

# USB4 SigTest User Manual rev 0.8

SigTest is the USB4 post analysis software tool. The data captured with the Oscilloscope is imported into this software for post processing. SigTest is capable of rendering the signal quality measurements captured with the Oscilloscope. The post processed parameters are checked against the specified pass/fail criteria.

## **USB4 SigTest running template:**

```
USB4_SigTest.exe technology test_mode test_point cts_test_name wdir file1 file2  
report_name de_embedding
```

## **Input arguments:**

1. technology = **gen2\_rounded/gen2\_legacy/gen3\_rounded/gen3\_legacy**

SigTest supports all USB4 bitrates.

**gen2\_rounded** = 10Gb/s

**gen3\_rounded** = 20Gb/s

**gen2\_legacy** = 10.3125Gb/s

**gen3\_legacy** = 20.625Gb/s

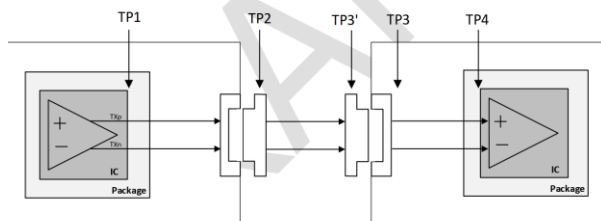
2. test\_mode = **tx/rx**

**tx** – SigTest supports the transmitter Router Assembly compliance tests.

**rx** – SigTest supports the receiver Router Assembly stressed eye calibration.

3. test\_point = **tp2/tp3\_prime/tp3**

SigTest supports the Router Assembly compliance tests at following test points.



**tp2** - transmitter Router Assembly compliance test point, which requires the de-embedding of 1 m coax cable.

**tp3** - transmitter Router Assembly compliance test point, which requires the de-embedding of 1 m coax cable and embedding of 2m/0.8m passive cable for Gen2/Gen3 respectively.

**tp3\_prime** (TP3' in the screenshot above) - receiver Router Assembly stressed eye calibration test point. No de-embedding / embedding is required.

**tp3** - receiver Router Assembly stressed eye calibration test point, which requires the de-embedding of 1 m coax cable.

4. cts\_test\_name = **ui\_ssc\_eye/rise\_fall\_time/jitter/ac\_common\_mode/transmitter\_equalization/electrical\_idle\_voltage/tx\_frequency\_variation\_training/tp3**

**ui\_ssc\_eye** – the test done using PRBS31 pattern and includes the following transmitter compliance tests: Minimum Unit Interval, SSC\_Down\_Spread\_Range,

SSC\_Down\_Spread\_Rate, SSC\_Phase\_Deviation, SSC\_Slew\_Rate, Eye Diagram Measurement ( including eye height and eye width measurements ).

Test Methods in the CTS section Gen2: 3.3.2.4, 3.3.3.4, 3.3.4.4, 3.3.5.4, 3.3.6.4, 3.3.17.4 Gen3: 3.4.2.4, 3.4.3.4, 3.4.4.4, 3.4.5.4, 3.4.6.4, 3.4.17.4

**rise\_fall\_time** – the test done using SQ128 pattern and includes the following transmitter compliance tests: Rise Time, Fall Time.

Test Method in the CTS section Gen2: 3.3.8.4 Gen3: 3.4.8.4

**jitter** - the test done using PRBS15 pattern and includes the following transmitter compliance tests: Total Jitter, UJ, UDJ, DDJ, UDJ\_LF, DCD.

Test Methods in the CTS section Gen2: 3.3.10.4, 3.3.11.4, 3.3.12.4, 3.3.13.4, 3.3.14.4, 3.3.15.4 Gen3: 3.4.10.4, 3.4.11.4, 3.4.12.4, 3.4.13.4, 3.4.14.4, 3.4.15.4

**ac\_common\_mode** – the test done using PRBS31 pattern and includes the following transmitter compliance test: AC\_CM.

Test Method in the CTS section Gen2: 3.3.16.4 Gen3: 3.4.16.4

**transmitter\_equalization** - the test done using SQ128 pattern and includes the following transmitter compliance test: Pre-shoot and De-emphasis for all USB4 presets.

Test Method in the CTS section Gen2: 3.3.1.4 Gen3: 3.4.1.4

**electrical\_idle\_voltage** - the test done when the DUT is in electrical idle mode and includes the following transmitter compliance test: V\_ELEC\_IDLE.

Test Method in the CTS section Gen2: 3.3.9.4 Gen3: 3.4.9.4

**frequency\_variation\_training** - the test done using several patterns PRBS31, SQ128, SQ4 as described in the CTS section 3.3.7.4 and includes the following transmitter compliance test: INIT\_FREQ\_VARIATION, DELTA\_FREQ\_200ns, DELTA\_FREQ\_1000ns.

Test Method in the CTS section Gen2: 3.3.7.4 Gen3: 3.4.7.4

**tp3** - the test done using several patterns PRBS31, PRBS15 as described in the CTS section Gen2: 3.3.18.4, 3.3.19.4, 3.3.20.4, 3.3.21.4 Gen3: 3.4.18.4, 3.4.19.4, 3.4.20.4, 3.4.21.4

5. wdir = waveform\_directory

**wdir** – the full path to the waveform location

6. file1 = waveform\_name.bin/ waveform\_name.trc/ waveform\_name.wfm

waveform\_name – the waveform full name, including the waveform format that represent the scope vendor:

**waveform\_name.bin** – KS Scope

**waveform\_name.trc** – Lecroy Scope

**waveform\_name.wfm** – TEK Scope

7. file2 = **none**

**none** – this input parameter shall be “none” in this SigTest revision.

8. report\_name = **report\_name**

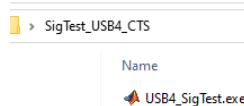
**report\_name** – any relevant report name chosen by operator.

9. de\_embedding = **none**

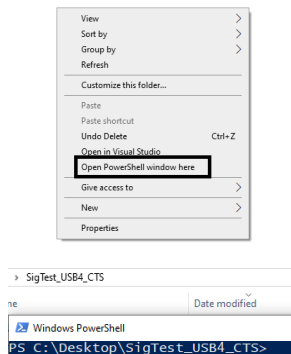
**none** – this input parameter shall be “none” in this SigTest revision.

## **USB4 SigTest installation and running:**

1. System requirements:  
Minimum memory: 16GB RAM  
Recommended memory: 32GB RAM and higher.
2. Install Matlab Runtime Compiler MCR R2019b (9.7).
3. Run the executable .exe file:
  - a) Create folder, for example "SigTest\_USB4\_CTS"
  - b) Place the USB4\_SigTest.exe into the folder "SigTest\_USB4\_CTS"



- c) Open PowerShell window from the folder created in #1 by pressing SHIFT + Right mouse button and then press on "Open PowerShell window here"



## **Scope definitions for saving waveforms:**

1. Sampling Rate  $\geq 80\text{GSa/s}$ .
2. The evaluated record length shall be  $500\mu\text{s}$  per channel.
3. No CDR, no average, no interpolation and no equalization shall be applied.
4. The scope BW shall be 16GHz for Gen2 and 21GHz for Gen3.
5. Adjust vertical scale to fit signal into scope screen.
6. The saved waveforms for all Router Assembly compliance transmitter and receiver tests shall be differential (for example: CH1 - CH3), except of the waveform for **ac\_common\_mode** test that shall be common (for example: (CH1 + CH3)/2).
7. The waveforms shall include the De-embedding and Embedding depend on the Router Assembly compliance test point and the test mode as following:  
Test mode: Tx, Test point: TP2
  - De-embedding of the cable from the plug test fixture to the scope.Test mode: Tx, Test point: TP3
  - De-embedding of the cable from the plug test fixture to the scope and the embedding of Type-C cable 2m for Gen2, 0.8m for Gen3 speeds.Test mode: Rx, Test point: TP3 Prime
  - No de-embedding and no embedding shall be applied.Test mode: Rx, Test point: TP3
  - De-embedding of the cable connecting from the last receptacle to the scope.
8. The waveforms shall include the correct test pattern type per test according to the CTS and the tests pattern length, otherwise the test will interrupt and exit.

# Router Assembly Transmitter Testing

## Note

- a) All setups and test procedures shall be the same as described in the USB4 Electrical - Router Assembly Compliance Test Specification paragraph 3.
- b) The SigTest post processed results shall replace the scope application calculations.

## TP2:

1.      cts\_test\_name - **ui\_ssc\_eye**

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded tx tp2 ui_ssc_eye
```





```
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\ tp2_prbs31.bin none ui_ssc_eye none
```

```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : TX, TestPoint : TP2
The following tests are in progress ...
Minimum Unit Interval Measurement
SSC Down Spread Range Measurement
SSC Down Spread Rate Measurement
SSC Phase Deviation Measurement
SSC Slew Rate Measurement
Eye Diagram Measurement
Loading File tp2_prbs31.bin ....
Writing tie_period_frequency_gen2_rounded_tp2_ui_ssc_eye.jpg
Writing eye_diagram_gen2_rounded_tp2_ui_ssc_eye.jpg
Writing result to .\ui_ssc_eye_result_21-Oct-2020.csv
The tests are completed
```

Report files location:

SigTest\_USB4\_CTS

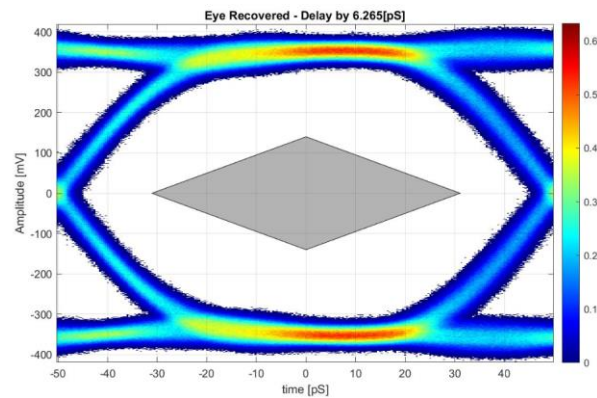
Name

-  ui\_ssc\_eye\_result\_21-Oct-2020.csv
-  eye\_diagram\_gen2\_rounded\_tp2\_ui\_ssc\_eye.jpg
-  tie\_period\_frequency\_gen2\_rounded\_tp2\_ui\_ssc\_eye.jpg
-  USB4\_SigTest.exe

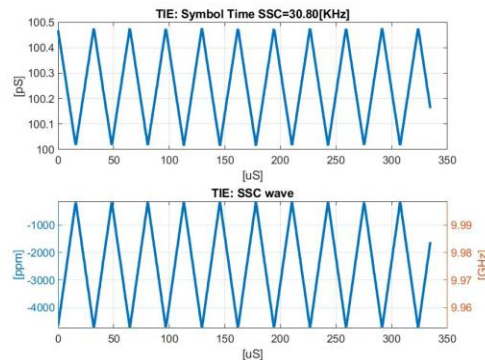
### 1.1. The .CSV file ui\_ssc\_eye\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen2_rounded									
Date:	21-Oct-20								
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\									
File: tp2_prbs31.bin									
Minimum Unit Interval Measurement [pS]:	PASS	UI Min Min	100.016081	UI Min Max	100.019604	CTS: UI Min Min	99.97	CTS: UI Min Max	100.03
SSC Down Spread Range Measurement[%]:	PASS	Min SSC_Down_Spread_Range	0.451389	Max SSC_Down_Spread_Range	0.458343	CTS: Min SSC_Down_Spread_Range	0.4	CTS: Max SSC_Down_Spread_Range	0.5
SSC Down Spread Rate Measurement[KHz]:	PASS	Min SSC Down Spread Rate	30.716886	Max SSC Down Spread Rate	30.887801	CTS: Min SSC Down Spread Rate	30	CTS: Max SSC Down Spread Rate	33
SSC Phase Deviation Measurement [ns p-p]:	PASS	SSC Phase Deviation	18.959192	CTS: Min SSC Phase Deviation	2.5	CTS: Max SSC Phase Deviation	22		
SSC Slew Rate Measurement [ppm/us]:	PASS	SSC Slew Rate	550.560944	CTS: SSC Slew Rate	1250				
Eye Diagram Measurement:	PASS	Eye: Count of Violation	0 EyeWidth [pS]		89.281492: EyeHeight[mV]		593.984185		
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.975472 Drift [PPM]		-2452.82				

### 1.2. The .jpg file eye\_diagram\_gen2\_rounded\_tp2\_ui\_ssc\_eye.jpg



### 1.3. The .jpg file tie\_period\_frequency\_gen2\_rounded\_tp2\_ui\_ssc\_eye.jpg



## 2. cts\_test\_name - **rise\_fall\_time**



Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded tx tp2 rise_fall_time
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\ tp2_sq128.bin none
gen2_rounded_rise_fall_time none
```

```
Running SIGTEST : Technology : GEN2_ROUND, TestMode : TX, TestPoint : TP2
The following tests are in progress ...
Rise/Fall Time Measurement
Loading File tp2_sq128.bin ....
Writing result to .\rise_fall_time_result_21-Oct-2020.csv
The tests are completed
```

Report files location:

SigTest\_USB4\_CTS

Name
 rise_fall_time_result_21-Oct-2020.csv
 USB4_SigTest.exe

2.1. The .CSV file gen2\_rounded\_rise\_fall\_time\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\					
File: tp2_sq128.bin					
Rise-Time Measurement[pS]:	PASS	Rise Time	33.009421	CTS: Min Rise Time	10
Fall-Time Measurement[pS]:	PASS	Fall Time	32.982458	CTS: Min Fall Time	10

3. cts\_test\_name – **jitter**

Run the following command from the PowerShell window:





```
.\USB4_SigTest.exe gen2_rounded tx tp2 jitter
```

```
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\ tp2_prbs15.bin none jitter none
```

```
Running SIGTEST : Technology : GEN2_ROUND, TestMode : TX, TestPoint : TP2
The following tests are in progress ...
Total Jitter Measurement
UJ Measurement
UDJ Measurement
DDJ Measurement
Low Frequency UDJ Measurement
DCD Measurement
Loading File tp2_prbs15.bin ....
Writing tj_bathtub_gen2_rounded_tp2_jitter.jpg
Writing histogram_pj_rj_ddj_gen2_rounded_tp2_jitter.jpg
Writing result to .\jitter_result_21-Oct-2020.csv
The tests are completed
```

Report files location:

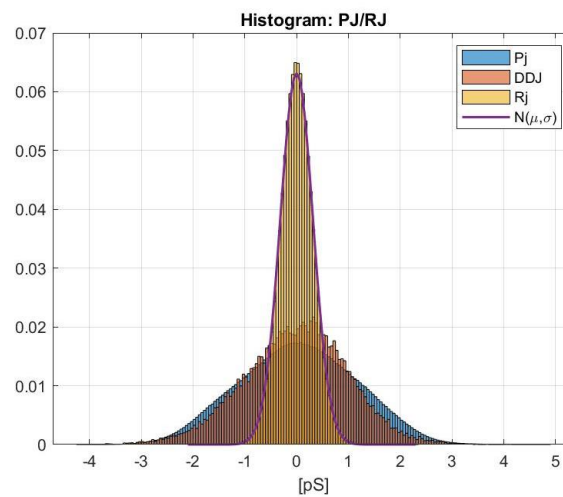
SigTest\_USB4\_CTS

Name
 jitter_result_21-Oct-2020.csv
 histogram_pj_rj_ddj_gen2_rounded_tp2_jitter.jpg
 tj_bathtub_gen2_rounded_tp2_jitter.jpg
 USB4_SigTest.exe

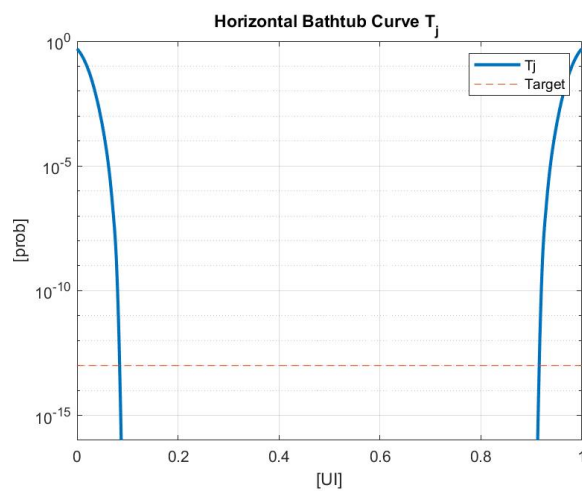
### 3.1. The .CSV file jitter\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\					
File: tp2_prbs15.bin					
Total Jitter (BER=1e-13) Measurement Ulp-p:	PASS	TJ	0.168537	CTS: Max TJ	0.38
UJ Measurement Ulp-p:	PASS	UJ Jitter Ulp-p	0.090646	CTS: Max UJ	0.31
UDJ Measurement Ulp-p:	PASS	UDJ jitter Ulp-p	0.031796	CTS: Max UDJ	0.17
UDJ LF Measurement Ulp-p:	PASS	UDJ LF jitter Ulp-p	0.018213	CTS: Max UDJ LF	0.04
DDJ Measurement Ulp-p:	PASS	DDJ jitter Ulp-p	0.077891	CTS: Max DDJ	0.15
DCD Measurement Ulp-p:	PASS	DCD jitter Ulp-p	0.015579	CTS: Max DCD	0.03
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.975472	Drift [PPM]	-2452.85

### 3.2. The .jpg file histogram\_pj\_rj\_ddj\_gen2\_rounded\_tp2\_jitter.jpg



### 3.3. The .jpg file tj\_bathtub\_gen2\_rounded\_tp2\_jitter.jpg



#### 4.      cts\_test\_name - **ac\_common\_mode**

Run the following command from the PowerShell window:



```
.\USB4_SigTest.exe gen2_rounded tx tp2 ac_common_mode  
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\ tp2_prbs31_common.bin none  
ac_common_mode none
```

```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : TX, TestPoint : TP2  
The following tests are in progress ...  
AC Common Mode Measurement  
Loading File tp2_prbs31_common.bin ....  
Writing result to .\ac_common_mode_result_21-Oct-2020.csv  
The tests are completed
```

Report files location:

SigTest\_USB4\_CTS

Name

 ac\_common\_mode\_result\_21-Oct-2020.csv  
 USB4\_SigTest.exe

##### 4.1.      The .CSV file ac\_common\_mode\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\					
File: tp2_prbs31_common.bin					
AC CM Measurement:	PASS	AC CM: Vac [mVp2p]	81.2	CTS: Max AC CM [mVp2p]	100

#### 5.      cts\_test\_name - **electrical\_idle\_voltage**

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded tx tp2 electrical_idle_voltage  
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\ tp2_eidle.bin none electrical_idle_voltage  
none
```



```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : TX, TestPoint : TP2  
The following tests are in progress ...  
Electrical Idle Voltage Measurement  
Loading File tp2_eidle.bin ....  
Writing result to .\electrical_idle_voltage_result_21-Oct-2020.csv  
The tests are completed
```



Report files location:

SigTest\_USB4\_CTS

Name

 electrical\_idle\_voltage\_result\_21-Oct-2020.csv  
 USB4\_SigTest.exe

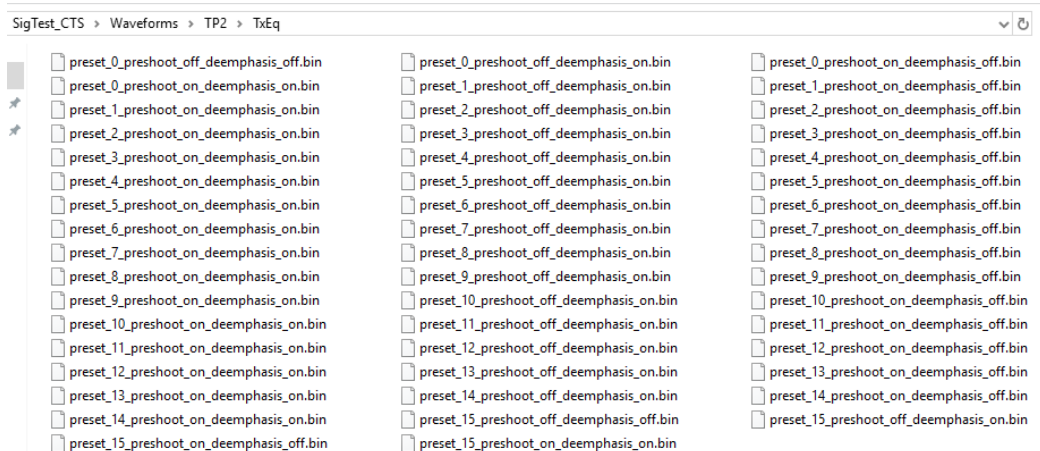
#### 5.1. The .CSV file electrical\_idle\_voltage\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\					
File: tp2_idle.bin					
Electrical Idle Voltage Measurement[mV]:	PASS	V_ELEC_IDLE	1.663508	CTS: Max V_ELEC_IDLE	20

#### 6. cts\_test\_name - **transmitter\_equalization**

Notes:

- The saved waveforms for each preset shall be located in the same folder.
- The waveforms names shall be the same as in the screenshot below.



Run the following command from the PowerShell window:



```
.\USB4_SigTest.exe gen3_rounded tx tp2 transmitter_equalization  
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\TxEq\ " " none transmitter_equalization  
none
```

```
Running SIGTEST : Technology : GEN3_ROUNDED, TestMode : TX, TestPoint : TP2  
The following tests are in progress ...  
Transmitter Equalization  
Loading File preset_0_preshoot_on_deemphasis_on.bin ....  
Loading File preset_0_preshoot_off_deemphasis_on.bin ....  
Loading File preset_0_preshoot_on_deemphasis_off.bin ....  
Loading File preset_1_preshoot_on_deemphasis_on.bin ....  
Loading File preset_1_preshoot_off_deemphasis_on.bin ....  
Loading File preset_1_preshoot_on_deemphasis_off.bin ....  
Loading File preset_2_preshoot_on_deemphasis_on.bin ....  
Loading File preset_2_preshoot_off_deemphasis_on.bin ....  
Loading File preset_2_preshoot_on_deemphasis_off.bin ....  
Loading File preset_3_preshoot_on_deemphasis_on.bin ....  
Loading File preset_3_preshoot_off_deemphasis_on.bin ....  
Loading File preset_3_preshoot_on_deemphasis_off.bin ....  
Loading File preset_4_preshoot_on_deemphasis_on.bin ....  
Loading File preset_4_preshoot_off_deemphasis_on.bin ....  
Loading File preset_4_preshoot_on_deemphasis_off.bin ....  
Loading File preset_5_preshoot_on_deemphasis_on.bin ....  
Loading File preset_5_preshoot_off_deemphasis_on.bin ....  
Loading File preset_5_preshoot_on_deemphasis_off.bin ....  
Loading File preset_6_preshoot_on_deemphasis_on.bin ....  
Loading File preset_6_preshoot_off_deemphasis_on.bin ....  
Loading File preset_6_preshoot_on_deemphasis_off.bin ....  
Loading File preset_7_preshoot_on_deemphasis_on.bin ....  
Loading File preset_7_preshoot_off_deemphasis_on.bin ....  
Loading File preset_7_preshoot_on_deemphasis_off.bin ....  
Loading File preset_8_preshoot_on_deemphasis_on.bin ....  
Loading File preset_8_preshoot_off_deemphasis_on.bin ....  
Loading File preset_8_preshoot_on_deemphasis_off.bin ....  
Loading File preset_9_preshoot_on_deemphasis_on.bin ....  
Loading File preset_9_preshoot_off_deemphasis_on.bin ....  
Loading File preset_9_preshoot_on_deemphasis_off.bin ....  
Loading File preset_10_preshoot_on_deemphasis_on.bin ....  
Loading File preset_10_preshoot_off_deemphasis_on.bin ....  
Loading File preset_10_preshoot_on_deemphasis_off.bin ....  
Loading File preset_11_preshoot_on_deemphasis_on.bin ....  
Loading File preset_11_preshoot_off_deemphasis_on.bin ....  
Loading File preset_11_preshoot_on_deemphasis_off.bin ....  
Loading File preset_12_preshoot_on_deemphasis_on.bin ....  
Loading File preset_12_preshoot_off_deemphasis_on.bin ....  
Loading File preset_12_preshoot_on_deemphasis_off.bin ....  
Loading File preset_13_preshoot_on_deemphasis_on.bin ....  
Loading File preset_13_preshoot_off_deemphasis_on.bin ....  
Loading File preset_13_preshoot_on_deemphasis_off.bin ....  
Loading File preset_14_preshoot_on_deemphasis_on.bin ....  
Loading File preset_14_preshoot_off_deemphasis_on.bin ....  
Loading File preset_14_preshoot_on_deemphasis_off.bin ....  
Loading File preset_15_preshoot_on_deemphasis_on.bin ....  
Loading File preset_15_preshoot_off_deemphasis_on.bin ....  
Loading File preset_15_preshoot_on_deemphasis_off.bin ....  
Loading File preset_0_preshoot_off_deemphasis_off.bin ....  
Loading File preset_15_preshoot_off_deemphasis_off.bin ....  
Writing result to .\transmitter_equalization_result_21-Oct-2020.csv  
The tests are completed
```

Report files location:

SigTest\_USB4\_CTS

Name

 transmitter\_equalization\_result\_21-Oct-2020.csv  
 USB4\_SigTest.exe

### 6.1. The .CSV file transmitter\_equalization\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen3_rounded						
Date:	21-Oct-20					
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP2\TxEq\						
File:						
Transmitter Equalization Test:						
Preset#	Pre-shoot	De-emphasis	Pre-shoot[dB]	De-emphasis[dB]	CTS: Pre-shoot[dB]	CTS: De-emphasis[dB]
0	PASS	PASS	0	0	0	0
1	PASS	PASS	0	-1.4	0	-1.9
2	PASS	PASS	0	-3.3	0	-3.6
3	PASS	PASS	0	-4.4	0	-5
4	PASS	PASS	0	-7.7	0	-8.4
5	PASS	PASS	0.7	0	0.9	0
6	PASS	PASS	0.8	-1.6	1.1	-1.9
7	PASS	PASS	1.2	-3.8	1.4	-3.8
8	PASS	PASS	1.4	-5.2	1.7	-5.8
9	PASS	PASS	2.4	-7.8	2.1	-8
10	PASS	PASS	1.4	0	1.7	0
11	PASS	PASS	1.8	-1.9	2.2	-2.2
12	PASS	PASS	2.2	-3	2.5	-3.6
13	PASS	PASS	3.2	-6.3	3.4	-6.7
14	PASS	PASS	4.2	0.2	3.6	0
15	PASS	PASS	1.4	-1.4	1.7	-1.7
Swing	Swing[dB]		CTS: Min Swing[dB]		CTS: Max Swing[dB]	
PASS	3.3		2.5		4.5	

### 7. cts\_test\_name – frequency\_variation\_training

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen3_rounded tx tp2 frequency_variation_training
C:\Desktop\SigTest_USB4_CTS\Waveforms\ tx_frequency_variation_training.bin none
tx_clk_switch none
```

```
***** SIGTEST Version: 0.6 *****
Running SIGTEST : Technology : GEN3_ROUNDED, TestMode : TX, TestPoint : TP2
The following tests are in progress ...
TX Frequency Variation Training Measurement
Loading File tx_frequency_variation_training.bin ...
Writing tx_clock_switch_analysis_gen3_rounded_tp2_tx_clk_switch.jpg
Writing result to .\tx_clk_switch_result_21-Jul-2021.csv
The tests are completed
PS C:\Users\lab\ss\01\Desktop\SigTest>
```

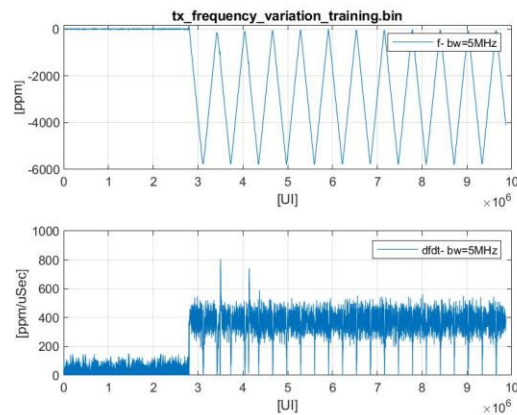
Report files location:

tx_clk_switch_result_21-Jul-2021.csv	7/21/2021 1:30 PM
tx_clock_switch_analysis_gen3_rounded_tp2_tx_clk_switch.jpg	7/21/2021 1:30 PM
USB4_SigTest.exe	7/21/2021 1:15 PM

### 7.1. The .csv file tx\_clk\_switch\_result\_21-Jul-2021.csv

Electrical Compliance Test Specification for gen3_rounded				
Date:21-Jul-2021				
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\				
File: tx_frequency_variation_training.bin				
TX Frequency Variation Training Measurement:				
INIT_FREQ_VARIATION:	PASS	INIT_FREQ_VARIATION result:	60.5711 CTS: Min INIT_FREQ_VARIATION	-300 CTS: Max INIT_FREQ_VARIATION 300
DELTA_FREQ_200nS:	PASS	DELTA_FREQ_200nS result:	190.233 CTS: Max DELTA_FREQ_200nS	1400
DELTA_FREQ_1000nS:	PASS	DELTA_FREQ_1000nS result:	672.266 CTS: Max DELTA_FREQ_1000nS	2200
FREQ_OVERSHOOT:	PASS	FREQ_OVERSHOOT result:	178.8158 CTS: Max FREQ_OVERSHOOT	1400
Informative: Symbol Rate [GHz]	NONE	Symbol Rate	19.94935 Drift [PPM]	-2532.28

7.2. The .jpg file tx\_clock\_switch\_analysis\_gen3\_rounded\_tp2\_tx\_clk\_switch.jpg



8. cts\_test\_name – **tp3**

Notes:

- Save 5 waveforms with PRBS31 pattern using the scope configuration above.
- Save 1 waveform with PRBS15 pattern using the scope configuration above.
- The saved waveforms for each trial shall be in the same folder.  
1 trial – prbs15 and 5 trials – prbs31.
- The waveforms names shall be the same as in the screenshot below.

SigTest\_USB4\_CTS > Waveforms > TP3

Name

- tp3\_prbs15.bin
- tp3\_prbs31\_trial\_1.bin
- tp3\_prbs31\_trial\_2.bin
- tp3\_prbs31\_trial\_3.bin
- tp3\_prbs31\_trial\_4.bin
- tp3\_prbs31\_trial\_5.bin

Run the following command from the PowerShell window:






```
.\USB4_SigTest.exe gen2_rounded tx tp3 tp3
```

```
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3\ tp3.bin none eye_jitter none
```

```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : TX, TestPoint : TP3
The following tests are in progress ...
Total Jitter TP3 Measurement
UJ TP3 Measurement
UDJ TP3 Measurement
Eye Diagram TP3 Measurement
Loading File tp3_prbs31_trial_1.bin ...
Loading File tp3_prbs31_trial_2.bin ...
Loading File tp3_prbs31_trial_3.bin ...
Loading File tp3_prbs31_trial_4.bin ...
Loading File tp3_prbs31_trial_5.bin ...
Loading File tp3_prbs31_trial_2.bin ...
Writing eye_diagram_gen2_rounded_tp3_eye_jitter.jpg
Loading File tp3_prbs15.bin ...
Writing tj_bathtub_gen2_rounded_tp3_eye_jitter.jpg
Writing histogram_pj_rj_ddj_gen2_rounded_tp3_eye_jitter.jpg
Writing result to .\eye_jitter_result_25-Oct-2020.csv
The tests are completed
```

Report files location:

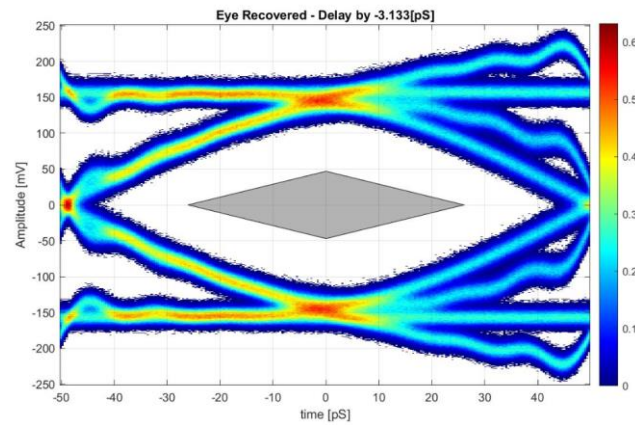
SigTest\_USB4\_CTS

Name
 eye_jitter_result_21-Oct-2020.csv
 histogram_pj_rj_ddj_gen2_rounded_tp3_eye_jitter.jpg
 tj_bathtub_gen2_rounded_tp3_eye_jitter.jpg
 eye_diagram_gen2_rounded_tp3_eye_jitter.jpg
 USB4_SigTest.exe

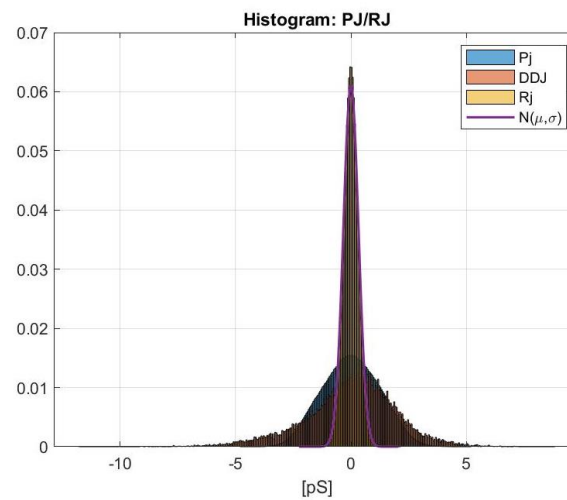
8.1. The .CSV file eye\_jitter\_result\_21-Oct-2020.csv

Electrical Compliance Test Specification for gen2_rounded															
Date:	21-Oct-20														
Dir: C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3\															
File: tp3.bin															
Total Jitter (BER=1e-13) Measurement Up-p:	PASS	TJ	0.299601 CTS: Max TJ		0.6										
UI Measurement Up-p:	PASS	UI Jitter Up-p	0.093693 CTS: Max UI		0.31										
UI Measurement Up-p:	PASS	UI Jitter Up-p	0.094974 CTS: Max UI		0.17										
Eye Diagram Measurements:	PASS	Eye Count of Violation	0 EyeWidth [ps]		81.841387 EyeHeight[mV]		207.027864								
Informative: Symbol Rate [Ghz]	NONE	Symbol Rate	9.975465 Drift [PPM]		-2453.53										
CTLE-Adc [dB]	0	DfE [mV]	Eye Height [mV]	Eye Width [ps]	Eye Height [mV]	Eye Width [ps]	Eye Height [mV]	Eye Width [ps]	Eye Height [mV]	Eye Width [ps]	Eye Height [mV]	Eye Width [ps]	Eye Height [mV]	Eye Width [ps]	Area[mV*ps]
1	0	50	1.409	0.785	0.285	1.175	0.318	1.175	1.457	0.783	0.315	0.783	0.76	0.94	0.64
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	8504.51
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	11990.66
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	15533.05
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	16943.65
0.562	5	27.8	196.69	80.275	195.141	82.233	197.331	83.016	199.43	82.625	194.596	81.45	196.64	81.92	16109.95
0.501	6	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	14233.46
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	12215.35
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	10476.95
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	8815.04
Optimal CTLE: 4															

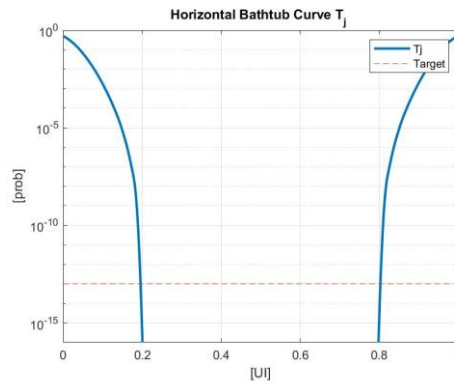
8.2. The .jpg file eye\_diagram\_gen2\_rounded\_tp3\_eye\_jitters.jpg



8.3. The .jpg file histogram\_pj\_rj\_ddj\_gen2\_rounded\_tp3\_eye\_jitters.jpg



8.4. The .jpg file tj\_bathtub\_gen2\_rounded\_tp3\_eye\_jitters.jpg



## Router Assembly Receiver stressed eye calibration.

### Note

- a) The receiver stressed eye calibration procedure shall be the same as described in the USB4 Electrical - Router Assembly Compliance Test Specification paragraph 4.
- b) The SigTest post processed results shall replace the scope application calculations.

### TP3'(Case1):

1. cts\_test\_name – **jitter**

The test below shall be used for the following calibrations:





- a) 4.2.1.1 Data Dependent Jitter - DDJ calibration
- b) 4.2.1.3 Random Jitter - RJ calibration
- c) 4.2.1.4 Periodic Jitter - PJ calibration
- d) 4.2.1.5 Total Jitter - TJ calibration

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded rx tp3_prime jitter
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\
TP3_Prime_Gen2_Rounded_prbs15.bin none jitters none
```

```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : RX, TestPoint : TP3_PRIME
The following tests are in progress ...
Data Dependent Jitter - DDJ Calibration
Random Jitter - RJ Calibration
Periodic Jitter - PJ Calibration
Total Jitter - TJ Calibration
Loading File TP3_Prime_Gen2_Rounded_prbs15.bin ....
Writing tj_bathtub_gen2_rounded_tp3_prime_jitters.jpg
Writing histogram_pj_rj_ddj_gen2_rounded_tp3_prime_jitters.jpg
Writing result to .\jitters_result_21-Oct-2020.csv
The tests are completed
```

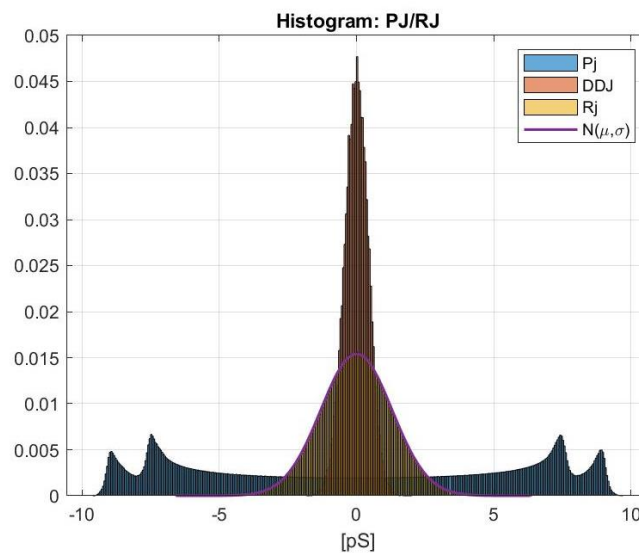
Report files location:

SigTest_USB4_CTS	
<input type="checkbox"/>	Name
	jitters_result_21-Oct-2020.csv
	histogram_pj_rj_ddj_gen2_rounded_tp3_prime_jitters.jpg
	tj_bathtub_gen2_rounded_tp3_prime_jitters.jpg
	USB4_SigTest.exe

1.1. The csv. File jitters\_result\_21-Oct-2020.csv

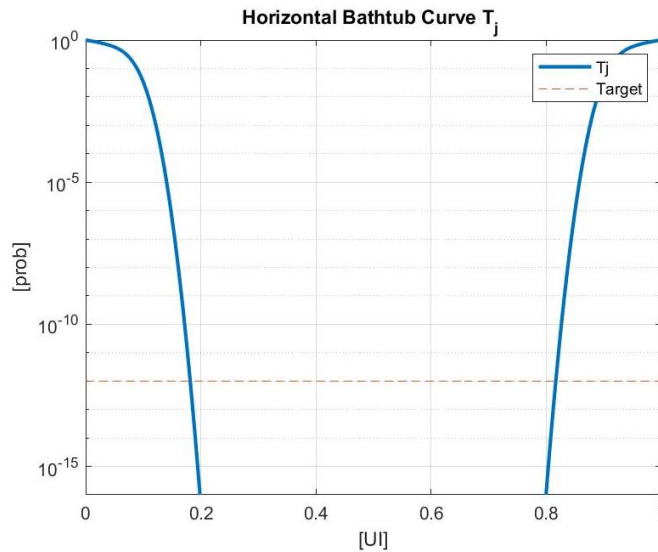
Electrical Compliance Test Specification for gen2_rounded					
Date:	21-Oct-20				
DIR:	C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\				
File:	TP3_Prime_Gen2_Rounded.bin				
Total Jitter (BER=1e-12) Measurement Ulp-p:	Tj	0.363443			
PJ Jitter Measurement mUI:	PJ-rms	58.981258			
RJ Jitter Measurement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

1.2. The .jpg file histogram\_pj\_rj\_ddj\_gen2\_rounded\_tp3\_prime\_jitters.jpg



1.3. The .jpg file tj\_bathtub\_gen2\_rounded\_tp3\_prime\_jitters.jpg





## 2. cts\_test\_name – **ac\_common\_mode**

The test below shall be used for the following calibration:

### a) 4.2.1.2 AC Common Mode Measurements

Run the following command from the PowerShell window:


```
.\USB4_SigTest.exe gen2_rounded rx tp3_prime ac_common_mode
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\
TP3_Prime_Gen2_Rounded_prbs31_common.bin none ac_common_mode none
```


```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : RX, TestPoint : TP3_PRIME
The following tests are in progress ...
AC Common Mode - Calibration
Loading File TP3_Prime_Gen2_Rounded_prbs31_common.bin ....
Writing result to .\ac_common_mode_result_21-Oct-2020.csv
The tests are completed
```

Report files location:

SigTest\_USB4\_CTS

☐ Name

 ac\_common\_mode\_result\_21-Oct-2020.csv

 USB4\_SigTest.exe

2.1. The .csv file ac\_common\_mode\_result\_21-Oct-2020.csv

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_common.bin		
AC CM Measurement:	AC CM: Vac [mVp2p]	81.2

### 3. cts\_test\_name – **ui\_ssc\_eye**

The test above shall be used for the following calibration:

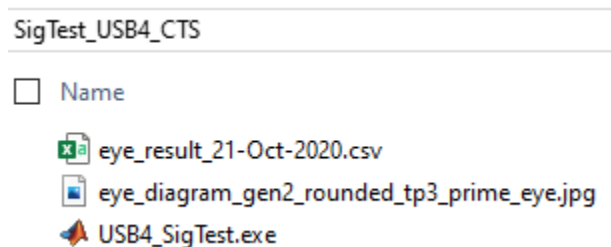
#### a) 4.2.1.6 Input Eye Diagram

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded rx tp3_prime ui_ssc_eye
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_Prime\
TP3_Prime_Gen2_Rounded_prbs31.bin none eye none
```

```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : RX, TestPoint : TP3_PRIME
The following tests are in progress ...
Input Eye Diagram - Calibration
Loading File TP3_Prime_Gen2_Rounded_prbs31.bin ....
Writing eye_diagram_gen2_rounded_tp3_prime_eye.jpg
Writing result to .\eye_result_21-Oct-2020.csv
The tests are completed
```

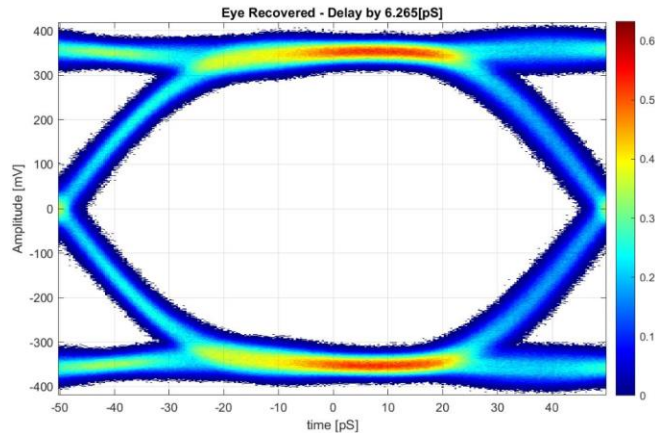
Report files location:



#### 3.1. The .csv file eye\_result\_21-Oct-2020.csv

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

#### 3.2. The .jpg file eye\_diagram\_gen2\_rounded\_tp3\_prime\_eye.jpg



#### 4. cts\_test\_name – **frequency\_variation\_training**

there is a need to calibrate the RX SSC profile to meet CTS requirement.

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded rx tp3_prime frequency_variation_training
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_prime\ rx_frequency_variation_training.bin
none rx_clk_switch_cal none
```

```
***** SIGTEST Version: 0.6 *****
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : RX, TestPoint : TP3_PRIME
The following tests are in progress ...
TX Frequency Variation Training Measurement
Loading File rx_frequency_variation_training.bin ...
Writing rx_clock_switch_analysis_gen2_rounded_tp3_prime_rx_clk_switch_cal.jpg
Writing result to .\rx_clk_switch_cal_result_21-Jul-2021.csv
The tests are completed
```

Report files location:

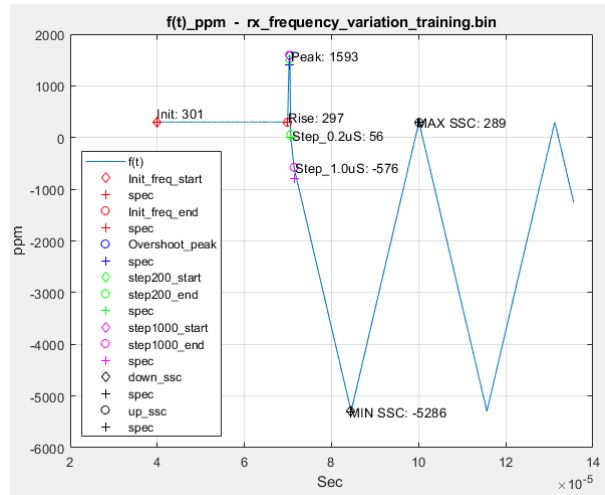
Name	Date modified	Type	Size
rx_clk_switch_cal_result_21-Jul-2021.csv	7/21/2021 3:40 PM	Microsoft Excel C...	2 KB
rx_clock_switch_analysis_gen2_rounded_tp3_prime_rx_clk_switch_cal.jpg	7/21/2021 3:40 PM	JPG File	75 KB

##### 4.1. The .csv file rx\_clk\_switch\_cal\_result\_21-Jul-2021.csv

Electrical Compliance Test Specification for gen2_rounded						
Date:21-Jul-2021						
DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3_prime\						
File: rx_frequency_variation_training.bin						
RX Frequency Variation Training Measurement:						
INIT_FREQ_VARIATION:	PASS	RX_INIT_FREQ_VARIATION result:	298.659135	CTS: Min RX_INIT_FREQ_VARIATION	-300	CTS: Target INIT_FREQ_VARIATION 300
DELTA_FREQ_200nS:	PASS	RX_DELTA_FREQ_200nS result:	-1389.83096	CTS: Abs target RX_DELTA_FREQ_200	1400	
DELTA_FREQ_1000nS:	PASS	RX_DELTA_FREQ_1000nS result:	-2189.70318	CTS: Abs target RX_DELTA_FREQ_1000	2200	
FREQ_OVERSHOOT:	PASS	RX_FREQ_OVERSHOOT result:	1593.431124	CTS: Target RX_FREQ_OVERSHOOT	1600	
Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	9.981822	Drift [PPM]	-1817.76	

##### 4.2. The .jpg file

rx\_clock\_switch\_analysis\_gen2\_rounded\_tp3\_prime\_rx\_clk\_switch\_cal.jpg



Note – there is a need to calibrate RX SSC profile for RX frequency variation training test over TP3, the usage is the same except the test point

.\USB4\_SigTest.exe gen3\_legacy rx **tp3** frequency\_variation\_training  
 C:\Desktop\SigTest\_USB4\_CTS\Waveforms\TP3\ rx\_frequency\_variation\_training.bin none  
 rx\_clk\_switch\_cal\_tp3 none

All same but over results the overshoot limit is 1400ppm

	A	B	C	D	E	F	G	H
1	Electrical Compliance Test Specification for gen3_legacy							
2	Date:21-Jul-2021							
3	DIR:C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3\							
4	File: rx_frequency_variation_training.bin							
5	RX Frequency Variation Training Measurement:							
6	INIT_FREQ_VARIATION:	PASS	RX_INIT_FREQ_VARIATION result:	299.818	CTS: Min RX_INIT_FREQ_VARIATION	-300	CTS: Target INIT_FREQ_VARIATION	300
7	DELTA_FREQ_200nS:	PASS	RX_DELTA_FREQ_200nS result:	-1386.11	CTS: Abs target RX_DELTA_FREQ_200nS	1400		
8	DELTA_FREQ_1000nS:	PASS	RX_DELTA_FREQ_1000nS result:	-2184.71	CTS: Abs target RX_DELTA_FREQ_1000nS	2200		
9	FREQ_OVERSHOOT:	PASS	RX_FREQ_OVERSHOOT result:	1389.743	CTS: Target RX_FREQ_OVERSHOOT	1400		
10	Informative: Symbol Rate [GHz]:	NONE	Symbol Rate	20.58823	Drift [PPM]	-1782.83		
11								
12								

## 5. cts\_test\_name – tp3

The test below shall be used for the following calibration:

### a) 4.2.2.1 Input Eye Diagram

Notes:

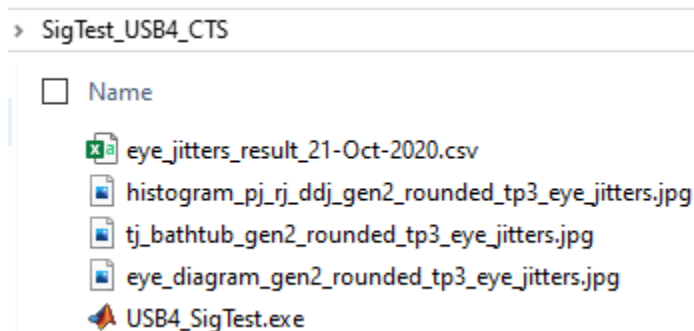
- Save 5 waveforms with PRBS31 pattern using the scope configuration above.
- Save 1 waveform with PRBS15 pattern using the scope configuration above.
- The saved waveforms for each trial shall be in the same folder.  
1 trial – prbs15 and 5 trials – prbs31.
- The waveforms names shall be the same as in the screenshot below.

Run the following command from the PowerShell window:

```
.\USB4_SigTest.exe gen2_rounded rx tp3 tp3  
C:\Desktop\SigTest_USB4_CTS\Waveforms\TP3\Rx\ tp3.bin none eye_jitters none
```

```
Running SIGTEST : Technology : GEN2_ROUNDED, TestMode : RX, TestPoint : TP3  
The following tests are in progress ...  
Receiver TP3 Input Eye Diagram Calibration  
Loading File tp3_prbs31_trial_1.bin ...  
Loading File tp3_prbs31_trial_2.bin ...  
Loading File tp3_prbs31_trial_3.bin ...  
Loading File tp3_prbs31_trial_4.bin ...  
Loading File tp3_prbs31_trial_5.bin ...  
Loading File tp3_prbs31_trial_2.bin ...  
Writing eye_diagram_gen2_rounded_tp3_eye_jitters.jpg  
Loading File tp3_prbs15.bin ...  
Writing tj_bathtub_gen2_rounded_tp3_eye_jitters.jpg  
Writing histogram_pj_rj_ddj_gen2_rounded_tp3_eye_jitters.jpg  
Writing result to .\eye_jitters_result_25-Oct-2020.csv  
The tests are completed
```

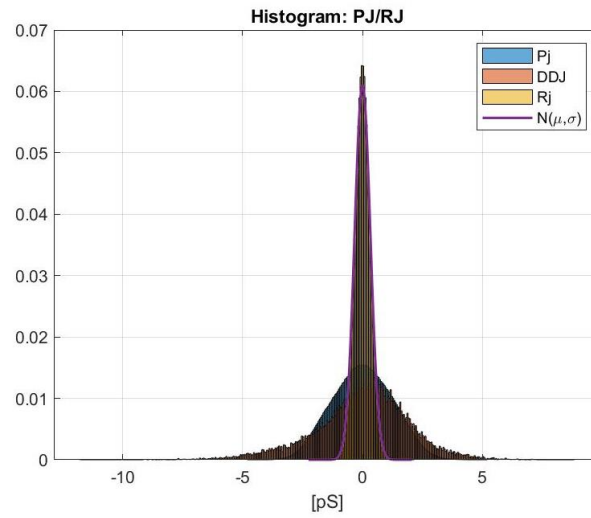
Report files location:



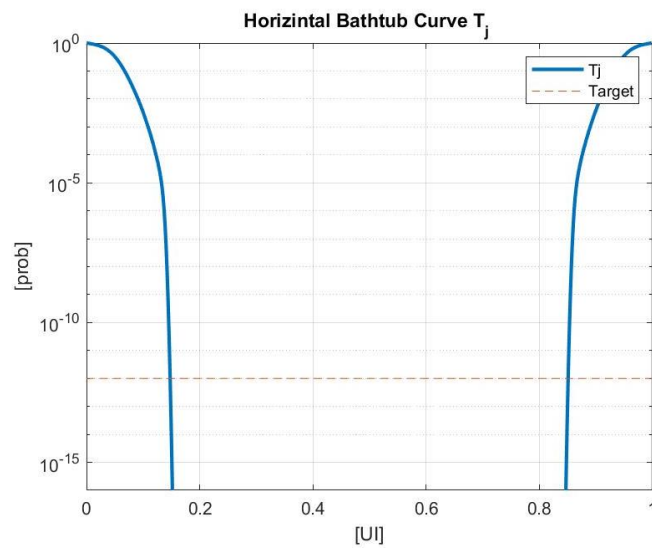
### 5.1. The .csv file eye\_jitters\_result\_21-Oct-2020.csv

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-OC Gain[dB]	DfE[mV]	Eye Height[mV]	Eye Width[ps]	Eye Height[mV]	Eye Width[ps]	Eye Height[mV]	Eye Width[ps]	Eye Height[mV]	Eye Width[ps]	Eye Height[mV]	Eye Width[ps]	Avg. Height[mV]	Avg. Width[ps]	Area[mV*ps]	
	1	0	50	1.409	0.783	0.285	1.175	0.318	1.175	1.457	0.783	0.313	0.76	0.94	0.64	
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	8504.51	
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	11990.66	
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	15533.05	
0.631	4	32	208.352	82.233	205.568	80.667	206.991	81.058	208.658	82.233	205.37	83.016	207.03	81.841	16943.65	
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	16108.95	
0.501	6	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	14233.46	
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	12215.35	
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	10476.95	
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	8813.04	
Optimal CTLE: 4																

### 5.2. The .jpg file histogram\_pj\_rj\_ddj\_gen2\_rounded\_tp3\_eye\_jitters.jpg



5.3. The .jpg file `tj_bathtub_gen2_rounded_tp3_eye_jitters.jpg`



5.4. The .jpg file `eye_diagram_gen2_rounded_tp3_eye_jitters.jpg`

