



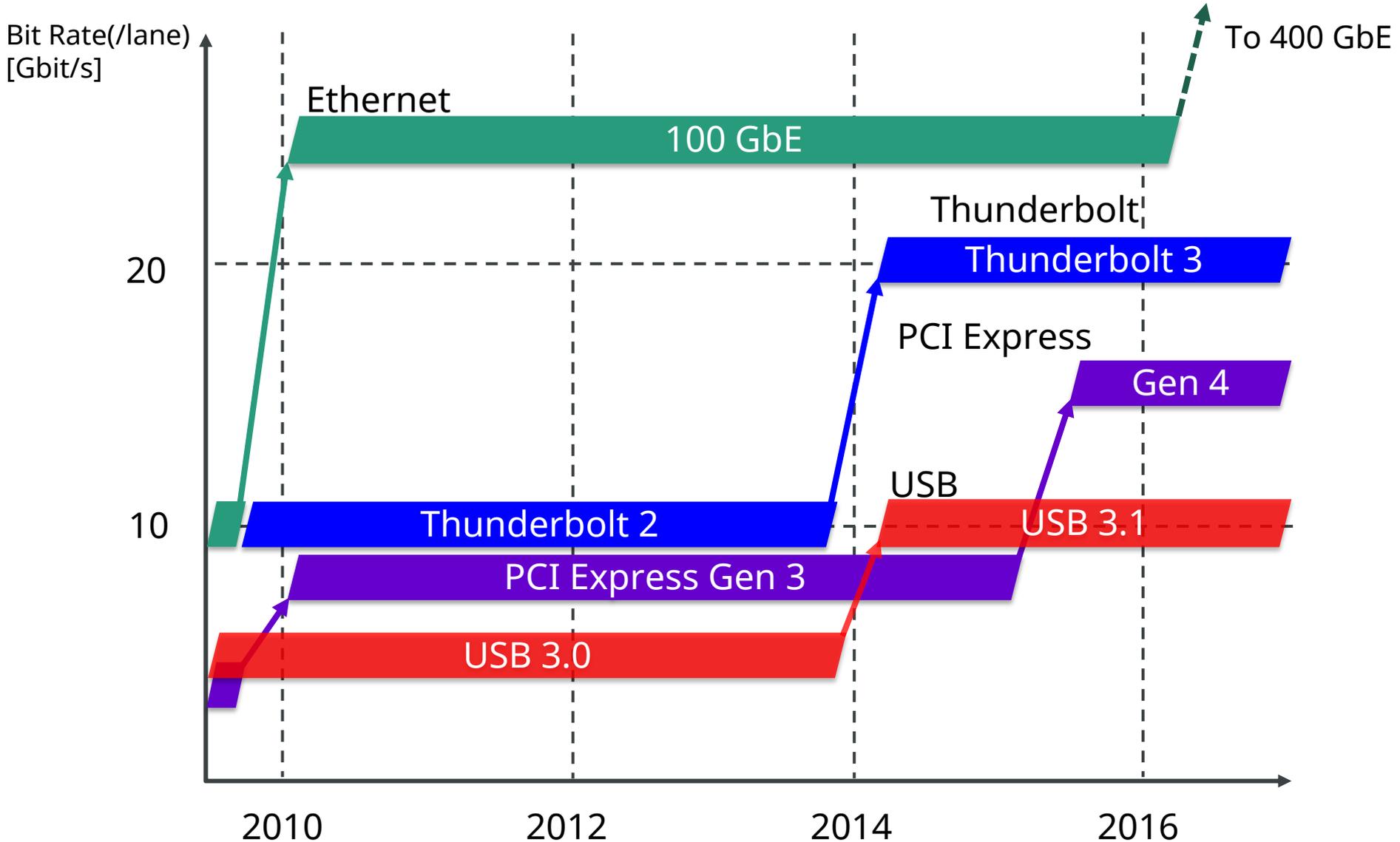
# High-Speed Serial Bus Interface Solution for PCI Express, Thunderbolt, USB

Signal Quality Analyzer  
MP1800A Series

# Outline

- Traffic volumes at data centers are exploding due to the spread of cloud computing services. Consequently, faster interfaces such as 100 GbE, 400 GbE, InfiniBand EDR, etc., are being deployed for communications between the servers and network equipment, while on the other hand, speeding-up of equipment internal serial bus interfaces, such as PCI Express, is also being investigated.
- Moreover, USB Type-C connectors and cables are being deployed as high-end computing interfaces supporting faster Thunderbolt 3 and USB 3.1 speeds.
- This product introduction explains MP1800A measurement solutions for high-speed serial interfaces such as PCI Express, Thunderbolt, and USB.

# Trends in Ethernet, Thunderbolt, PCI Express, USB Standards

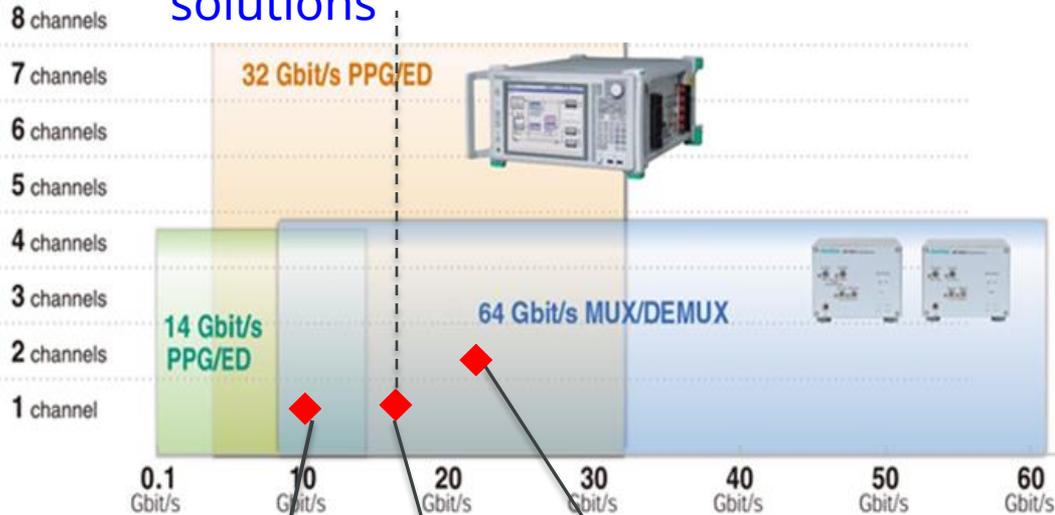


# 32 Gbit/s Wideband Multi-interface Test

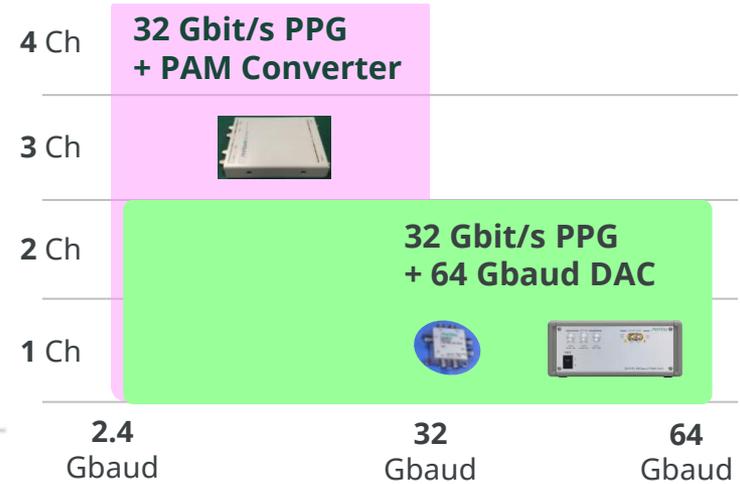
All-in-one MP1800A SQA expandability to 32 Gbit/s and 8CH max. for multi-interface evaluations

(PCI Express Gen 4 (16 G), USB 3.1 Gen 2 (10 G), Thunderbolt 3 (20 G),  
100 GbE (25.78 G), 400 GbE (26.6 G/53.1 G), InfiniBand (25.78 G), CEI (28 G))

## Multi-channel NRZ solutions



## Multi-channel PAM4 solutions



Thunderbolt 3

USB 3.1 Gen 2

PCI Express Gen 4

# MP1800A High-Speed Serial Bus Test Solution Features

## Supports multi-interface PHY layer tests using 32 Gbit/s MP1800A

- Applications: PCI Express Gen 4 (16 G), USB 3.1 Gen 2 (10 G), Thunderbolt 3 (20 G), 100 GbE (25.28 G), 400 GbE (26.6 G/53.1 G), InfiniBand (25.28 G), CEI (28 G)
- Multiple channels and high expandability
- Supports both 100 GbE equipment interconnects and equipment internal interfaces (PCI Express)
- Supports both USB 3.1 Gen 2 and Thunderbolt 3 via USB 3.1 Type-C connectors and cables
- Useful Jitter Tolerance measurement software supporting each standard (MX183000A-PL001)

## Link Sequence generation for device RX tests

- PCI Express Gen 1, 2, 3, 4 (MX183000A-PL011)
- USB 3.0/3.1 Link Sequence Generation (MX183000A-PL012)

## Reduces engineering test workload with high-reproducibility calibration and Jitter measurement functions

- Automatic calibration and Jitter tests
  - Supports PCI Express Gen 4 base spec, Thunderbolt 3/2, USB 3.1 Gen 2

\*Automation software sold by Granite River Labs (<http://graniteriverlabs.com/>)

## Supports efficient device design tests with high-quality waveforms and high input sensitivity

- High-accuracy testing due to PPG outputting waveform with low Residual Jitter (RJ) of 200 fs (rms) and ED with high input sensitivity of 10 mV

# MP1800A Series Software Products

- High-expandability software solutions supporting multi-interface tests
- Calibration and test automation for device receiver tests

Model	Name
MX183000A	High-Speed Serial Data Test Software (standard accessory)
MX183000A-PL001	Jitter Tolerance Test
MX183000A-PL011	PCIe Link Sequence
MX183000A-PL012	USB Link Sequence
GRL-PCIE4-BASE-RXA*	PCIE Gen 4 Automation Software
GRL-TBT3-RXA*	Thunderbolt 3 Automation Software

\*Automation software sold by Granite River Labs (<http://graniteriverlabs.com/>)

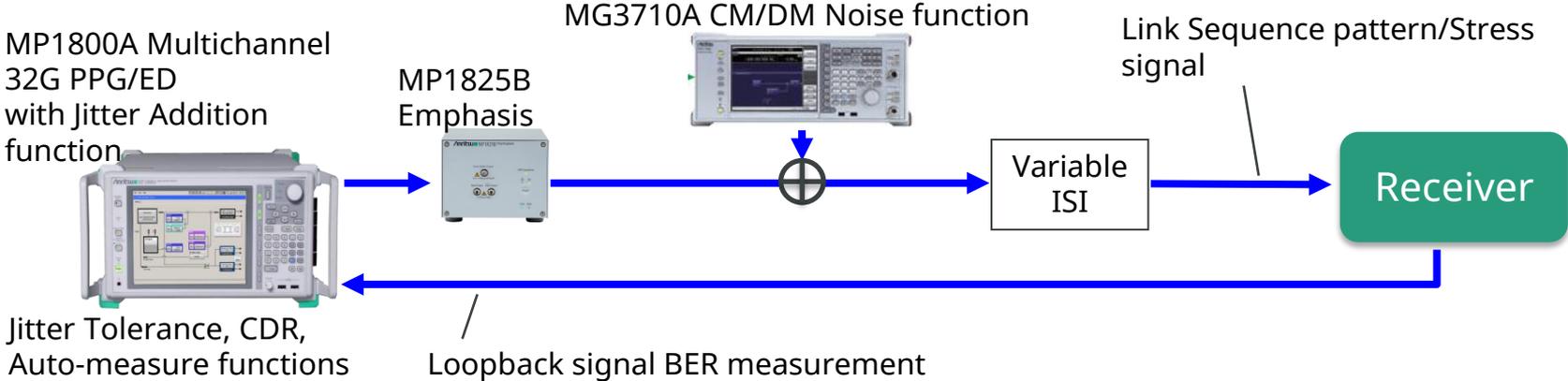
# Generating Stressed Signal for Rx Tests and Measuring BER using MP1800A

## ➤ Generating Stressed Signal

- Jitter Addition function: SJ/RJ/BUJ/SSC
- Noise Addition function: Common Mode/Differential Mode (using MG3710A SG)
- ISI Control (using Artek Variable ISI)
- Emphasis Control
- Crosstalk Signal Generation: 8CH max. with all-in-one MP1800A multichannel
- Link sequence pattern generation for transitioning DUT state to Loopback

## ➤ BER Measurement

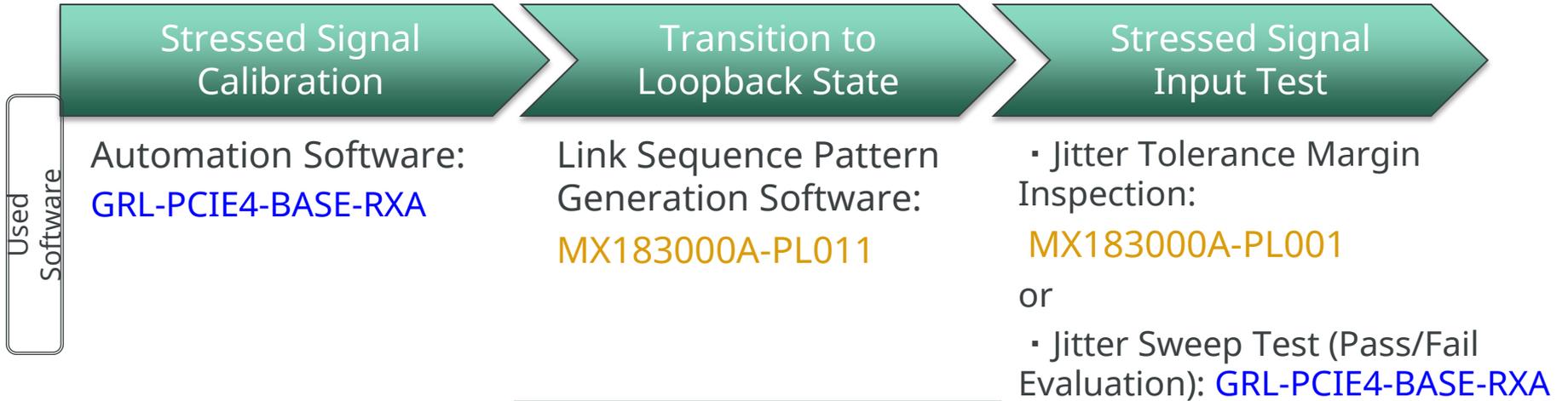
- Jitter Tolerance measurement
- High-sensitivity Input function: 10 mV (typ.) Eye Height input
- CDR Function: 2.4 to 32.1 Gbit/s wideband
- Auto-measurement function: Bathtub/Eye Diagram/Eye Contour/ Eye Margin



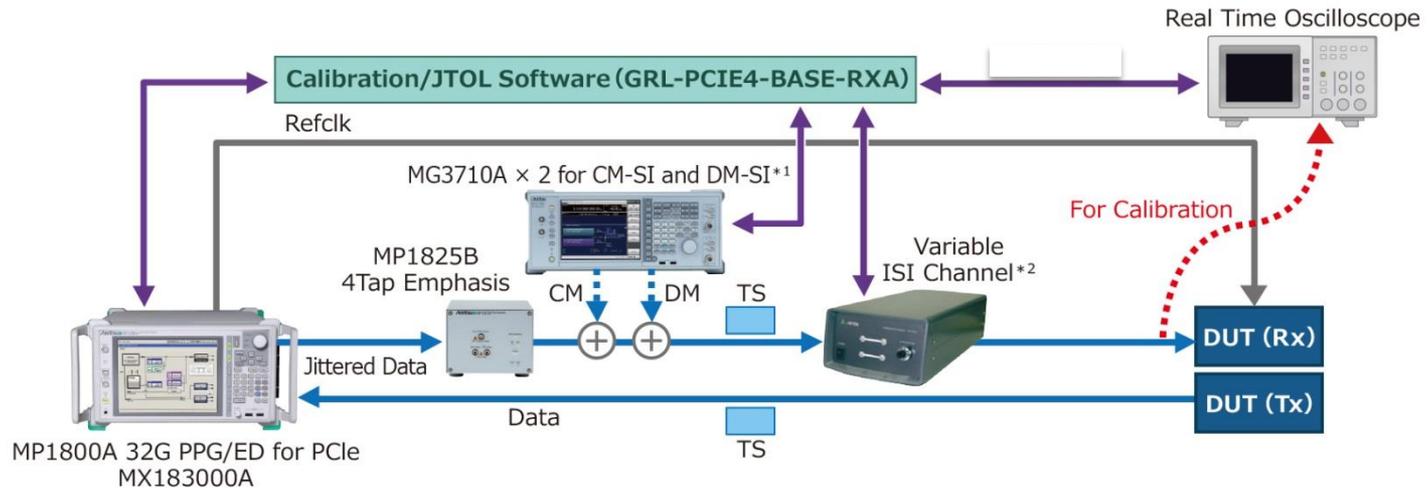
# PCI Express Gen 4 Base Specification Test Solution

# Outline of PCI Express Gen 4 Base Spec. Rx Test

## ➤ Flow of PCI Express PHY IP Device Rx Test



### PCI Express Measurement Set-up



# PCI Express Gen 4 Base Spec. Rx Test Features

## ✓ Key Features

- Automatic measurement and automatic calibration using GRL-PCIE4-BASE-RX Automation Software
- Logical Sub-Block evaluation using MX183000A
- Jitter Tolerance testing by transitioning to device status by generating Link Sequence

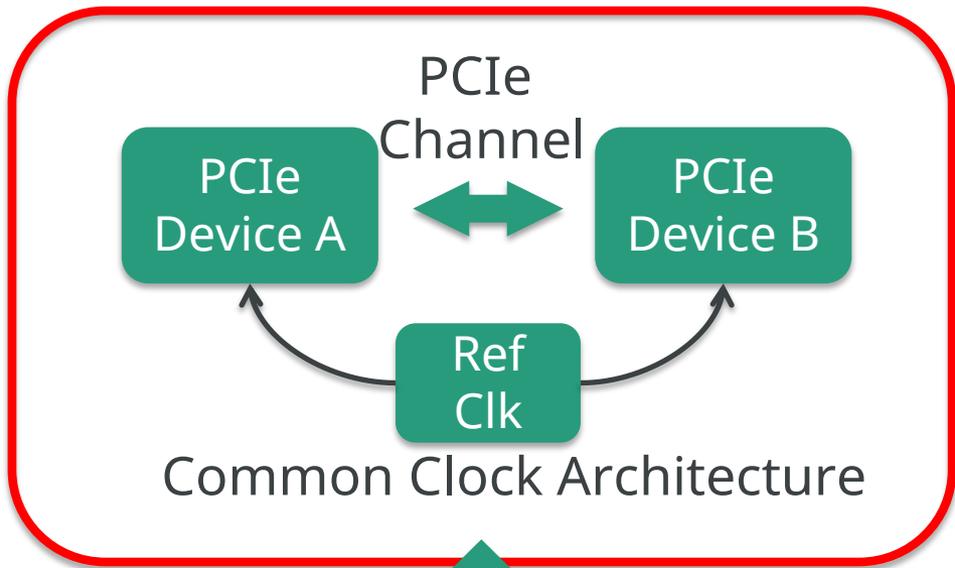
### Supported Standards

Supported Standard		DUT	Calibration	Link Sequence Generation	Jitter Tolerance Test
PCI Express	1.x/2.0/3.x/4.	Host SERDES	Support v4.0	Supported	Supported
	0	End Point SERDES	Not supported	Not supported	Not supported
Jitter Tolerance Test Function (Option PL001)			PCI Express Link Sequence Generation Function (Option PL011)		
<ul style="list-style-type: none"> <li>✓ Impress SJ/RJ to test PHY device Jitter Tolerance</li> <li>✓ Test device margin using low-rate estimate BER measurement</li> <li>✓ Output measurement results report in HTML and CSV format</li> </ul>			<ul style="list-style-type: none"> <li>✓ Control status of PCIe Base Spec. Rev. 4.0 devices to support Logical Sub-Block evaluation</li> <li>✓ Support 8B/10B, 128B/130B, Scramble, SKIP Insertion</li> </ul>		

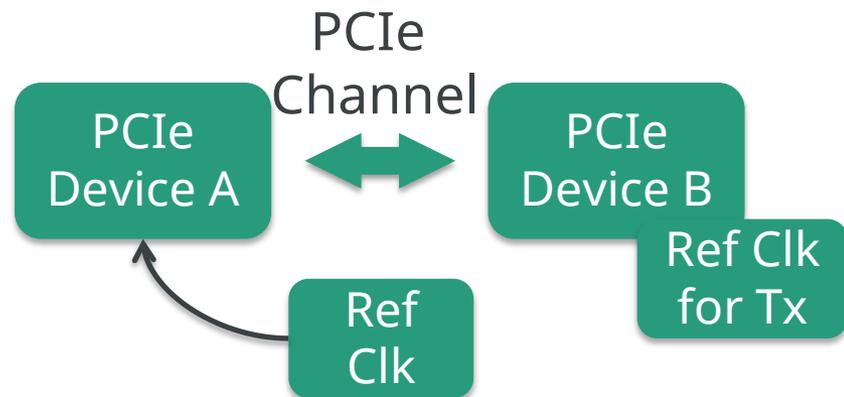
\*Control items: Only at following measurements

- Common Clock Architecture
- Loopback data from DUT only at SSC Off

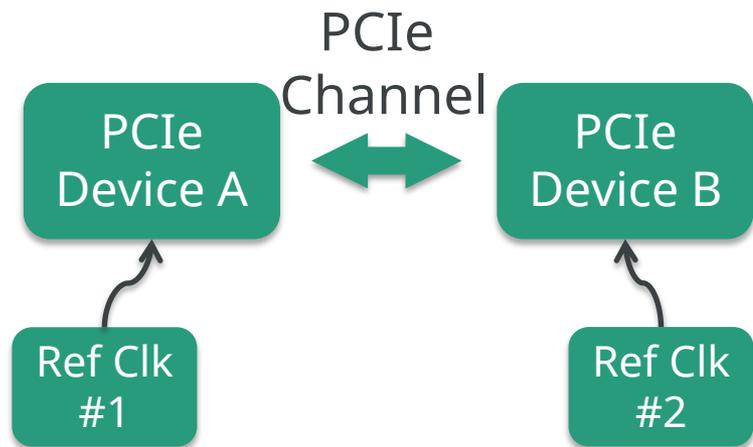
# Supported PCI Express Clock Architecture



Common Clock Architecture



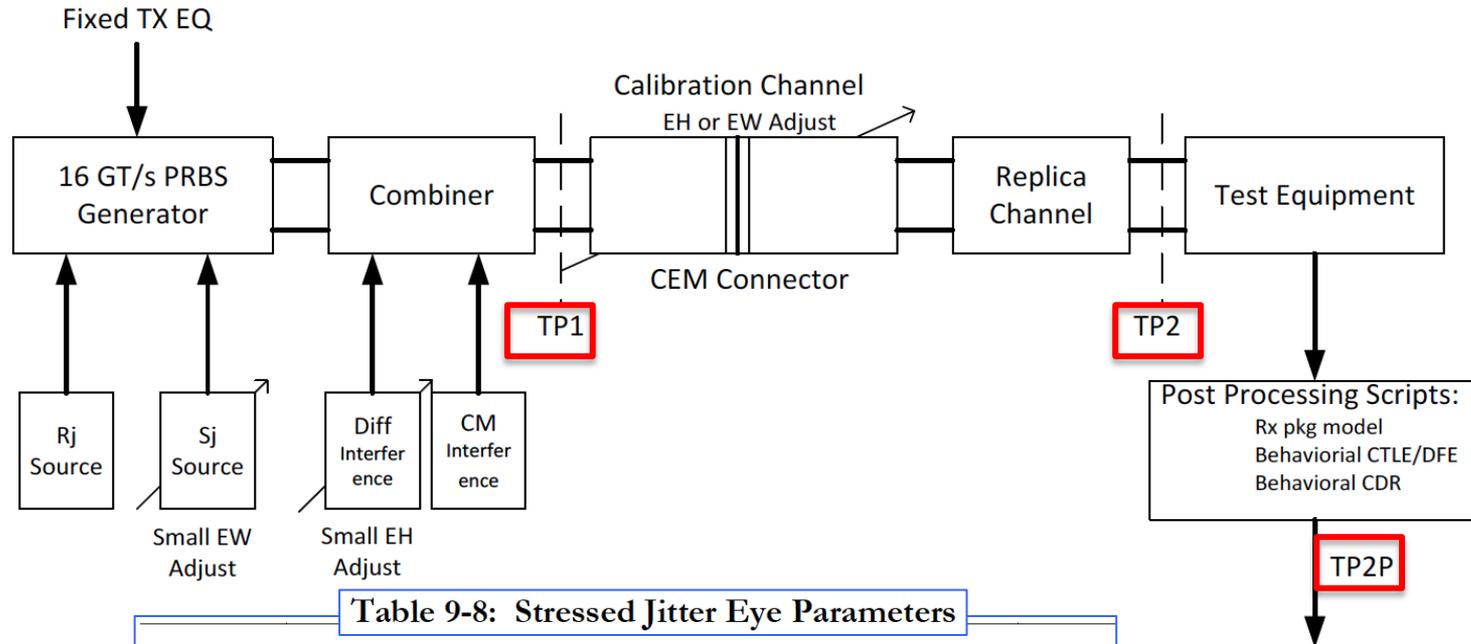
Data Clocked Architecture



Separate Ref Clk Architecture

Only Supports  
Common Clock  
Architecture

# PCI Express Gen 4 Base Spec. Calibration Points (1/2)



**Table 9-8: Stressed Jitter Eye Parameters**

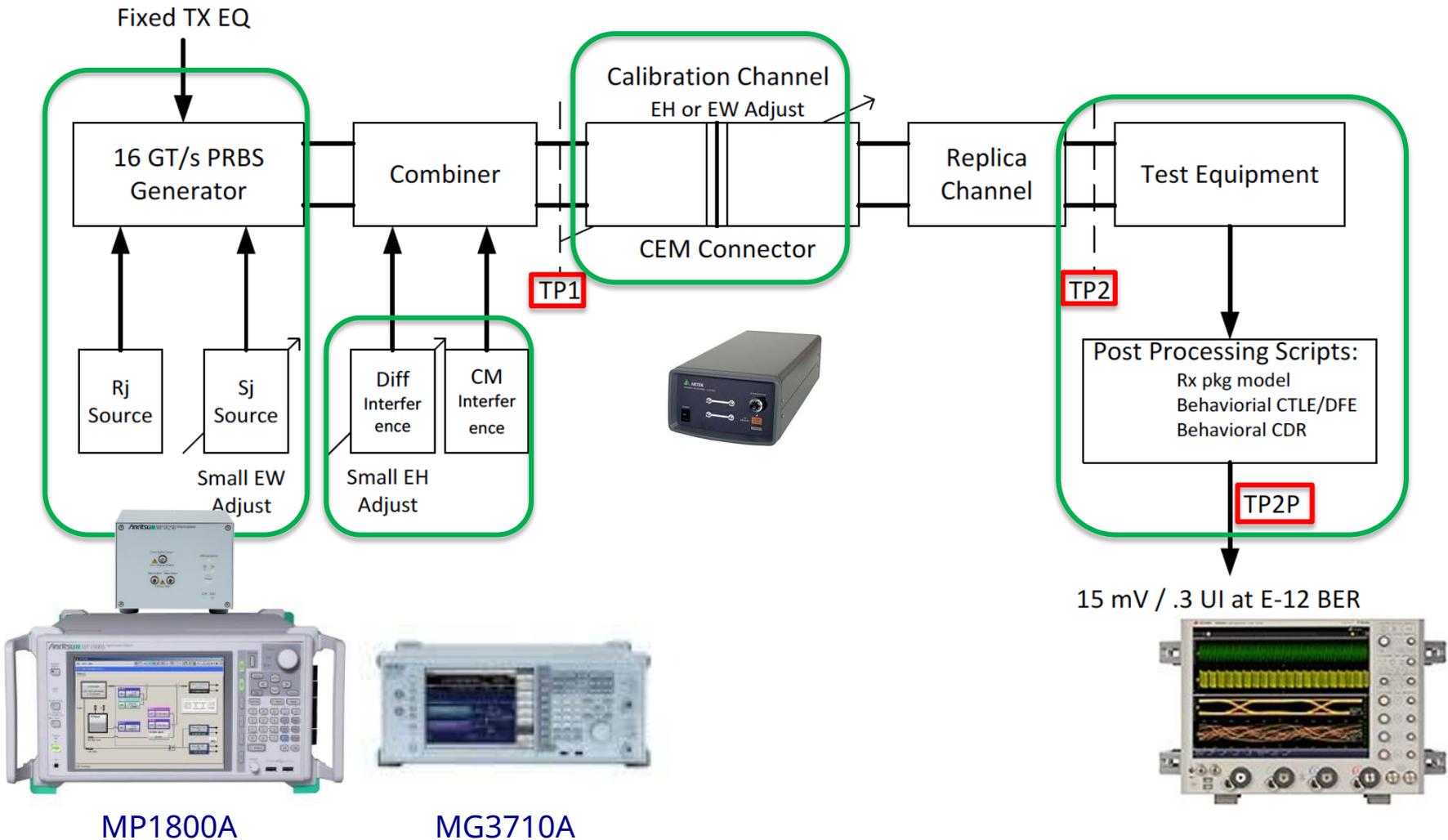
Symbol	Parameter	2.5 GT/s	5.0 GT/s	8.0 GT/s	16.0 GT/s	Units
$V_{RX-LAUNCH}$	Generator launch voltage	800-1200	800-1200	800-1200	800-1200	mV PP
$T_{RX-UI}$	Unit Interval	400	200	125	62.5	ps
$T_{RX-ST}$	Eye width at TP2P	<0.4	<0.32	0.30	0.30	UI
$T_{RX-ST-SJ}$	Swept Sj	33 KHz spur only	33 KHz spur only	Figure 9-29, Figure 9-30	Figure 9-29, Figure 9-30	UI PP
$T_{RX-ST-RJ}$	Random Jitter	TBD	TBD	3.0 (max)	~1.0 (max)	ps RMS
$V_{RX-DIFF-INT}$	Differential noise	TBD	TBD	TBD	TBD	mV PP
$V_{RX-CM-INT}$	Common mode noise	150	150	150	150	mV PP

# PCI Express Gen 4 Base Spec. Calibration Points (2/2)

Stressed Signal Calibration

Transition to Loopback State

Stressed Signal Input Test

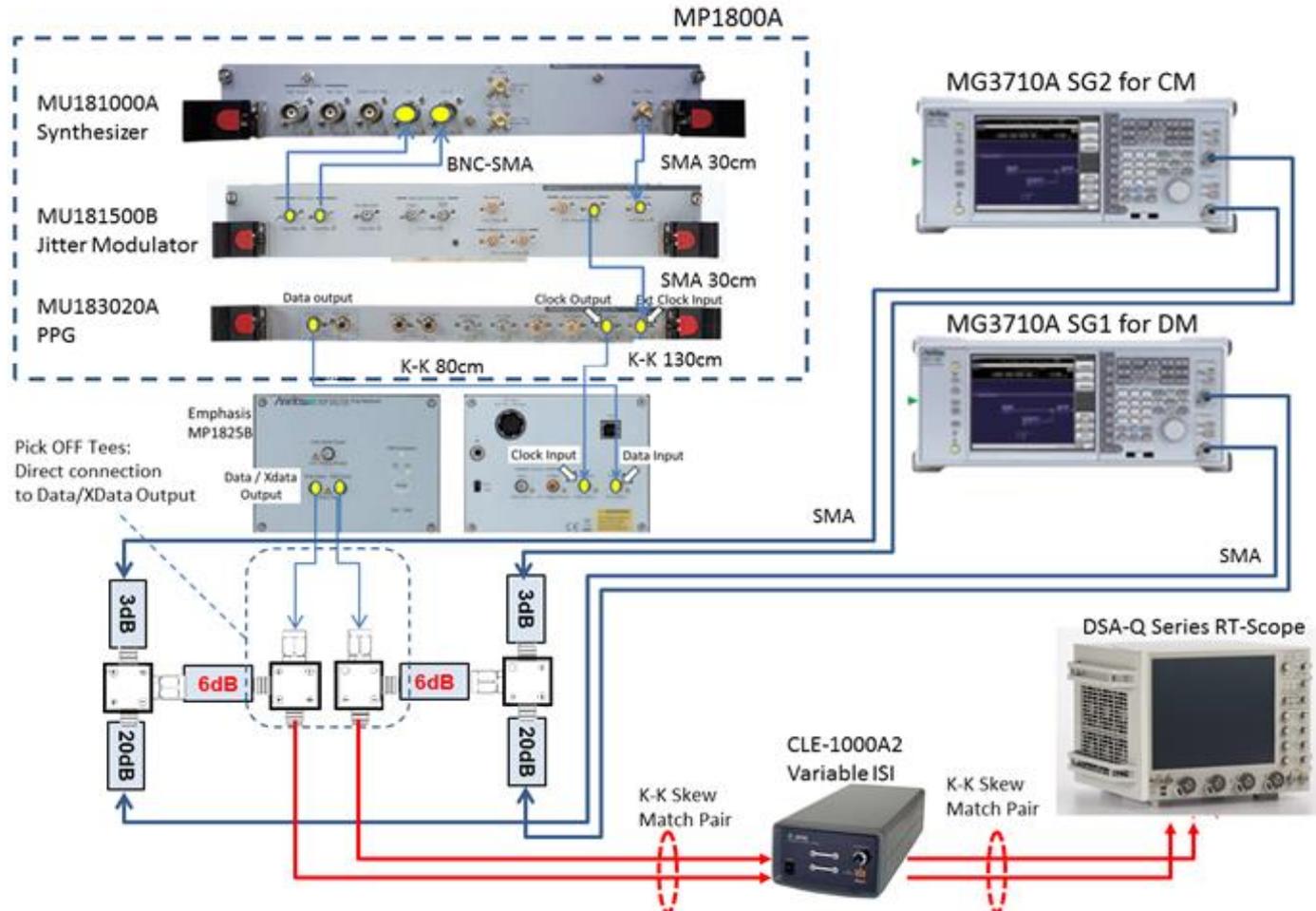


# PCI Express Gen 4 Base Spec. Calibration Test Setup for TP2

Stressed Signal Calibration

Transition to Loopback State

Stressed Signal Input Test



\*Variable ISI filtered at TP1

# PCI Express Gen 4 Base Spec. Calibration

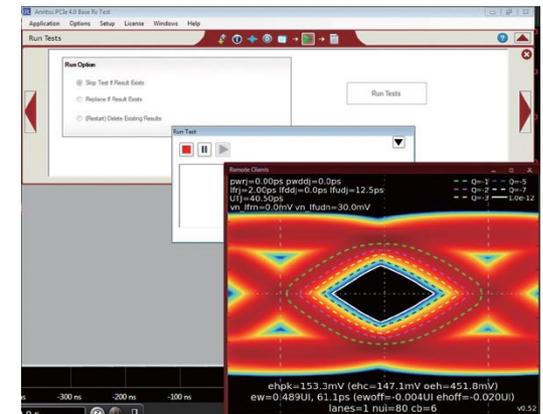
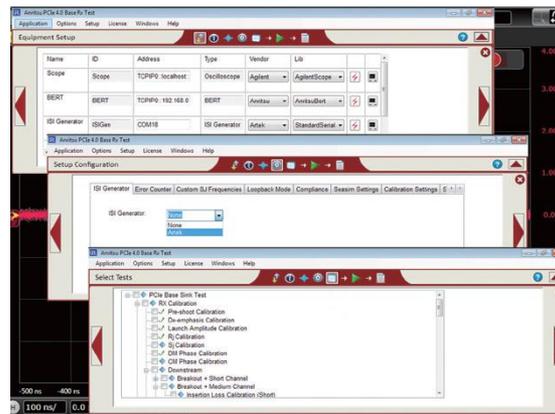
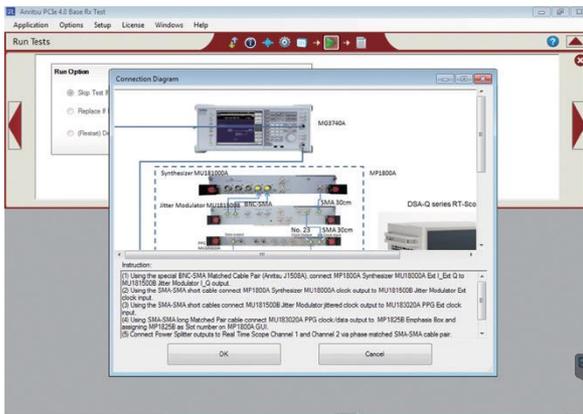
Stressed Signal Calibration

Transition to Loopback State

Stressed Signal Input Test

## ➤ Stressed Signal Calibration

## Features of GRL-PCIE4-BASE-RXA Automation Software



Calibration Setting and Measurement Screens

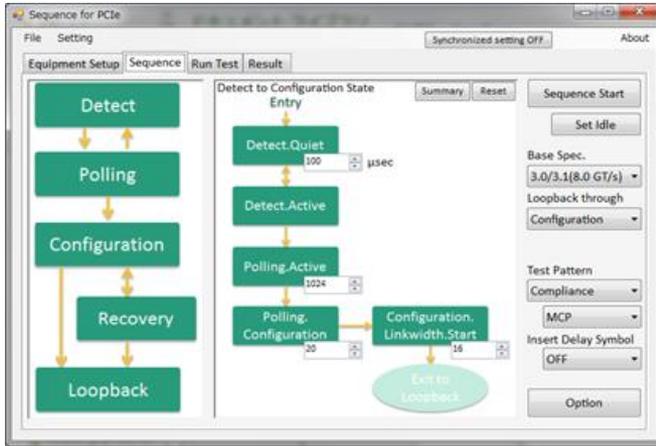
One-button calibration and testing of stress input signals using GRL-PCIE4-BASE-RXA

- ✓ Supports PCIe Gen 4 Rev. 0.5 devices
- ✓ Calibration of high-reproducibility test signal and Rx tests
- ✓ Auto-control of variable ISI channel and Eye opening calibration

# PCI Express Gen 4 Base Spec. Rx Test (1/3)



## ➤ Generating Link Sequence using MX183000A-PL011



PCI Express Link Sequence Setting Screen

PPG Pattern control using MX183000A

- ✓ GUI for easy setting of measurement conditions and simple test execution
- ✓ Built-in PDF format reporting function
- ✓ Control of PCIe device status using sequence generation and evaluation of Logical Sub-Block
- ✓ 8B/10B, 128B/130B, Scramble SKIP Insertion

Item	MX183000A-PL011 Specification
Supported Standards	PCIe Rev 1.x (2.5 GT/s), 2.0 (5 GT/s), 3.x (8 GT/s), 4.0 (16 GT/s)
Test Pattern	Compliance (MCP, CP), PRBS (7, 9, 10, 11, 15, 20, 23, 31)
LTSSM State	Transition to Detect, Polling, Configuration, Recovery, Loopback
Loopback Through	Configuration, Recovery
TS Setting Parameters	SKIP Insertion, 8B/10B, 128B/130B, FTS, Link Number, Lane Number, Scrambling

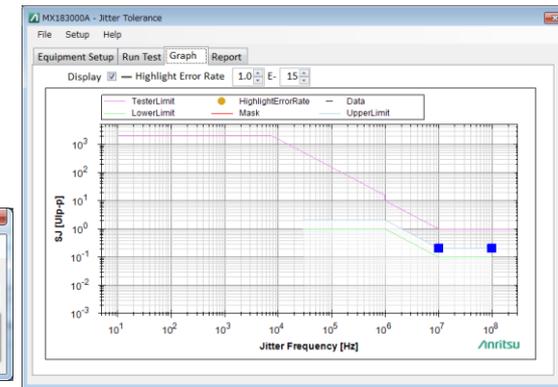
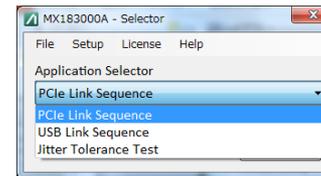
# PCI Express Gen 4 Base Spec. Rx Test (2/3)



## ➤ Stressed Signal Input Test (Jitter Tolerance Margin test using MX183000A-PL001)

Control jitter and measure Jitter Tolerance using MX183000A

- ✓ Impress SJ/RJ to test Jitter Tolerance of PHY devices
- ✓ Test device margin using low-rate estimate BER measurement
- ✓ Create measurement results reports in HTML and CSV format



Item	MX183000A-PL001 Specifications
Jitter Setting Range	Based on MU181500B Jitter Modulation Source spec.
Direction Search	Binary, Downward Linear, Downward Log, Upward Linear, Upward Log, Binary + Linear
Detection	Error Rate, Error Count, Estimate
Error Threshold	1.0E-3 to 1.0E-14
Highlight Error Rate	9.9E-9 to 1.0E-20 (at estimate)
Report Function	Reports results in HTML and CSV formats

# PCI Express Gen 4 Base Spec. Rx Test (3/3)

Stressed Signal Calibration

Transition to Loopback State

Stressed Signal Input Test

- Stressed Signal Input Test (GRL-PCIE4-BASE-RXA Pass/Fail Test)

The screenshot displays the Anritsu PCIe 4.0 Base Rx Test software interface. The top window, titled "Run Tests", shows the "Run Option" section with two radio buttons: "Skip Test if Result Exists" (selected) and "Replace if Result Exists". A "Run Tests" button is visible. The bottom window, titled "Report", shows a table with the following columns: "No", "Test Name", "Result", "Limits", "Value", and "SJ". The table is currently empty. To the right of the table are three buttons: "Generate report", "Delete", and "Delete All". At the bottom right, there is a checkbox labeled "Plot Calibration Data" which is checked.

(2) Run Tests (Go/No Go at test points)

(3) Generate report

# Thunderbolt 3 Test Solution

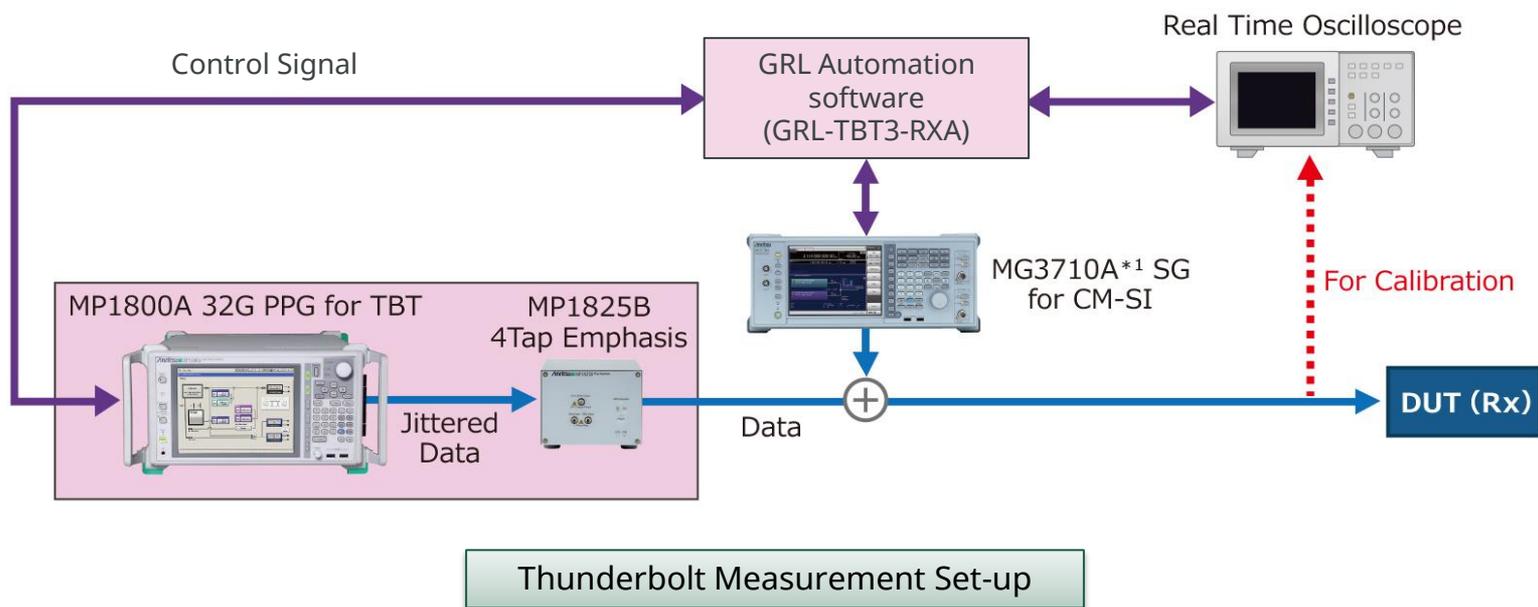
# Thunderbolt 3 Rx Test Outline

## ➤ Flow of Thunderbolt 3 Rx Test



Used Software

Automation Software:  
**GRL-TBT3-RXA**



# Thunderbolt 3 Rx Test Features

## ✓ Key Features

- Supported Standard: Thunderbolt 2/3
- As in Recommended Equipment for Thunderbolt Compliance Test Standard
- As in Thunderbolt 3 (including USB Type-C Thunderbolt Alternate Mode Electrical Host/Device Compliance Test Specification) Standard, automatic calibration of signal loss due to Stressed Rx Jitter parameter configuration
- Rx BER measurement as required by Host/Device compliance test
- Automatic Rx test using Tenlira scripts

Supported Standard

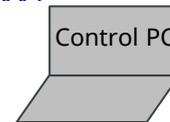
Supported Standard	DUT
Thunderbolt 2 (10 G) Thunderbolt 3 (20 G)	Device

# Thunderbolt 3 Rx Test (1/4)

## ➤ Stressed Signal Calibration



Automation Software:  
GRL-TBT3-RXA



### MP1800A Signal Quality Analyzer

MU181000A  
Synthesizer



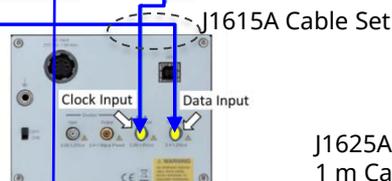
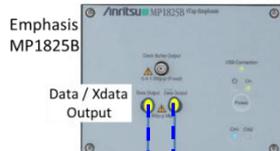
MU181500B  
Jitter Modulation  
Source



MU183020A  
PPG



Emphasis  
MP1825B



MG3710A SG for CM



J1510A x2  
Pickoff Tee

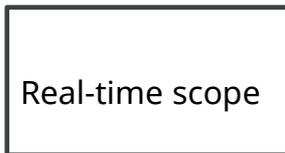
K261 x2



J1551A 80 cm  
Skew Matched Cable

Compliance  
board and  
Standard  
cable

J1551A 80 cm  
Skew Matched Cable



Ethernet

# Thunderbolt 3 Rx Test (2/4)

## ➤ Stressed Signal Input Test (Jitter Sweep Test (Pass/Fail Evaluation))

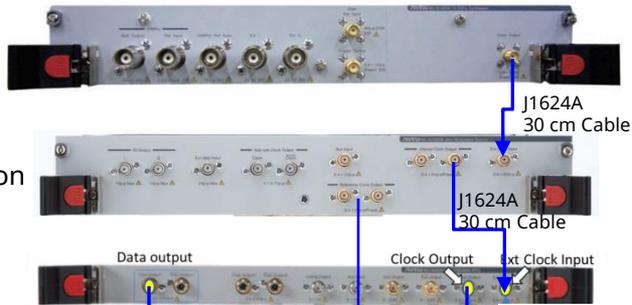


### MP1800A Signal Quality Analyzer

MU181000A  
Synthesizer

MU181500B  
Jitter Modulation  
Source

MU183020A  
PPG



Emphasis  
MP1825B

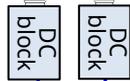
Data / Xdata  
Output

Clock Input

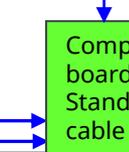
Data Input

J1510A x2  
Pickoff Tee

K261 x2



J1551A 80cm  
Skew Matched Cable



USB  
Type-C



Automation Software:  
**GRL-TBT3-RXA**

Control PC

Ethernet

USB Type-C

MG3710A SG for CM



J1625A x2  
1 m Cable

J1625A x2  
1 m Cable

J1615A Cable Set

J1624A  
30 cm Cable

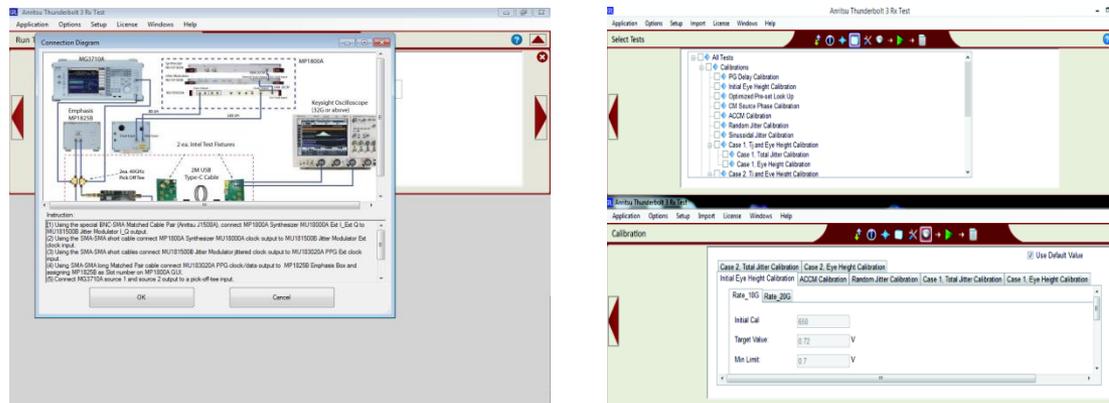
J1624A  
30 cm Cable

# Thunderbolt 3 Rx Test (3/4)

Stressed Signal Calibration

Stressed Signal Input Test

- Stressed Signal Calibration
- ## Features of Automation Software GRL-TBT3-RXA



Calibration Setting Screen

Performs one-button calibration of stressed input signal using GRL-TBT3-RXA

- ✓ Supports Thunderbolt 3 (USB Type-C Thunderbolt Alternate Mode Electrical Host/Device Compliance Test Specification)
- ✓ Performs calibration of high-reproducibility test signal and executes receiver test

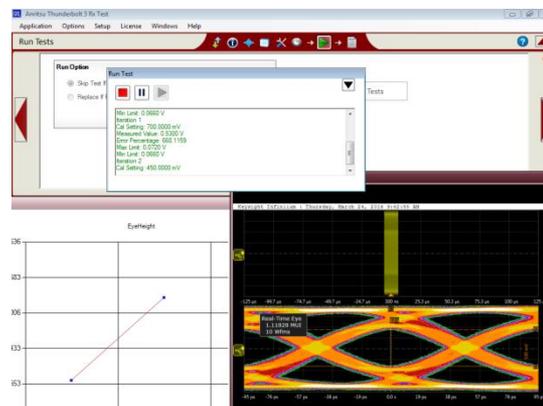
# Thunderbolt 3 Rx Test (4/4)

Stressed Signal Calibration

Stressed Signal Input Test

## ➤ Stressed Signal Input Test

Features of automation software GRL-TBT3-RXA



Measurement Screen

Performs one-button stressed input signal test using GRL-TBT3-RXA

- ✓ Performs calibration of high-reproducibility test signal and executes Rx test
- ✓ GUI screen for easy setting of test conditions and test execution
- ✓ Built-in PDF format reporting function

# USB 3.1 Test Solution

# USB 3.1 Rx Test Outline

## ➤ Flow of USB 3.1 Rx Test

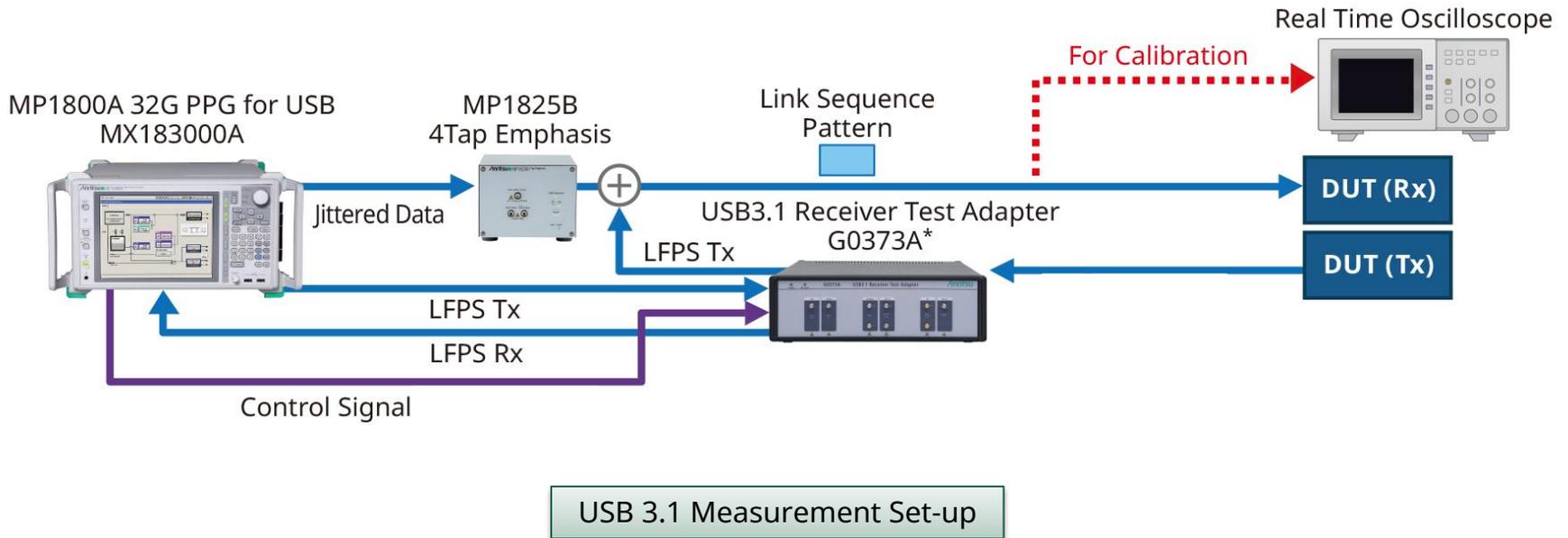


Used Software

Automation Software:  
GRL-USB31-RXA

Link Sequence Pattern  
Generation Software:  
MX183000A-PL012

• Jitter Sweep Test (Pass/Fail Evaluation)  
GRL-USB31-RXA



# USB 3.1 Rx Test Features

## ✓ Key Features

- Automatic measurement and automatic calibration using automation software GRL-USB31-RXA
- Transition to Loopback mode for evaluating USB 3.1 Gen 1-2 devices
- BER Measurement

### Supported Standard

Supported Standard		DUT	Link Sequence Generation	Jitter Tolerance Test
USB	3.0/3.1	Device	Supported	*
		Host	Supported	*

### USB Link Sequence Generation Function (MX183000A-PL012)

- ✓ Supports transition to Loopback Mode for evaluation of USB 3.1 Gen 1-2 devices
- ✓ 8B/10B, 128B/132B, Scramble, SKIP Insertion, LFPS generation

\*Enquire about BER-related and Jitter power measurements

# USB 3.1 Rx Test (1/4)



## ➤ Stressed Signal Calibration

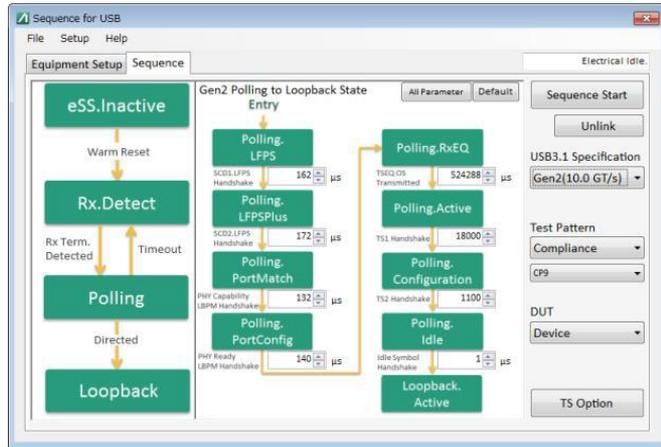
Features of automation software GRL-USB31-RXA

One-button calibration and testing of stressed input signal using GRL-USB31-RXA

- ✓ Supports USB 3.1 Gen 1-2 devices
- ✓ Performs calibration and Rx test of high-reproducibility test signal
- ✓ Supports automatic control of variable ISI and calibration of EYE opening

# USB 3.1 Rx Test (2/4)

## ➤ Generating Link Sequence using MX183000A-PL012



USB Link Sequence Setting Screen

Control PPG pattern using MX183000A

- ✓ Transition to Loopback Mode for evaluation of USB 3.1 Gen 1-2 devices
- ✓ 8B/10B, 128B/132B, Scramble, SKIP Insertion, LFPS generation function

Item	MX183000A-PL012 Specifications
Support Standards	USB 3.0, 3.1 Gen 1 (5 Gbit/s), 3.1 Gen 2 (10 Gbit/s)
Test Pattern	Compliance (Gen 1: CP0, CP1, CP2, CP4, CP5, CP6, Gen 2: CP9), User
LTSSM State	Transition to eSS.Inactive, Rx.Detect, Polling, Loopback
Loopback Through	Configuration
TS Setting Parameters	SKIP Insertion, 8B/10B, 128B/132B, Scrambling

# USB 3.1 Rx Test (3/4)

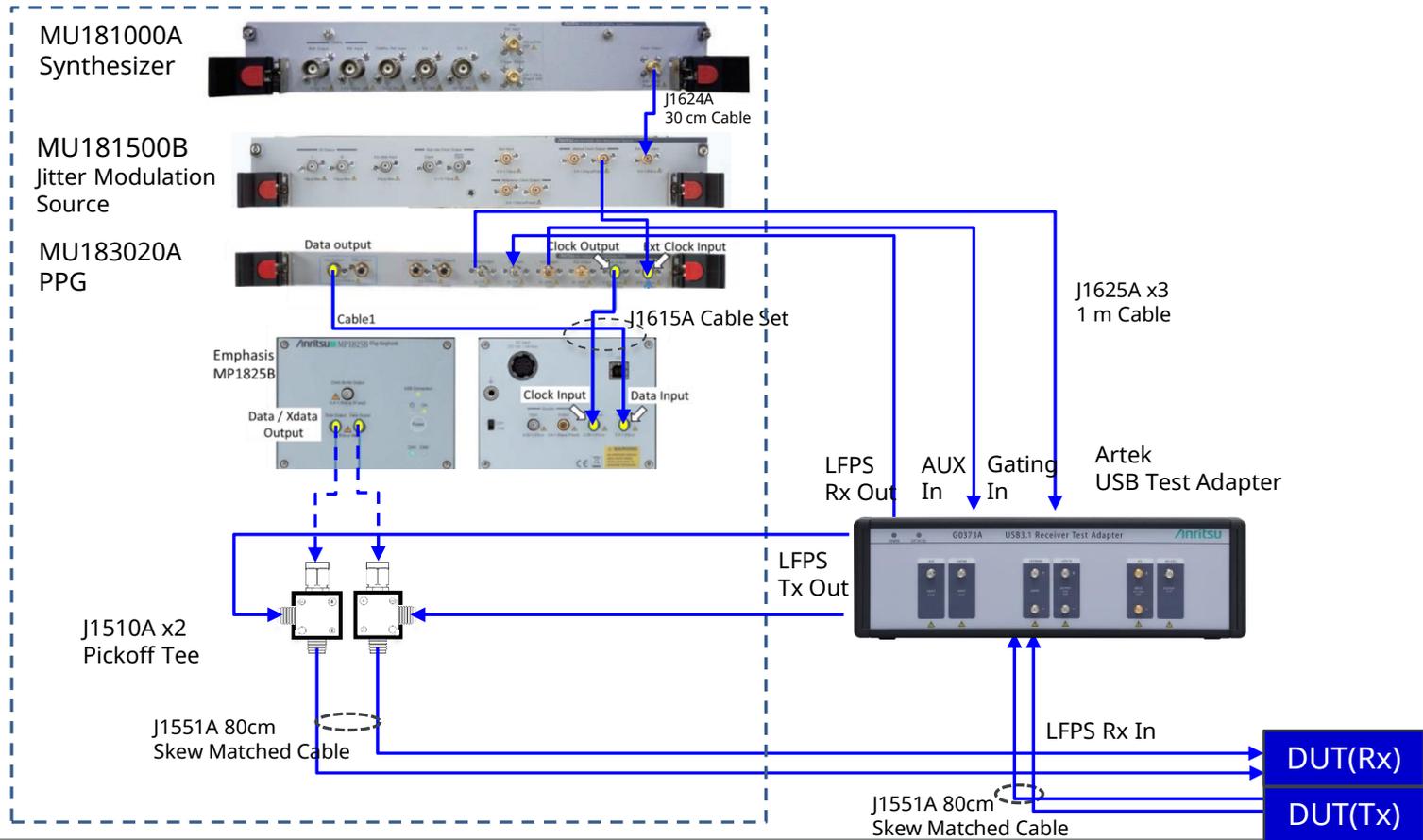
Stressed Signal Calibration

Transition to Loopback State

Stressed Signal Input Test

## ➤ Transition to Loopback State and Stressed Signal Input Test ①

MP1800A Signal Quality Analyzer (Configuration using Artek USB Test Adapter)  
MX183000A-PL012 USB Link Sequence (Installed in MP1800A or external PC)



# USB 3.1 Rx Test (4/4)



- Stressed Signal Input Test (GRL-USB31-RXA Pass/Fail Test)

# Appendix

# Ordering Information (1/2)

Model	Name	Option	Qty.		
			PCIe	TBT	USB
MP1800A	Signal Quality Analyzer	X02, x07, x32	1	1	1
MU181000A/B	Synthesizer	-	-	-	1
		x01	1	-	-
MU181500B	Jitter Source	-	1	1	1
MU183020A	32G PPG	X12/x30	1	1	1
MU183040B	32G ED	X10/X22	1	-	-
MP1825B	Emphasis	x02	1	1	1
MG3710A	Vector signal generator	x02, x29, x36, x41, x42, x66, x71, x72	2	1	-
MX183000A	High-Speed Serial Data Test Software	-	1	-	1
GRL-PCIe4 – BASE-RXA		-	1	-	-
GRL-TBT3-RXA		-	-	1	-
GRL-USB31-RXA		-	-	-	1
G0373A	USB3.1 Receiver Test Adaptor	-	-	-	1

\*Automation software sold by Granite River Labs (<http://graniteriverlabs.com/>)

# Ordering Information (2/2)

	Model	Name	Qty.		
			PCIe	TBT	USB
Components	J1398A	N-SMA ADAPTER	4	2	-
	41KC-3	3 dB ATT	2	-	-
	41KC-6	6 dB ATT	2	-	-
	41KC-20	20 dB ATT	2	2	-
	K241C	Splitter	2	-	-
	J1510A	Pickoff Tee	2	2	2
	Z1927A	USB Measurement Kit	-	-	1
	J1508A	BNC-SMA Connector Cable	2*	-	-
	J1615A	Cable Set	1*	1*	1*
	J1551A	Coaxial Skew Matched Cable (0.8 m, K-connector)	2	2	-
	J1624A	Coaxial Cable 0.3 m	2*	2*	2*
	J1625A	Coaxial Cable 1 m	6	3	-
	J1715A	Coaxial Cable 0.1 m (SMP-J, SMA-J)	4	-	-

\*Standard accessory for MP1800A series

