset.
- 8. Change the preset in the BERT according to the newly requested preset.
- 9. Configure the DUT for the next negotiation step with the new preset.
- 10. If needed, change the preset in the BERT according to the newly requested preset.
- 11. Run the 20Gb/s or 20.625Gb/s test script for Rx testing to determine the BER measured by the Receiver and record the error count for 10 seconds.

Note the error checking procedure is different between Host or Device types:



- a) For Windows Host testing, TenLira scripts are run on the Host Under Test, to determine the error count. Refer to the release notes of the scripts for details on how to run the scripts.
- b) For Non-Windows Host testing, proprietary methods are used for error count.
- c) For Device testing, TenLira scripts are run on a separate controller PC that is connected to the device under test if TenLira is not installed. For details on how to run the test scripts to determine the error count, refer to the release notes of the scripts.
- 12. If the BER is \leq 1E-6, the test is considered passed, otherwise the test has failed.
- 13. Repeat all the above steps 20 times for each lane.



11 Appendix B: Receiver Stressed Eye Calibration Using SigTest

The SigTest post processing analysis application can be run to ensure signal quality compliance for the USB4 receiver stressed eye calibration.

Note: When using SigTest, apply the same procedure for receiver stressed eye calibration (for all USB4 data rates) as described in Appendix A, but replace the Scope measurements with the SigTest results.

Below provides a summary of SigTest requirements. Please refer to the USB4 SigTest User Manual from USB-IF for the full set of instructions to perform SigTest measurements.

Note: It is required that you are a member of USB-IF and have attained the proper permissions from USB-IF in order to have access to the USB4 SigTest User Manual.

11.1 Install and Run SigTest

[Note: The following procedure was extracted from the "USB4 SigTest installation and running:" section in the USB4 SigTest User Manual.]

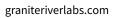
First, make sure that ≥ 16GB RAM (or recommended 32GB RAM and higher) is available on the Controller PC or Scope where SigTest is to be run.

- 1. Install Matlab Runtime Compiler MCR R2019b (9.7).
- 2. Create a new folder, for example "SigTest_USB4_CTS" and place the "USB4_SigTest.exe" file into the folder. Run the "USB4_SigTest.exe".
- 3. Open PowerShell window from the folder by pressing SHIFT + Right mouse button and then click on "Open PowerShell window here".

11.2 Set Up Scope for Saving Waveforms

[Note: The following description was extracted from the "Scope definitions for saving waveforms:" section in the USB4 SigTest User Manual.]

- a) Scope requirements and settings:
 - Sampling Rate: ≥ 80GSa/s
 - Evaluated record length: 500µs per channel
 - No CDR, no average, no interpolation and no equalization applied
 - Bandwidth: 16GHz (for USB4 Gen2) or 21GHz (for USB4 Gen3)
 - Adjust vertical scale to fit signal into Scope screen





- b) The saved waveforms for all receiver tests should be differential (for example: CH1 CH3), except of the waveform for the AC Common Mode test that should be common (for example: (CH1 + CH3)/2).
- c) De-embedding and embedding of the waveform should be applied for the following receiver compliance test points:
 - TP3_Prime test point: No de-embedding and no embedding should be applied.
 - TP3 test point: De-embedding of the cable connecting from the last receptacle to the Scope should be applied.
- d) The waveforms should use the correct test pattern type and length for the respective test as specified in the CTS to avoid test interruption and termination.



12 Appendix C: Connecting Keysight Oscilloscope to PC

If using a Keysight oscilloscope, refer to the following procedure on how to connect the Scope to be used with a controller PC. The Keysight Scope can be connected to the controller PC through GPIB, USB or LAN.

- 1. Download the latest version of the Keysight IO Libraries Suite software from the Keysight website and install on the controller PC.
- 2. When installed successfully, the IO icon () will appear in the taskbar notification area of the controller PC.
- 3. Select the IO icon to launch the Keysight Connection Expert.
- 4. Click Rescan.

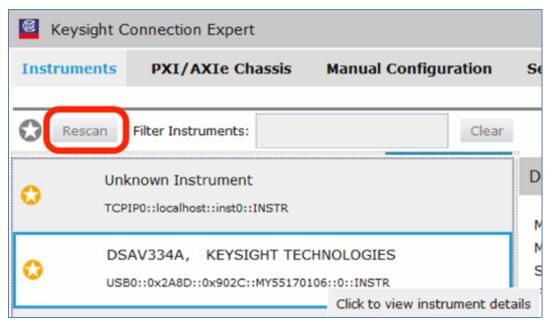


FIGURE 78. KEYSIGHT CONNECTION EXPERT

5. Refresh the system. The Keysight Scope is shown on the left pane and the VISA address is shown on the right pane.



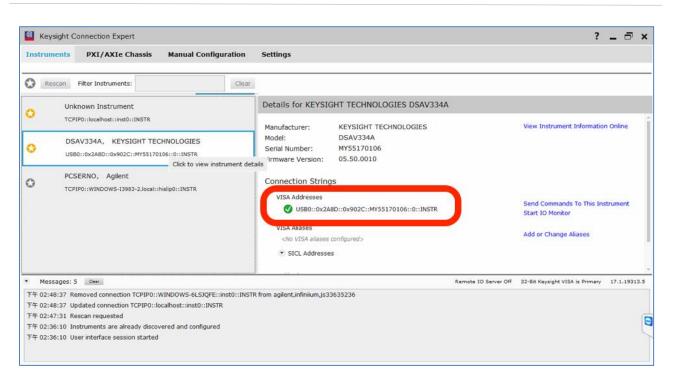


FIGURE 79. OSCILLOSCOPE'S VISA ADDRESS

6. When connecting the Keysight Scope to the PC through GPIB/USB, type in the VISA address into the 'Address' field on the Equipment Setup page of the GRL-Anritsu USB4 Rx Test Application. If the GRL-Anritsu USB4 Rx Test Application is installed on the Keysight Scope, type in the Scope IP address, for example "TCPIP0::127.0.0.1::inst0::INSTR". If the GRL software is installed on the controller PC to control the Scope via LAN, type in the Scope IP address, for example "TCPIP0::192.168.0.100::inst0::INSTR". Note to *omit* the Port number from the address.

If there is error in connection, type in the Scope IP address as "TCPIP0:: 192.168.0.100::5025::SOCKET".



13 Appendix D: Connecting Tektronix Oscilloscope to PC

If using a Tektronix DPOJET Series oscilloscope, refer to the following procedure on how to connect the Scope to be used with a controller PC. The Tektronix Scope can be connected to the controller PC through GPIB, USB, or LAN.

- 1. Download the latest version of the Tektronix TekVISA software from the Tektronix website and install on the controller PC.
- 2. When installed successfully, open the OpenChoice Instrument Manager application.

GRL - Automated Test Solutions	
Notepad +	Tab Level Adusia
TekScope	Tek_Local_Admin Documents
Windows Explorer	Pictures
Internet Explorer	Music
Launch DisplayPort AUX Control	Games
😌 TeamViewer 10	Computer
USB 3.0 Receiver Testing	Control Panel
Paint •	Devices and Printers
CLE1000	Default Programs
OpenChoice Instrument Manager	Help and Support
All Programs	
Search programs and files	Shut down 🕨
📀 🔤 🍪 🔛	0

FIGURE 80. OPENCHOICE INSTRUMENT MANAGER IN START MENU

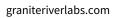
- 3. The left "Instruments" panel on the OpenChoice Instrument Manager will display all connected instruments. The functional buttons below the "Instruments" panel "Instrument List Update", "Search Criteria", "Instrument Identify" and "Properties" can be used to detect the Scope in case it does not initially appear under "Instruments".
 - a) "Instrument List Update": Select to refresh the instrument list and locate new instruments connected to the controller PC.
 - b) "Search Criteria": Select to configure the instrument search function.
 - c) "Instrument Identify": Select to use a supported programming language to send a query to identify the selected instrument.



- 🐯 OpenChoice Instrument Manager --- -- X File Edit Help Applications and Utilities Instruments GPIB GPIB8::1::INSTR OpenChoice Call Monitor Socket TCPIP::192.168.0.39::23::SOCKET OpenChoice Talker Liste... USB_USB::0x0699::0x0345::C022203::INSTR ast Updated: 5/10/2015 8:25 PM Instrument List Instrument Update Identify... Start Application or Utility Search Criteria.. Properties. Tektronix
- d) "Properties": Select to display and view the selected instrument properties.

FIGURE 81. OPENCHOICE INSTRUMENT MANAGER MENU

- 4. If connecting the Tektronix Scope to the controller PC via USB, select the "Search Criteria" function to ensure that USB connection is enabled, and then select the "Instrument List Update" function. When the Scope appears on the "Instruments" panel, select it and then go to the "Instrument Identify" function. This will display the model and serial number of the Scope once detected. Select the "Properties" function to view the Scope address.
- 5. If connecting the Tektronix Scope to the controller PC via LAN, the Scope IP address must be pre-determined beforehand. Then select the "Search Criteria" function to ensure that LAN connection is enabled and type in the Scope IP address. When the Scope shows up in the list, select it followed by "Search". The Scope should then appear on the "Instruments" panel. Select it and access the "Instrument Identify" function to view the Scope model and serial number as well as the "Properties" function to view the Scope address.
- 6. On the Equipment Setup page of the GRL-Anritsu USB4 Rx Test Application, type in the Scope address into the 'Address' field. If the GRL-Anritsu USB4 Rx Test Application is installed on the Tektronix Scope, ensure the Scope is connected via GPIB and type in the GPIB network address, for example "GPIB8::1::INSTR". If the GRL software is installed on the controller PC to control the Scope, type in the Scope IP address, for example "TCPIP0:: 192.168.0.100::inst0::INSTR". Note to *omit* the Port number from the address.





14 Appendix E: Connecting Teledyne LeCroy Oscilloscope to PC

If using a Teledyne LeCroy oscilloscope, refer to the following procedure on how to connect the scope to be used with a PC. The Teledyne LeCroy scope can be connected to the PC through LAN.

1. From the oscilloscope main menu bar, select **Utilities → Utilities Setup...**.

lay	,	Cu	rsors	E	Me	asure	Math	Ŀ≂ A	nalysis	* L	Itilities	 Support 	t
									-	≫	Utilities	Setup	
										×	Disk Ut	ilities	
									-	ر کی	Prefere	nce Setup	-
					-								-

FIGURE 82. UTILITIES SETUP MENU

2. In the **Remote** tab, set the **Control from** settings to **LXI (VXI11)**. Note down the IP address of the scope.

+							
Utilities	Status	Remote	Aux Output	Date/Time	Options		
Contro	l from	1					
07	TCPIP			SCOPE-SERIAL	L.		
Off	(VICP)			0.0.0.0, 192.168	3.1.191		
	LXI (VXI11)			00-25-90-b9-89-	9c, 00-25-90-b9-89-ec	2	
				c	Net onnections		
TELEDYNE L	ECROY						

FIGURE 83. OSCILLOSCOPE'S IP ADDRESS

3. On the Equipment Setup page of the GRL Anritsu USB-4 Rx Test Application, type in the Scope IP address into the 'Address' field.



15 Appendix F: SMA Cable Transfer Function Setup Procedure for Cable De-embedding

This section describes how to create and set up transfer function on the Scope for de-embedding of SMA cables.

15.1 Set Up Transfer Function for the Keysight Scope

15.1.1 For SMA Cable De-embedding on Scope Channels 1 & 3

 On the Keysight Scope, select Setup → Channel 1 → Differential Channels 1 & 3 → 4 Port (Channels 1 & 3) on the InfiniiSim pane:

Channel 1

File Control Setup Display Trigger Measure/Mark

		2 Channel 2 3 Channel 3 4 Channel 4	
0		Measure Math Analyze Utilities De	
R	Channel		🔅 ? 🔀
Wa	2 9 4		Channels
lime Meas	✔ On Invert Ch 1 -	Ch 3 Differential Channels 1 & 3	
eas	Channels 1 & 3 Acquisition HW	C Differential Display	
	Scale	Scale 🗹 Auto 🔲 Fine	
Vertical Meas	1.00 V/	2.00 V/	
al M	Offset	Offset	
eas	0.0 V YO A	0.0 V	
10	Channel 1 Skew	Channels 1 & 3 Skew	
hse	0.0 s	0.0 s	Bandwidth Limit
0	Labels 1	InfiniiSim ————	Probe
\bigcirc	PrecisionProbe/PrecisionCable	4 Port (Channels 1 & 3)	Probe
Inf	On Setup	Setup	Probe Cal
Sc			Trigger

FIGURE 84. SMA CABLE TRANSFER FUNCTION – SET UP SCOPE CHANNELS 1 & 3

2. On the InfiniiSim Setup screen, select Setup Wizard:







FIGURE 85. SMA CABLE TRANSFER FUNCTION – SELECT SETUP WIZARD ON SCOPE

3. On the InfiniiSim Wizard screen, select **Next**:

nfiniiSim Wizard	🔅 🖓
General Setup	This wizard will help you quickly set up InfiniiSim on your Infiniium oscilloscope by walking you through the necessary steps.
Select Model	Any selections or changes you make in the wizard will be undone if you press Cancel at the bottom of a page.
Measurement Block Setup	To begin setting up InfiniiSim, click the Next button.
Simulation Block Setup	
Observation Nodes	
Save File	
	Cancel < Back Next > Einish

FIGURE 86. SMA CABLE TRANSFER FUNCTION- SET UP INFINIISIM ON SCOPE #1

4. On the InfiniiSim Wizard > General Setup screen, select Next:



InfiniiSim Wizard	👘 ?
General Setup Select Model	InfiniiSim consists of two circuits: Measurement and Simulation. The Measurement Circuit is a description of what your system actually is, while the Simulation Circuit is what you want it to be like. The key concept is that InfiniiSim creates a transfer function to convert between the Measurement Circuit (real) and the Simulation Circuit (desired).
Measurement Block Setup Simulation Block Setup	For example, you may be using a cable that is having undesired effects on your oscilloscope measurements. The Measurement Circuit would have a block that describes the electrical characteristics of the cable (such as an RLC circuit or S-parameter file). The Simulation Circuit would have a "Thru" because InfiniiSim creates a transfer function that compensates
Observation Nodes	for the electrical impact of the cable. This means the waveforms shown on the scope are what you would be seeing if the cable had no electrical impact at all.
Save File	These are the colors for the Measurement and Simulation Circuits
	Measurement Circuit
	Simulation Circuit
	Cancel < Back Next > Einish

FIGURE 87. SMA CABLE TRANSFER FUNCTION- SET UP INFINIISIM ON SCOPE #2

5. On the InfiniiSim Wizard > Select Model screen, select **Remove insertion loss of a fixture or** cable → Next:

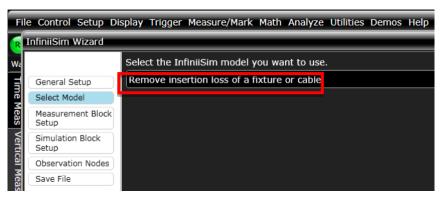
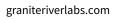


FIGURE 88. SMA CABLE TRANSFER FUNCTION- SET UP INFINIISIM ON SCOPE #3

- 6. On the InfiniiSim Wizard > Measurement Block Setup screen, set the following parameters for de-embedding of the SMA cable:
 - In the" Port Type" field, select **4 Port**.
 - In the "Block Type" field, select **S-parameter File**.
 - In the "S-parameter file" field, browse and select the SMA cable S4P file which has been measured using the ENA vector network analyzer.
 - In the "4 Port Numbering" field, select 1↔3, 2↔4.

Select **Next** to proceed.

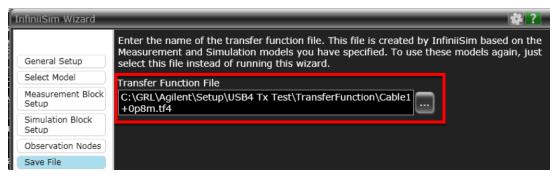




InfiniiSim Wizard		* ?
General Setup Select Model	Measurement Block Setup Block Name Port Type Channel 4 Port	_
Measurement Block Setup Simulation Block Setup	Ports 1, 2, 3 & 4 Block Type S-parameter File	
Observation Nodes	S-parameter file	
Save File	C:\GRL\Agilent\Setup \USB4 Tx Test\s4p $\frac{4 \text{ Port Numbering}}{1 \leftrightarrow 3, 2 \leftrightarrow 4}$ Flip Model	
	Cancel < Back Next	> Finish

FIGURE 89. SMA CABLE TRANSFER FUNCTION- SET UP INFINIISIM ON SCOPE #4

 On the InfiniiSim Wizard > Save File" screen, specify the file name for the newly created transfer function file. Make sure the file is saved to the following default location– "C:\GRL\Agilent\Setup\ Anritsu USB4 Rx Test\TransferFunction\xxx.tf4" on the Scope and then select Next → OK → Finish.





InfiniiSim Wizard		?
	Congratulations! You have set up InfiniiSim. Click the Finish button to apply your settir	ngs.
General Setup		
Select Model		
Measurement Block Setup		
Simulation Block Setup		
Observation Nodes		
Save File		
	Successful computation of transfer function.	
	Cancel < Back Next > Fin	ish

FIGURE 90. SMA CABLE TRANSFER FUNCTION – SET UP INFINIISIM ON SCOPE COMPLETED

8. On the GRL-Anritsu USB4 Rx Test Application → Configurations page, select **True** for the "Enable DeEmbedding" field and specify the transfer function file to be used in the "Cable DeEmbedding File" field.

¢	Û	🔶 🔅 🛧	
		PG Delay Value: ACCM Channel:	False Set Default 0
	٢	Manual ACCM: Enable DeEmbedding:	False ~ True ~
	L	Cable DeEmbedding File: Custom Preset Table:	Cable 1.tf 4
		Enable Test Characterization	Mode: False ~
	-	EQ DC Gain 10G:	Default \checkmark

9. Repeat all the above steps to generate a new transfer function as required.





15.2 Create Filter Files for the Tektronix Scope

15.2.1 Convert Single-Ended S-Parameter Files to Mixed Mode

- 1. Turn on the "Serial Data Link Analysis" (SDLA) software on the Tektronix scope.
- 2. Select Analyze → Serial Data Link Analysis:

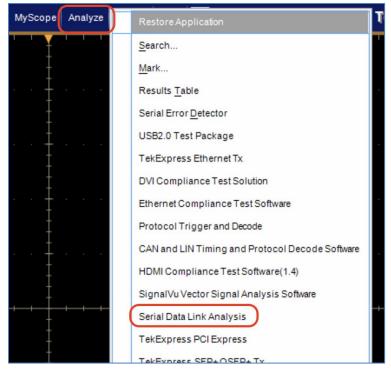


FIGURE 91. SELECT AND OPEN SERIAL DATA LINK ANALYSIS ON TEKTRONIX SCOPE

- 3. On the SDLA Visualizer screen, select the **Convert** tab button.
- 4. Click on the **Load** button to load the SMA cable S-parameters.
- 5. Select the correct port definition for the S-parameter file.
- 6. Click on the **Apply** button.

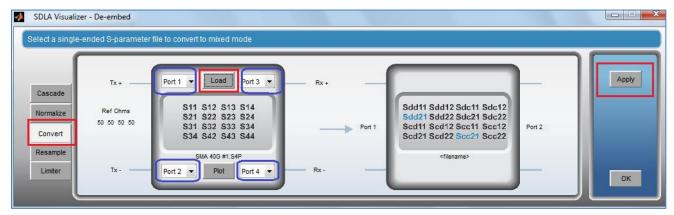


FIGURE 92. CONVERT TO MIXED MODE S-PARAMETERS



7. Click on the **Save** button to save the mixed mode S-parameters after conversion.

SDLA Visualize	er - De-embed					
Select a single-	-ended S-parameter	file to convert to mixed mode				
Cascade	Tx +	Port 1 V Load Port 3 V	Rx +	Plot	\vdash	Apply
Normalize	Ref Ohms 50 50 50 50	S11 S12 S13 S14 S21 S22 S23 S24 S31 S32 S33 S34 S34 S42 S43 S44	Port 1	Sdd11 Sdd12 Sdc11 Sdc12 Sdd21 Sdd22 Sdc21 Sdc22 Scd11 Scd12 Scc11 Scc12 Scd21 Scd22 Scc21 Scc22	Port 2	
Resample Limiter	Tx -	SMA 40G #1.54P Port 2 Plot Port 4	Rx -	SMA 40G #1 Diff.S4P		ОК

FIGURE 93. SAVE CONVERTED MIXED MODE S-PARAMETERS

15.2.2 Create SMA Cable De-embedding Files for Scope Channels 1 & 3

1. On the Tektronix Scope, click on the **De-embed** button on the SDLA Visualizer screen.

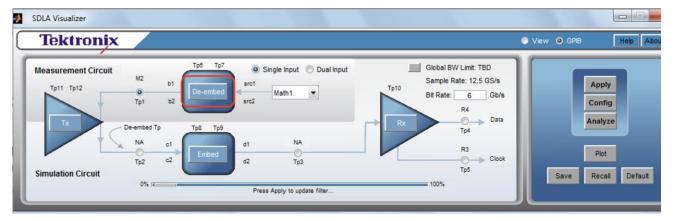


FIGURE 94. CREATE SMA CABLE DE-EMBEDDING FILES – #1

2. Click on the **B1** button.

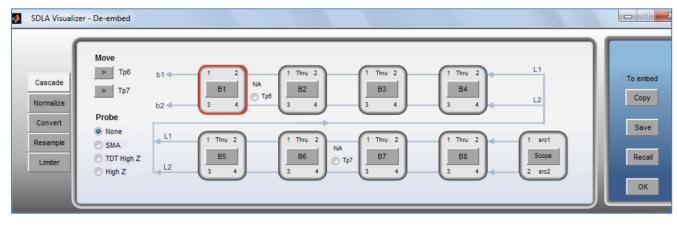


FIGURE 95. CREATE SMA CABLE DE-EMBEDDING FILES – #2



3. Click on the **Browse** button to load the mixed mode S-parameter file that has been created from Section 15.2.1. Then click **OK**.

📣 SDLA Visualize	r - Block Configuration					
Select B1 mode	and the applicable files if required					
1	Model		SMA 40G Diff #1.S4P		Label	
Thru	Model 4-Port Differential	▼ Sdd11 Sdd12 Sdc11 Sdc12 Sdd21 Sdd22 Sdc21 Sdc22 Scd11 Scd12 Scc11 Scc12	Dort1	Differential Port2	Label B1	
File	Typical	Scd21 Scd22 Scc21 Scc22	Ļ	Browse	Check	
T Line	Alternate	S11 S12 S13 S14	Port1 V	Single Port2 -	Passivity	Plot
	Scaling Factor	S21 S22 S23 S24 S31 S32 S33 S34 S34 S42 S43 S44	Port3 V	Ended Port4 V		ок

FIGURE 96. CREATE SMA CABLE DE-EMBEDDING FILES – #3

- 4. Make sure signals are actively flowing through **Channel 1** on the scope.
- 5. Select the **Tp1** radio button.

SDLA Visualizer		
Tektronix		O View O GPIB Help About
Measurement Circuit Tp11 Tp12 Tx De-embed T	b1 De-embed src1 Ch1 Tr10 Bit Rate:	V Limit 19.998GHz Late: 100 GS/s 20.625 Gb/s R4 Onfig Data Tp4
Simulation Circuit	c1 c2	R3 Clock Tp5 Clock Save Recall Default

FIGURE 97. CREATE SMA CABLE DE-EMBEDDING FILES – #4

6. Select the Math2 radio button and then click OK.

SDLA Visualizer - Test Poir	t and Bandwidth C	Configuration						X
Tp1 - Map the desired tes	st points to Math to	see the processed waveform						
Tp On/Off	Map Tp to Ma	th	Label	Filters	Global BW Limit	Delay		
C Math1	None	•	NA	Save	None	Keep Delay		
Math2	Tp1	•	Tp1	Save	Auto	Remove Delay	ы	
Math3	Tp2	•	Tp2	Save	Custom	Adjust Delay		
Math4	ТрЗ	•	ТрЗ	Save				
Ref3	Tp5				BW: 19.9988GHz			
© Ref4	Tp4	Scaling Factor		Export filters for	or 32-bit scope 🔋			ок

FIGURE 98. CREATE SMA CABLE DE-EMBEDDING FILES – #5



7. Click on the **Apply** button.

SDLA Visualizer			
Tektronix		🔘 View 🛛 GPIB	Help About
Measurement Circuit	M2 b1 De-embed src1 Ch1 src2 Ch1 src2 Ch1 src2 Ch1 src2 Ch1 src2 Tp8 Tp9 Tp8	Apph Confi Analyz	g
Simulation Circuit	NA of Tp2 o2 0% IT Press Apply to update filter Tp3 Tp4 Tp4 R3 Clock Tp5 100%	Piot Save Reca	II Default

FIGURE 99. CREATE SMA CABLE DE-EMBEDDING FILES – #6

- The filter file will be created at "C:\Users\Public\Tektronix\TekApplications\SDLA\output filters\sdlatp1.flt". Copy this file to the "C:\TekApplications\DPOJET\Setups\Anritsu USB4 Rx Test\TransferFunction" directory on the Tektronix scope and rename the file for deembedding of channels 1 & 3.
- On the GRL-Anritsu USB4 Rx Test Application → Configurations page, select True for the "Enable DeEmbedding" field and specify the filter file to be used in the "Cable DeEmbedding File" field.

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		oronnito i o bolaj.	False Set Default
		PG Delay Value:	0
		ACCM Channel:	Both ~
		Manual ACCM:	False ~
	ſ	Enable DeEmbedding:	True
	ŀ	Cable DeEmbedding File:	Cable 1.fit
		Custom Preset Table:	False ~
		Enable Test Characterization I	Node: Vode:
		EQ DC Gain 20G:	Default ~
		EQ DC Gain 10G:	Default ~

END_OF_DOCUMENT