AMD ZCU102 with Renesas ClockMatrix, ITU-T G.8273.4 APTS

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1.1 Notes on Single Path Operation

When operating in single path mode, only the Sync packets from the master are used for timing. This results in an unknown floor delay. In PTS mode a floor delay is manually entered by the user in the PCM4L Json file:

```
"floorDelayEstimateSeconds": 0.000008800,
```

The test description contains the floor delay estimate used in each case. The floor delay estimate changes depending on the PDV pattern being tested as well as the inherent delay in the measurement device.

PDV noise cases "With BC's Normal Stability" and "With BC's High Stability" were omitted as they are not applicable to the Single Path use case.

2. Test Configuration

Table 1. Test Configuration

Device Under Test	AMD + CM
Oscillator	Rakon M6141 MiniOcxo
1pps Source	Symmetricom TP5000
Instrument	Paragon Neo
Instrument Serial Number	00036081
Ethernet Interface	Optical

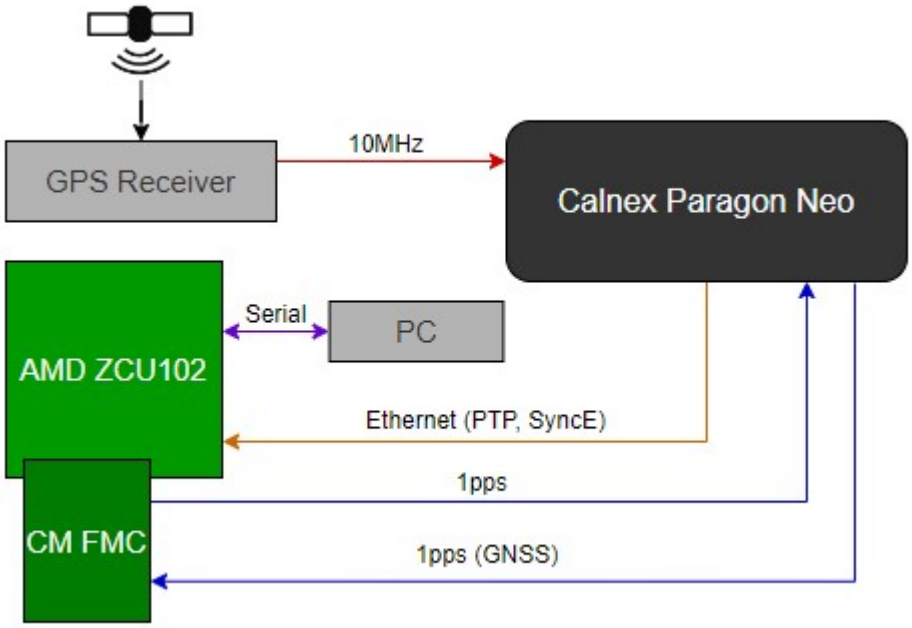


Figure 1. Equipment Configuration

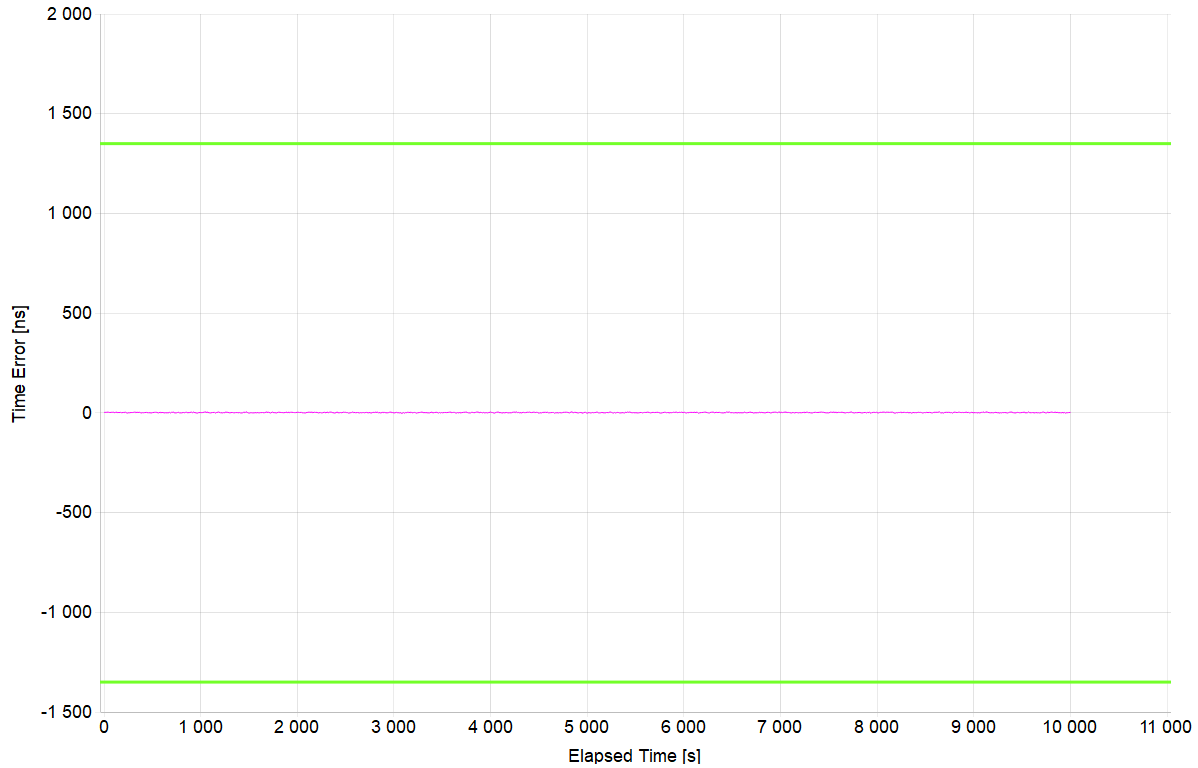
3. G.8273.4 APTS: Noise Generation (with PTP)

Test Description	Noise Generation
Report Date	22-10-18_08-30-41
Packet Rate (pkt/s)	16
Test Duration	02:46:40
Time to Phase Lock (s)	6

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask CTE	0.02µs
Mask CTE Result	**Pass**
Mask DTE	0.2µs
Mask DTE Result	**Pass**
Mask DTEHF	-
Mask DTEHF Result	No Mask

4. ONEPPS Analysis

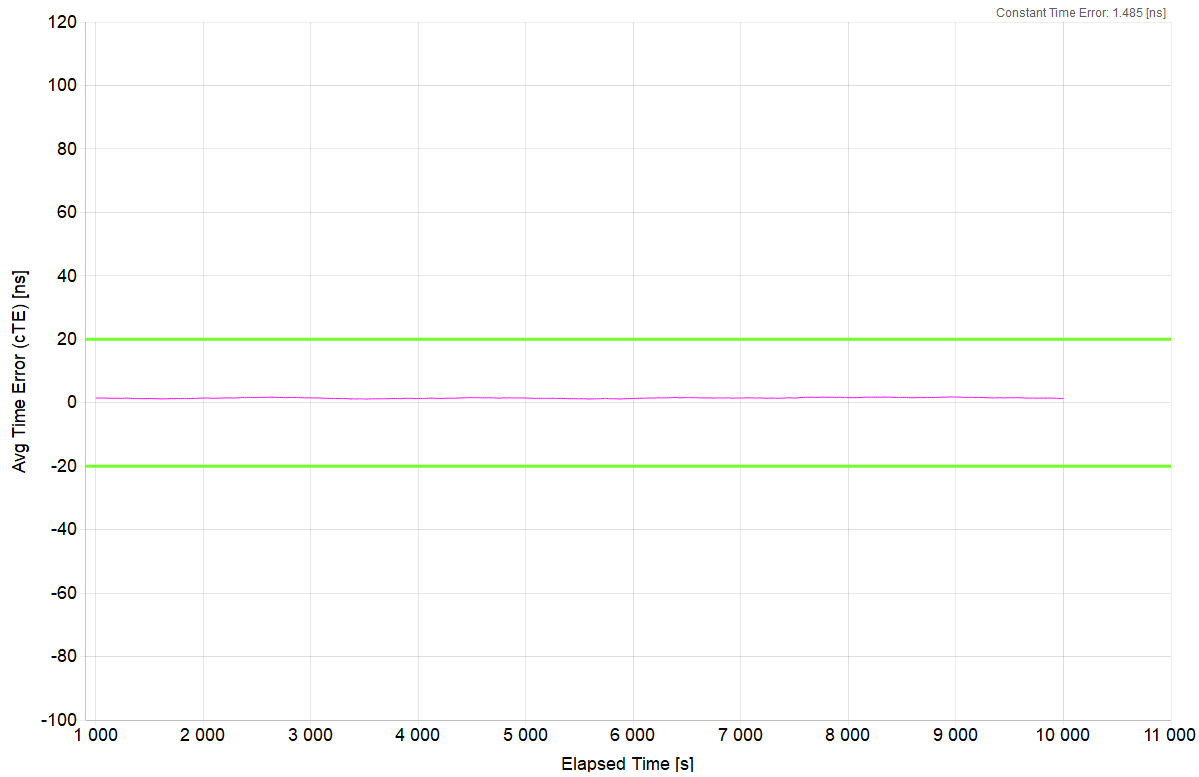
Offset Removal Applied	Off
Zero Offset	2.197ns



Mean [ns]	1.489
Min [ns]	-3.303
Max [ns]	6.197
Max-Min [ns]	9.5

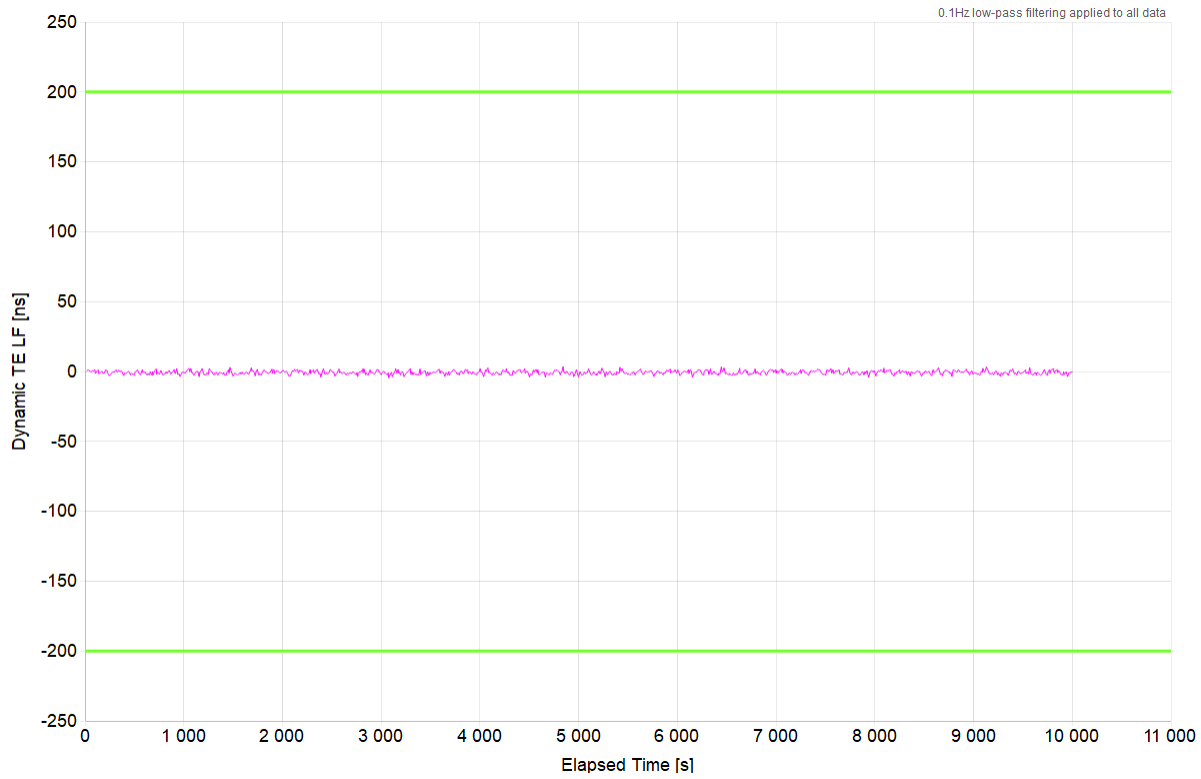
4.1 CTE Analysis

Averaging Time (s)	1000



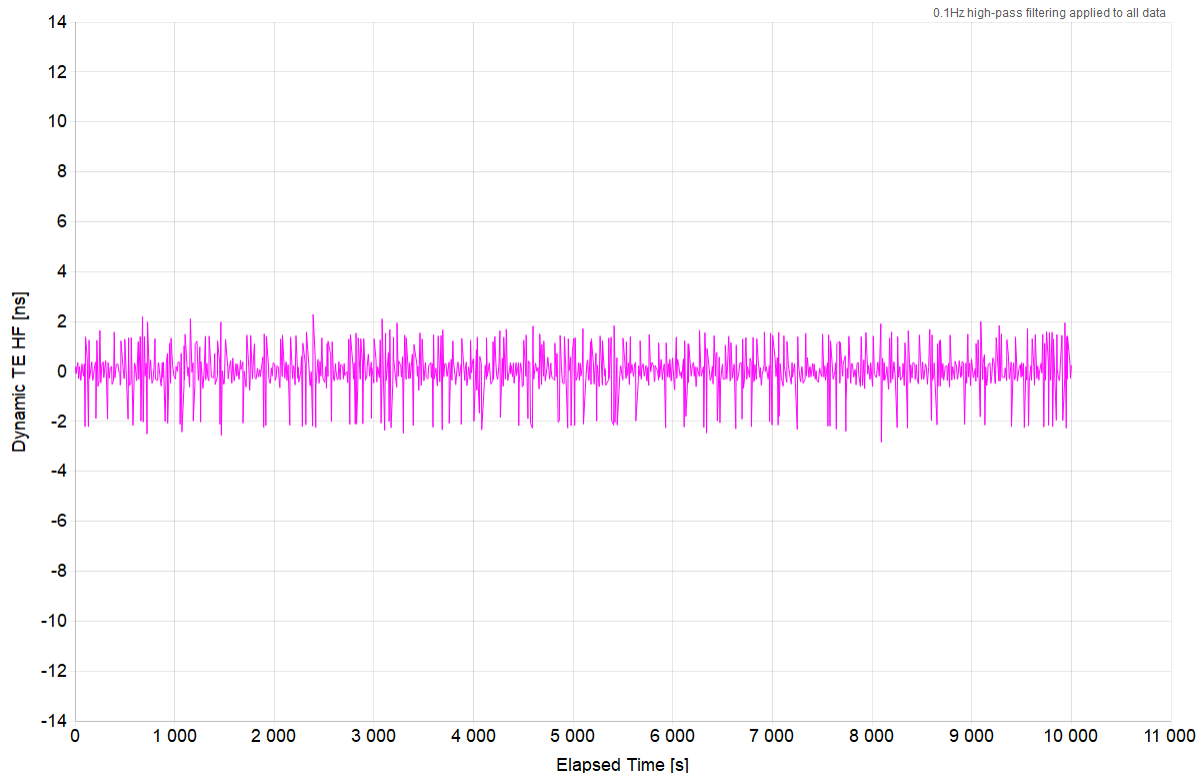
Constant Time Error [ns]	1.485
Min [ns]	1.157
Max [ns]	1.832
Max-Min [ns]	0.676

4.2 DTE Analysis



Mean [ns]	-0.709
Min [ns]	-4.708
Max [ns]	3.548
Max-Min [ns]	8.256

4.3 DTEHF Analysis



Mean [ns]	0
Min [ns]	-2.832
Max [ns]	2.285
Max-Min [ns]	5.118

5. G.8273.4 APTS: Holdover (with PTP)

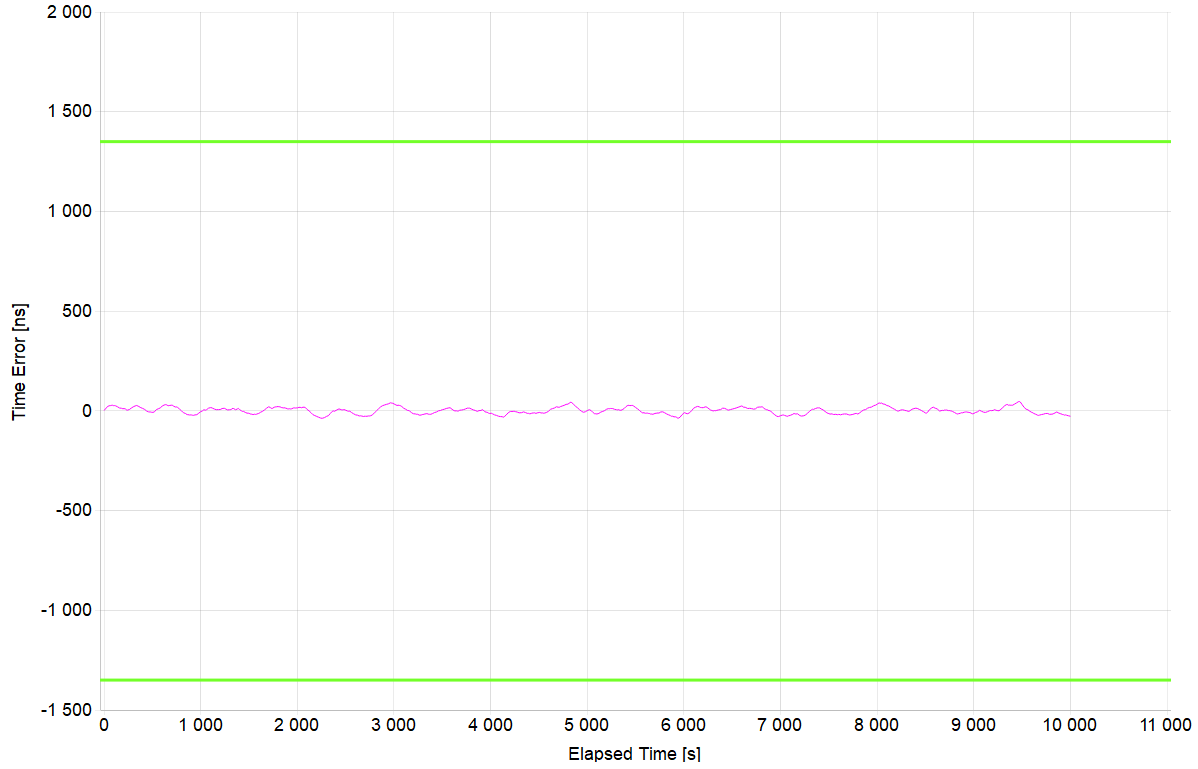
Test Description	Holdover
Report Date	22-10-18_08-30-41
Packet Rate (pkt/s)	16
Test Duration	02:46:40
Time to Phase Lock (s)	N/A

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask MTIE	G.8273.4 APTS Holdover (PTP) Const. Temp.
Mask MTIE Result	**Pass**

1. This test is a continuation of the previous Noise Generation test. This allows for an appropriate amount of settling time before collecting holdover data (10 000s). The results are split because holdover requires a different mask than noise generation.

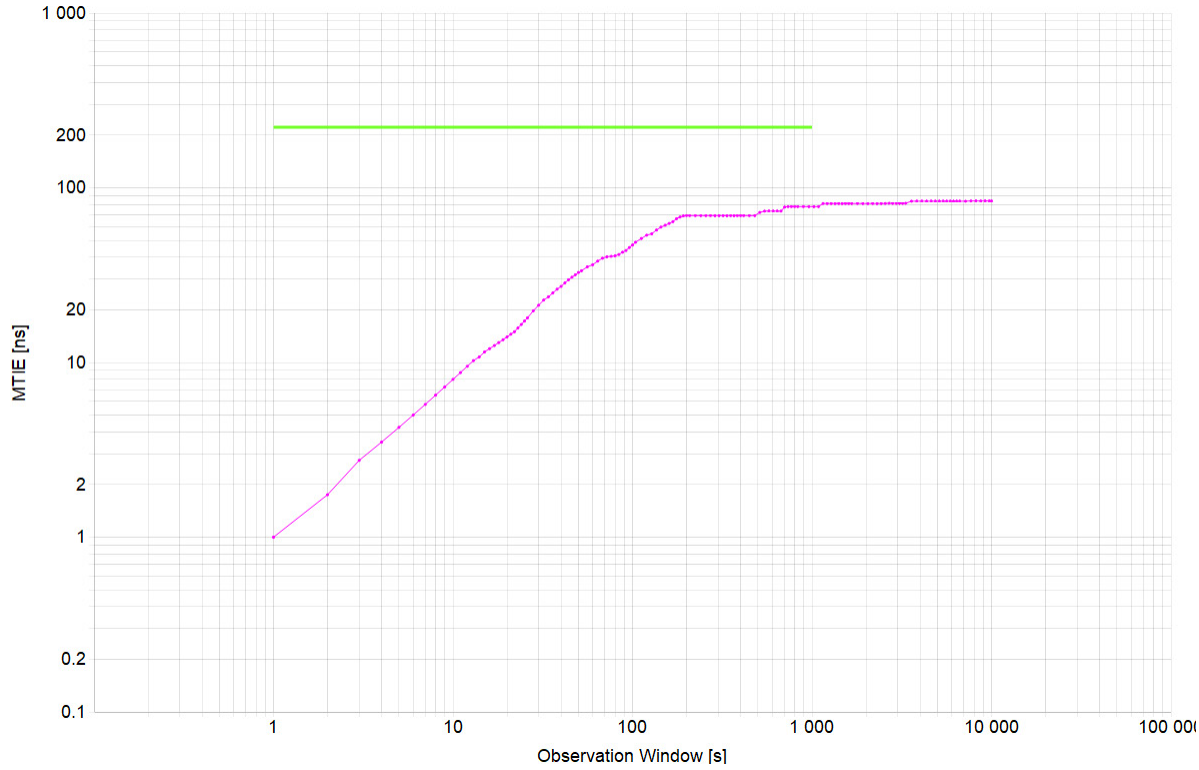
5.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	2.197ns



Mean [ns]	1.244
Min [ns]	-37.553
Max [ns]	46.447
Max-Min [ns]	84

5.2 MTIE Analysis



Min [ns]	1
Max [ns]	84
Max-Min [ns]	83

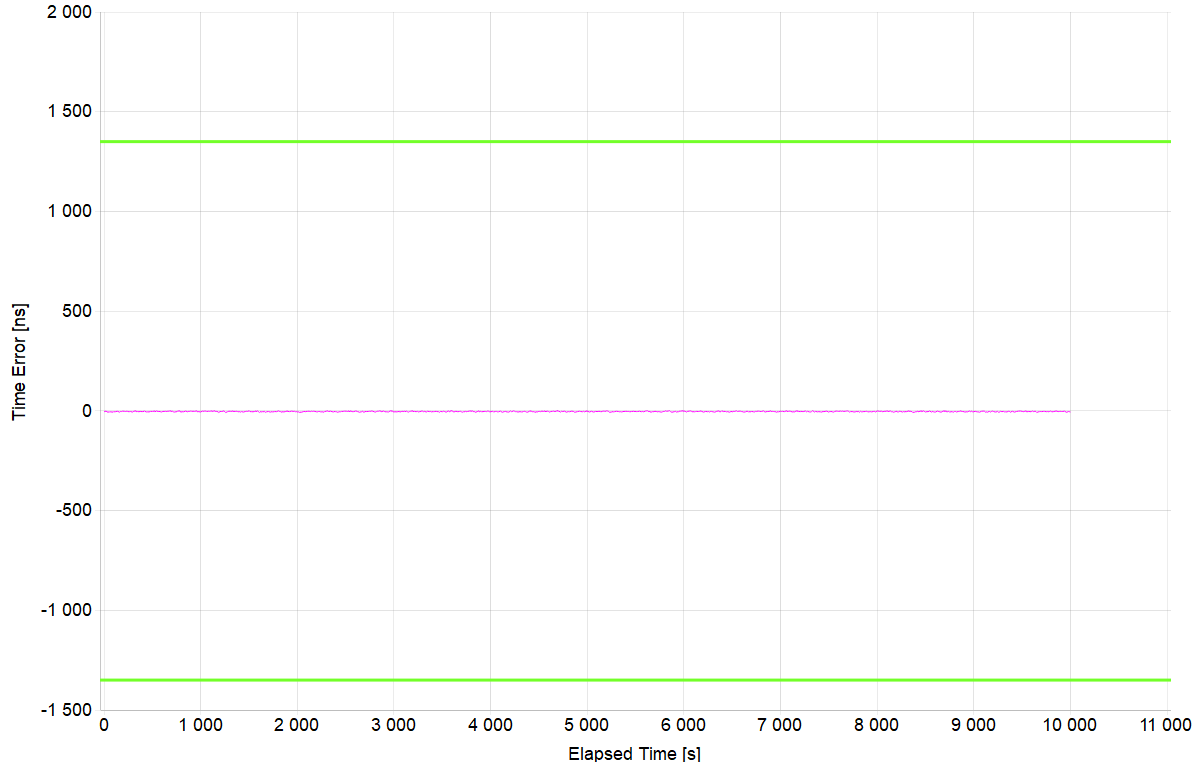
6. G.8273.4 APTS: Noise Generation (with Oscillator)

Test Description	Noise Generation
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	02:46:40
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask CTE	0.02µs
Mask CTE Result	**Pass**
Mask DTE	0.2µs
Mask DTE Result	**Pass**
Mask DTEHF	-
Mask DTEHF Result	No Mask

6.1 ONEPPS Analysis

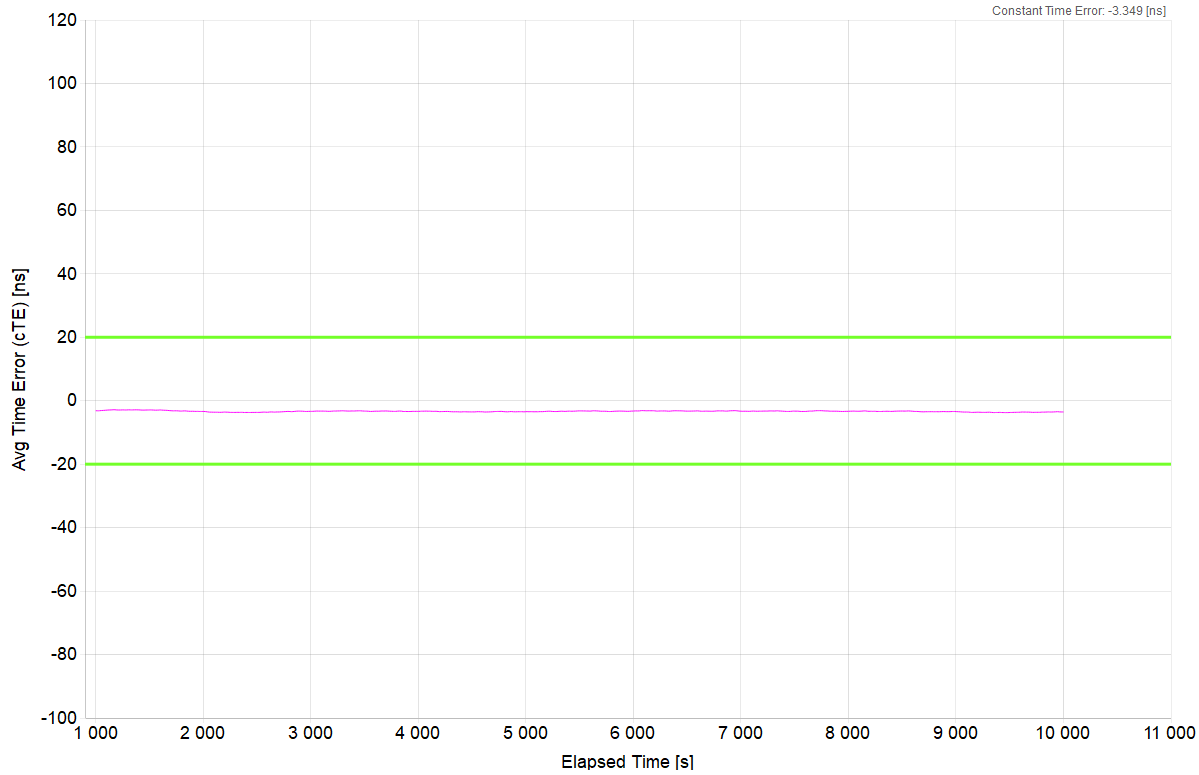
Offset Removal Applied	Off
Zero Offset	-4.703ns



Mean [ns]	-3.355
Min [ns]	-8.453
Max [ns]	1.797
Max-Min [ns]	10.25

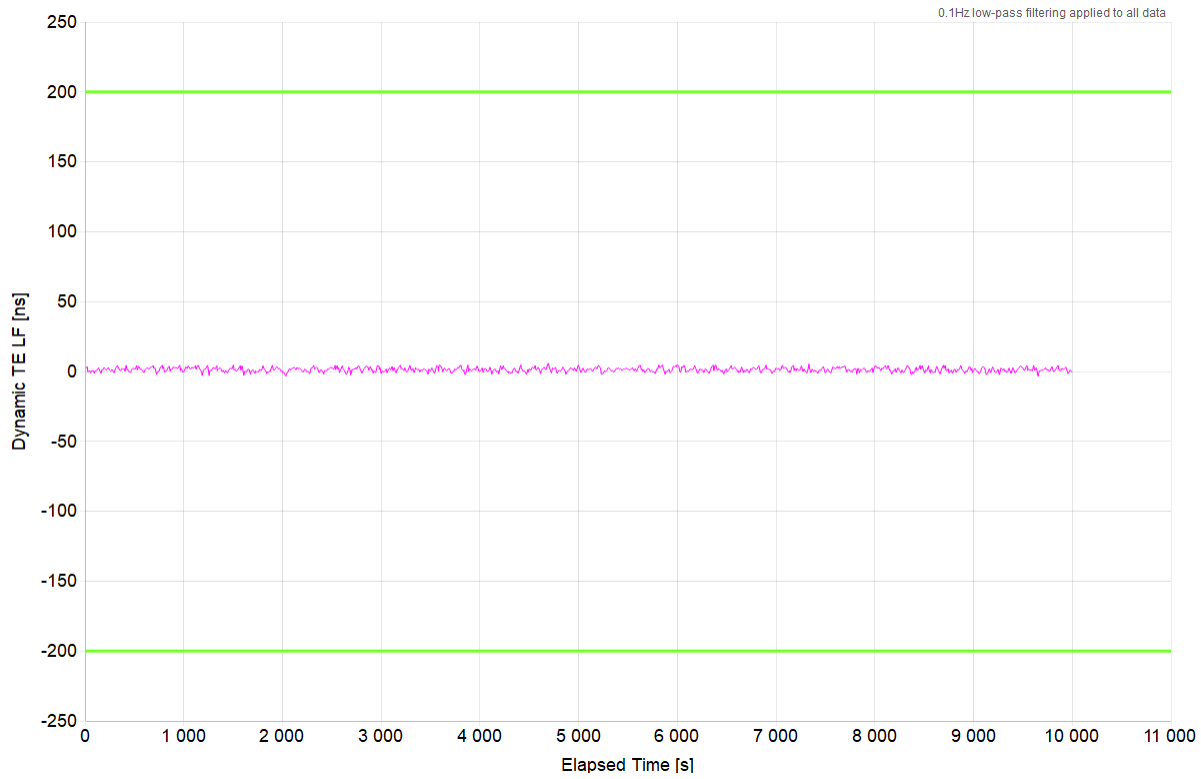
6.2 CTE Analysis

Averaging Time (s)	1000



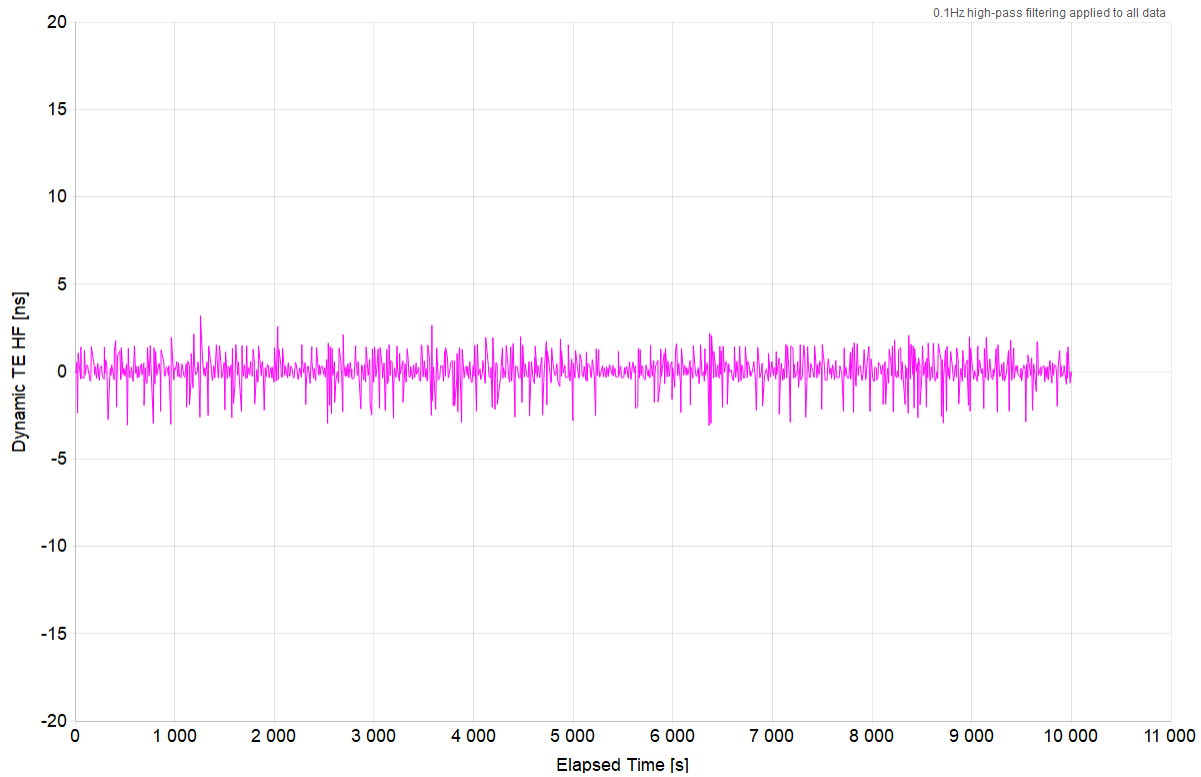
Constant Time Error [ns]	-3.349
Min [ns]	-3.746
Max [ns]	-2.843
Max-Min [ns]	0.903

6.3 DTE Analysis



Mean [ns]	1.348
Min [ns]	-3.507
Max [ns]	5.843
Max-Min [ns]	9.35

6.4 DTEHF Analysis



Mean [ns]	0
Min [ns]	-3.097
Max [ns]	3.191
Max-Min [ns]	6.289

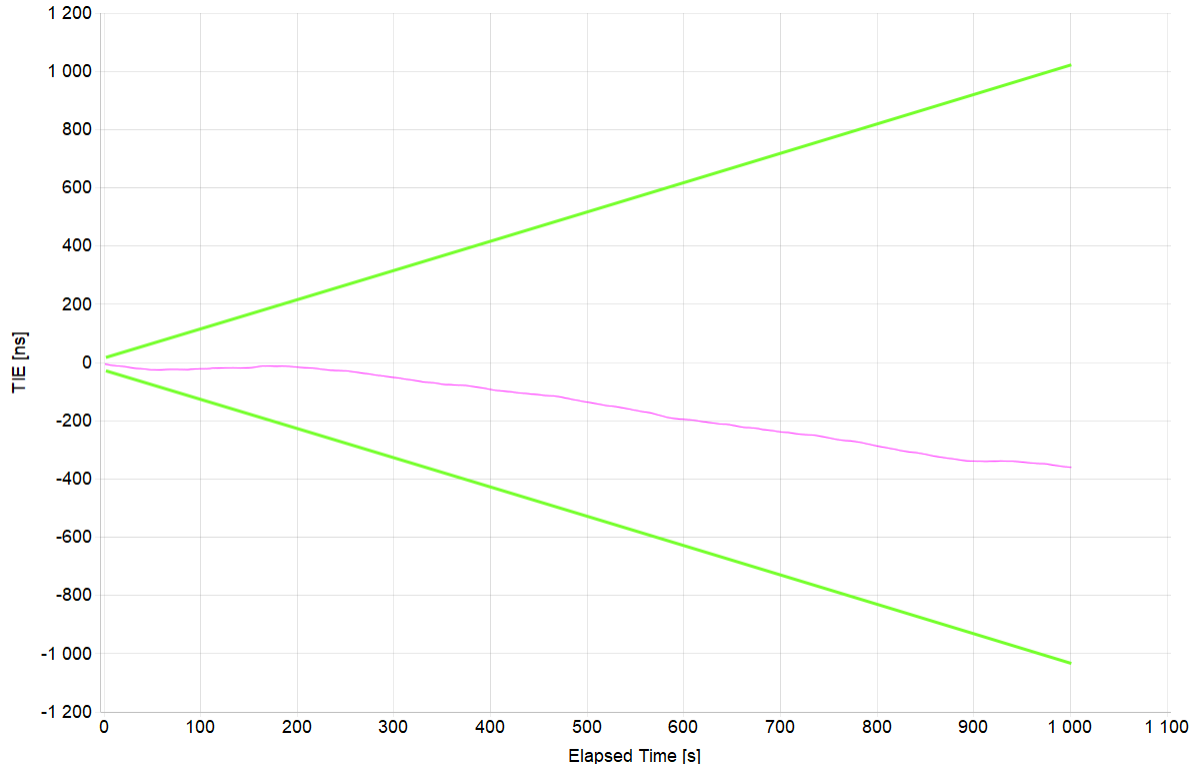
7. G.8273.4 APTS: Holdover (with Oscillator)

Test Description	Holdover (with Oscillator)
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	00:16:40
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask TIE	G.8273.4 APTS Holdover (Oscillator) Const. Temp.
Mask TIE Result	**Pass**

1. This test is a continuation of the previous Noise Generation test. This allows for an appropriate amount of settling time before collecting holdover data (10 000s). The results are split because holdover requires a different mask than noise generation. Both GNSS and PTP are disconnected connected during Holdover.

7.1 TIE Analysis



Mean [ns]	-155.812
Min [ns]	-359.953
Max [ns]	-5.703
Max-Min [ns]	354.25

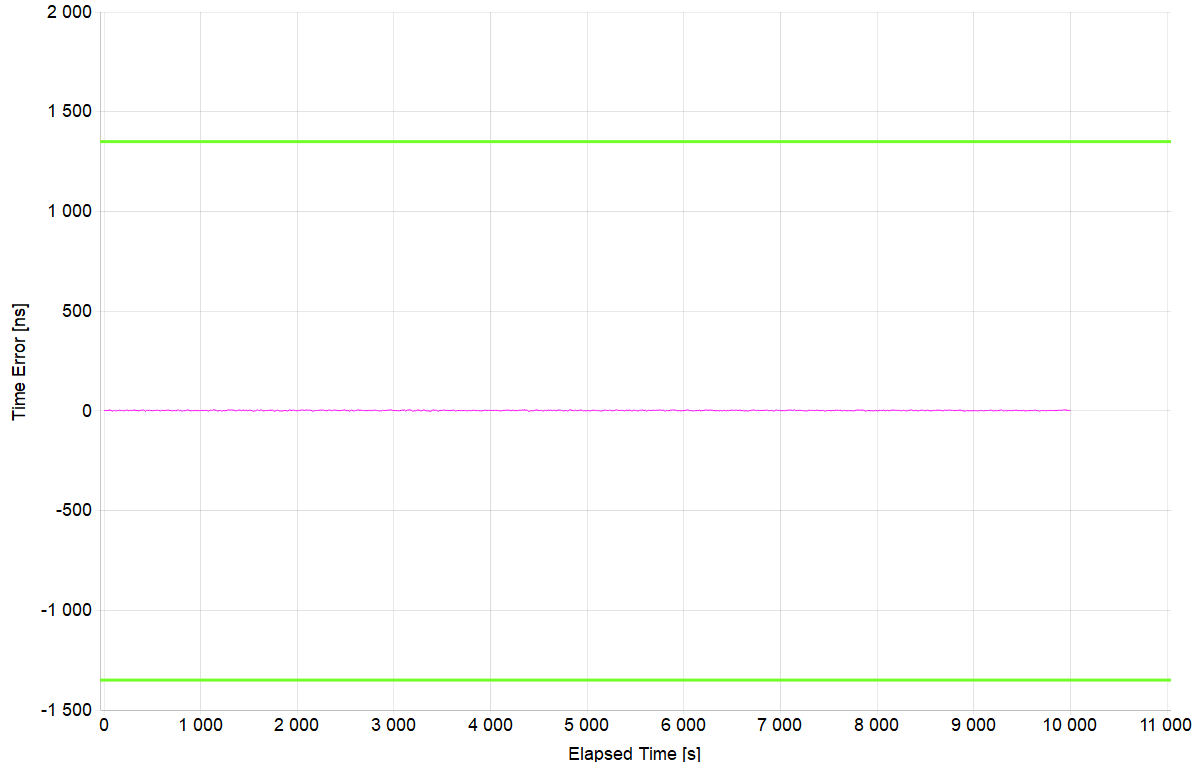
8. G.8273.4 APTS: Noise Generation – Single Path (with PTP)

Test Description	Noise Generation – Single Path
Report Date	22-10-18_08-30-41
Packet Rate (pkt/s)	16
Test Duration	02:46:40
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask CTE	0.02µs
Mask CTE Result	**Pass**
Mask DTE	0.2µs
Mask DTE Result	**Pass**
Mask DTEHF	-
Mask DTEHF Result	No Mask

8.1 ONEPPS Analysis

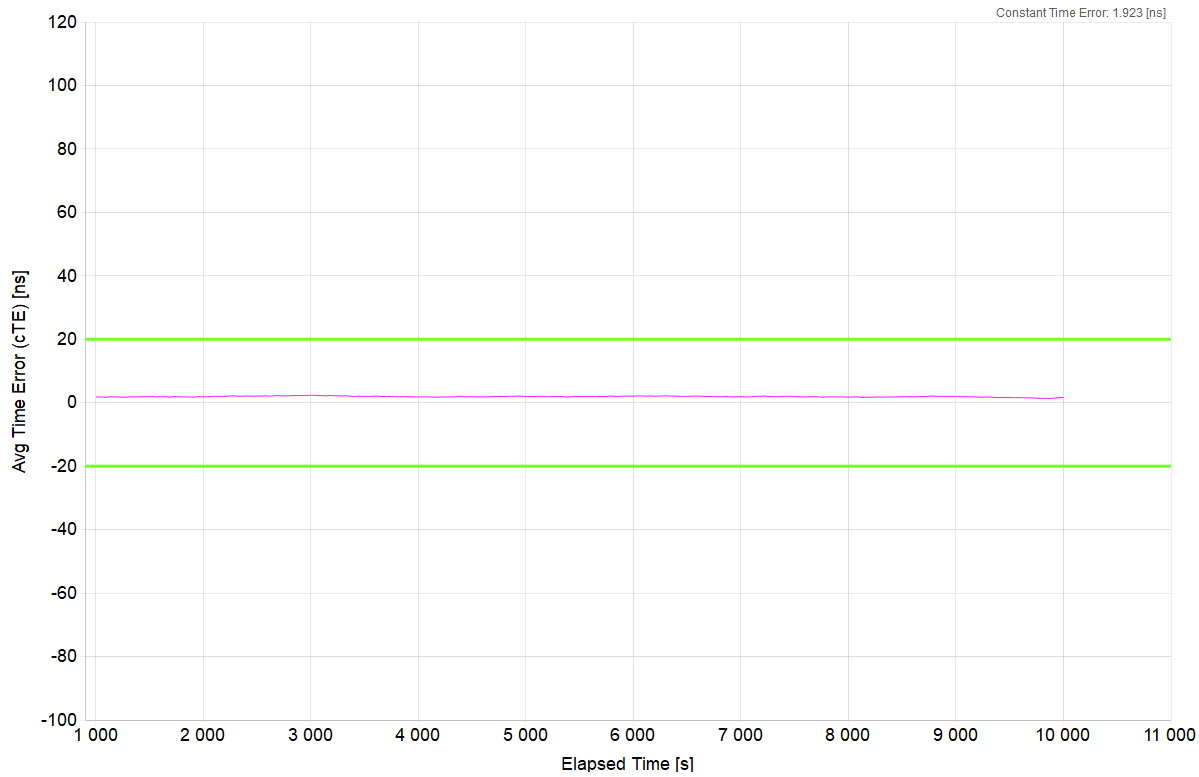
Offset Removal Applied	Off
Zero Offset	1.697ns



Mean [ns]	1.919
Min [ns]	-2.803
Max [ns]	5.697
Max-Min [ns]	8.5

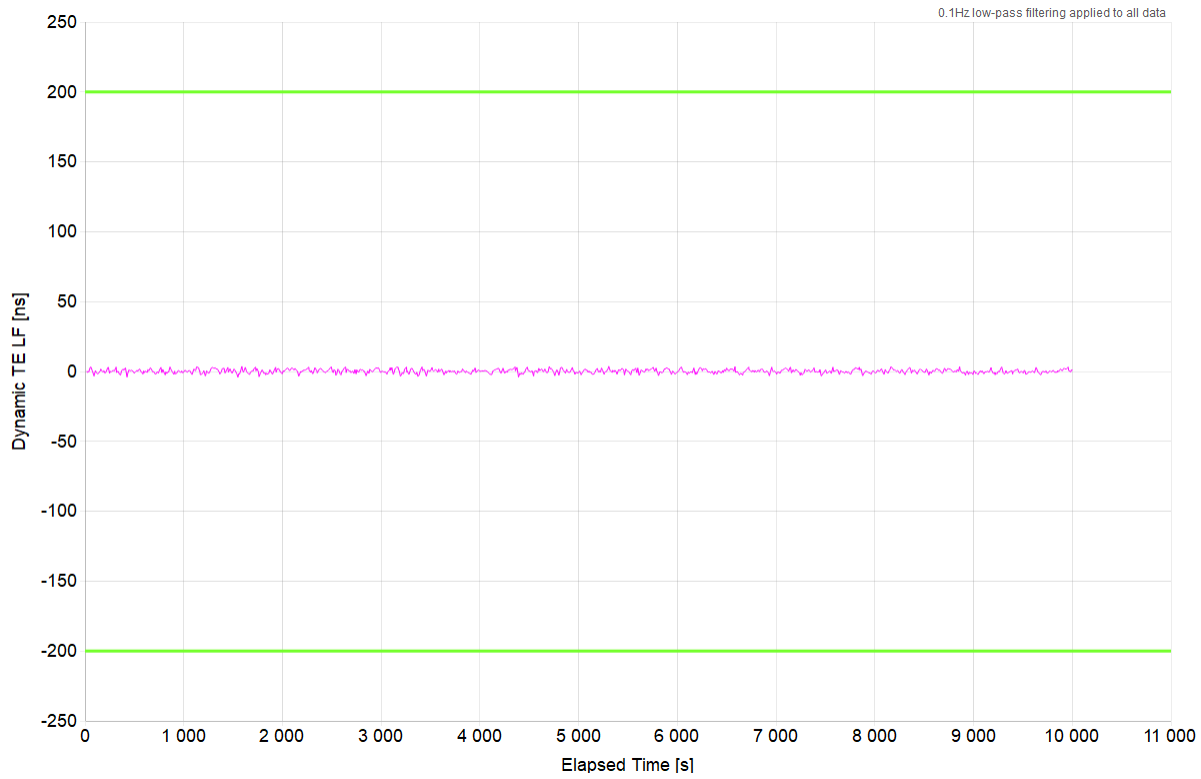
8.2 CTE Analysis

Averaging Time (s)	1000



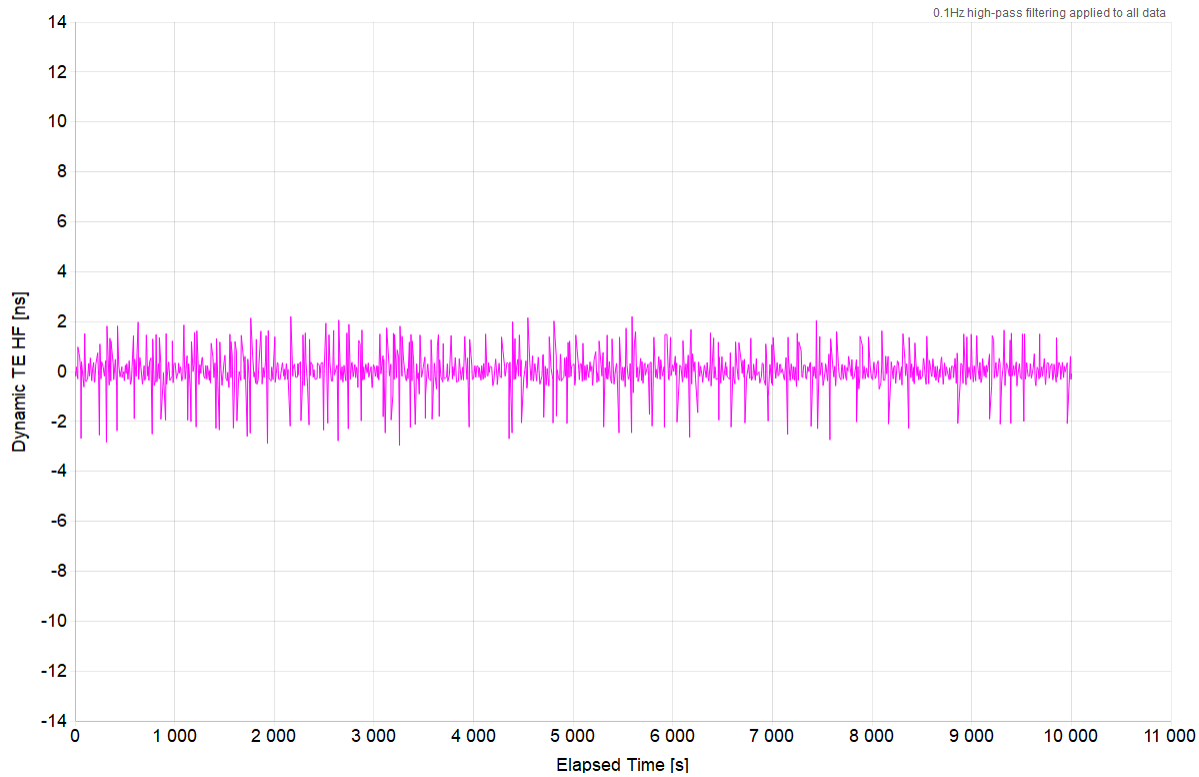
Constant Time Error [ns]	1.923
Min [ns]	1.347
Max [ns]	2.349
Max-Min [ns]	1.002

8.3 DTE Analysis



Mean [ns]	0.222
Min [ns]	-4.098
Max [ns]	3.674
Max-Min [ns]	7.771

8.4 DTEHF Analysis



Mean [ns]	0
Min [ns]	-2.969
Max [ns]	2.205
Max-Min [ns]	5.174

9. G.8273.4 APTS: Holdover – Single Path (with PTP)

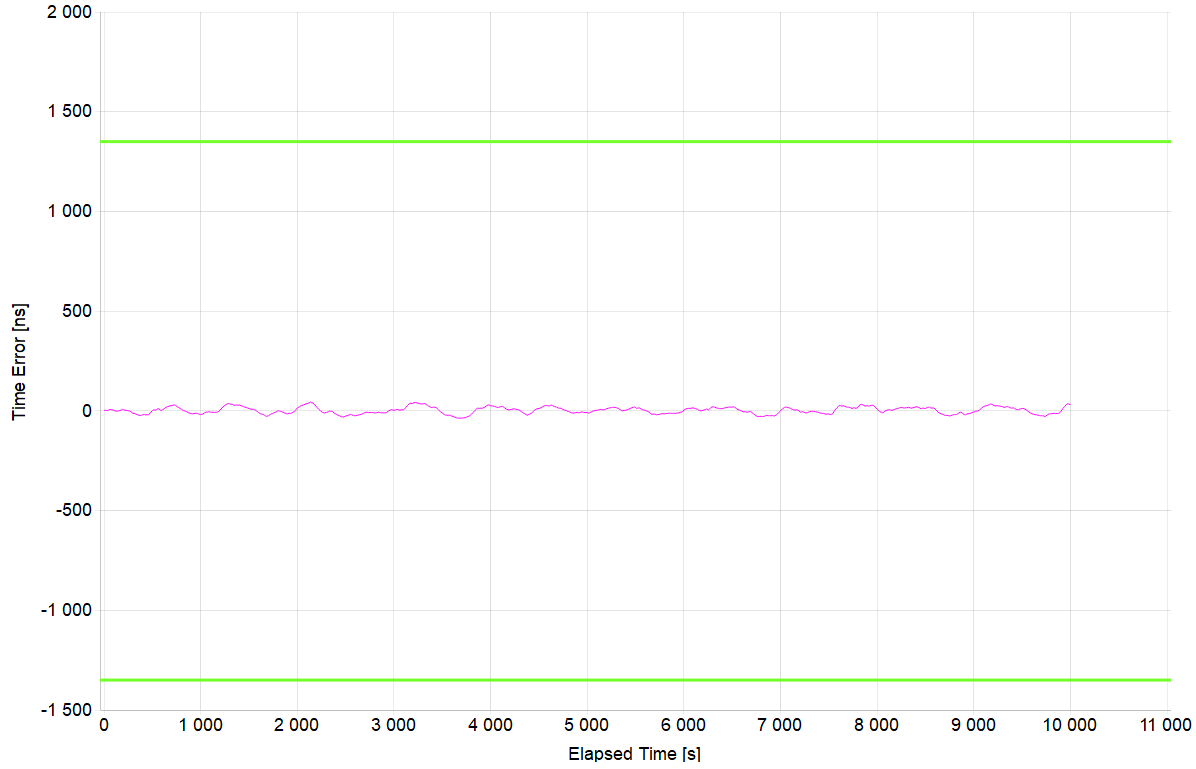
Test Description	Holdover – Single Path
Report Date	22-10-18_08-30-41
Packet Rate (pkt/s)	16
Test Duration	02:46:40
Time to Phase Lock (s)	N/A

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask MTIE	G.8273.4 APTS Holdover (PTP) Const. Temp.
Mask MTIE Result	**Pass**

1. This test is a continuation of the previous Noise Generation test. This allows for an appropriate amount of settling time before collecting holdover data (10 000s). The results are split because holdover requires a different mask than noise generation.

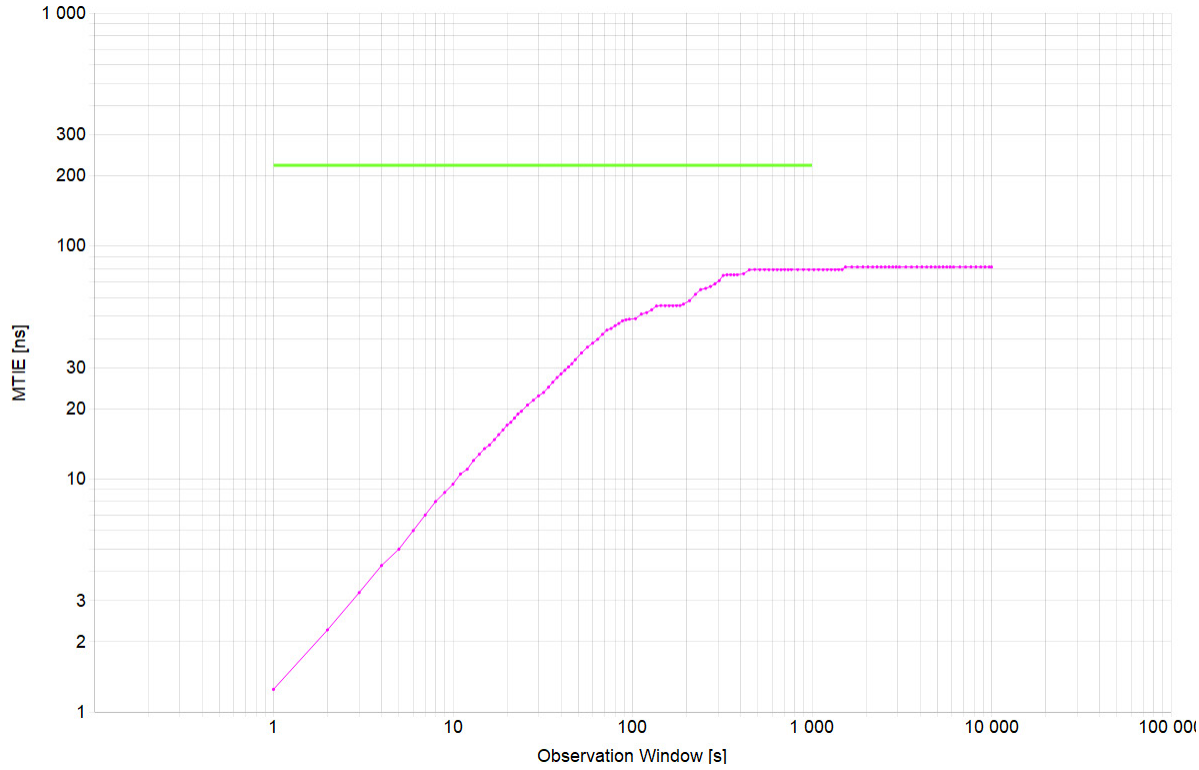
9.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	2.197ns



Mean [ns]	2.357
Min [ns]	-36.803
Max [ns]	44.447
Max-Min [ns]	81.25

9.2 MTIE Analysis



Min [ns]	1.25
Max [ns]	81.25
Max-Min [ns]	80

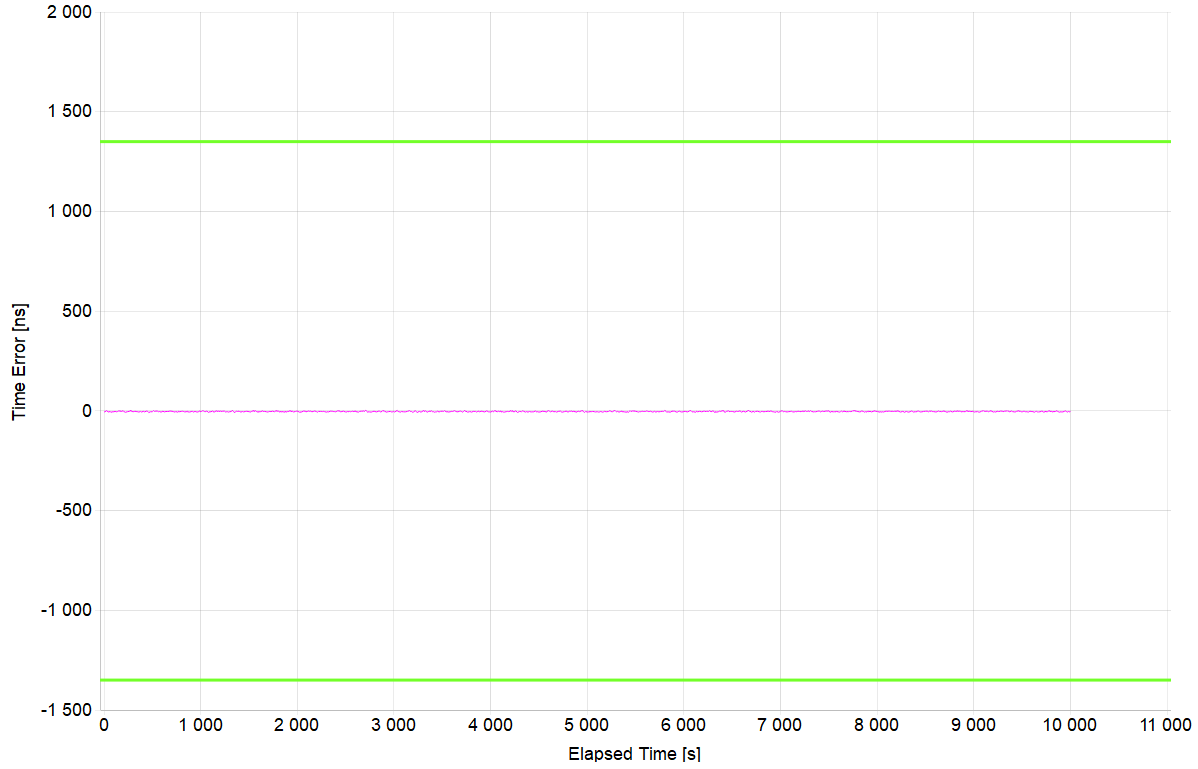
10. G.8273.4 APTS: Noise Generation – Single Path (with Oscillator)

Test Description	Noise Generation
Report Date	22-04-29_10-17-08
Packet Rate (pkt/s)	16
Test Duration	02:46:40
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask CTE	0.02µs
Mask CTE Result	**Pass**
Mask DTE	0.2µs
Mask DTE Result	**Pass**
Mask DTEHF	-
Mask DTEHF Result	No Mask

10.1 ONEPPS Analysis

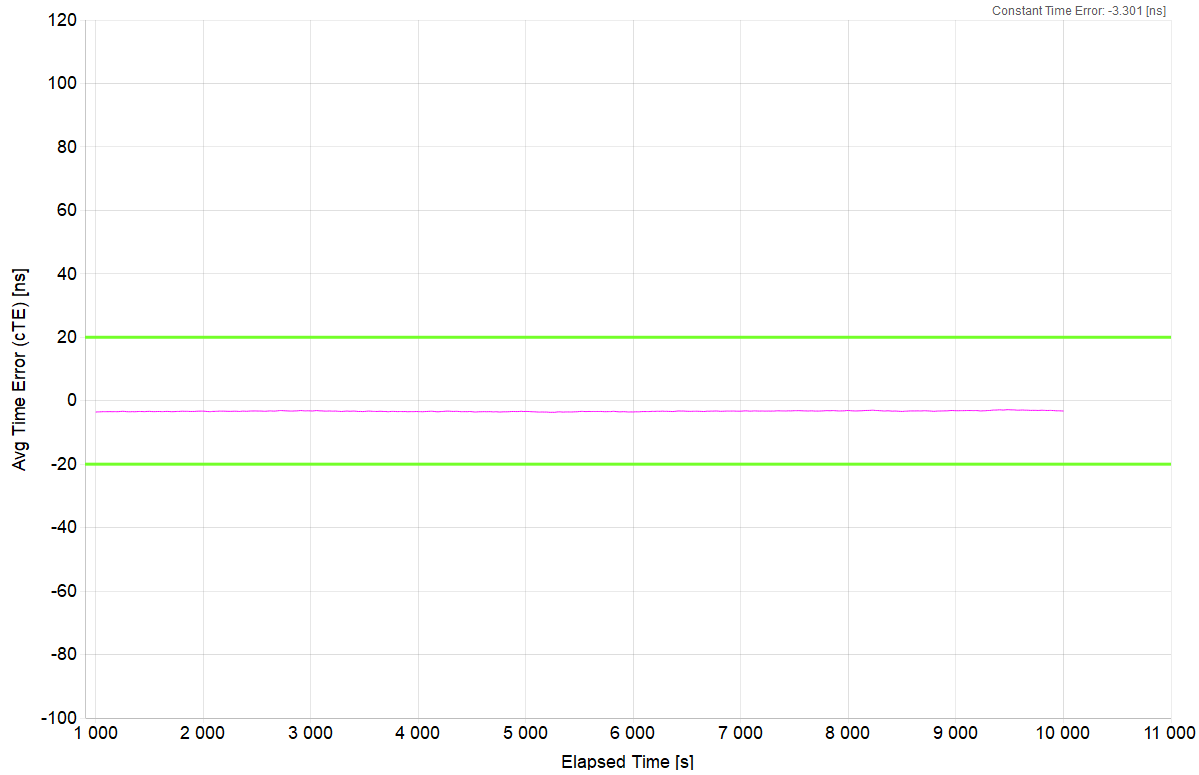
Offset Removal Applied	Off
Zero Offset	-5.953ns



Mean [ns]	-3.318
Min [ns]	-8.703
Max [ns]	3.547
Max-Min [ns]	12.25

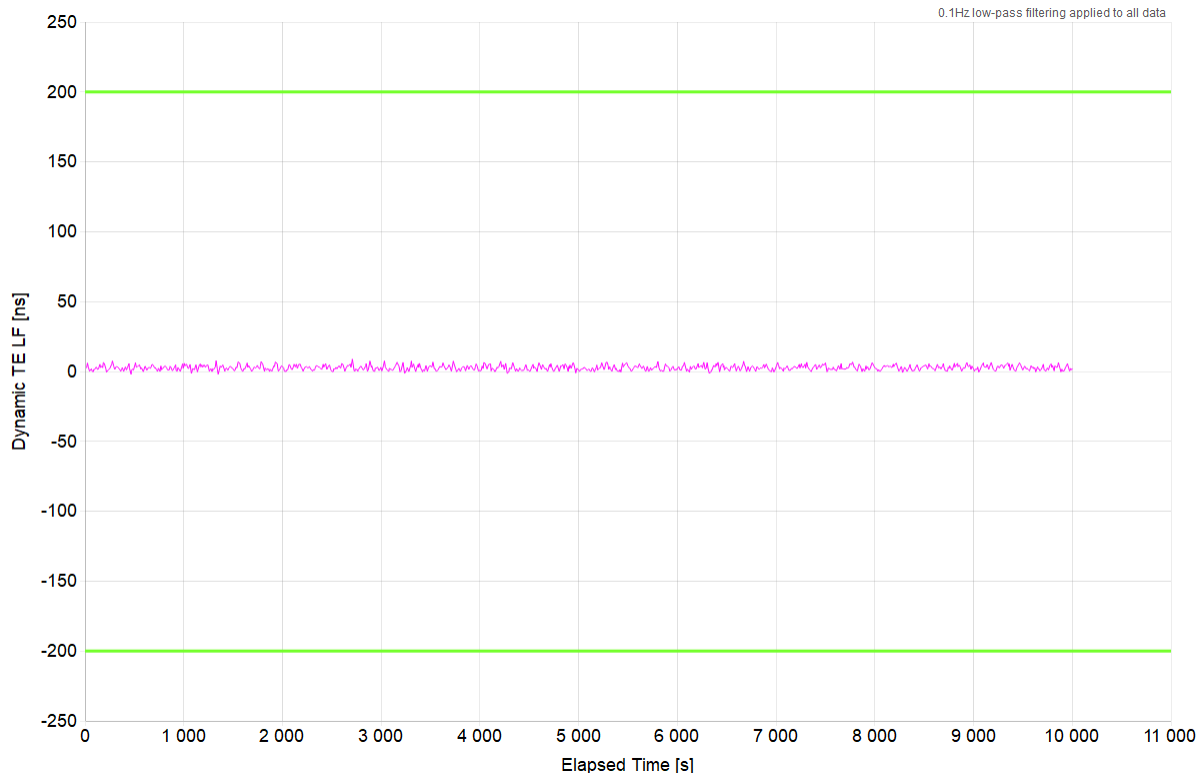
10.2 CTE Analysis

Averaging Time (s)	1000



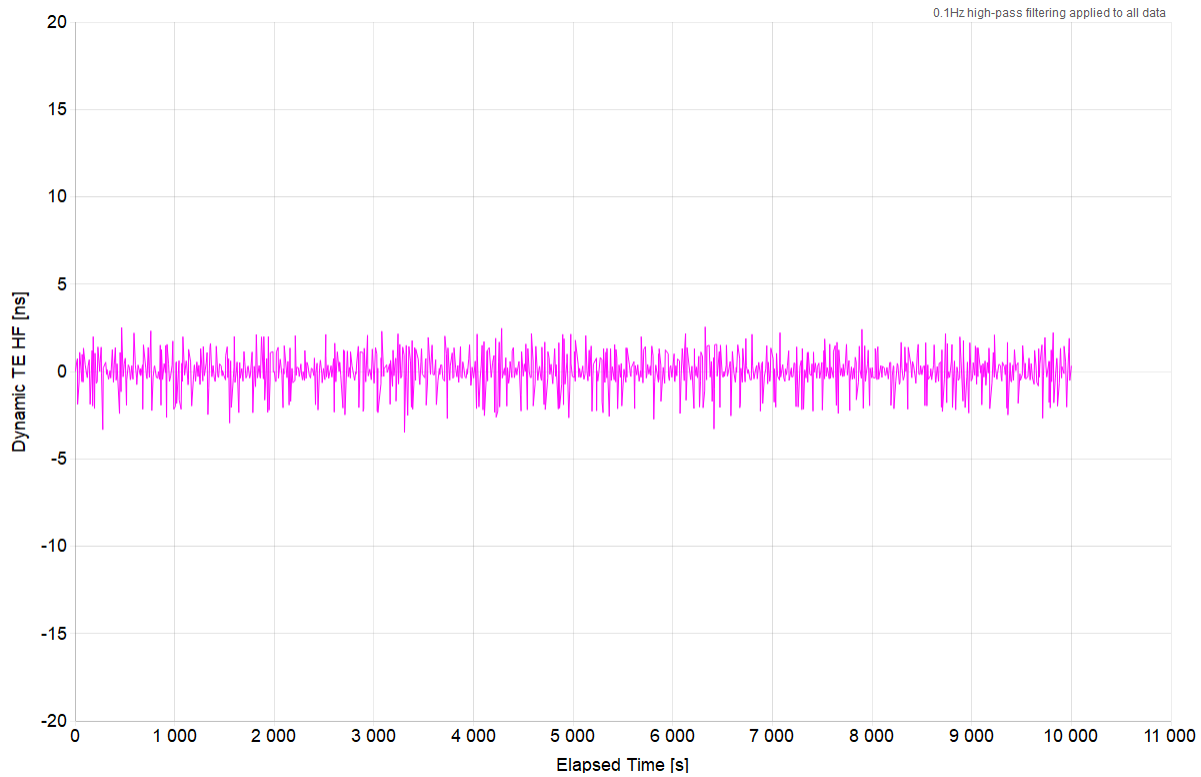
Constant Time Error [ns]	-3.301
Min [ns]	-3.666
Max [ns]	-2.822
Max-Min [ns]	0.845

10.3 DTE Analysis



Mean [ns]	2.638
Min [ns]	-2.008
Max [ns]	8.816
Max-Min [ns]	10.824

10.4 DTEHF Analysis



Mean [ns]	0
Min [ns]	-3.492
Max [ns]	2.551
Max-Min [ns]	6.042

11. G.8273.4 APTS: Holdover – Single Path (with Oscillator)

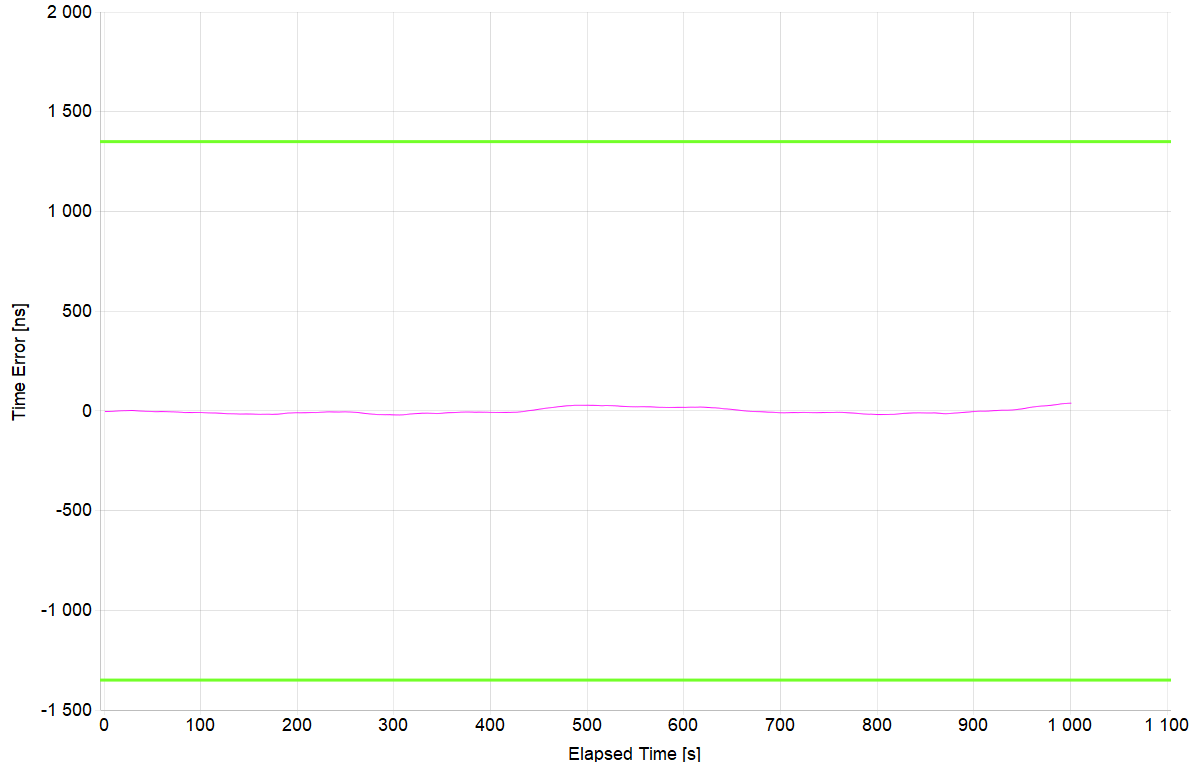
Test Description	Holdover (with Oscillator)
Report Date	22-04-29_10-17-08
Packet Rate (pkt/s)	16
Test Duration	00:16:40
Time to Phase Lock (s)	N/A

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**
Mask MTIE	G.8273.4 APTS Holdover (PTP) Const. Temp.
Mask MTIE Result	**Pass**

1. This test is a continuation of the previous Noise Generation test. This allows for an appropriate amount of settling time before collecting holdover data (10 000s). The results are split because holdover requires a different mask than noise generation. Both GNSS and PTP are disconnected connected during Holdover.

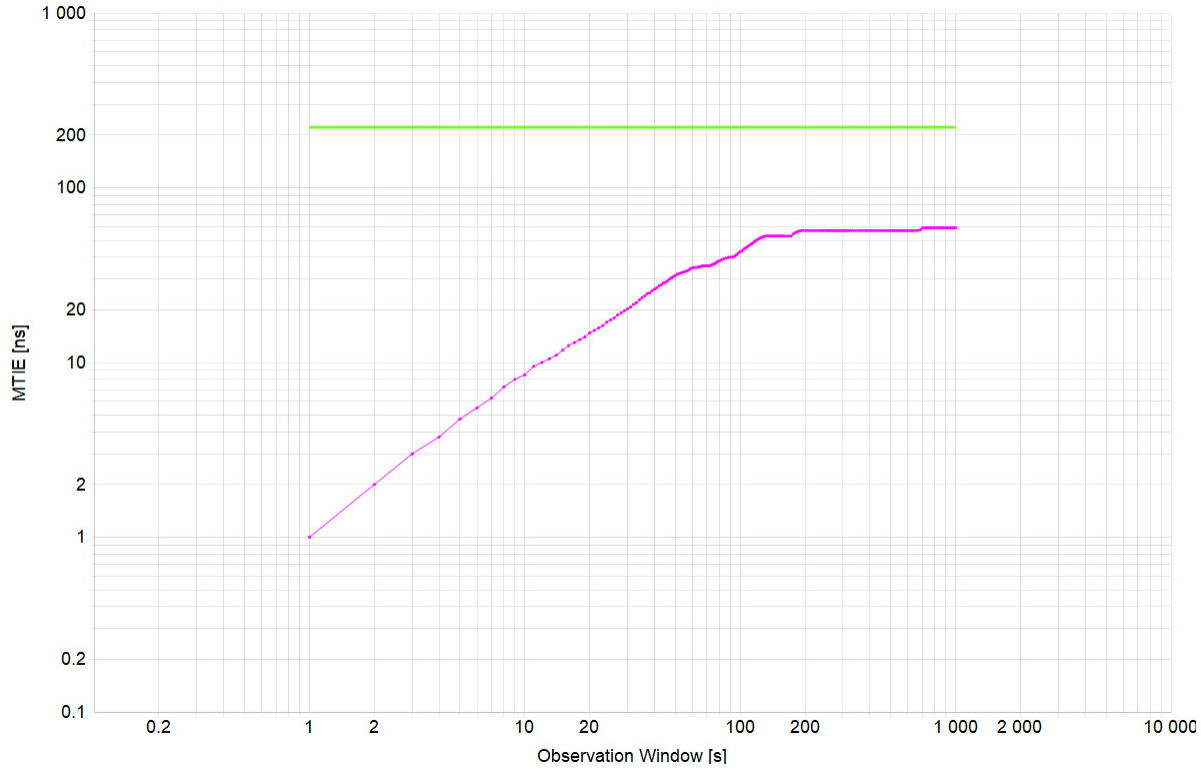
11.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-3.453ns



Mean [ns]	-1.14
Min [ns]	-20.703
Max [ns]	38.297
Max-Min [ns]	59

11.2 MTIE Analysis



Min [ns]	1
Max [ns]	59
Max-Min [ns]	58

12. G.8273.4 APTS: Noise Tolerance – No BC's High Stability PDV

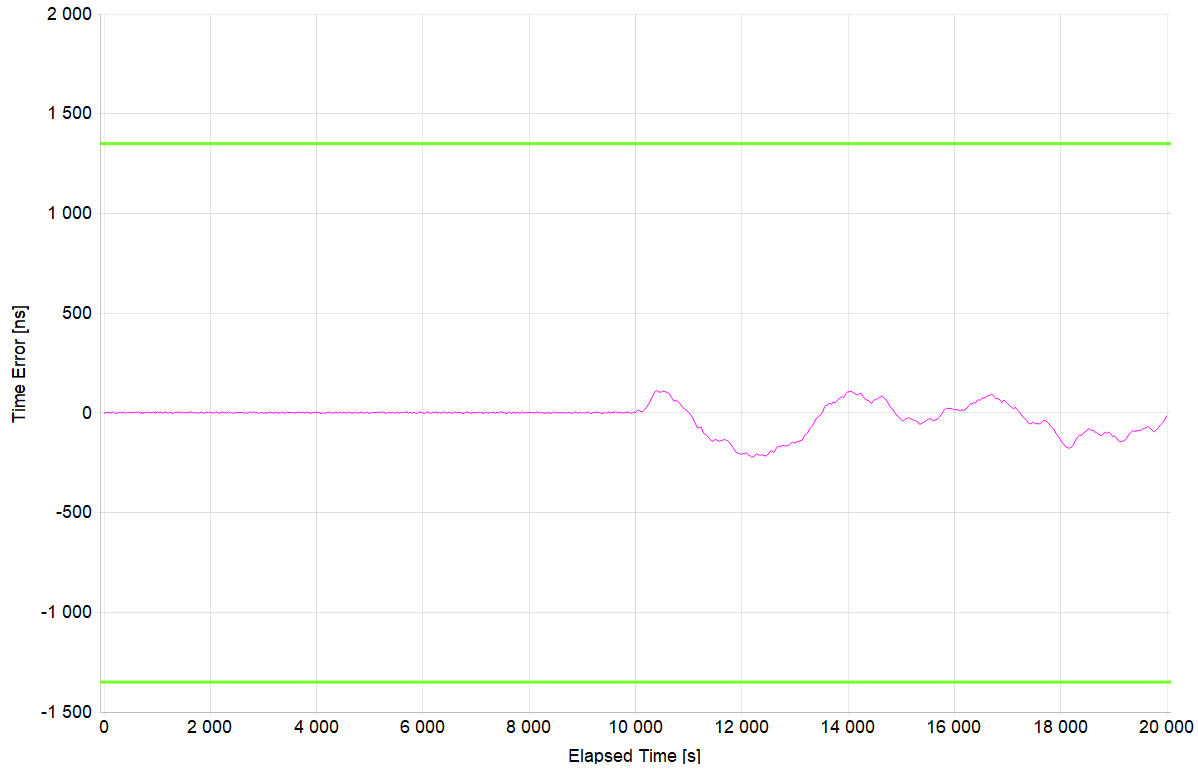
Test Description	Noise Tolerance – No BC's High Stability PDV
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	3

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

12.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-1.203ns



Mean [ns]	-20.993
Min [ns]	-223.453
Max [ns]	112.547
Max-Min [ns]	336

13. G.8273.4 APTS: Noise Tolerance – No BC's Normal Stability PDV

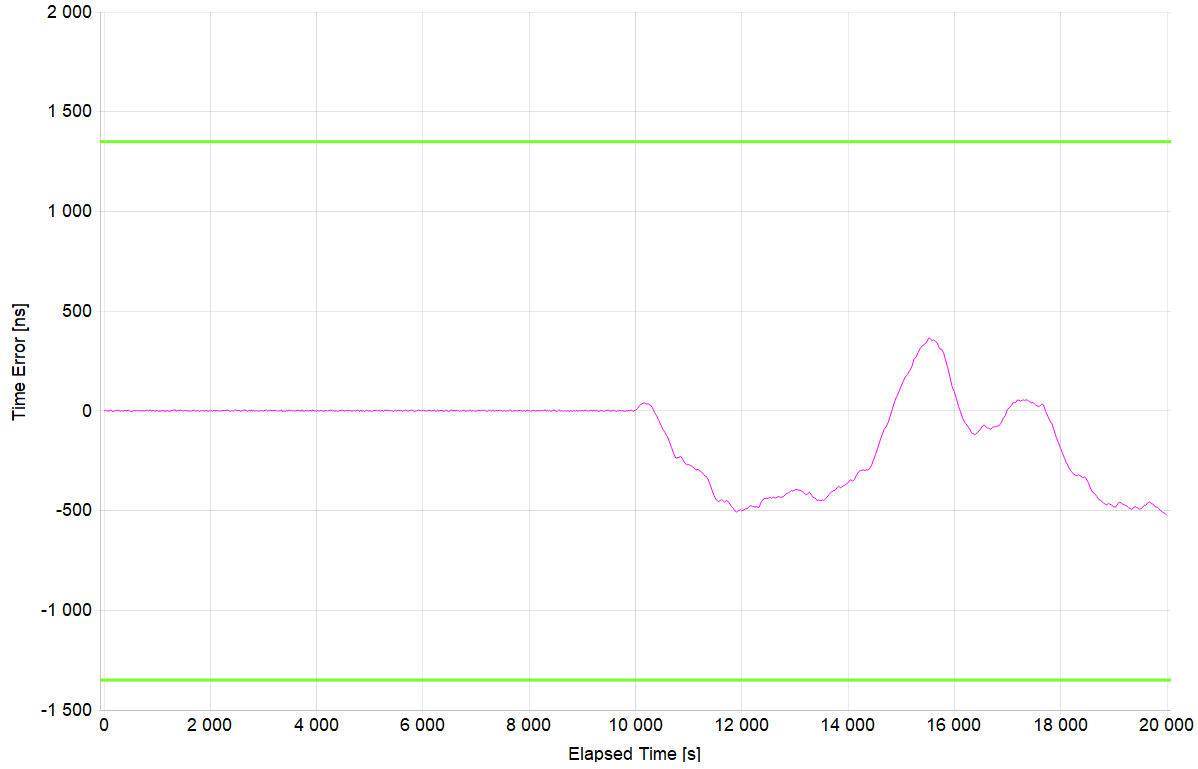
Test Description	Noise Tolerance – No BC's Normal Stability PDV
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

13.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-0.953ns



Mean [ns]	-108.372
Min [ns]	-524.203
Max [ns]	365.797
Max-Min [ns]	890

14. G.8273.4 APTS: Noise Tolerance – With BC's High Stability PDV

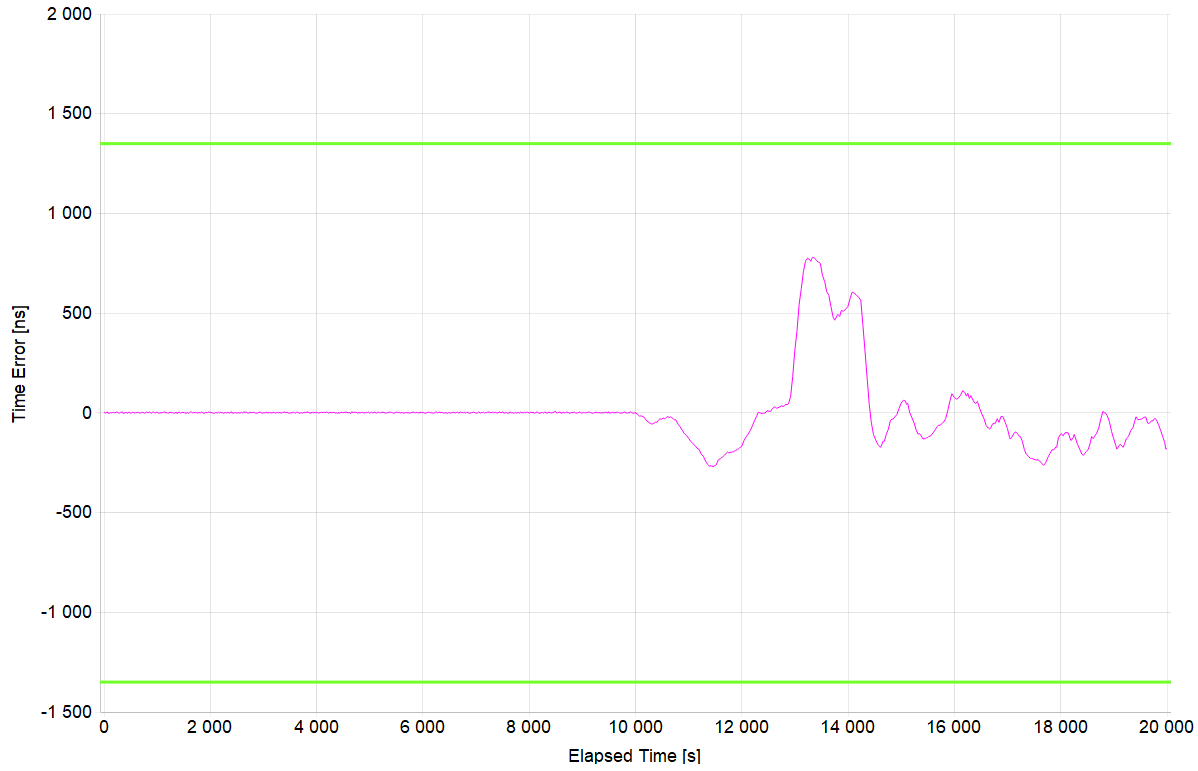
Test Description	Noise Tolerance – With BC's High Stability PDV
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

14.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	3.297ns



Mean [ns]	5.459
Min [ns]	-270.953
Max [ns]	779.547
Max-Min [ns]	1050.5

15. G.8273.4 APTS: Noise Tolerance – With BC's Normal Stability PDV

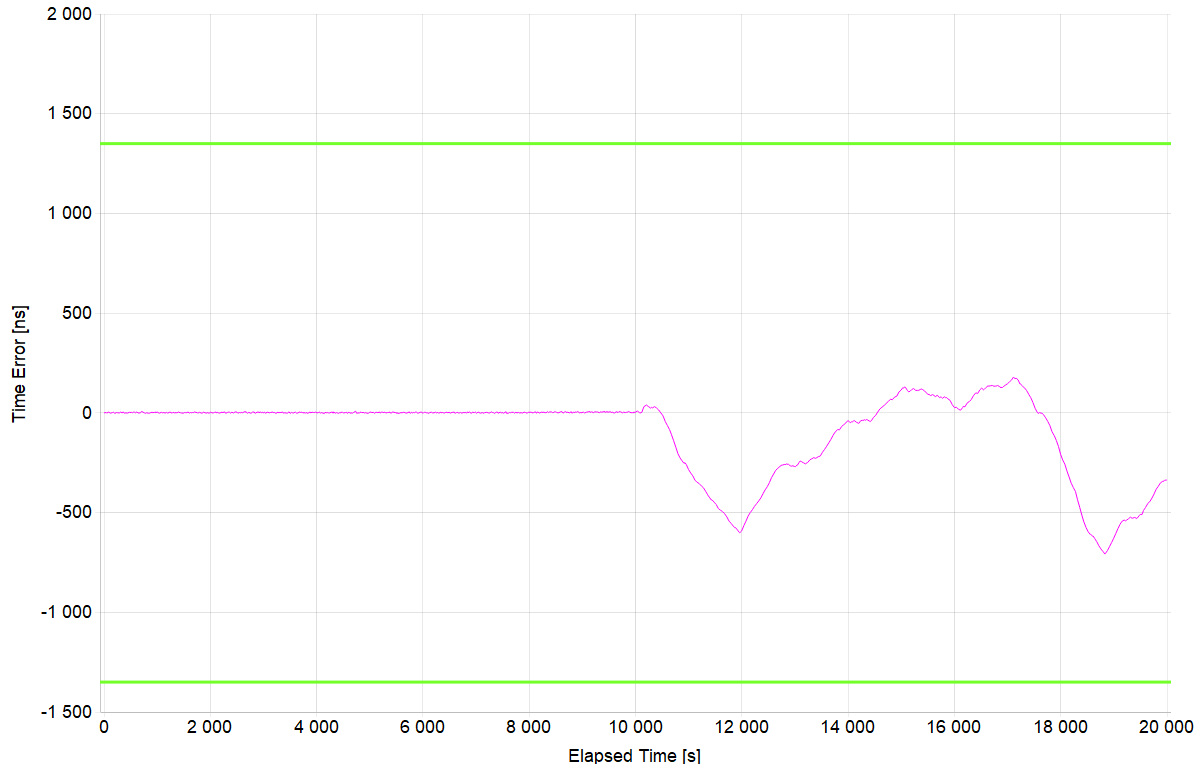
Test Description	Noise Tolerance – With BC's Normal Stability PDV
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	3

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

15.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-0.203ns



Mean [ns]	-91.43
Min [ns]	-708.203
Max [ns]	179.297
Max-Min [ns]	887.5

16. G.8273.4 APTS: Noise Tolerance – ITU-T G.8271.2 PDV Pattern

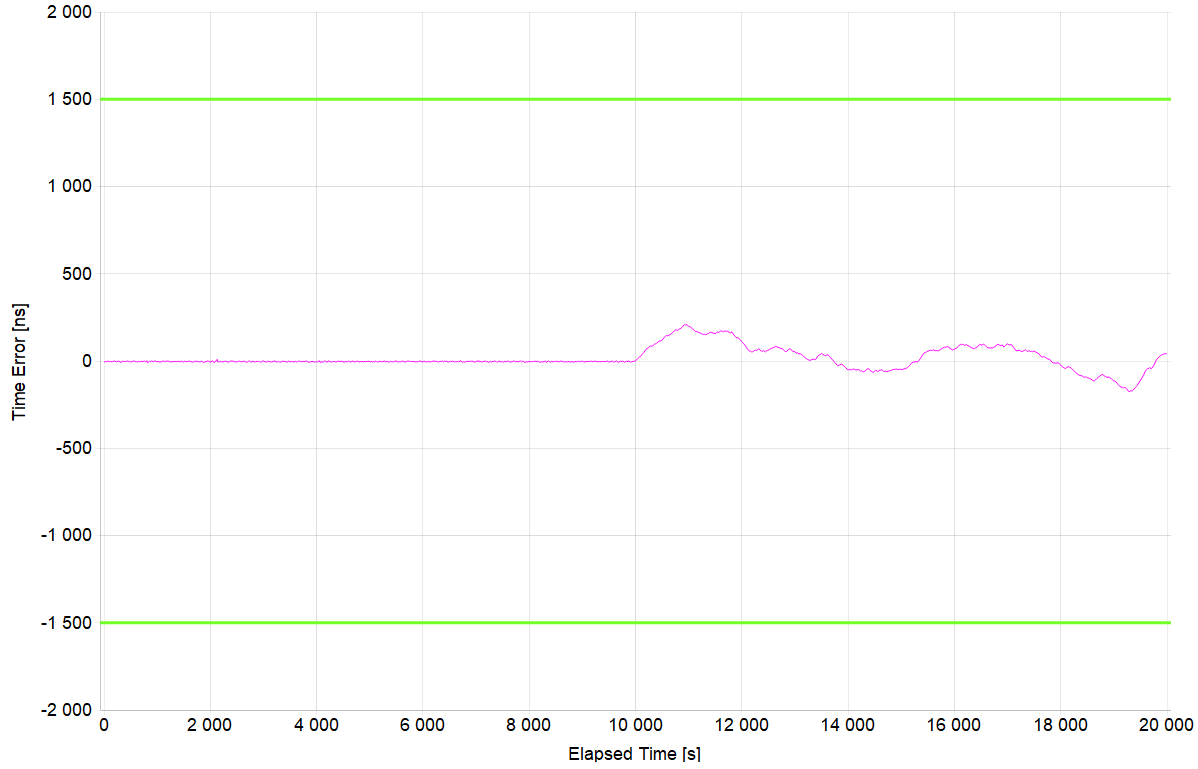
Test Description	Noise Tolerance – ITU-T G.8271.2 PDV Pattern
Report Date	22-04-28_17-01-53
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	3

All Mask Results	**Pass**
Mask ONEPPS	1.5µs
Mask ONEPPS Result	**Pass**
Mask FILTEREDTIMEERROR	1.35µs
Mask FILTEREDTIMEERROR Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

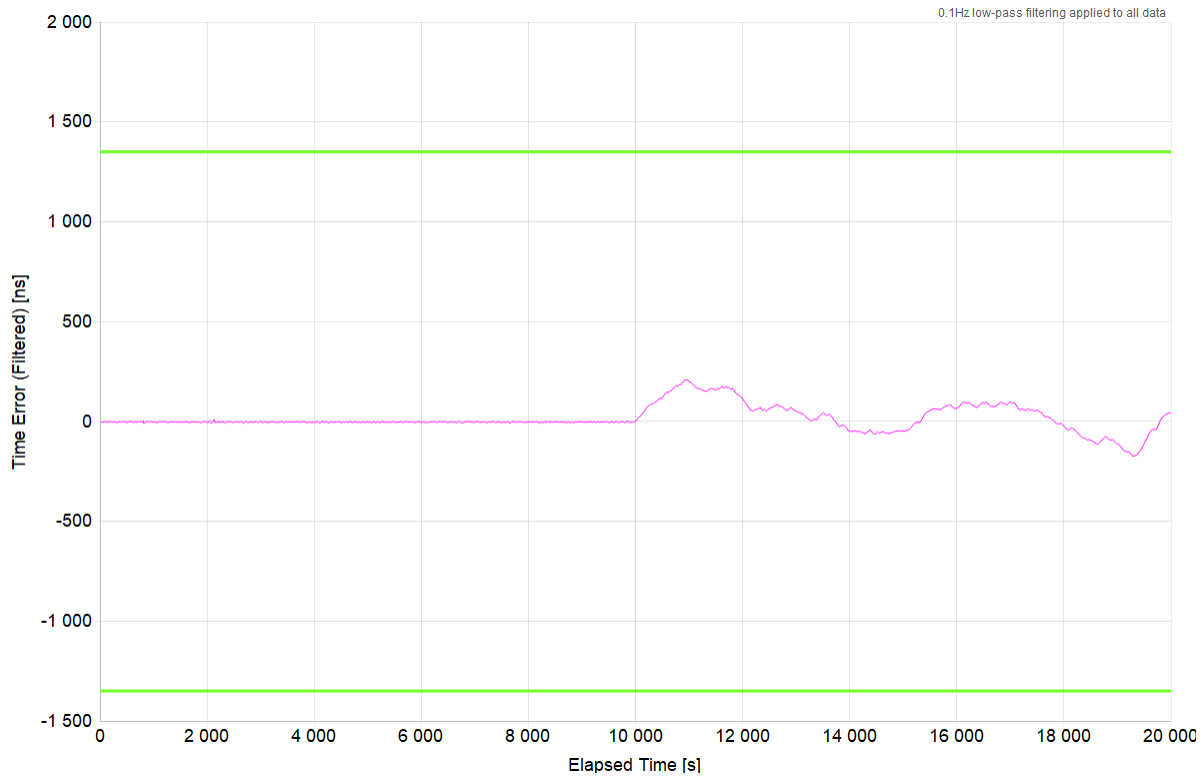
16.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-3.703ns



Mean [ns]	13.451
Min [ns]	-174.953
Max [ns]	208.797
Max-Min [ns]	383.75

16.2 FILTEREDTIMEERROR Analysis



Mean [ns]	13.461
Min [ns]	-174.752
Max [ns]	208.646
Max-Min [ns]	383.398

17. G.8273.4 APTS: Noise Tolerance – No BC's High Stability PDV – Single Path

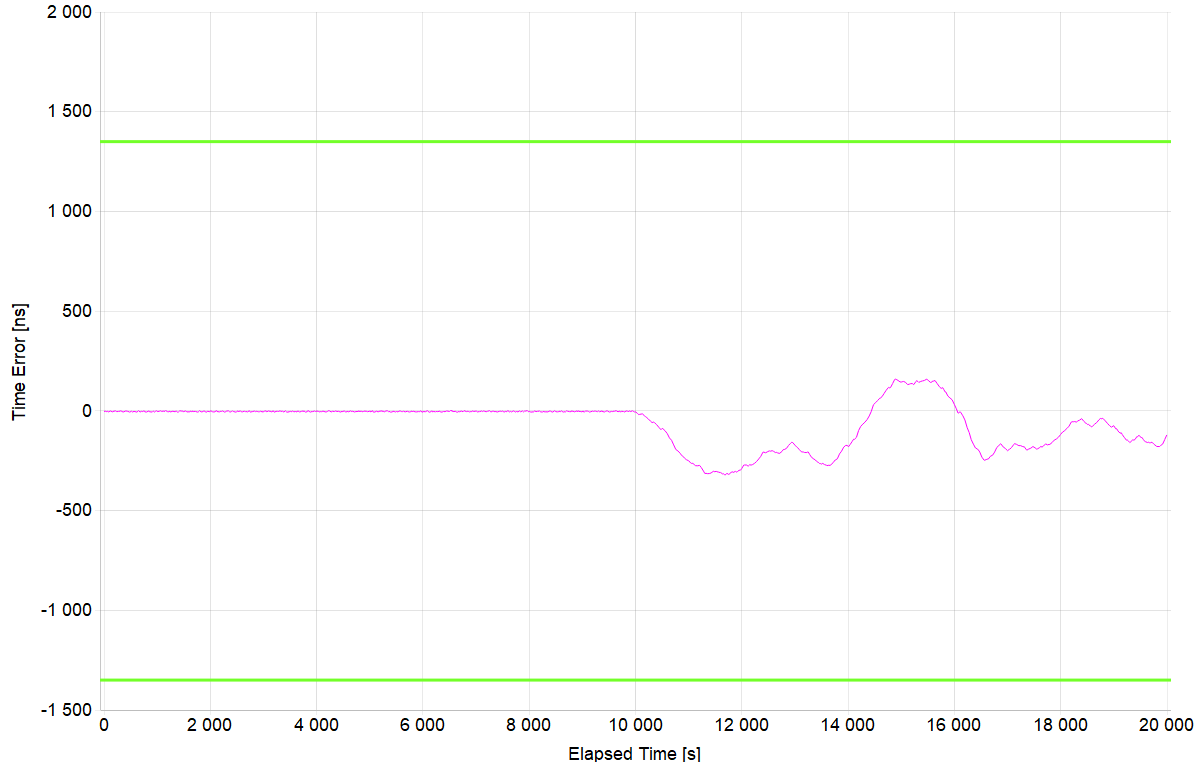
Test Description	Noise Tolerance – No BC's High Stability PDV
Report Date	22-04-29_10-17-08
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

17.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-3.203ns



Mean [ns]	-64.038
Min [ns]	-321.953
Max [ns]	159.047
Max-Min [ns]	481

18. G.8273.4 APTS: Noise Tolerance – No BC's Normal Stability PDV – Single Path

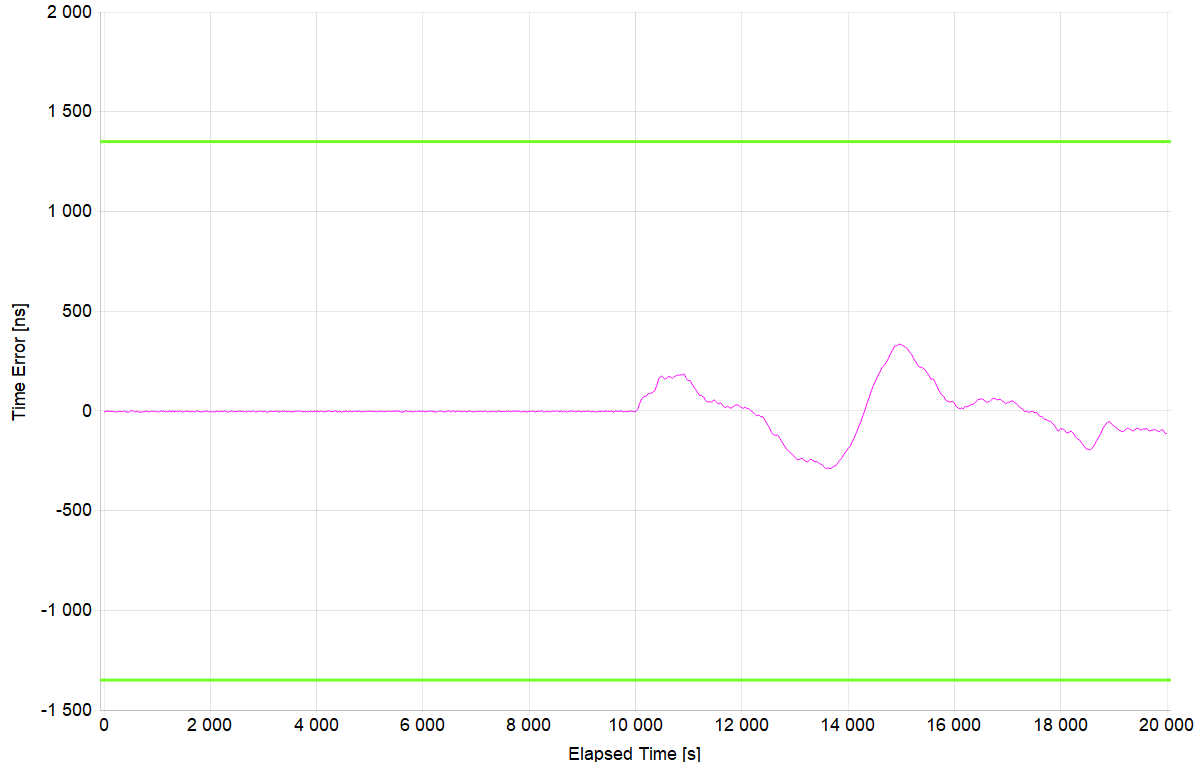
Test Description	Noise Tolerance – No BC's Normal Stability PDV
Report Date	22-04-29_10-17-08
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.35µs
Mask ONEPPS Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

18.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-4.703ns



Mean [ns]	-4.787
Min [ns]	-289.703
Max [ns]	334.547
Max-Min [ns]	624.25

19. G.8273.4 APTS: Noise Tolerance – ITU-T G.8271.2 PDV Pattern – Single Path

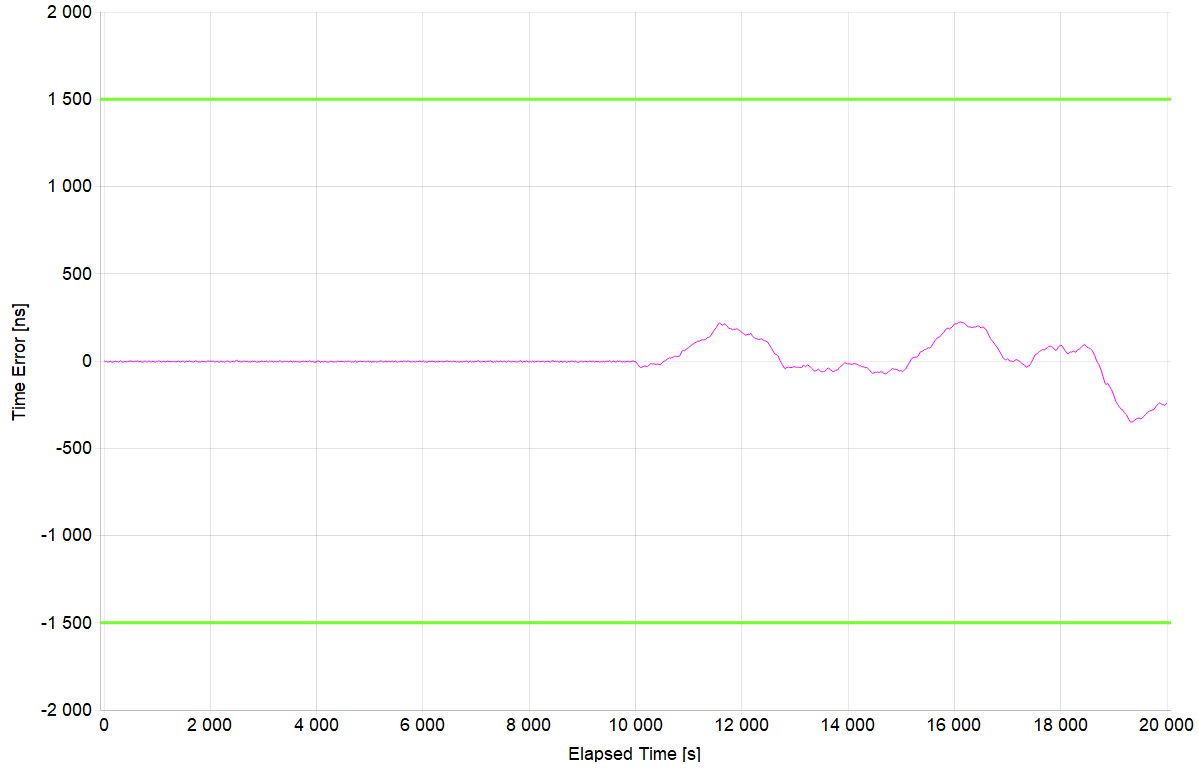
Test Description	Noise Tolerance – ITU-T G.8271.2 PDV Pattern
Report Date	22-04-29_10-17-08
Packet Rate (pkt/s)	16
Test Duration	05:33:17
Time to Phase Lock (s)	4

All Mask Results	**Pass**
Mask ONEPPS	1.5µs
Mask ONEPPS Result	**Pass**
Mask FILTEREDTIMEERROR	1.35µs
Mask FILTEREDTIMEERROR Result	**Pass**

1. This test shows the 1pps performance with PDV for 10000s with GNSS connected, then for an additional 10000s with GNSS disconnected. PTP is running during the entire test.

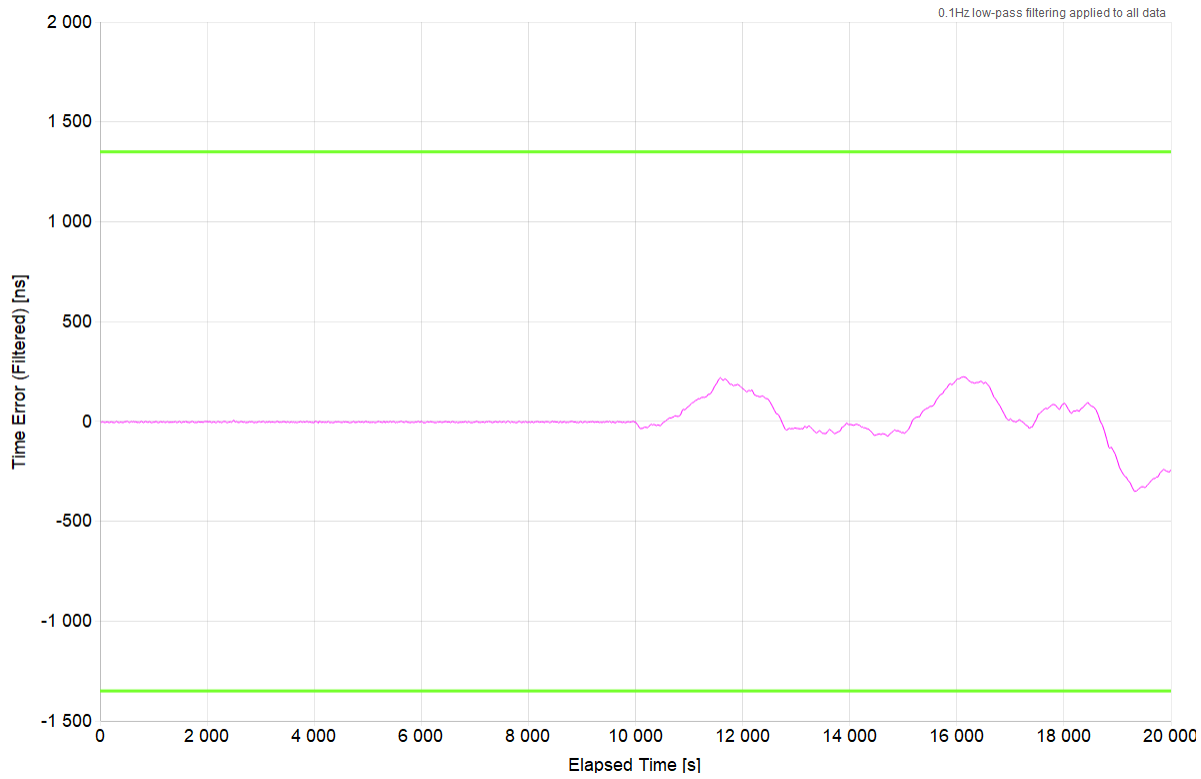
19.1 ONEPPS Analysis

Offset Removal Applied	Off
Zero Offset	-1.703ns



Mean [ns]	4.65
Min [ns]	-350.453
Max [ns]	223.297
Max-Min [ns]	573.75

19.2 FILTEREDTIMEERROR Analysis



Mean [ns]	4.673
Min [ns]	-350.296
Max [ns]	223.296
Max-Min [ns]	573.593

20. Revision History

Revision	Date	Description
1.01	Jul 16, 2024	Replaced Xilinx with AMD throughout the document.
1.00	May 4, 2023	Initial release.

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