Application Note

Anritsu envision:ensure

-Anritsu Automotive Solution-
PCIe® Receiver Test by MP1900A series

Signal Quality Analyzer-R

MP1900A Series

SQA-R

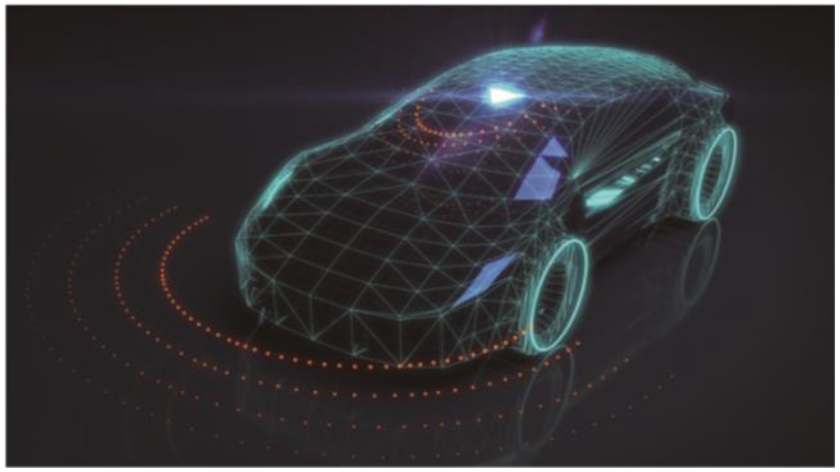
Automotive market trend

Automated Driving

ADAS / Collision avoidance ➔ Full autonomous driving / Upgrades via OTA

Infotainment

Features for Luxury car ➔ General options for poplar cars and more features



- Real time processing / reliable system
- High quality / stress free experience
- Harsh environment tolerance such as high/low temperature, vibration etc.…

➔ **Automotive :**

Data Center class computing power and Home theater complexity

What is required for automotive

Data Center class computing power and Home theater complexity

More reliability

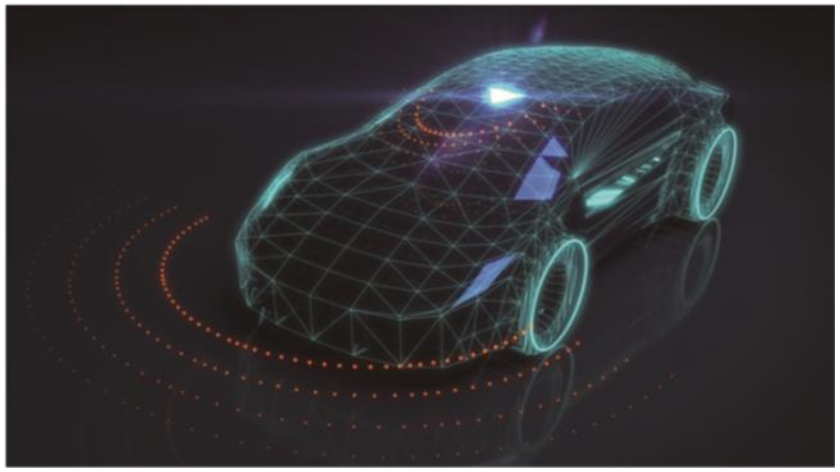
Fault tolerance with enough margin

More bandwidth

Higher bandwidth architecture

One of possible solutions as in-Vehicle connection

PCI Express



PCI Express features

- Fault tolerance by multiple error correction system architecture
- Secured interoperability among vendors
- High bandwidth by generations (Gen3 to Gen5) and bus width (16 lanes)

Anritsu automotive solutions

Wireless Connectivity & Infotainment

MT8000A
5G RF/Protocol

MD8475B
e.g eCall/HO/T-put

MT8821C
RF/OTA w/signalling

MT8870A
Production

MT8852B
BT incl. audio

MT8862A
WLAN w/ signalling

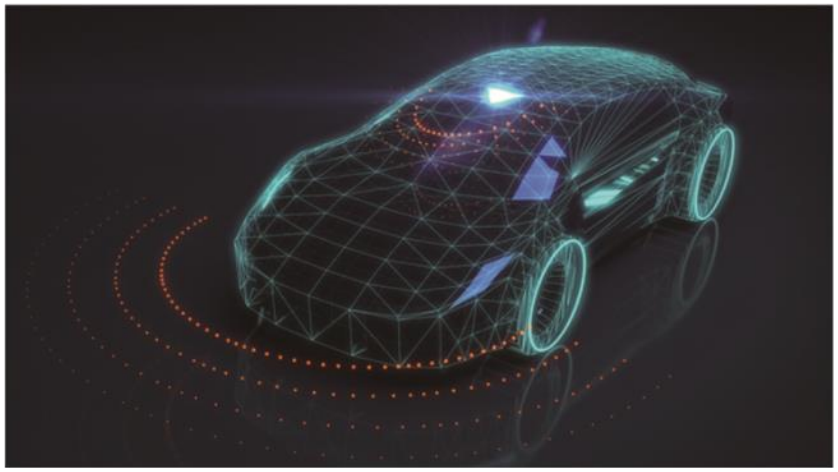
MS2690A/MS2830A
RF/HW w/o signalling

ADAS

MS2690A/MS2830A
RF/HW w/o signalling

TPMS
Power vs Time

MS464X
Vector Star e.g. Radar



Intelligent Transport System

MS2690A/MS2830A
V2X Message evaluation sofrware

MT8870A
C-V2X RF Testing

EMC/EMI

MS2720T
Spectrum Master

MS2830A
Spectrum Analyzer

Wired connectivity

MS9740B
Optical module test

MP1900A
PCIe Test

S331E
Cable & Antenna

MS46122B
Vector Network Analyzer

Datacom

MT1000A
Latency test

Anritsu automotive solutions

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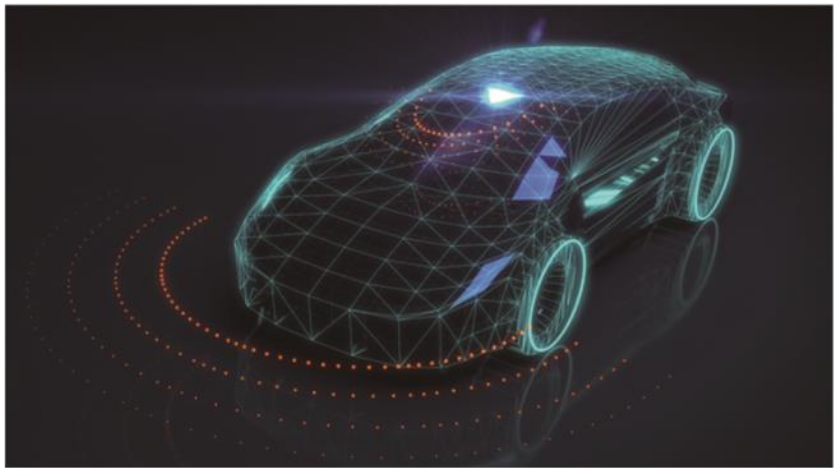

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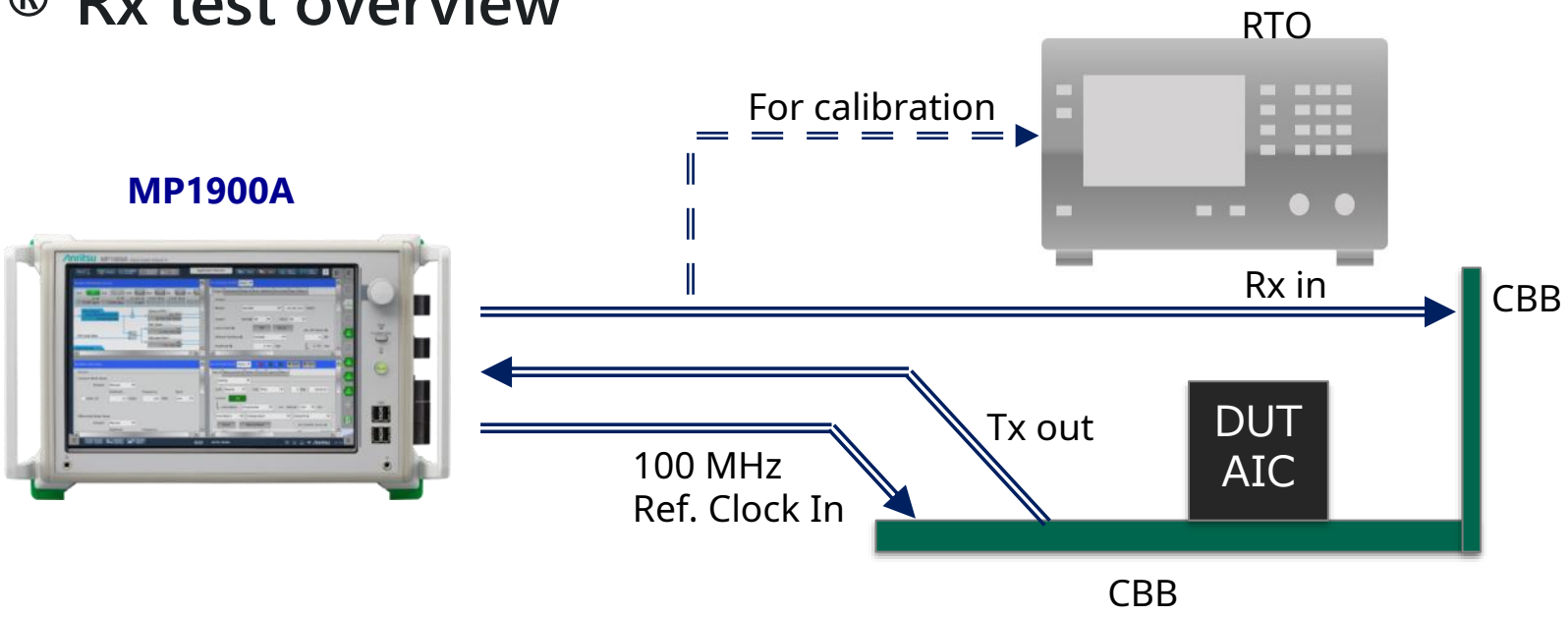
PCIe® Rx test overview



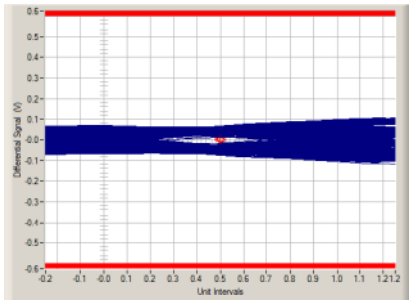
Model	Name	Option	Qty	Remark
MP1900A	Signal Quality Analyzer-R	-	1	
MU181000B	12.5GHz 4port Synthesizer	002	1	
MU181500B	Jitter Modulation Source	-	1	
MU195020A	21G/32G bit/s SI PPG	010, 011	1	Add Opt-001 for expansion to Gen5 (32 GT/s)
MU195040A	21G/32G bit/s SI ED	010, 011, 022	1	
MU195050A	Noise Generator	-	1	
MX183000A-PL001	Jitter Tolerance Test	-	1	Optional
MX183000A-PL021	PCIe Link Training	-	1	Mandatory

PCIe® Rx test overview - test procedure -

Steps of Receiver Testing

Step1: Calibration

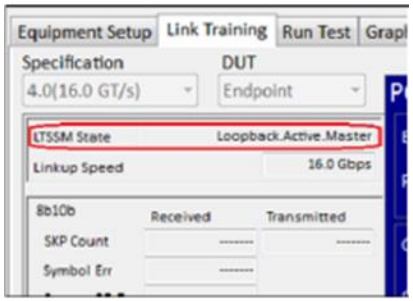
- Channel Loss by VNA
- Eye Amplitude, Preset, SJ and RJ by BERT and RTO
- DM-I and Eye Height/Eye Width by BERT and RTO

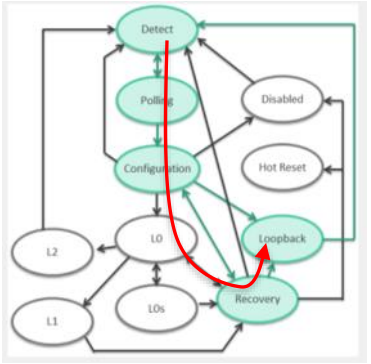


	Min	Max
EH	13.5 mV	16.5 mV
EW	18.25 ps	19.25 ps

Step2: Link Training

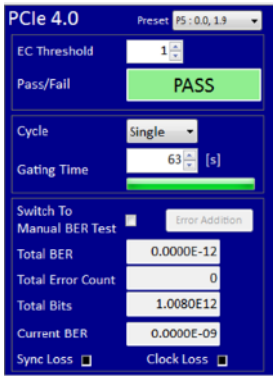
- Make DUT looped-back-mode by BERT
  ->DUT is necessary success through Recovery State.
- Troubleshooting

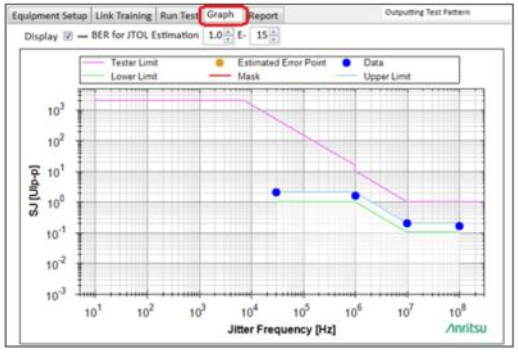




Step3: Measurement

- Checking BER <1E-12 with Stressed EYE (Mandatory)
- Jitter Tolerance Testing (Optional)



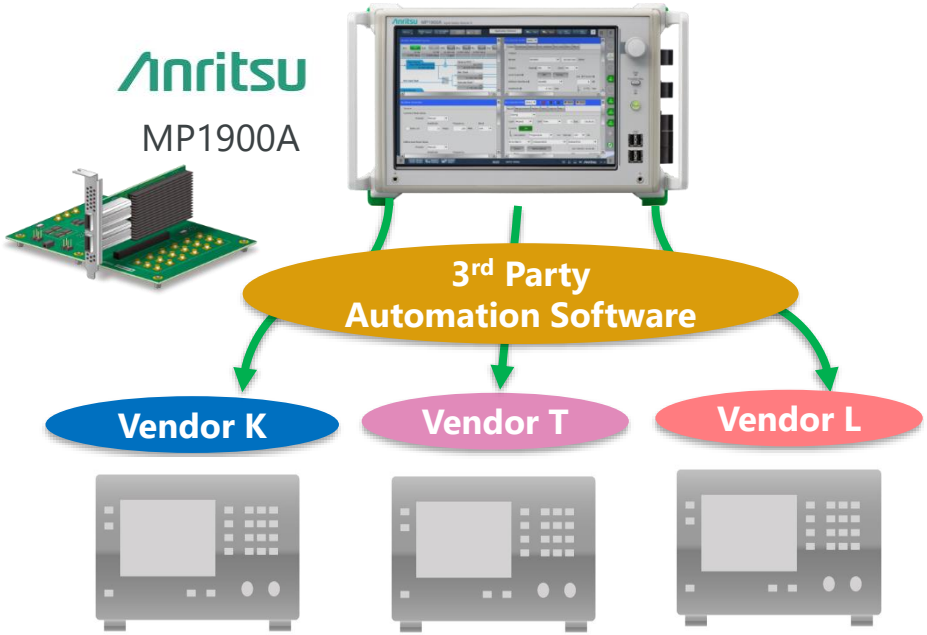


PCIe® Tx LEQ/Rx compliance test

- Combination of best-performance BERT MP1900A and preferred oscilloscope -

Shorter test times and reduced investment cost

- Supports Combination with Lecroy/Tektronix/Keysight Real-Time Oscilloscopes
- Automated Rx CEM and Base Tests: Calibration, Link EQ and Automated Tx Test
- Protocol Aware: Link Training/Equalization and LTSSM Analysis
- High Expandability 32G Multichannel BERT for PCIe®1 to 5 and 6!



Customers' Real-Time Oscilloscope

Best BERT Performance

Fully Automated SW and Analysis

Preferred Oscilloscope

PCIe® solution for automated driving / Infotainment

To secure more reliability and more bandwidth

- AAA) Seamless support for entire debugging phase
- BBB) Easy and deeper debugging method
- CCC) Certified by industry
- DDD) Evolving technology support

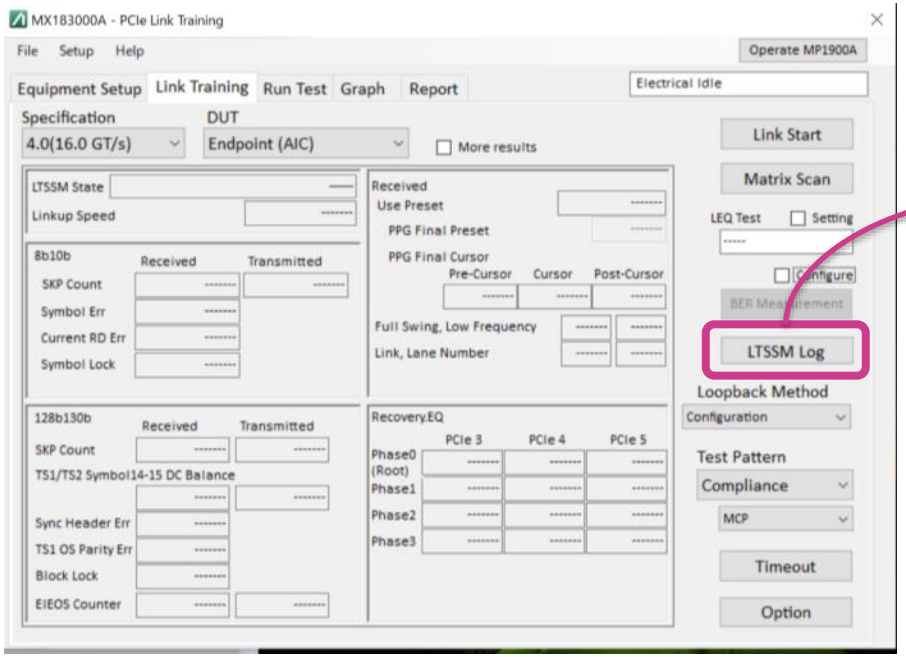
AAA) Seamless support for entire debugging phase

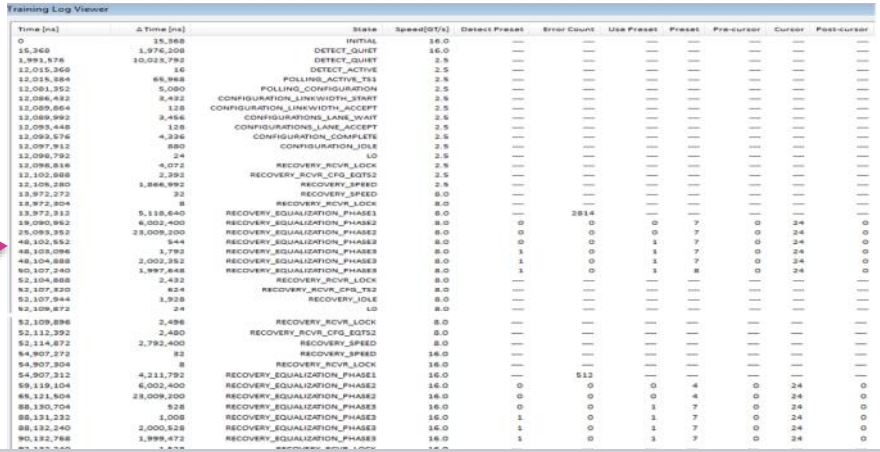
	Troubleshooting Example	Protocol Analyzer	SCOPE	BERT
1	Rx Test troubleshooting analysis	√	-	√√
2	2.5 GT/s Link failure	-	√	√√
3	Speed change failure	√	√	√√
4	Loopback failure	-	√	√√
5	Never Becomes Error-Free	-	√	√√
6	Debug Example using Scope at Tx Link EQ Test	-	√√	√
7	PCI Express – Incorrect Tx EQ Cursor Value	√√	-	√
8	Debug Example using Scope – Signal Integrity Problems	-	√√	-
9	PCI Express – Analysis Focusing on Flow Control	√√	-	-
		Lecroy	L / T / K	Anritsu

√√: Main instrument for troubleshooting
√ : Measuring instrument for analysis from different viewpoint
- : Difficult to troubleshoot or no appropriate instrument

We can cover all of those troubleshooting with our partners

BBB) Easy and deeper debugging method – ① LTSSM log



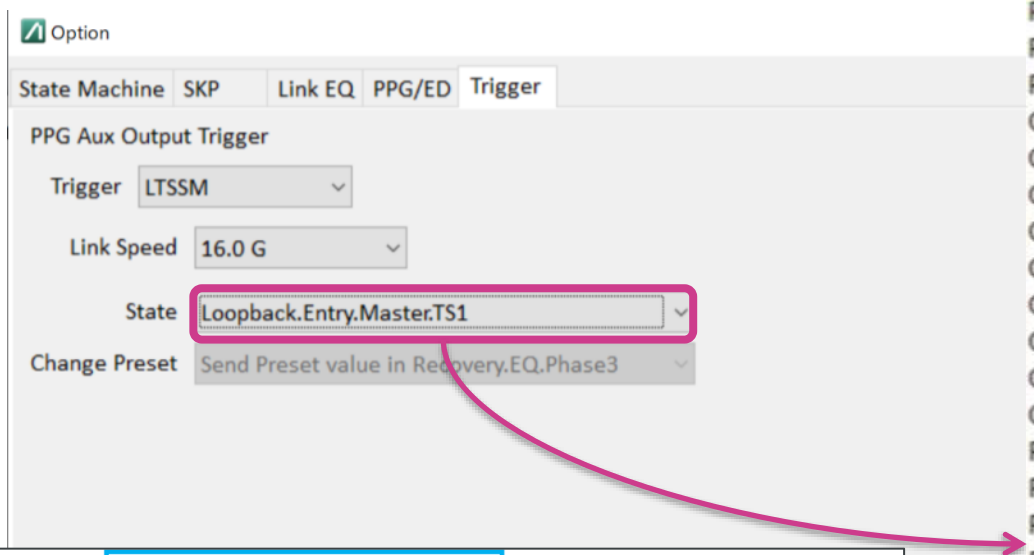


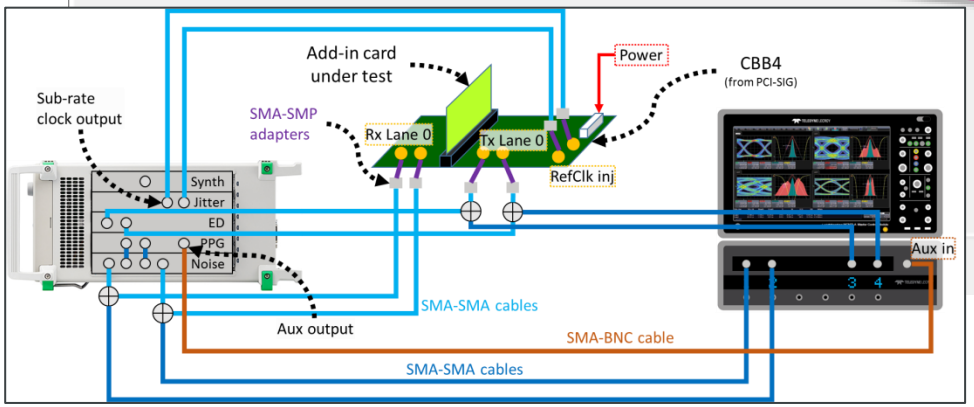
Training Log Viewer

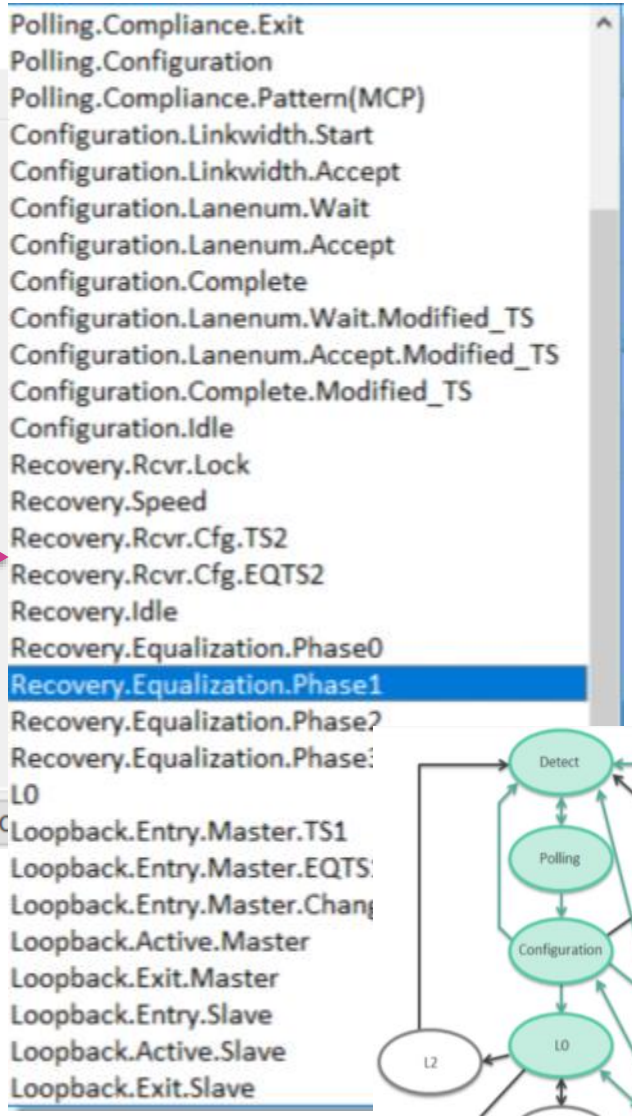
Time [ns]	ΔTime [...	State	Speed[GT/s]	Detect Pre
0	0	INITIAL	16.0	
17280	17280	DETECT_QUITE	16.0	
12017280	12000000	DETECT_ACTIVE	16.0	
12017296	16	POLLING_ACTIVE_TS1	16.0	
36017296	24000000	INITIAL	16.0	
36017312	16	DETECT_QUITE	16.0	
48017312	12000000	DETECT_ACTIVE	16.0	
48017328	16	POLLING_ACTIVE_TS1	16.0	
72017328	24000000	INITIAL	16.0	
72017344	16	DETECT_QUITE	16.0	
84017344	12000000	DETECT_ACTIVE	16.0	
84017360	16	POLLING_ACTIVE_TS1	16.0	
108017360	24000000	INITIAL	16.0	

- The MP1900A Training Log Viewer shows the actual Training State transition logs.
- The state transition path (route) and transition times can be analyzed in detail.

BBB) Easy and deeper debugging method – ② LTSSM trigger



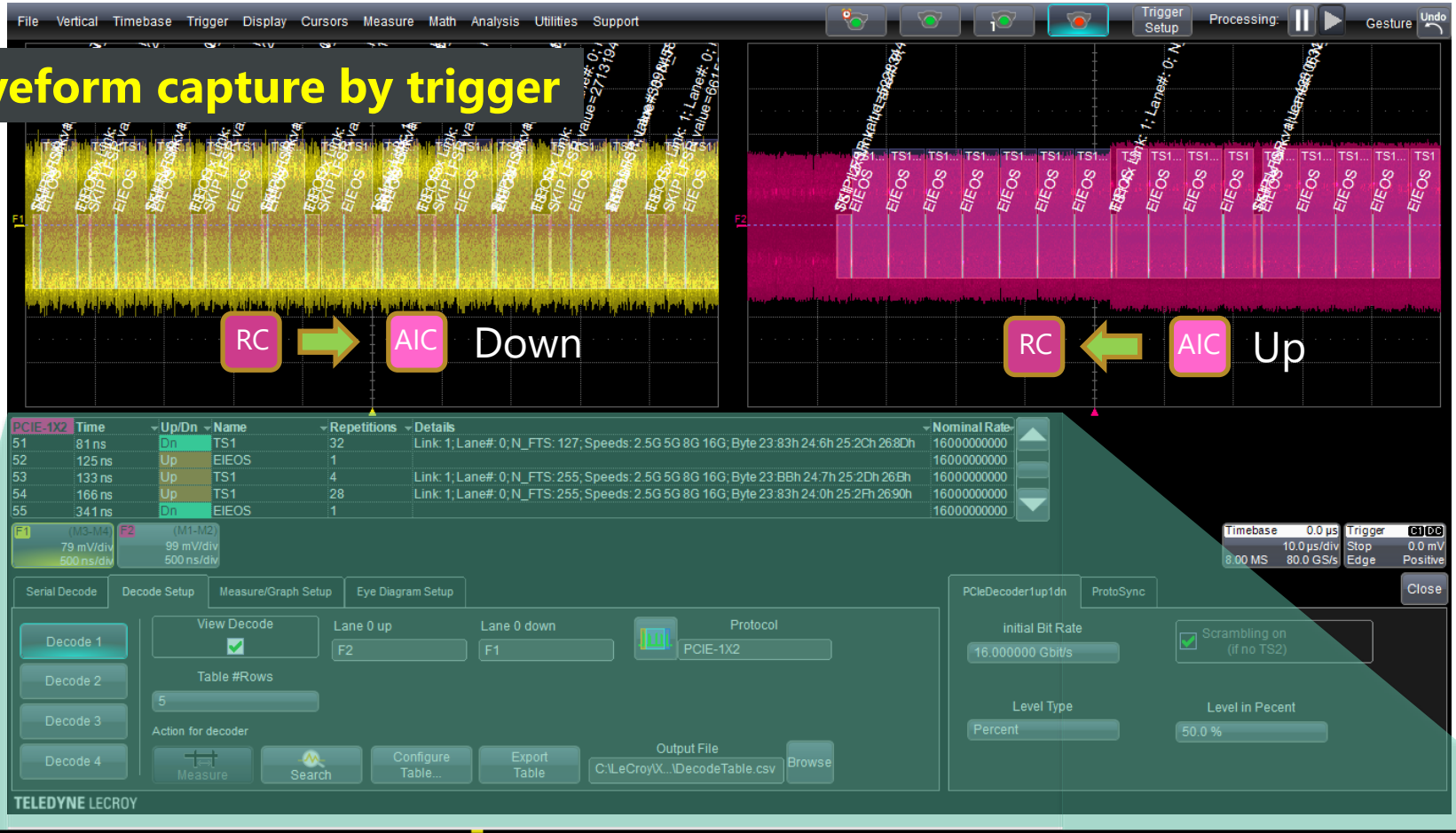




- In case something strange in LTSSM, trigger can be generated at specific state to see waveform and more.

BBB) Easy and deeper debugging method – ③ Protocol decoding

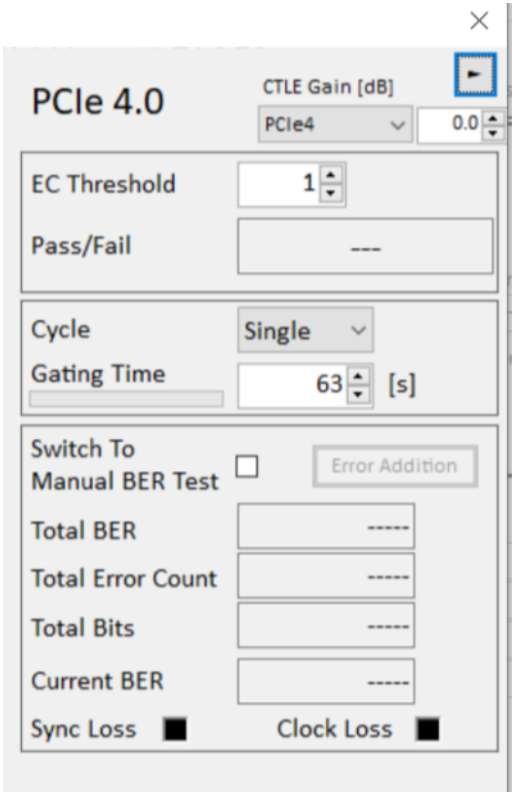
Waveform capture by trigger

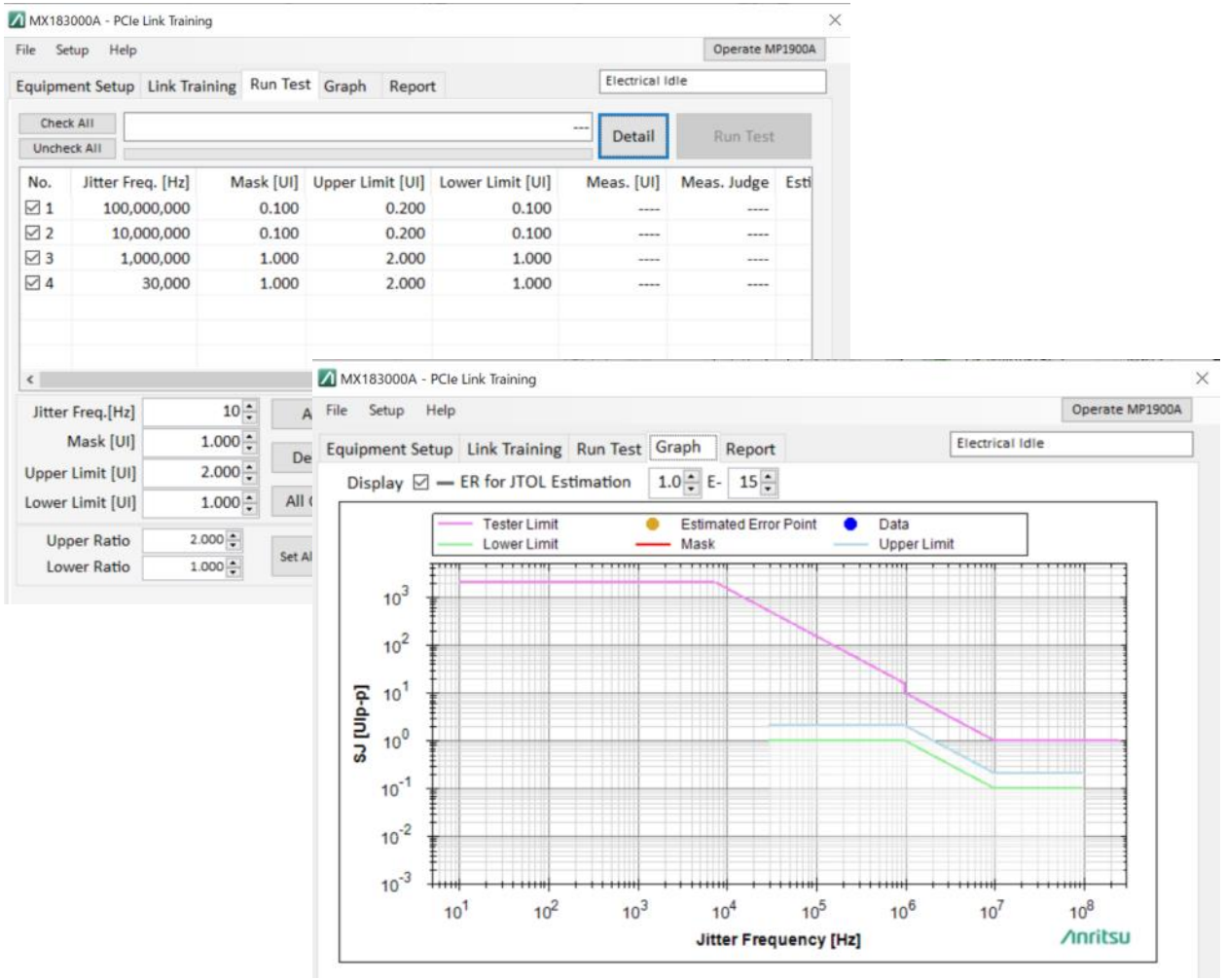


PCIE-1X2	Time	Up/Dn	Name	Repetitions	Details	Nominal Rate
51	81 ns	Dn	TS1	32	Link: 1; Lane#: 0; N_FTS: 127; Speeds: 2.5G 5G 8G 16G; Byte 23:83h 24:6h 25:2Ch 26:8Dh	16000000000
52	125 ns	Up	EIEOS	1		16000000000
53	133 ns	Up	TS1	4	Link: 1; Lane#: 0; N_FTS: 255; Speeds: 2.5G 5G 8G 16G; Byte 23:BBh 24:7h 25:2Dh 26:Bh	16000000000
54	166 ns	Up	TS1	28	Link: 1; Lane#: 0; N_FTS: 255; Speeds: 2.5G 5G 8G 16G; Byte 23:83h 24:0h 25:2Fh 26:90h	16000000000
55	341 ns	Dn	EIEOS	1		16000000000

And protocol decoding at captured area

BBB) Easy and deeper debugging method – BER & Margin (1/2)





BER measurement

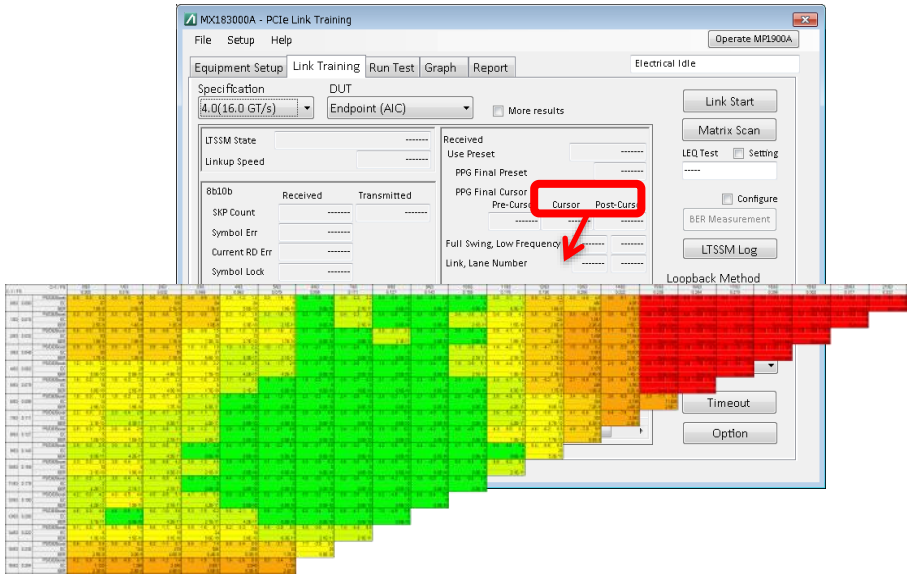
Jitter Tolerance Test

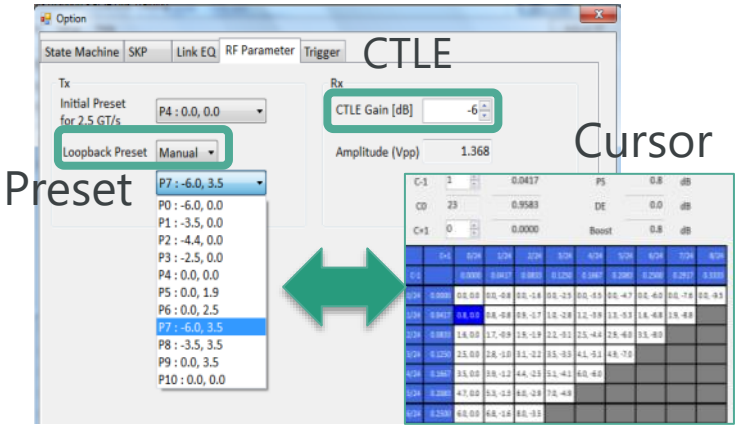
BBB) Easy and deeper debugging method – BER & Margin (2/2)

- Find a optimum Preset/Cursor

- Matrix Scan:
  Automatically find the optimum Tx EQ value.

- Manual setting
  Set Loopback Preset to Manual and change the preset from P0 to P10 to determine the optimum preset/Cursor at the DUT.



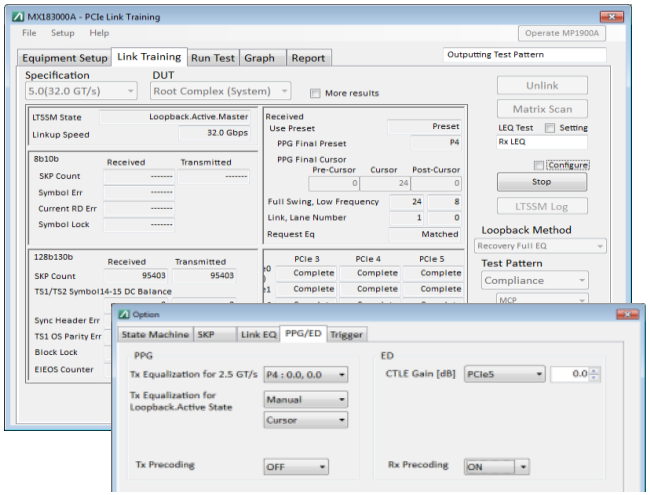


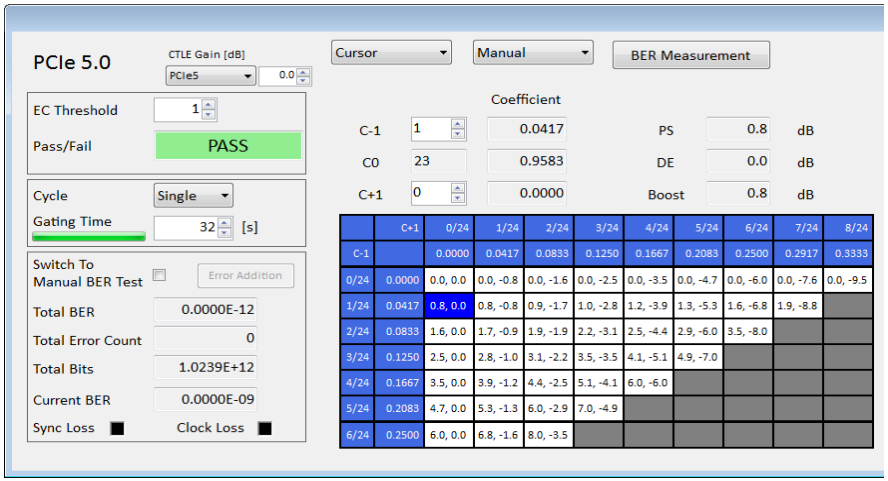
CCC) Certified by industry

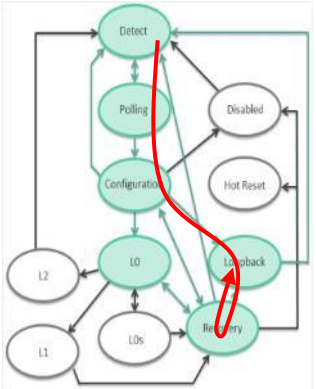
PCI Express	Gen4	Gen5	Gen6
General BERT	Released	Released	Released
Base Spec	Released	Released	In planning
CEM Spec (Link Training)	Released	Released	In planning
Compliance Testing (RX LEQ)			
w/ Lecroy Scope	Approved as Gold	-	-
w/ Tektronix Scope	Approved as Gold	-	-
w/ Keysight Scope	Approved as Gold	-	-

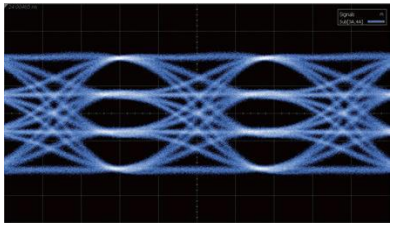
DDD) Evolving technology support - Gen5 and more

- Anritsu already supports newly added below **Gen5** functions:
  - ✓ Enhanced Link Behavior Control
  - ✓ Precoding
  - ✓ SKP OS/EIEOS
  - ✓ MCP 5.0









And ready for next **Gen6**
(32Gbaud PAM4)

Anritsu MP1900A Standardization Contributions

G3 Approved **G4 Approved** **G5 Ready**

MP1900A PCIe-G3 and G4 solution with Lecroy RTO for Rx test was approved by PCI-SIG. Anritsu will aim to get next G5 certification.

USB 3.2 Approved **USB4 Planning**

MP1900A USB solution with Lecroy RTO for Rx test was approved by USB-IF.

TBT3 Approved

MP1900A was approved as a measurement equipment vendor for Thunderbolt 3 compliance test specs.

DisplayPort

DP1.4 FYI **DP2.0 Planning**

MP1900A will be approved as a Sink test equipment in next DP workshop.

Standardization activities for IEEE 802.3 25, 50, 100, 200 ,400GbE, and future 800GbE/1.6 TE.

Anritsu has joined the Physical and Link Layer Working Group. CEI-56G/112G

FDR/EDR Approved **HDR FYI**

MP1900A is approved as a recommended ATD test equipment vendor for Infiniband FDR and EDR.

Anritsu

envision : ensure

公知 2021-2 MJM No. MP1900A_PCIE-E-F-2-(1.00)