USB 3.2 ELECTRICAL COMPLIANCE TESTING

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AGENDA

- Introduction (Johannes)
- Details about USB3.2 Gen1/2 Electrical Compliance Testing (Pascal)
- Demonstration with the R&S RTP164 Oscilloscope (Johannes)
- Summary

INTRODUCTION

- This webinar will be focused on USB3.2 Gen1 and Gen2 Electrical Compliance testing.
- USB3.2 products require to be backwards compatible and compliant with USB2.0
  - Look previous at the R&S Webinar: USB 3.2 compliance testing for more details on USB2.0 testing.

- For official USB-IF compliance there are more tests required
- Official compliance can only be done at approved ATL like GRL or USB-IF Workshops
- All Gen2 products also need to be compliant with Gen1 tests
- USB4 products also need to be compliant with the USB3.2 Electrical requirements

GOING FROM USB 3.0 TO USB 3.2

- USB3.0 was released in 2008 where the latest USB3.2 version was released in 2022
- New features were introduced like
  - Introduced Gen2 with an increase of speed from 5Gb/s to 10Gb/s
  - Improved EMC performance on the USB connector
  - Re-timer spec updated
  - Updates on Link Layer and Protocol Layer
  - Incorporate many ECN's that were required due to Power Delivery and Type-C
  - Double the speed again with Gen1/2 **X2** by using second data pair in the Type-C

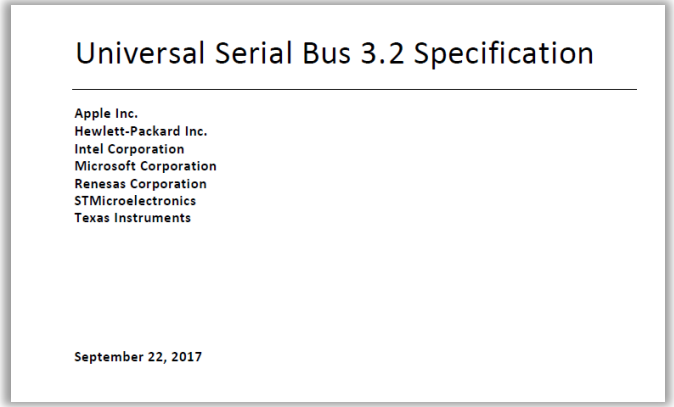
- All USB-IF compliance testing is now a days against the USB3.2 Spec

BEFORE WE START

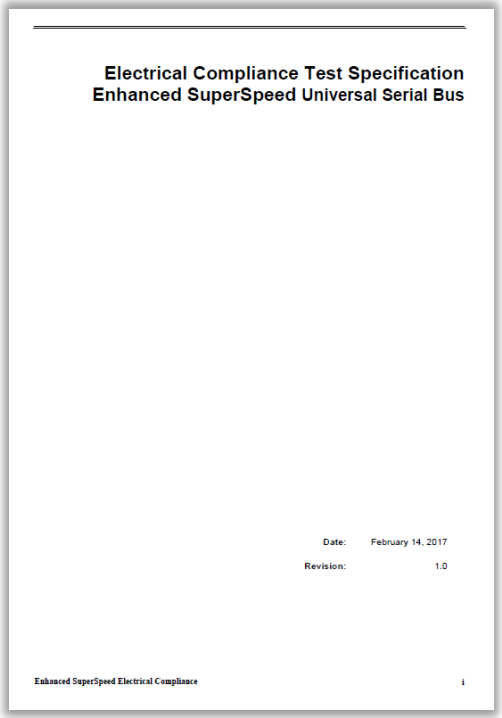
- USB3.2 Gen1 = USB 5Gb/s = Super Speed = Gen1x1
- USB3.2 Gen2 = USB 10Gb/s = Super Speed plus = Gen2x1
- USB Upstream ports are device or hub ports that will be connected towards the host
  - Std-B, µ-B, Type-C Plug or Captive A or C-Plug
- USB Downstream ports are host or hub ports
  - A-receptacle or C-receptacle
- Legacy connector are A/B and µB
- Upstream port with captive or tethered cable have a USB A-plug or C-plug that is connected directly to the upstream port. This can be with a cable or without cable and directly to the PCB.
  - Products with detachable vendor specific connector at the upstream are considered captive products.
- Re-driver is an active component that is used to compensate the loss in cable or PCB. The component can boost the signal by changing settings like de-emphasis, Equalizer and amplitude.
- Re-Timer is similar to a Re-driver but has a Clock Data Recover

USB 3.2 COMPLIANCE TESTING

USB 3.2 ELECTRICAL COMPLIANCE



USB 3.2 Spec + ECN



USB-IF USB 3.2 Electrical Compliance

TEST EQUIPMENT NEEDED

- High-performance oscilloscope e.g. RTP164
  - USB automation software
- High-performance BERT e.g. Anritsu MP1900A
  - Pattern Generator (PG)
  - BERT (Bit Error Rate Tester)
  - USB loopback option
- SMA cables
  - 2 Pairs of matched SMA cables

SETUP REQUIREMENTS

www.usb.org

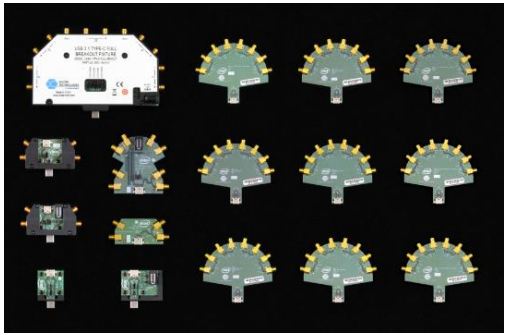
TEST FIXTURES AND CABLES

	Supplier
Legacy Connector Gen1	Fixture Solution
Legacy Connector Gen2	Fixture Solution by the end of 2023
Type-C Connector Gen1/2	Wilder Technologies

The required cables are included!

Fixture Solution

WILDER TECHNOLOGIES
It's all about integrity



USB3.2 GEN1/2 COMPLIANCE MODES

Gen1

Gen2

Compliance Pattern	Value	Bit Sequence Description
CP0	D0.0 scrambled	A pseudo-random data pattern that is exactly the same as logical idle (refer to Chapter 7) but does not include SKP sequences.
CP1	D10.2	Nyquist frequency
CP2	D24.3	Nyquist frequency/2
CP3	K28.5	COM pattern
CP4	LFPS	The low frequency periodic signaling pattern
CP5	K28.7	With de-emphasis
CP6	K28.7	Without de-emphasis
CP7	50-250 1's and 0's	With de-emphasis. Repeating 50-250 1's and then 50-250 0's.
CP8	50-250 1's and 0's	Without de-emphasis. Repeating 50-250 1's and then 50-250 0's.
CP9		Pseudo-random data pattern (see section 6.4.4.1)
CP10	AAh	Nyquist pattern at 10Gb/s. This is not 128b132b encoded.
CP11	CCh	Nyquist/2 at 10Gb/s. This is not 128b132b encoded.
CP12	LFSR15	Uncoded LFSR15 for PHY level testing and fault isolation. This is not 128b132b encoded. The polynomial is x^15+x^14+1
CP13	64 1's and 0's	With pre-shoot defined in section 6.7.5.2 (no de-emphasis). Repeating 64 1's and then 64 0's at 10Gb/s. This is not 128b132b encoded.
CP14	64 1's and 0's	With de-emphasis defined in section 6.7.5.2 (no pre-shoot). Repeating 64 1's and then 64 0's at 10Gb/s. This is not 128b132b encoded.
CP15	64 1's and 0's	With pre-shoot and de-emphasis defined in section 6.7.5.2. Repeating 64 1's and then 64 0's at 10Gb/s. This is not 128b132b encoded.
CP16	64 1's and 0's	No de-emphasis or pre-shoot. Repeating 64 1's and then 64 0's at 10Gb/s. This is not 128b132b encoded.

Product shall start with CP0 and increment by one when sending one PING.LFPS

USB 3.2 GEN1/2 UPSTREAM TX

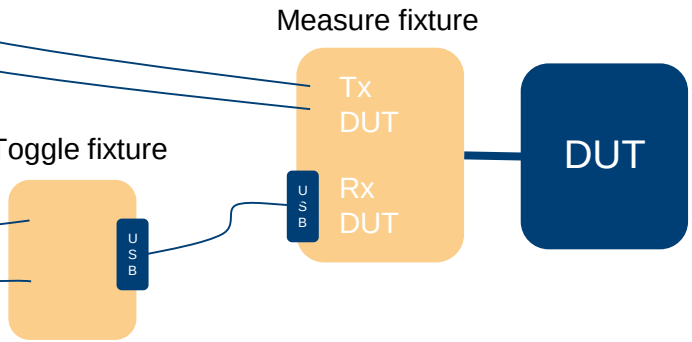
- Tx EYE and Jitter short and long channel
- Tx LFPS
- Tx SSC
- Tx Pre-Shoot & De-Emphasis (Gen2 only)
- Intel SigTest is doing all the calculations in the background
- Use appropriate USB-IF fixture
- All Tx measurements are done near end with SMA cables
- The long channel Tx eye and jitter will be embedded with the USB-IF provide S-parameter
- Toggling between test patterns is done by sending Ping.LFPS
- For Type-C test the receiver in both orientations
- When the product is a DRD (Host & Device) test both modes
- For USB3.2 Gen1/2**X2** Test all data lanes
- When the test patterns work properly USB3.2 is easier than USB2.0 testing

USB 3.2 GEN1/2 UPSTREAM SETUP TX

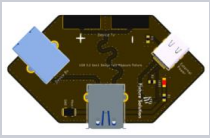
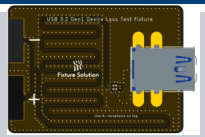
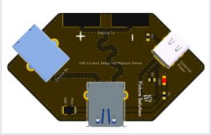
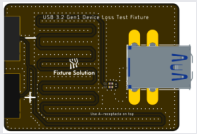
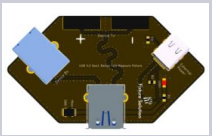
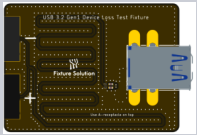
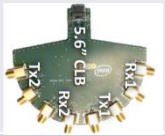
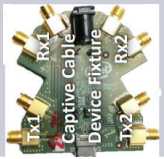
Gen1
CP0 = Pseudo Random
CP1 = Nyquist Freq. (10101..) 2.5GHz

Gen2
CP9 = Pseudo Random
CP10 = Nyquist Freq. (10101..) 5GHz
CP13 = Pre-shoot
CP14 = De-emphasis
CP15 = Pre-shoot & De-emphasis

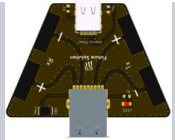
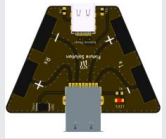
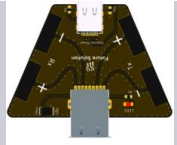
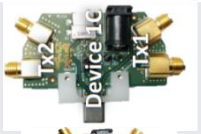
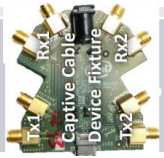
RTP-B6
Generator option
Send PING.LFPS for
Toggle CPx



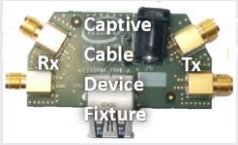
USB 3.2 GEN1 UPSTREAM LONG CHANNEL TX

	Loss channel Embedded by scope	Measure Fixture	Toggle Fixture	Cable DUT and Fixture
Std-B	 11” PCB + 3m cable			15cm A-B
µB	 11” PCB + 1m cable			15cm A-µB
Captive-A	 11” PCB			-
Type-C				-
Captive-C			-	-

USB 3.2 GEN1 UPSTREAM SHORT CHANNEL TX

Device with	Loss channel Embedded by scope	Measure Fixture	Toggle Fixture	Cable DUT and Fixture
Std-B	-		Rx directly connect to toggle generator	15cm A-B
µB	-		Rx directly connect to toggle generator	15cm A-µB
Captive-A	-		Rx directly connect to toggle generator	-
Type-C	-			-
Captive-C	-		-	-

USB 3.2 GEN2 UPSTREAM SHORT & LONG CHANNEL TX

Device with	Loss channel Embedded by scope	Measure Fixture	Toggle Fixture	Cable DUT and Fixture
µB				-
Captive-A				-
Type-C				-
Captive-C			-	-

USB 3.2 GEN1/2 DOWNSTREAM SETUP TX

Gen1
CP0 = Pseudo Random
CP1 = Nyquist Freq. (10101..) 2.5GHz

Gen2
CP9 = Pseudo Random
CP10 = Nyquist Freq. (10101..) 5GHz
CP13 = Pre-shoot
CP14 = De-emphasis
CP15 = Pre-shoot & De-emphasis

RTP-B6
Generator option
Send PING.LFPS for
Toggle CPx

Measure fixture

Tx
DUT

Rx
DUT

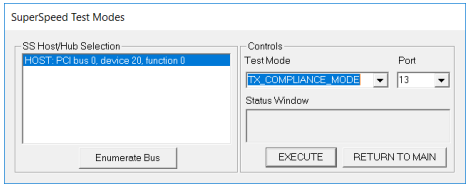
Toggle fixture

USB

USB

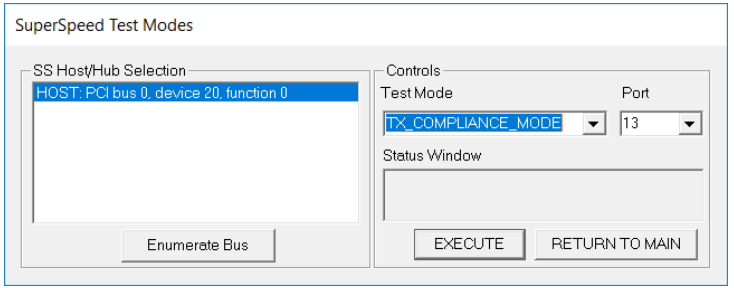
DUT

xHCI HSETT

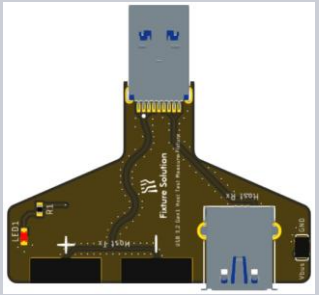
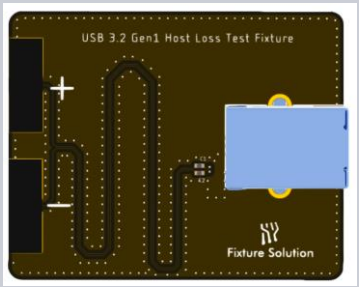
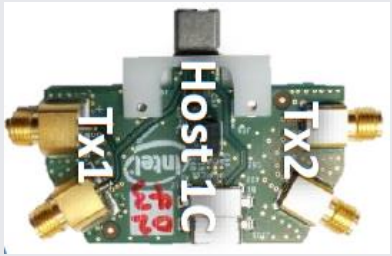


USB3.2 GEN1/2 DOWNSTREAM MEASUREMENTS USING XHCI HSETT

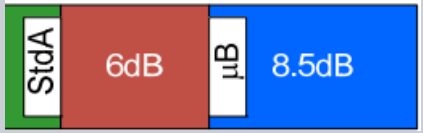
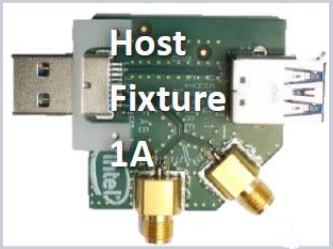
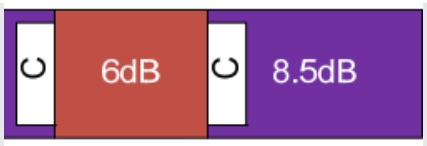
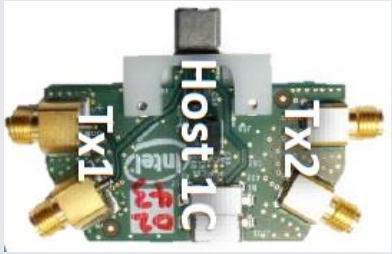
- HSETT is a free tool from www.usb.org
- A downstream port need to be forced in Tx_Compliance_Mode in order to toggle between CPx
- First place the downstream port in test mode before connecting the fixtures
- If the host OS is not Windows you need to find another way
- Might be a challenge with some products in getting the compliance mode



USB 3.2 GEN1 DOWNSTREAM SHORT & LONG CHANNEL TX

Hub or Host with	Loss channel Embedded by scope	Measure Fixture	Toggle Fixture
A-Port			
Type-C Port			

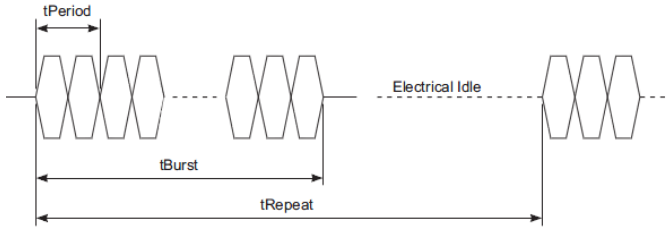
USB 3.2 GEN2 DOWNSTREAM SHORT & LONG CHANNEL TX

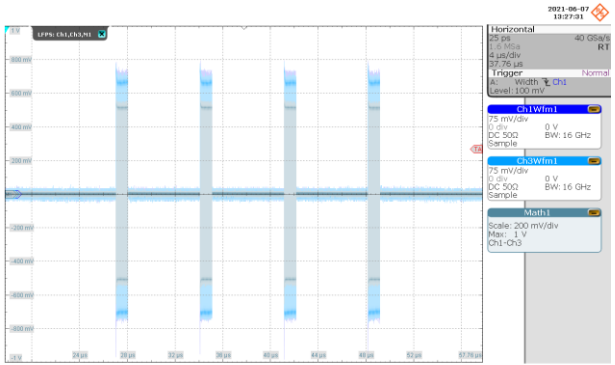
Hub or Host with	Loss channel Embedded by scope	Measure Fixture	Toggle Fixture
A-Port			
Type-C			

USB 3.2 LOW FREQUENCY PERIODIC SIGNALING

USB-IF Compliance test Polling.LFPS
Vpp >=800mV <= 1.2V
tPeriod >= 20ns <= 100ns
tBurst >= 600ns <= 1.4 µs
tRepeat >= 6µs <= 14 µs
Rise/Fall time <= 4ns
Duty cycle >= 40% <= 60%
AC Common Mode Voltage <= 100mV

From the moment the product under test is powered on it will send this Polling.LFPS





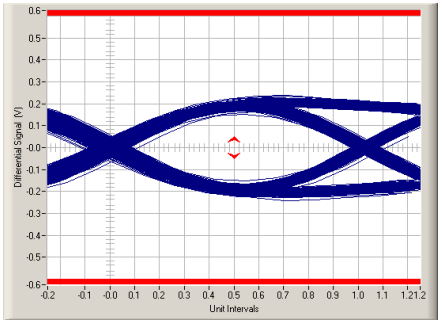
USB 3.2 SPREAD SPECTRUM CLOCKING

- Spread Spectrum Clocking is mandatory in the Tx
  - However, some vendors disable this feature
- SSC reduce the emitted energy from a signal
- SSC distributes energy from a single frequency to a frequency band near the original frequency
- CP1 is used for measuring

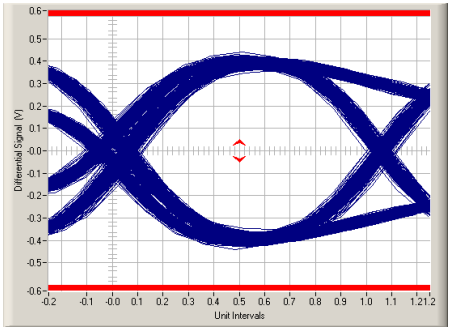
Measurement	Value	Limits
SSC Modulation Rate	32.949 kHz	30 kHz <= x <= 33 kHz
SSC Deviation Max (max)	119.27 ppm	-300.00<= x <= 300.00 ppm
SSC Deviation Max (min)	118.95 ppm	-300.00<= x <= 300.00 ppm
SSC Deviation Min (max)	-4890.97 ppm	-5300.00<= x <= -3700.00 ppm
SSC Deviation Min (min)	-4893.88 ppm	-5300.00<= x <= -3700.00 ppm
SSC DfDt	360.98 ppm	x < 1250.00 ppm

USB 3.2 GEN1 JITTER AND EYE

- Near end measurement is done with CP0 and CP1
- Toggling between test modes is done by sending Ping.LFPS on the Rx pair



Long Channel Transmitted Eye - Transition Eye

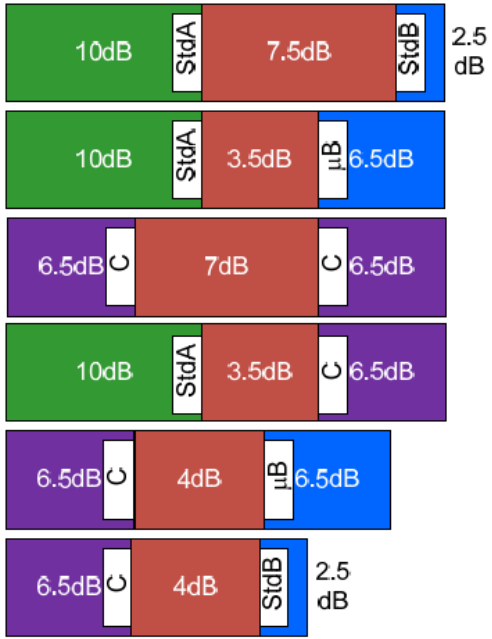


Short Channel Transmitted Eye - Transition Eye

Measurement	Value	Limits
Tj CP1	8.469 ps	x <= 132 ps
Rj (rms) CP1	631.209 fs	x <= 3.27 ps
Tj CP0	16.153 ps	x <= 132 ps
Rj (rms) CP0	631.209 fs	x <= 3.27 ps
Dj CP0	7.278 ps	x <= 86 ps
Avg UI	200.514 ps	199.94 ps <= x <= 201.06 ps
Min Time Between Crossover	0 s	Information Only
Max Peak to Peak Jitter	14.711 ps	Information Only
Non Transition Eye Violation	0 hits	x = 0 Violation Point
Transition Eye Violation	0 hits	x = 0 Violation Point
Total Eye Violation Points	0 hits	x = 0 Violation Point
Max Non Transition Voltage	428.486 mV	Information Only
Min Non Transition Voltage	-425.668 mV	Information Only
Max Transition Voltage	487.185 mV	Information Only
Min Transition Voltage	-481.629 mV	Information Only
Min Non Transition Upper Margin	242.434 mV	Information Only
Min Non Transition Lower Margin	-235.718 mV	Information Only
Min Transition Upper Margin	341.311 mV	Information Only
Min Transition Lower Margin	-345.84 mV	Information Only
Transmitted Eye Height	578.151 mV	Information Only
Transmitted Eye Width	183.847 ps	Information Only

USB 3.2 GEN1 JITTER AND EYE

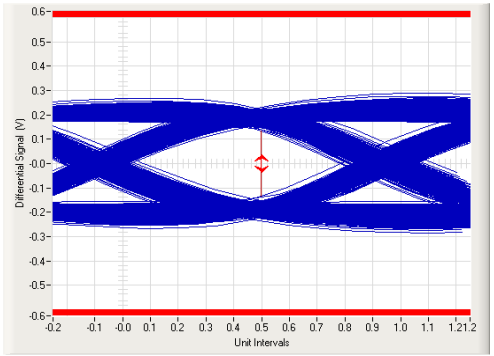
- The CTLE equalization is done in making the EYE diagram
- Tj at BER-12 <= 132 ps with CP0 at TP1
- Dj <= 86 ps with CP0 at TP1
- Rj <= 3.27 ps with CP1 at TP1 (Informative and no PASS FAIL criteria)
- For long channel measurement the RTP scope embedded appropriate S-Parameter provided by the USB-IF
- The long channel loss depend on:
  - Up or downstream port
  - Type of USB connector



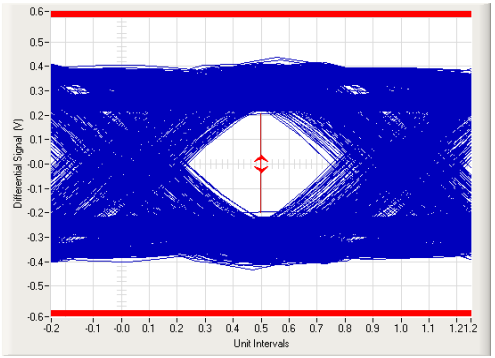
USB3.2 Gen1
IL @ 2.5GHz
max -20dB

USB 3.2 GEN2 JITTER AND EYE

- Near end measurement is done with CP9 and CP10
- Toggling between test modes is done by sending Ping.LFPS on the Rx pair



Long Channel Transmitted Eye - Transition Eye



Short Channel Transmitted Eye - Transition Eye

Measurement	Value	Limits
Tj CP10	5.839 ps	x <= 67.1 ps
Rj (rms) CP10	463.816 fs	x <= 1 ps
Tj CP9	25.723 ps	x <= 67.1 ps
Rj (rms) CP9	463.816 fs	x <= 1 ps
Dj CP9	21.314 ps	x <= 53 ps
Avg UI	100.242 ps	99.96999 ps <= x <= 100.5301 ps
Min Time Between Crossover	85.699 ps	Information Only
Max Peak to Peak Jitter	29.768 ps	Information Only
Non Transition Eye Violation	0 hits	x = 0 Violation Point
Transition Eye Violation	0 hits	x = 0 Violation Point
Total Eye Violation Points	0 hits	x = 0 Violation Point
Max Non Transition Voltage	278.073 mV	Information Only
Min Non Transition Voltage	-275.339 mV	Information Only
Max Transition Voltage	274.19 mV	Information Only
Min Transition Voltage	-267.792 mV	Information Only
Min Non Transition Upper Margin	106.139 mV	Information Only
Min Non Transition Lower Margin	-106.451 mV	Information Only
Min Transition Upper Margin	110.654 mV	Information Only
Min Transition Lower Margin	-109.801 mV	Information Only
Transmitted Eye Height	282.589 mV	Information Only
Transmitted Eye Width	74.277 ps	Information Only

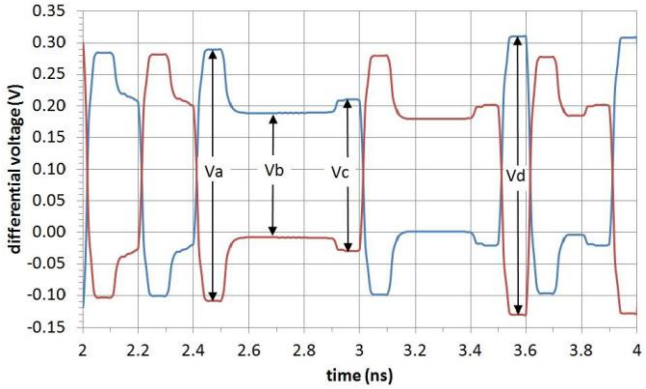
USB 3.2 GEN2 JITTER AND EYE

- The CTLE + DFE equalization is done in making the EYE diagram
- Tj at BER-12 <= 67.1 ps with CP0 at TP1
- Dj <= 53 ps with CP0 at TP1
- Rj <= 1 ps with CP1 at TP1 (Informative and no PASS FAIL criteria)
- Long channel measurement is the same as the short channel end setup measurement with the difference that the RTP scope embedded the USB-IF S-Parameter to the signal.
- Different than Gen1 the long channel is always same S-parameter except for devices with captive cable

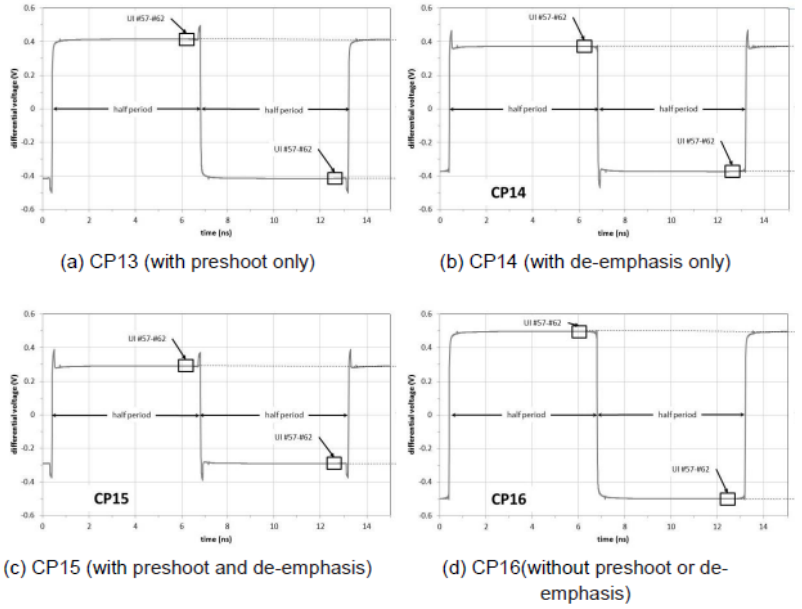
USB3.2 Gen2
IL @ 5GHz
-23dB

USB 3.2 GEN2 PRE-SHOOT/DE-EMPHASIS

- Only applicable for Gen2
- CP13, CP14 and CP15 required
- Can be difficult to differentiate the patterns



Preshoot = 20log(Vc/Vb)
De-emphasis = 20log(Vb/Va)



(a) CP13 (with preshoot only)

(b) CP14 (with de-emphasis only)

(c) CP15 (with preshoot and de-emphasis)

(d) CP16(without preshoot or de-emphasis)

USB3.2 TRANSMITTER TESTING

- Use the USB3.2 Transmitter Automation solution
  - RTP Generator makes it possible to toggle between CPx
  - RTP will guide you through the setup and test patterns
  - RTP will provide you with a report.
- Use the proper USB fixtures, cables and SMA cables
- For Type C test the receiver in both orientations
- When the product is a DRD (Host & Device) test both modes
- For USB3.2 Gen1/2**X2** Test all data lanes

USB3.2 RECEIVER TESTING

- Testing is done with short channel and behind long channel
- The long channel is depending on the speed and type of connector
- Pattern Generator (PG) will send the calibrated compliance test pattern to Rx of the product under test :
  - With max allowed Jitter
    - Rj & Dj (Sj)
  - SSC (33KHz Downspread 5000ppm)
  - Minimum voltage
- Place the product under test in loopback (done by the PG)
- BERT will read out error send back by product under test at Tx
- BER according to spec is 10^{-12} but reduce testing time to 10^{-10} and increase Dj
- If the DUT is Type-C repeat all testing with the alternate Rx path

USB3.2 RX TESTING CALIBRATION

- Before doing the USB3.2 Receiver testing it is essential to calibrate the pattern send to the DUT
- The calibration shall be done for long and short channel.
- Following parameters need to be calibrated
  - Voltage swing and de-emphasis (for short and long channel)
  - Rj, Sj and Tj
- Calculation is done in the background with SigTest
- This is a very intense and long process and automation is highly recommended (it's a must)
  - There is a lot of room for error on setup and keeping track of the calibration values.
- An automated calibration have a lead time of ~4 hours where a manual will take days.
- When changing the USB or SMA cables the setup will need to be calibrated again.

USB 3.2 RX CALIBRATION

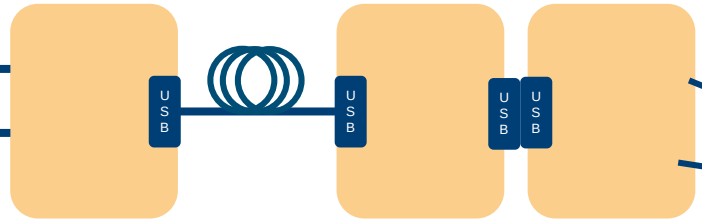
PG

Direct

Some of the calibration values are obtained with direct connection from PG to Scope. While other values are measured after the long channel.

PG

Worst Cable



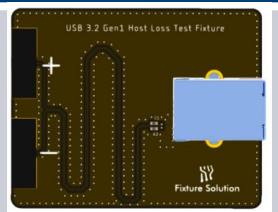
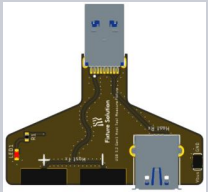
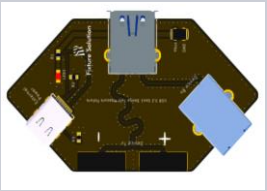
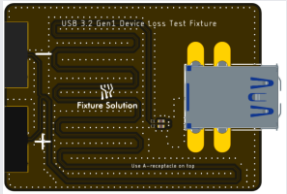
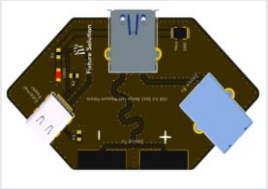
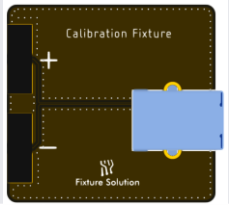
Loss Fixture

Measure Fixture

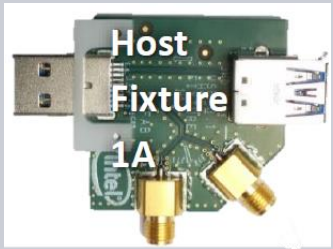
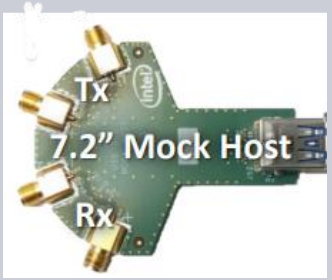
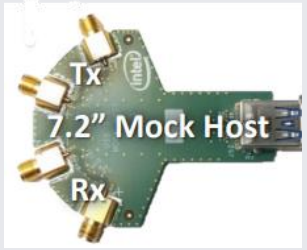
Probe Fixture

Long channel

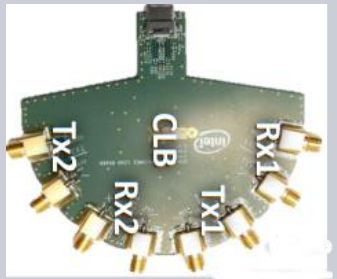
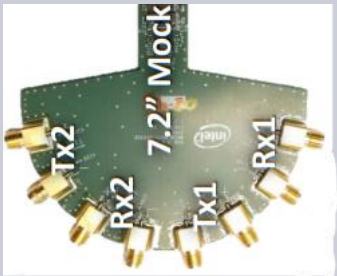
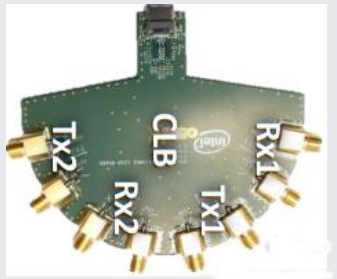
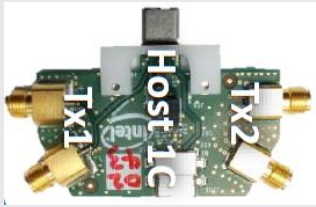
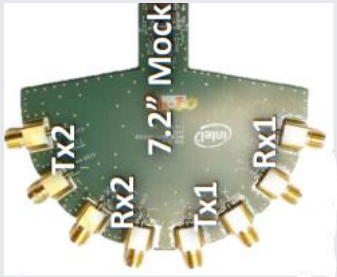
USB 3.2 GEN1 CALIBRATION SETUP

	Loss Fixture	Worst Cable	Measure Fixture	Probe Fixture
A- port Downstream		3m A-B		
Legacy connector Device		3m A-B		
Type-C Device & Host	Direct PG -> SCOPE	Direct PG -> SCOPE	Direct PG -> SCOPE	Direct PG -> SCOPE

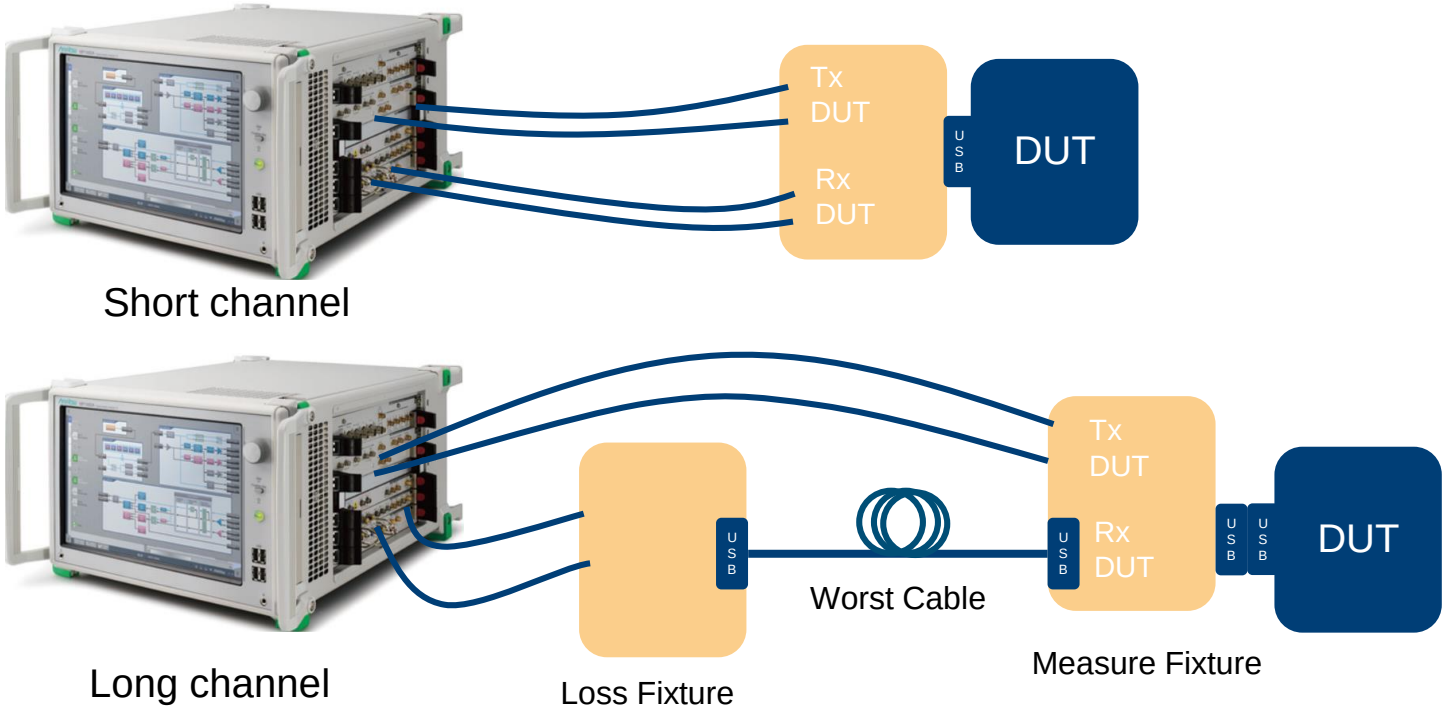
USB 3.2 GEN2 RX CALIBRATION LEGACY CONNECTOR

	Loss Fixture	Worst Cable	Measure Fixture	Probe Fixture
A- port Downstream		1m A-µB		
Legacy connector Device		1m A-µB		

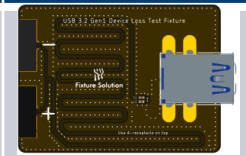
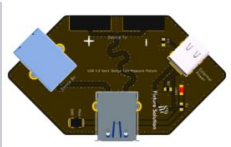
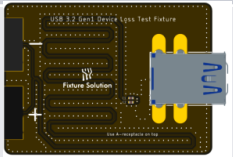
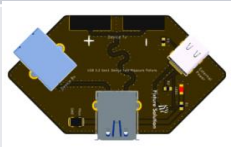
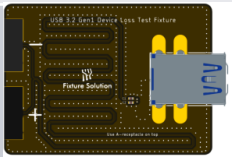
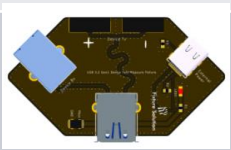
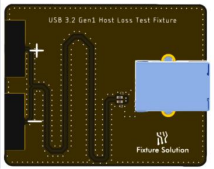
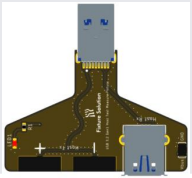
USB 3.2 GEN2 RX CALIBRATION TYPE-C CONNECTOR

	Loss Fixture	Worst Cable	Measure Fixture	Probe Fixture
Type-C Device		1m C-C		
Type-C Host		1m C-C		

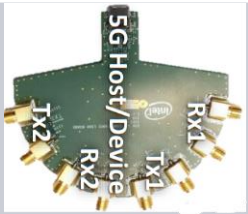
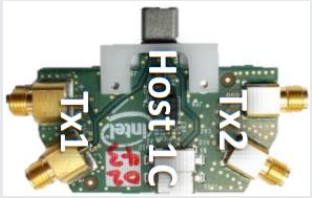
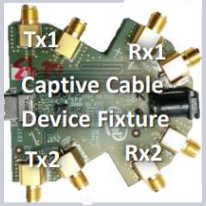
USB 3.2 GEN1/2 RECEIVER TESTING SETUP



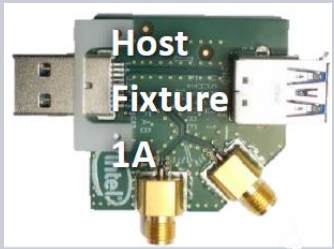
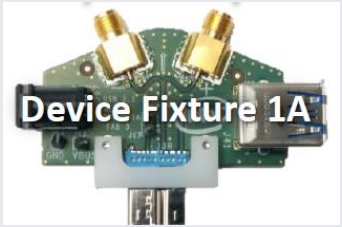
USB3.2 GEN1 RX LONG CHANNEL TEST LEGACY CONNECTOR

	Loss Fixture	Worst Cable	Measure Fixture	Cable between Measure Fixture and DUT
Upstream Std-B Gen1		3m A-B		15cm A-B
Upstream µB Gen1		1m A-B		15cm A-µB
Upstream Captive-A Gen1		15cm A-B		15cm A-B
Downstream A-Port		3m A-B		-

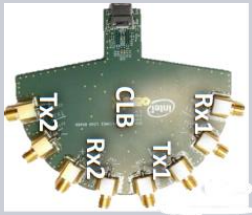
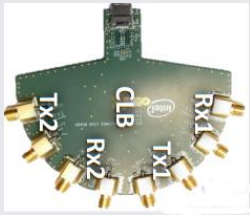
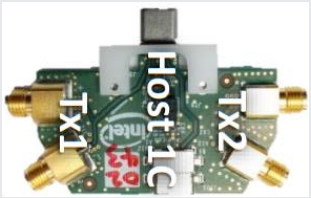
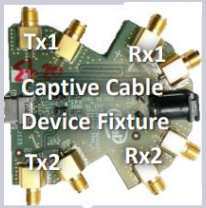
USB3.2 GEN1 RX LONG CHANNEL TEST TYPE-C CONNECTOR

	Loss Fixture	Worst Cable	Measure Fixture	Cable between Measure Fixture and DUT
Upstream Type-C		2m C-C		-
Downstream Type-C		2m C-C		-
Upstream Captive-C Gen1 & Gen2	-	-		-

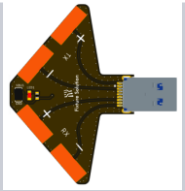
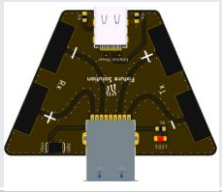
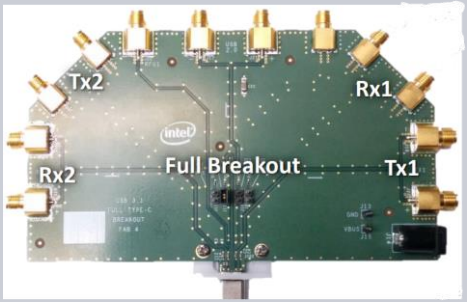
USB3.2 GEN2 RX LONG CHANNEL TEST LEGACY CONNECTOR

	Loss Fixture	Worst Cable	Measure Fixture
A- port Downstream		1m A-µB	
Std-B Device		1m A-µB	

USB3.2 GEN2 RX LONG CHANNEL TEST TYPE-C CONNECTOR

	Loss Fixture	Worst Cable	Measure Fixture
Upstream Type-C		1m C-C	
Downstream Type-C		1m C-C	
Upstream Captive-C Gen1 & Gen2	-	-	

USB3.2 GEN1/2 RX SHORT CHANNEL TEST

	Short channel fixture
Gen1 / Gen2 A-Port	
Gen1 / Gen2 Std-B, µB, Captive	
Up/Downstream Type-C	

USB 3.2 GEN1/2 RX TESTING

- After the calibration, the values are being stored at the BERT and will be used during the testing
- Compliance testing is done with minimum and maximum voltage at maximum allowed Sj
- USB-IF have the following values to test against:

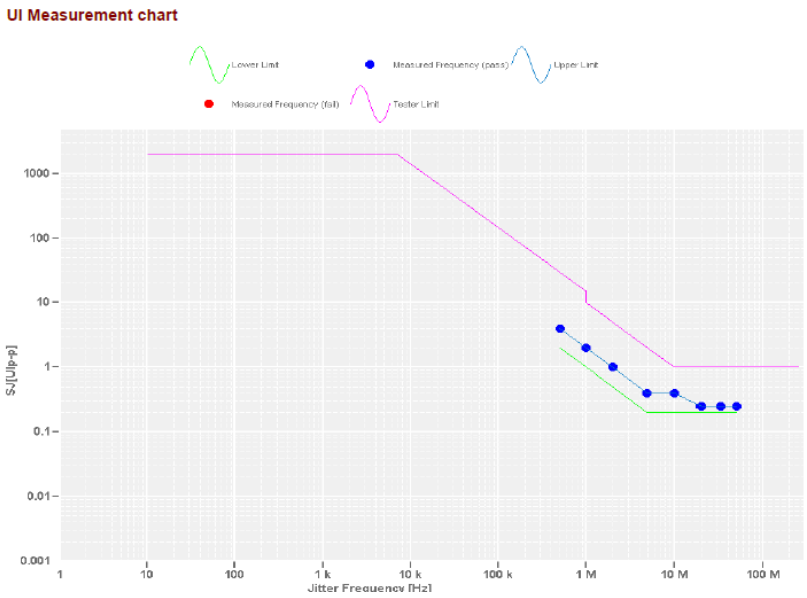
Measurement	Value	Limits
BER Pass/Fail	PASS	
Total BER	0.0000E-10	
Total Error Count	0	
Total Bits	4.9902E+10	
SJ 50 MHz 0.212 UIp-p	PASS	PASS/FAIL
SJ 33 MHz 0.212 UIp-p	PASS	PASS/FAIL
SJ 20 MHz 0.212 UIp-p	PASS	PASS/FAIL
SJ 10 MHz 0.212 UIp-p	PASS	PASS/FAIL
SJ 4.9 MHz 0.212 UIp-p	PASS	PASS/FAIL
SJ 2 MHz 0.5 UIp-p	PASS	PASS/FAIL
SJ 1 MHz 1 UIp-p	PASS	PASS/FAIL
SJ 500 kHz 2 UIp-p	PASS	PASS/FAIL
UI Measurement chart	-------	

Gen1

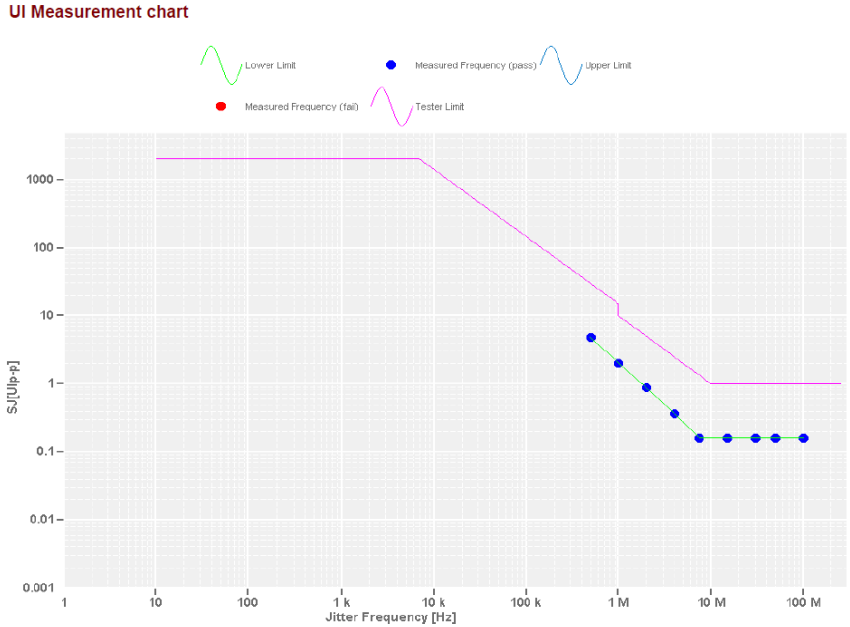
Measurement	Value	Limits
BER Pass/Fail	PASS	
Total BER	0.0000E-10	
Total Error Count	0	
Total Bits	9.9688E+10	
SJ 100 MHz 0.16 UIp-p	PASS	PASS/FAIL
SJ 50 MHz 0.16 UIp-p	PASS	PASS/FAIL
SJ 30 MHz 0.16 UIp-p	PASS	PASS/FAIL
SJ 15 MHz 0.16 UIp-p	PASS	PASS/FAIL
SJ 7.5 MHz 0.16 UIp-p	PASS	PASS/FAIL
SJ 4 MHz 0.37 UIp-p	PASS	PASS/FAIL
SJ 2 MHz 0.87 UIp-p	PASS	PASS/FAIL
SJ 1 MHz 2.03 UIp-p	PASS	PASS/FAIL
SJ 500 kHz 4.76 UIp-p	PASS	PASS/FAIL
UI Measurement chart	-------	

Gen2

USB3.2 RECEIVER TESTING RESULT IN GRAPH



Gen1 Tolerance



Gen2 Compliance

USB3.2 RECEIVER TESTING

- Use the USB3.2 Receiver Automation solution
  - It will place the product under test in the required loopback mode
    - It is very hard to force the product in loopback manual
  - Doing the calibration manual is very challenging and time consuming
  - There is room for errors
- Use the proper USB fixtures, cables and SMA cables
- Go beyond the compliance testing
  - Do receiver tolerance test and find amplitude and jitter margin of the product
- Calibration takes around 4hours
- For Type C test the receiver in both orientations
- When the product is DRD (Host & Device) test both modes
- For USB3.2 Gen1/2**X2** Test all data lanes

POSSIBLE ISSUES DURING USB3.2 RECEIVER TESTING

- When a product does not enter loopback try the following:
  - Verify setup with reference product
  - Disable jitter and/or increase amplitude during the loopback training
- For Type-C it might be required to flip the cable in order to select the correct lane or make the proper setting on CC line with jumper of the test fixture.
- If the product FAIL Receiver tolerance tests and the PHY have Rx Equalizer settings try to change these.
  - Make adjustment accordingly on Re-Timers or Re-Driver when implemented.
- High amplitude on Tx may cause crosstalk on Rx path what cause the Receiver test to Fail

MOST COMMON ISSUE

- Bad PCB design:
  - Traces too long or not matched
  - Not follow PCB design rules
- Bad internal cabling
- ESD, EMI components on the data lines that do not meet the USB requirements
- Wrong PHY settings (Boost, Emphasis, Equalizer,..)
- Improper crystal oscillator
- Re-driver or Re-timer not set properly
- Noisy power supply
- Interference from other signals

- Unable to enter the required test modes
- Capture the wrong USB packet for analysis
- Wrong or broken test fixture
- Setup of SMA cables are not de-skewed
- Not just use any USB cable during Rx and Tx testing but use the provided cable
- Product is marginal and may Pass on one setup but might Fail on another setup

HOW CAN GRANITE RIVER LABS HELP

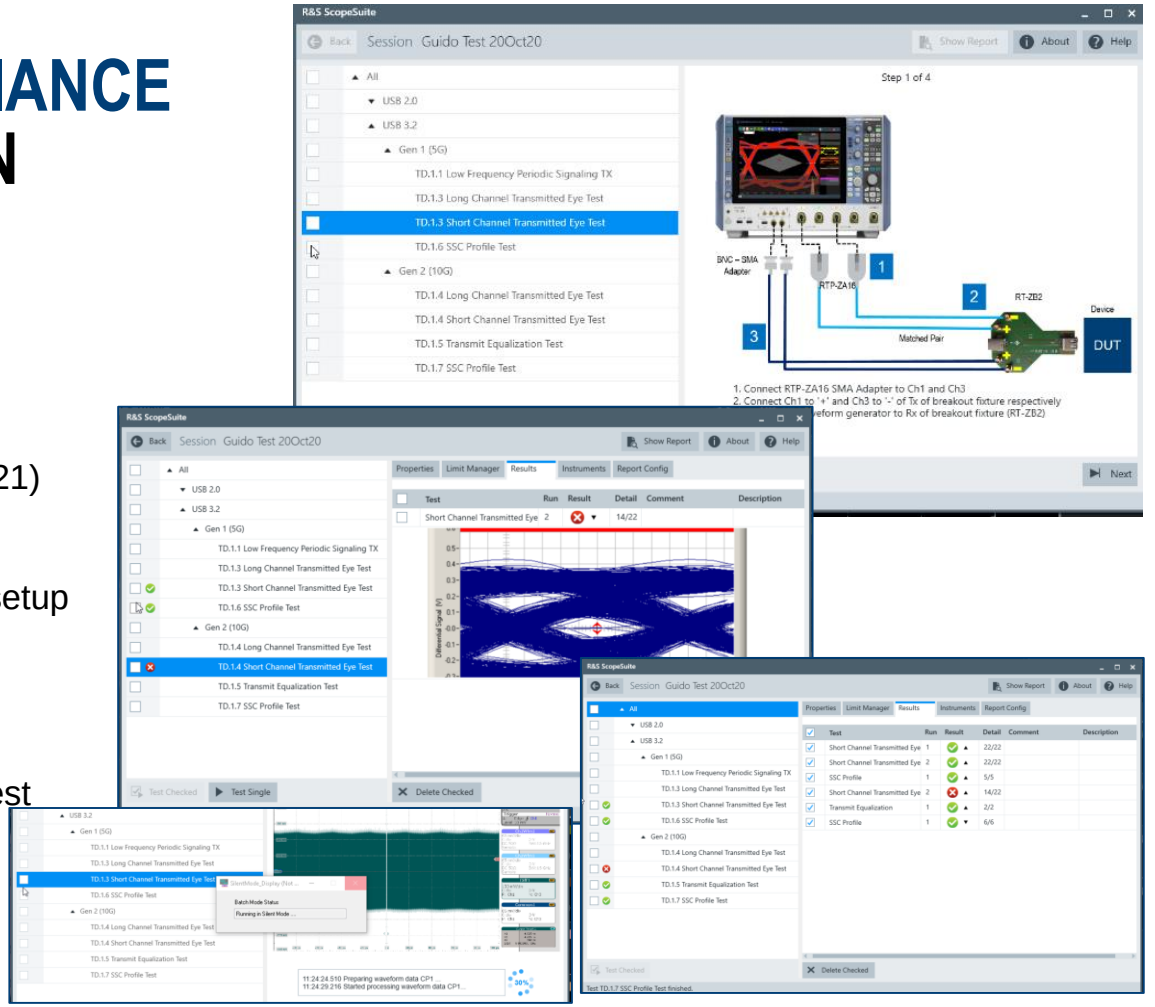
- GRL offers USB-IF logo compliance at 8 different locations world-wide
- GRL offers debug and test services that go beyond USB-IF compliance
- Testing is our daily activity
- Beside USB we cover Compliance & Certification for many other technology standards
- Signal & Power Integrity Simulation/Modeling & Validation
- Chip Characterization (also under PVT)
- Debugging, Consulting & Training
- GRL GTrusted & Interoperability Testing

DEMONSTRATION WITH R&S RTP OSCILLOSCOPE

SUMMARY

USB3.2 GEN1/2 COMPLIANCE AUTOMATED SOLUTION

- Option: R&S®RTP-K101
- Functions:
  - TX compliance test for USB 3.2 Gen1 & 2
  - Includes USB1.x/2.0 test (R&S®RTP-K21)
- Advantages:
  - Automated test execution with guided setup steps and final report
  - Integrated generator option to toggle compliance pattern
  - Channel embedding for long channel test without additional options
  - R&S®RT-ZB2 test fixture for USB3.2 Gen1 pre-compliance



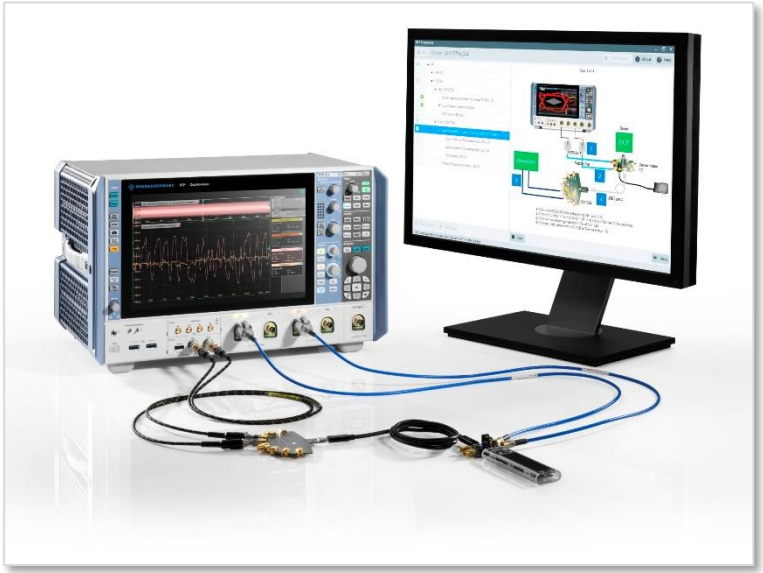
SUMMARY

- The USB interface gains more and more popularity
- To assure interoperability use compliance test

- <some points from >
- ...

- R&S offers a full suite of compliance test options up to USB 3.2 Gen 2

- Close cooperation between GRLR&S on Compliance Test solutions for Highspeed interfaces



Find out more

www.rohde-schwarz.com/solutions/test-and-measurement/electronic-design/high-speed-digital-interface-testing/usb/usb_251317.html

https://www.graniteriverlabs.com/en-us/usb-standards-service

Thank you!

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