

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

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# 1. Results Summary

Standard	Test Case	Results
G.8273.4 APTS	Noise Generation – PTP	Pass
G.8273.4 APTS	Holdover – PTP	Pass
G.8273.4 APTS	Noise Generation (with Oscillator)	Pass
G.8273.4 APTS	Holdover (with Oscillator)	Pass
G.8273.4 APTS	Noise Generation – Single Path (with PTP)	Pass
G.8273.4 APTS	Holdover – Single Path (with PTP)	Pass
G.8273.4 APTS	Noise Generation – Single Path (with Oscillator)	Pass
G.8273.4 APTS	Holdover – Single Path (with Oscillator)	Pass
G.8273.4 APTS	Noise Tolerance – No BC’s High Stability PDV	Pass
G.8273.4 APTS	Noise Tolerance – No BC’s Normal Stability PDV	Pass
G.8273.4 APTS	Noise Tolerance – With BC’s High Stability PDV	Pass
G.8273.4 APTS	Noise Tolerance – With BC’s Normal Stability PDV	Pass
G.8273.4 APTS	Noise Tolerance – ITU-T G.8271.2 PDV Pattern	Pass
G.8273.4 APTS	Noise Tolerance – No BC’s High Stability PDV – Single Path	Pass
G.8273.4 APTS	Noise Tolerance – No BC’s Normal Stability PDV – Single Path	Pass
G.8273.4 APTS	Noise Tolerance – ITU-T G.8271.2 PDV Pattern – Single Path	Pass

## 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

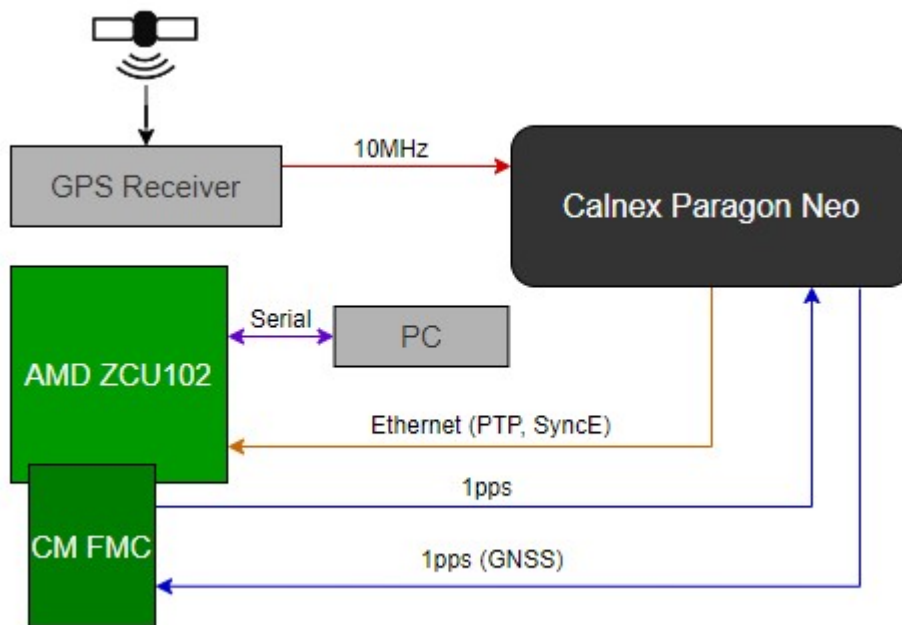


Figure 1. Equipment Configuration

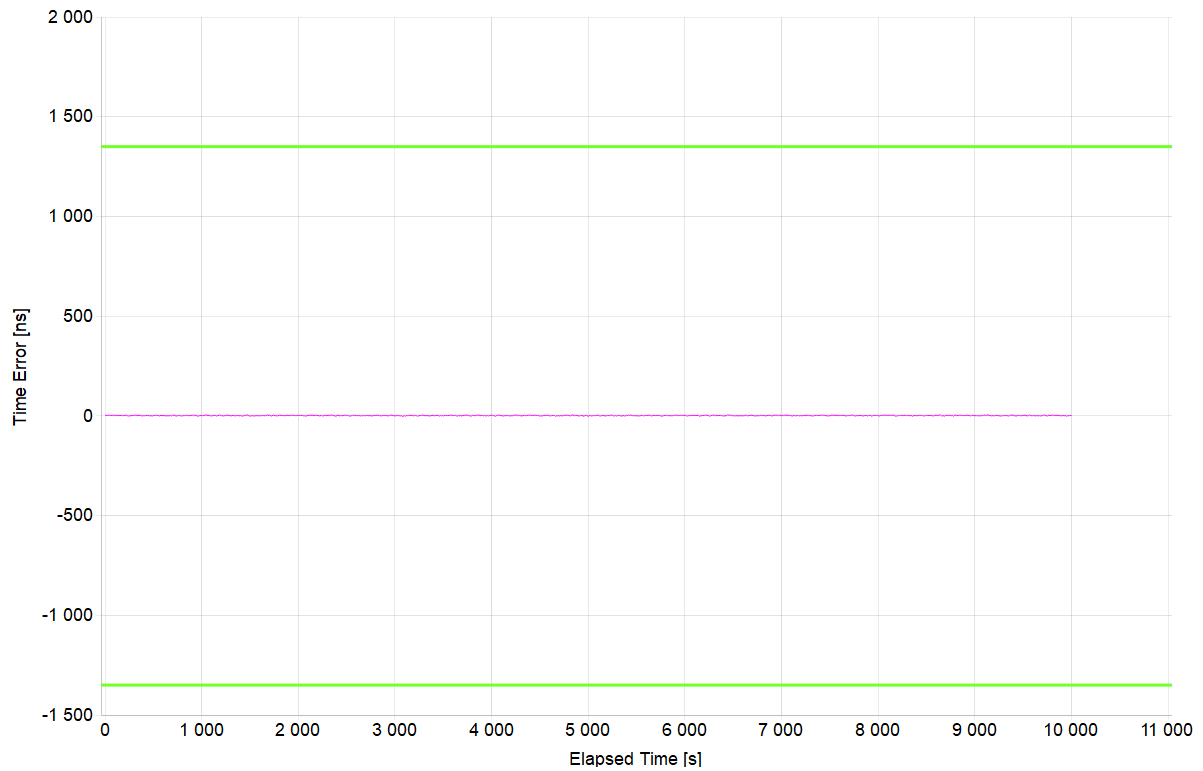
### 3. G.8273.4 APTS: Noise Generation (with PTP)

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

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35μs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask CTE</b>	0.02μs
<b>Mask CTE Result</b>	<b>Pass</b>
<b>Mask DTE</b>	0.2μs
<b>Mask DTE Result</b>	<b>Pass</b>
<b>Mask DTEHF</b>	-
<b>Mask DTEHF Result</b>	No Mask

## 4. ONEPPS Analysis

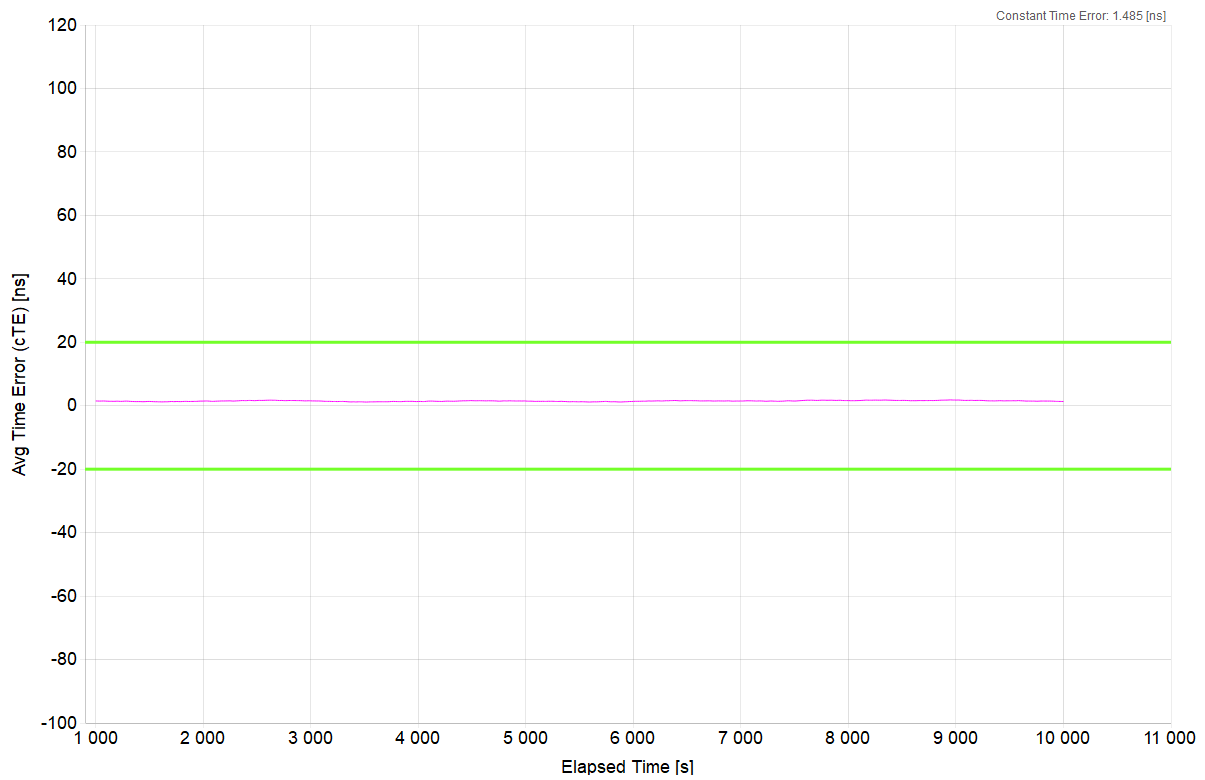
<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	2.197ns



<b>Mean [ns]</b>	1.489
<b>Min [ns]</b>	-3.303
<b>Max [ns]</b>	6.197
<b>Max-Min [ns]</b>	9.5

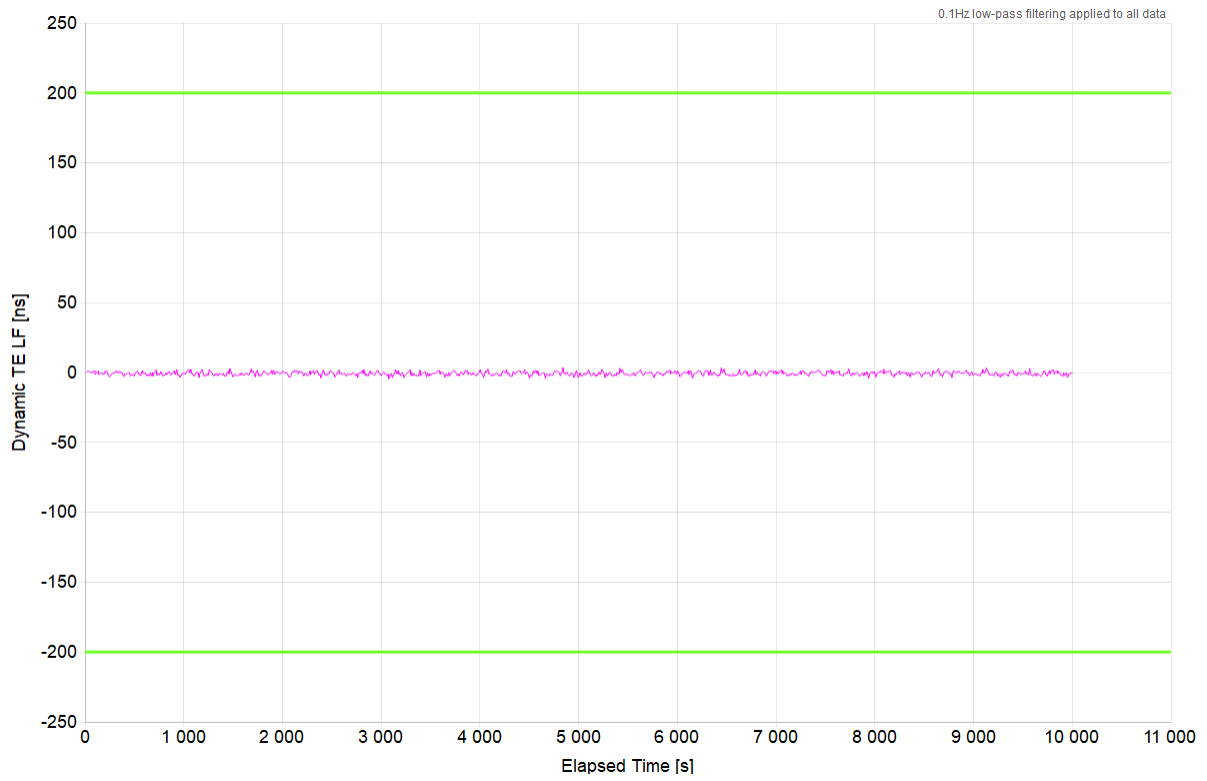
## 4.1 CTE Analysis

<b>Averaging Time (s)</b>	1000
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<b>Constant Time Error [ns]</b>	1.485
<b>Min [ns]</b>	1.157
<b>Max [ns]</b>	1.832
<b>Max-Min [ns]</b>	0.676

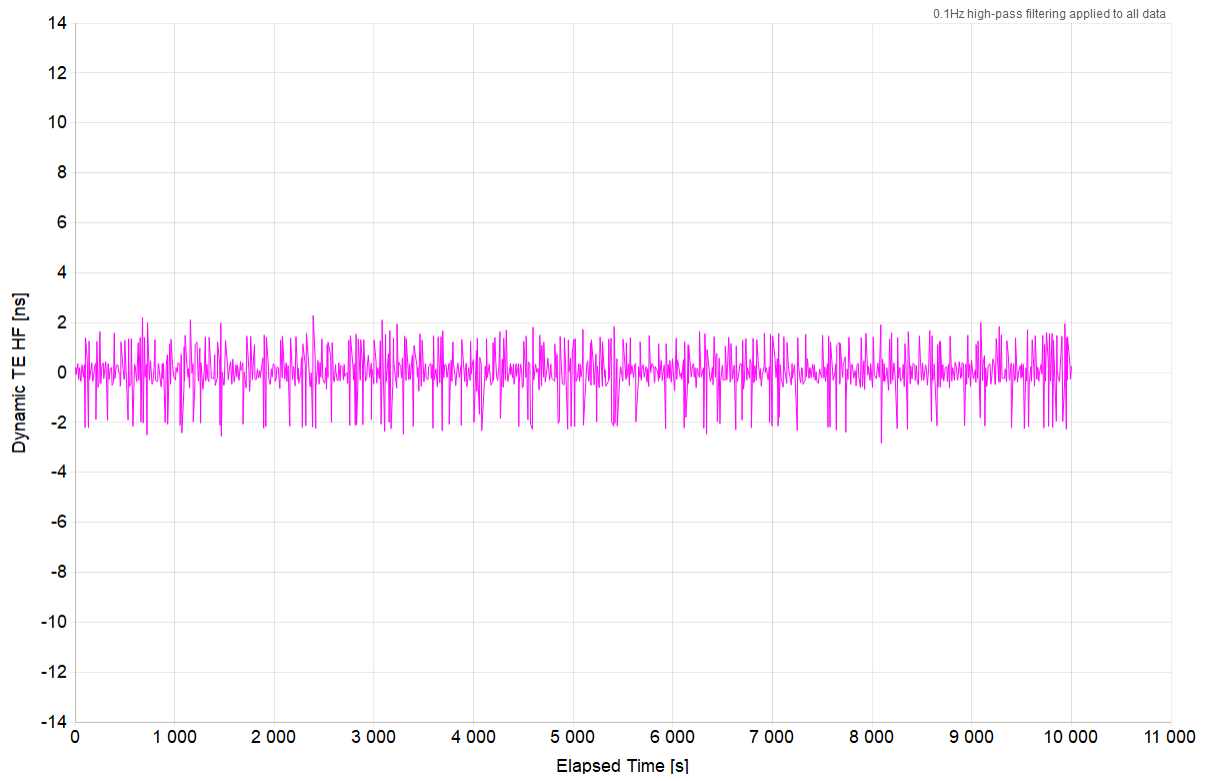
## 4.2 DTE Analysis



<b>Mean [ns]</b>	-0.709
<b>Min [ns]</b>	-4.708
<b>Max [ns]</b>	3.548
<b>Max-Min [ns]</b>	8.256



### 4.3 DTEHF Analysis



<b>Mean [ns]</b>	0
<b>Min [ns]</b>	-2.832
<b>Max [ns]</b>	2.285
<b>Max-Min [ns]</b>	5.118

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

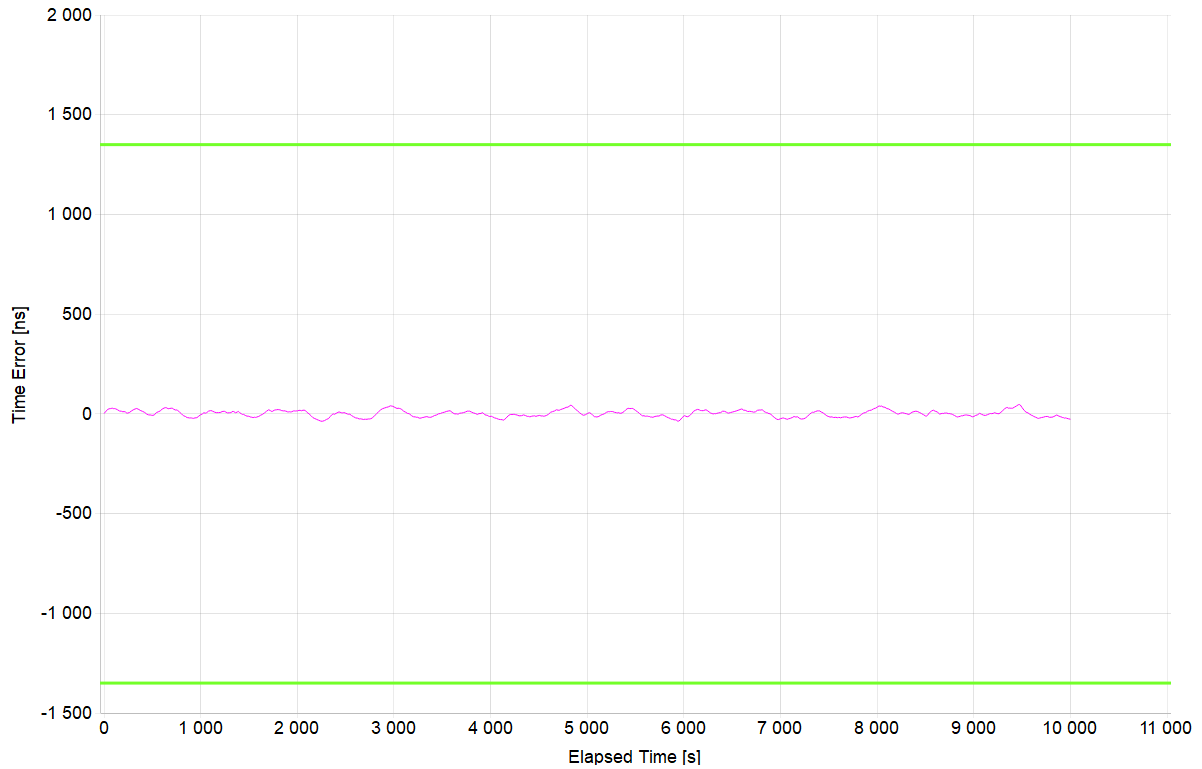
<b>Test Description</b>	Holdover
<b>Report Date</b>	22-10-18_08-30-41
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	02:46:40
<b>Time to Phase Lock (s)</b>	N/A

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35 $\mu$ s
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask MTIE</b>	G.8273.4 APTS Holdover (PTP) Const. Temp.
<b>Mask MTIE Result</b>	<b>Pass</b>

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.

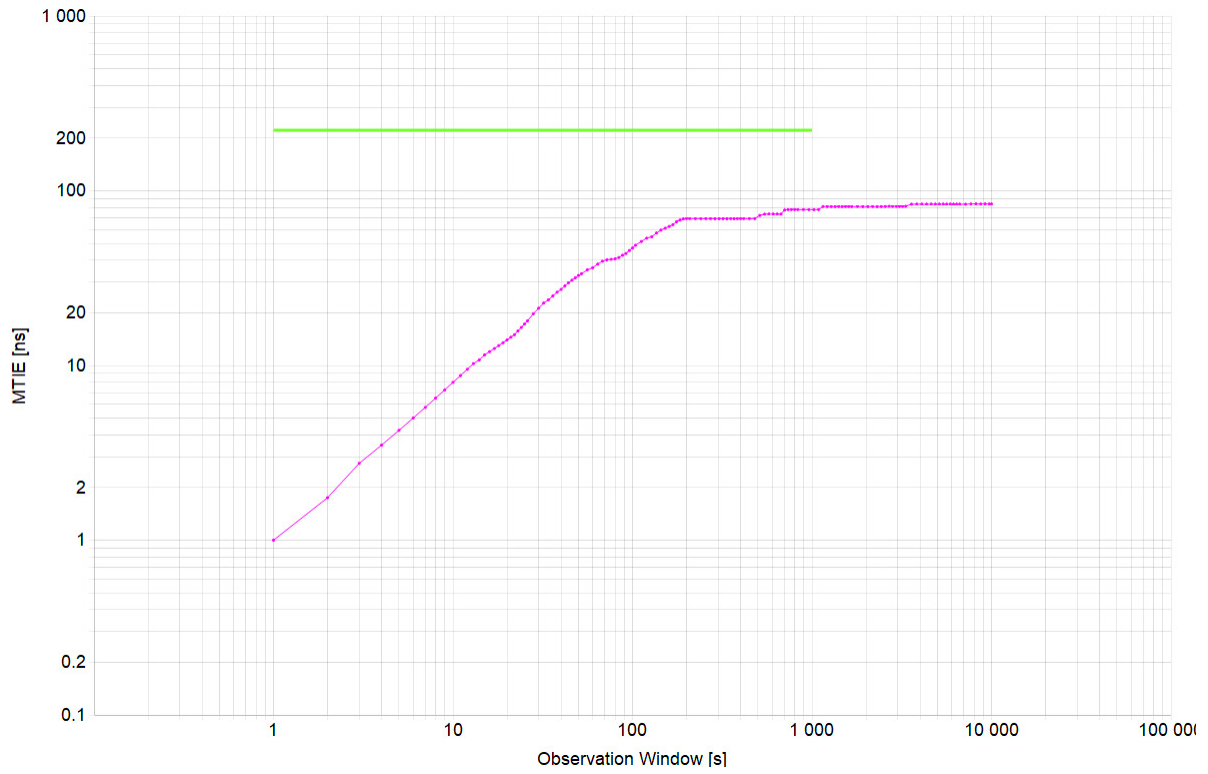
### 5.1 ONEPPS Analysis

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



<b>Min [ns]</b>	1
<b>Max [ns]</b>	84
<b>Max-Min [ns]</b>	83

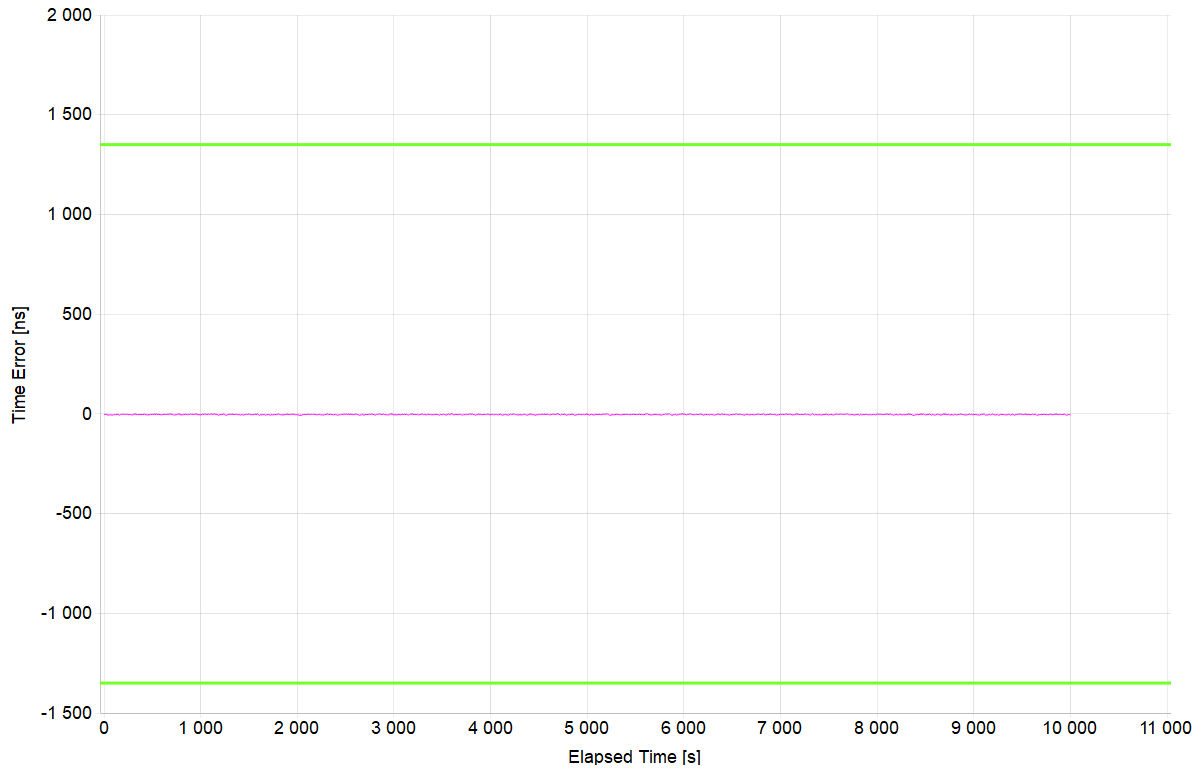
## 6. G.8273.4 APTS: Noise Generation (with Oscillator)

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

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35μs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask CTE</b>	0.02μs
<b>Mask CTE Result</b>	<b>Pass</b>
<b>Mask DTE</b>	0.2μs
<b>Mask DTE Result</b>	<b>Pass</b>
<b>Mask DTEHF</b>	-
<b>Mask DTEHF Result</b>	No Mask

## 6.1 ONEPPS Analysis

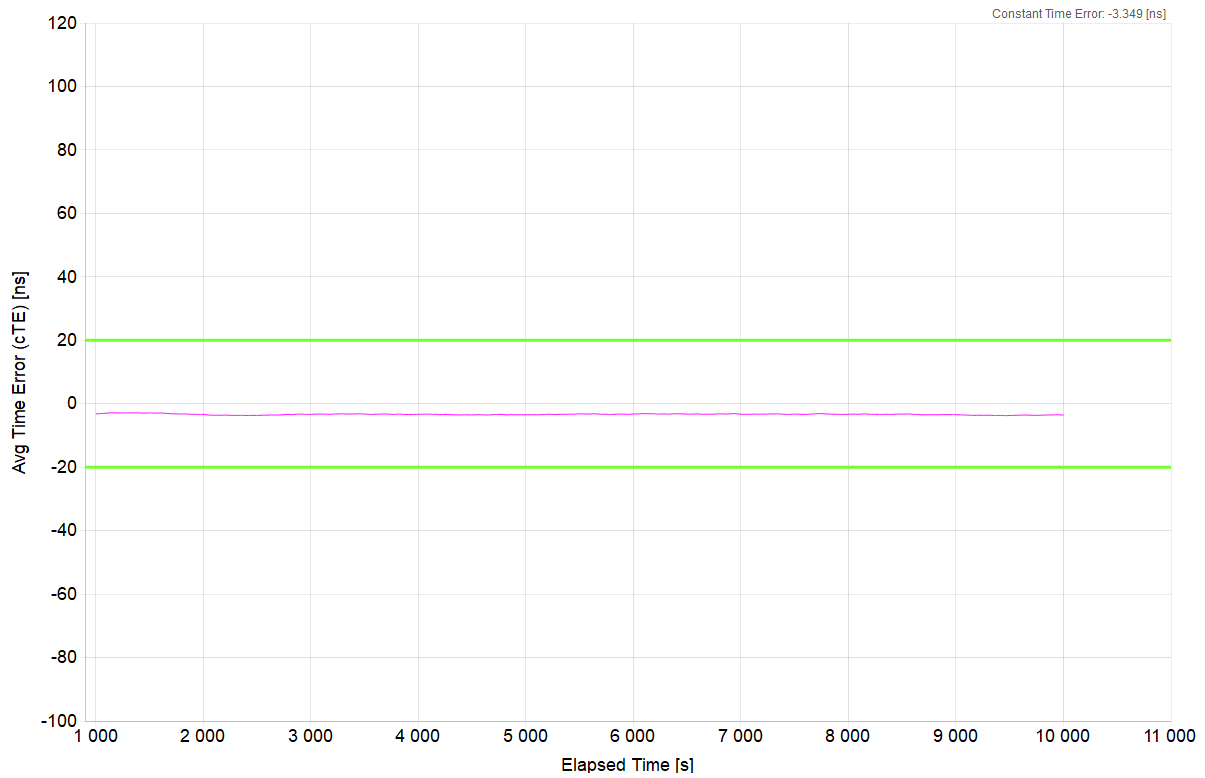
Offset Removal Applied	Off
Zero Offset	-4.703ns



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

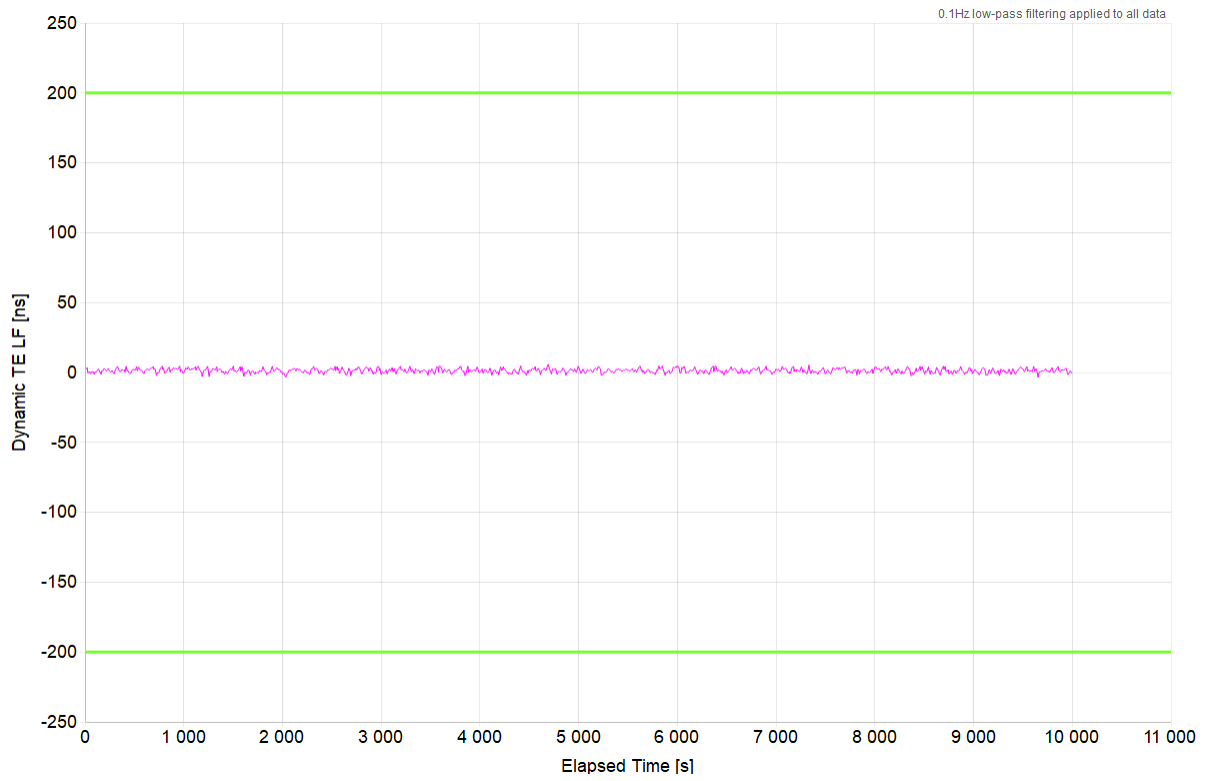
## 6.2 CTE Analysis

<b>Averaging Time (s)</b>	1000
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<b>Constant Time Error [ns]</b>	-3.349
<b>Min [ns]</b>	-3.746
<b>Max [ns]</b>	-2.843
<b>Max-Min [ns]</b>	0.903

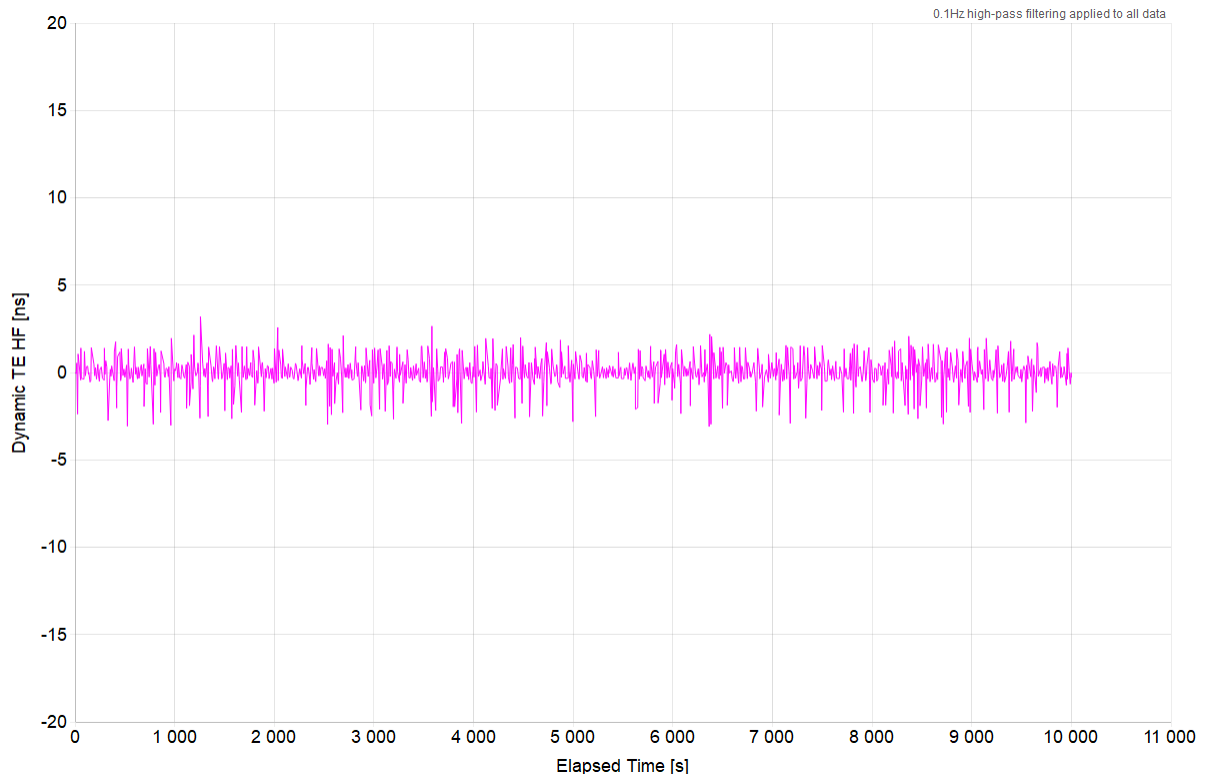
### 6.3 DTE Analysis



<b>Mean [ns]</b>	1.348
<b>Min [ns]</b>	-3.507
<b>Max [ns]</b>	5.843
<b>Max-Min [ns]</b>	9.35



## 6.4 DTEHF Analysis



<b>Mean [ns]</b>	0
<b>Min [ns]</b>	-3.097
<b>Max [ns]</b>	3.191
<b>Max-Min [ns]</b>	6.289

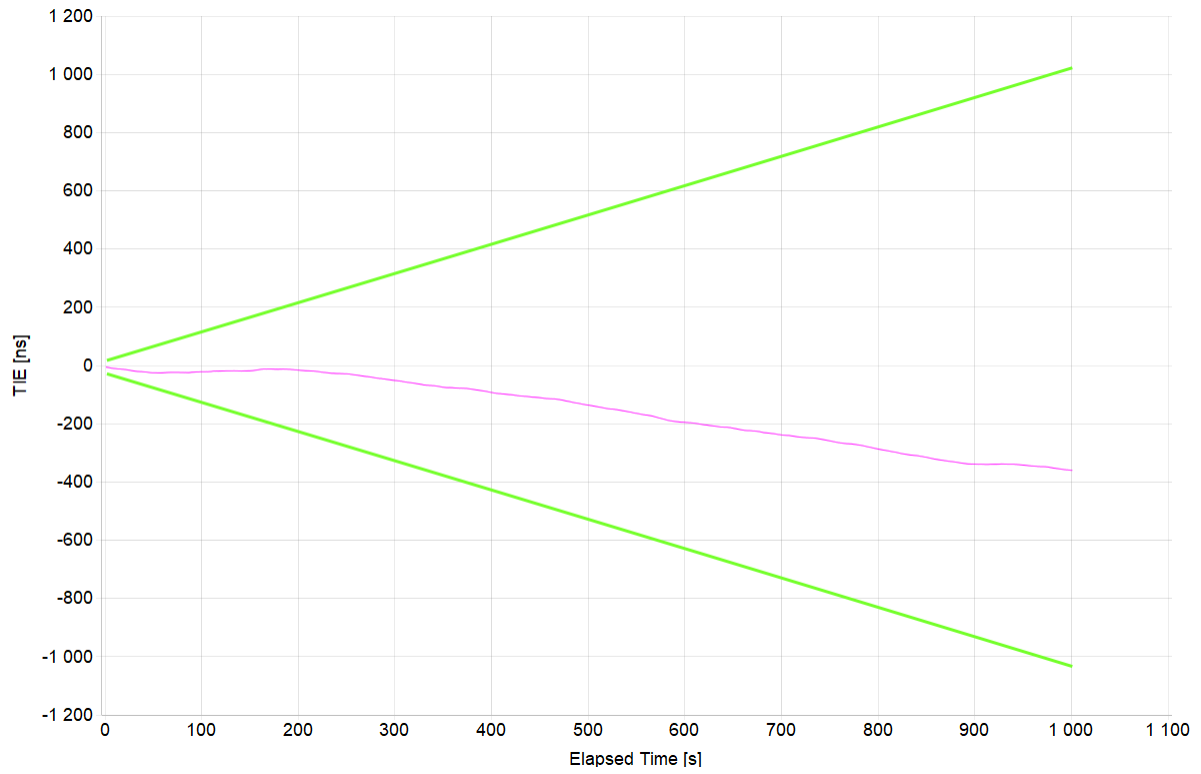
## 7. G.8273.4 APTS: Holdover (with Oscillator)

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

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask TIE</b>	G.8273.4 APTS Holdover (Oscillator) Const. Temp.
<b>Mask TIE Result</b>	<b>Pass</b>

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



<b>Mean [ns]</b>	-155.812
<b>Min [ns]</b>	-359.953
<b>Max [ns]</b>	-5.703
<b>Max-Min [ns]</b>	354.25

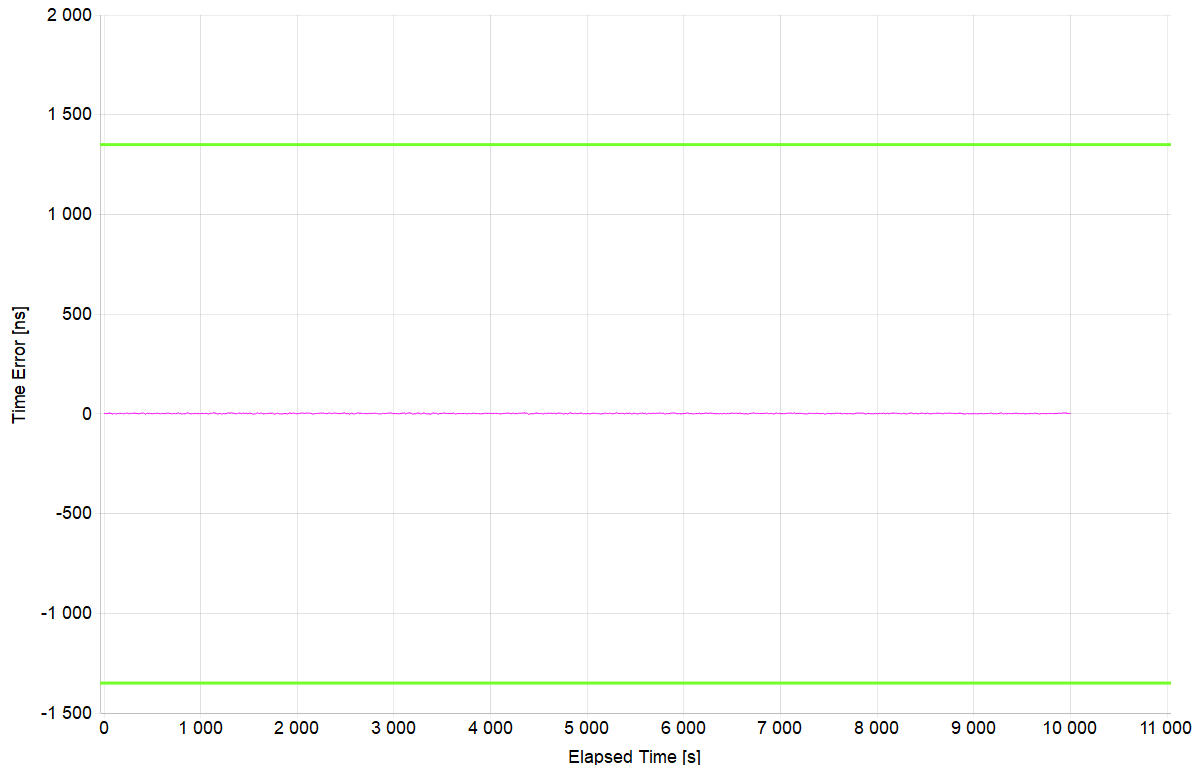
## 8. G.8273.4 APTS: Noise Generation – Single Path (with PTP)

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

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35μs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask CTE</b>	0.02μs
<b>Mask CTE Result</b>	<b>Pass</b>
<b>Mask DTE</b>	0.2μs
<b>Mask DTE Result</b>	<b>Pass</b>
<b>Mask DTEHF</b>	-
<b>Mask DTEHF Result</b>	No Mask

### 8.1 ONEPPS Analysis

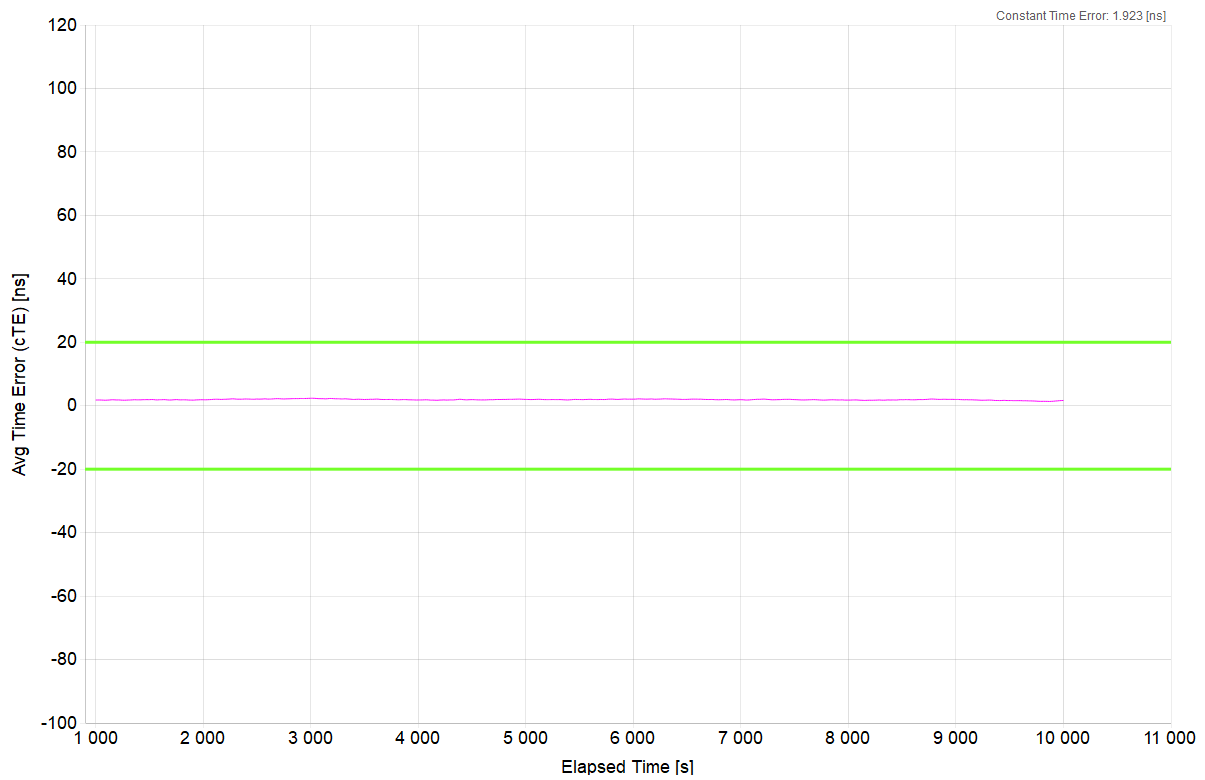
Offset Removal Applied	Off
Zero Offset	1.697ns



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

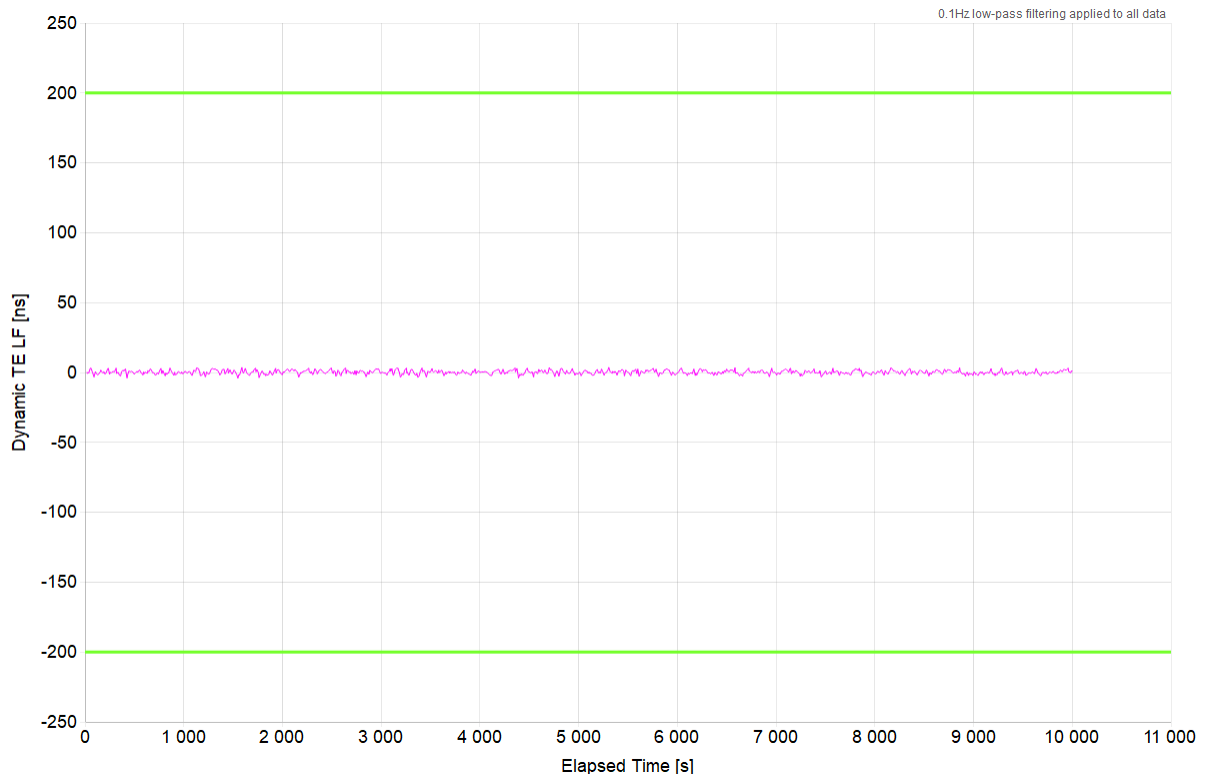
## 8.2 CTE Analysis

<b>Averaging Time (s)</b>	1000
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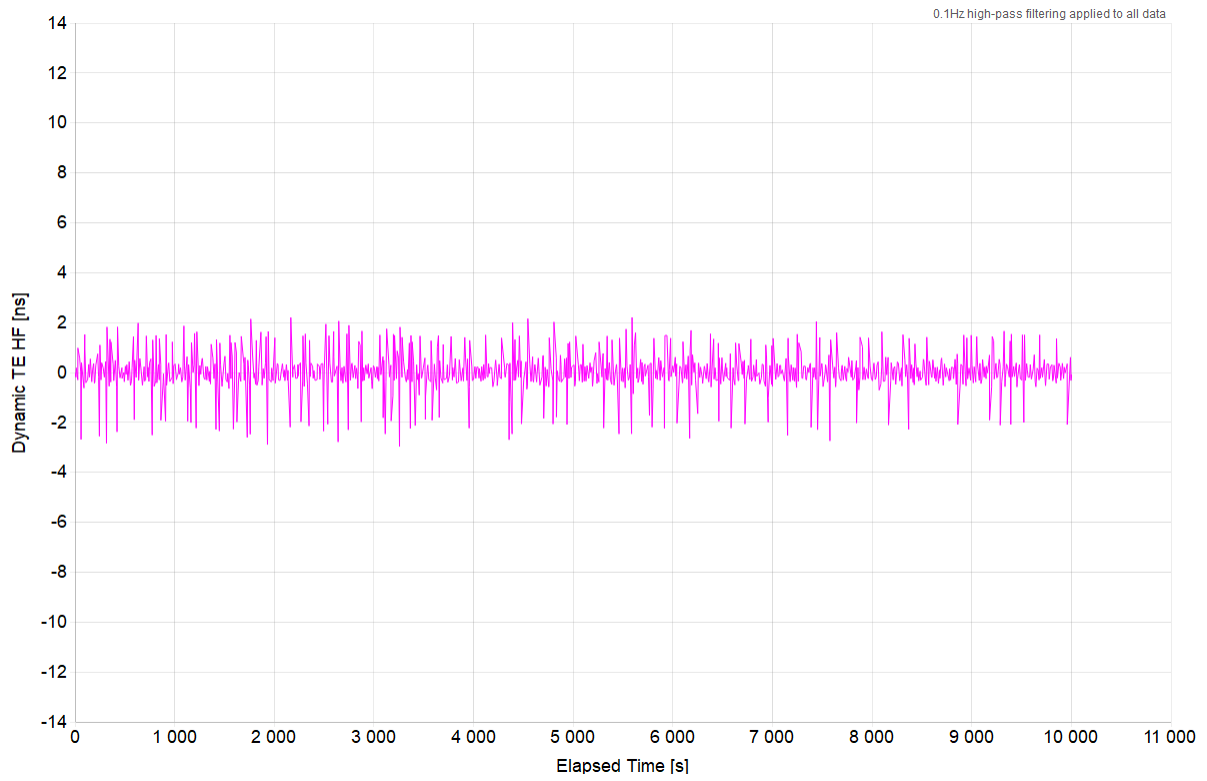
<b>Constant Time Error [ns]</b>	1.923
<b>Min [ns]</b>	1.347
<b>Max [ns]</b>	2.349
<b>Max-Min [ns]</b>	1.002

### 8.3 DTE Analysis



<b>Mean [ns]</b>	0.222
<b>Min [ns]</b>	-4.098
<b>Max [ns]</b>	3.674
<b>Max-Min [ns]</b>	7.771

## 8.4 DTEHF Analysis



<b>Mean [ns]</b>	0
<b>Min [ns]</b>	-2.969
<b>Max [ns]</b>	2.205
<b>Max-Min [ns]</b>	5.174



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

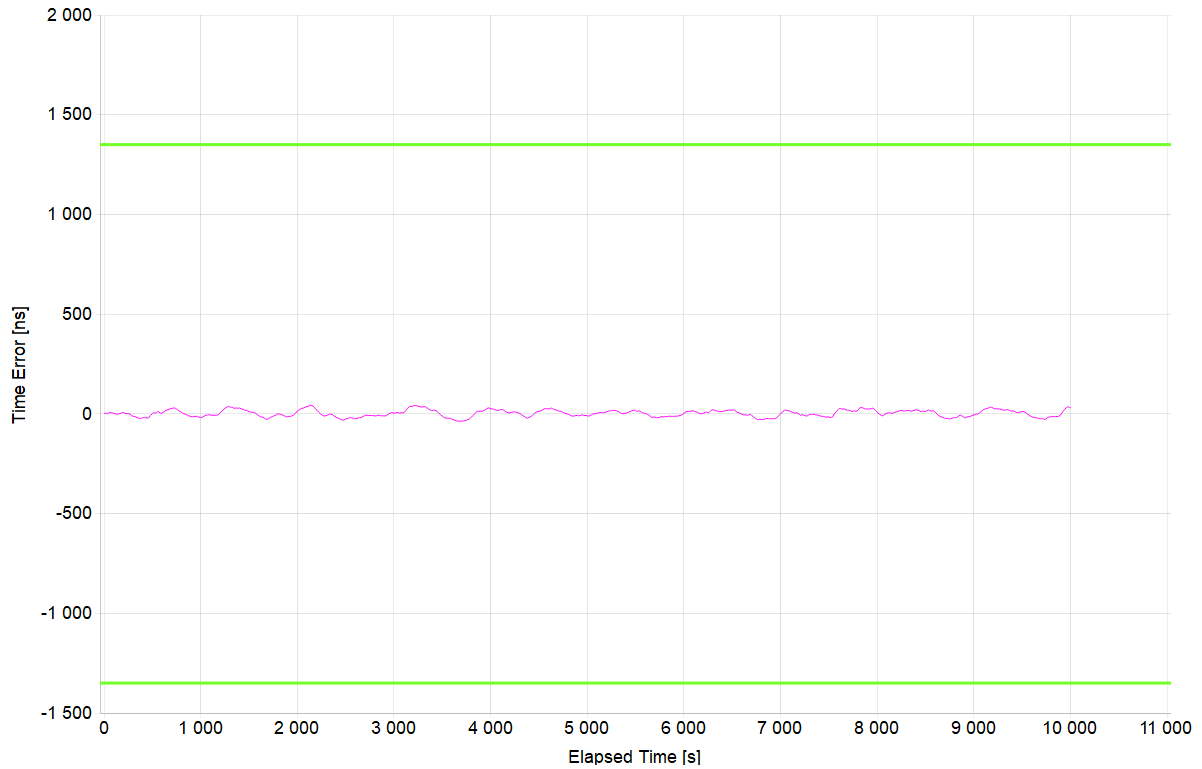
<b>Test Description</b>	Holdover – Single Path
<b>Report Date</b>	22-10-18_08-30-41
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	02:46:40
<b>Time to Phase Lock (s)</b>	N/A

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask MTIE</b>	G.8273.4 APTS Holdover (PTP) Const. Temp.
<b>Mask MTIE Result</b>	<b>Pass</b>

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.

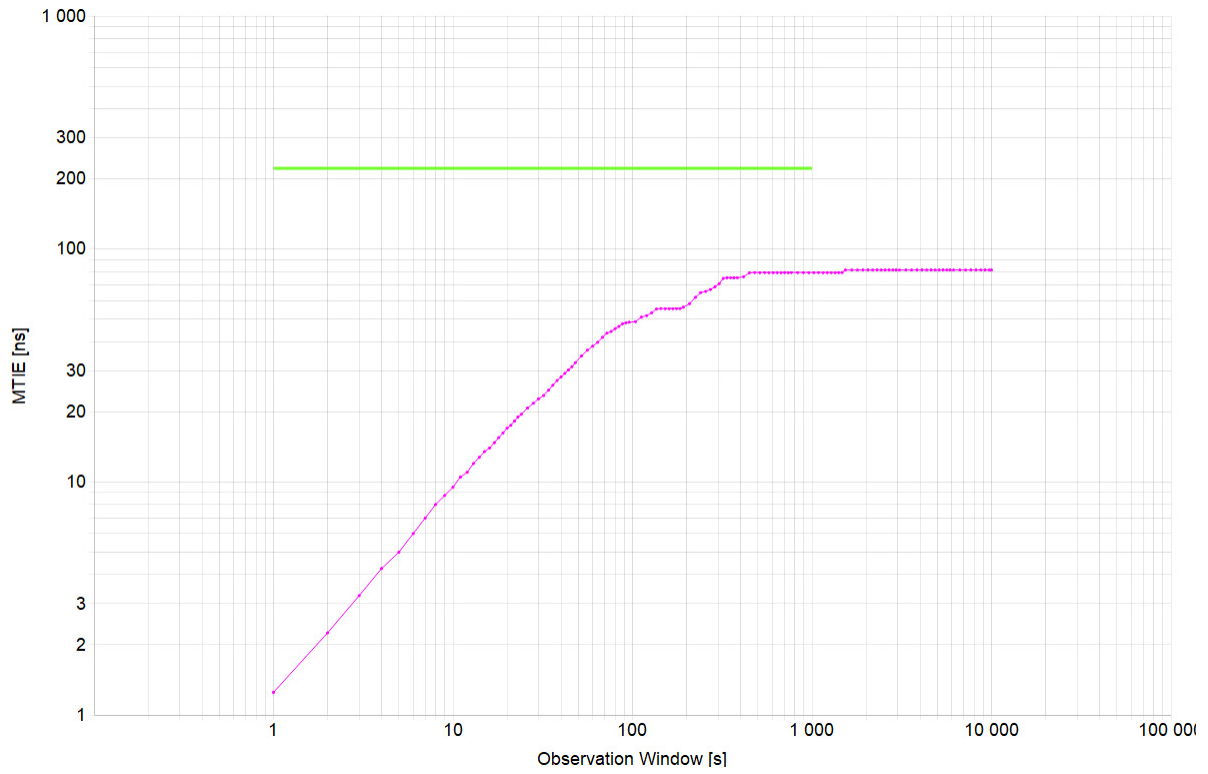
## 9.1 ONEPPS Analysis

<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	2.197ns



<b>Mean [ns]</b>	2.357
<b>Min [ns]</b>	-36.803
<b>Max [ns]</b>	44.447
<b>Max-Min [ns]</b>	81.25

## 9.2 MTIE Analysis



<b>Min [ns]</b>	1.25
<b>Max [ns]</b>	81.25
<b>Max-Min [ns]</b>	80

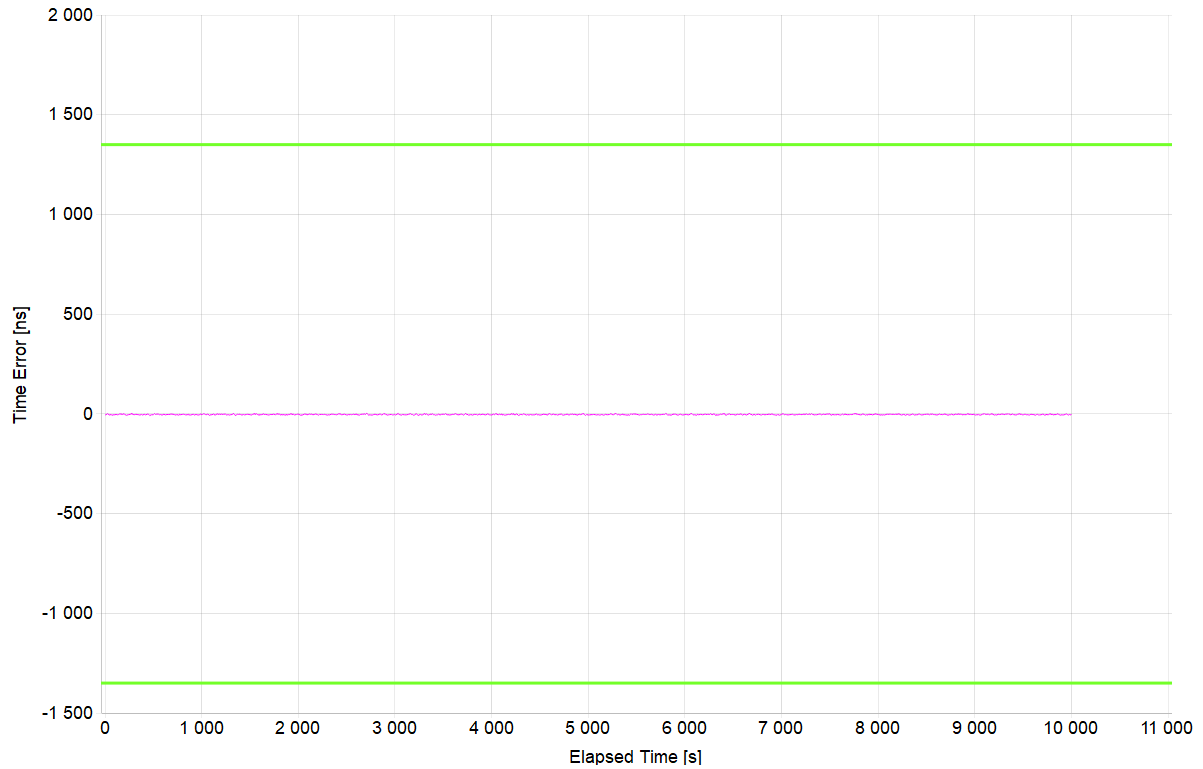
## 10. G.8273.4 APTS: Noise Generation – Single Path (with Oscillator)

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

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35μs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask CTE</b>	0.02μs
<b>Mask CTE Result</b>	<b>Pass</b>
<b>Mask DTE</b>	0.2μs
<b>Mask DTE Result</b>	<b>Pass</b>
<b>Mask DTEHF</b>	-
<b>Mask DTEHF Result</b>	No Mask

### 10.1 ONEPPS Analysis

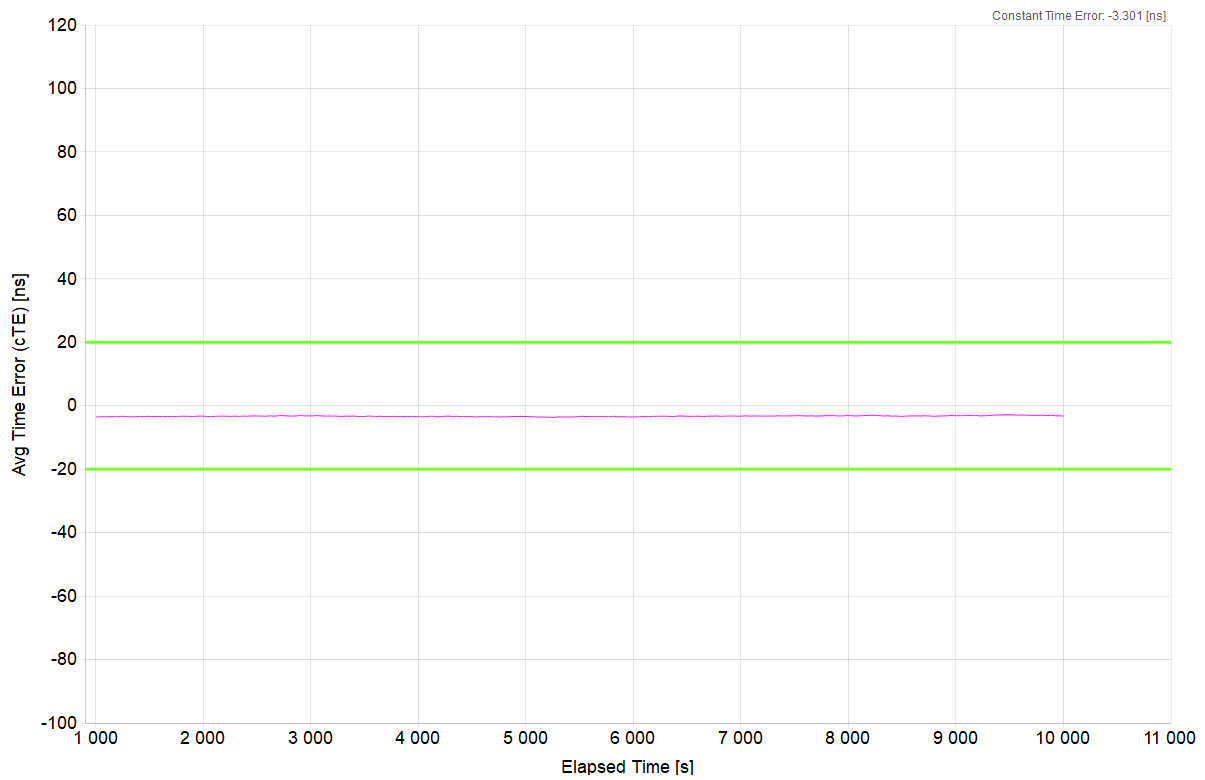
<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	-5.953ns



<b>Mean [ns]</b>	-3.318
<b>Min [ns]</b>	-8.703
<b>Max [ns]</b>	3.547
<b>Max-Min [ns]</b>	12.25

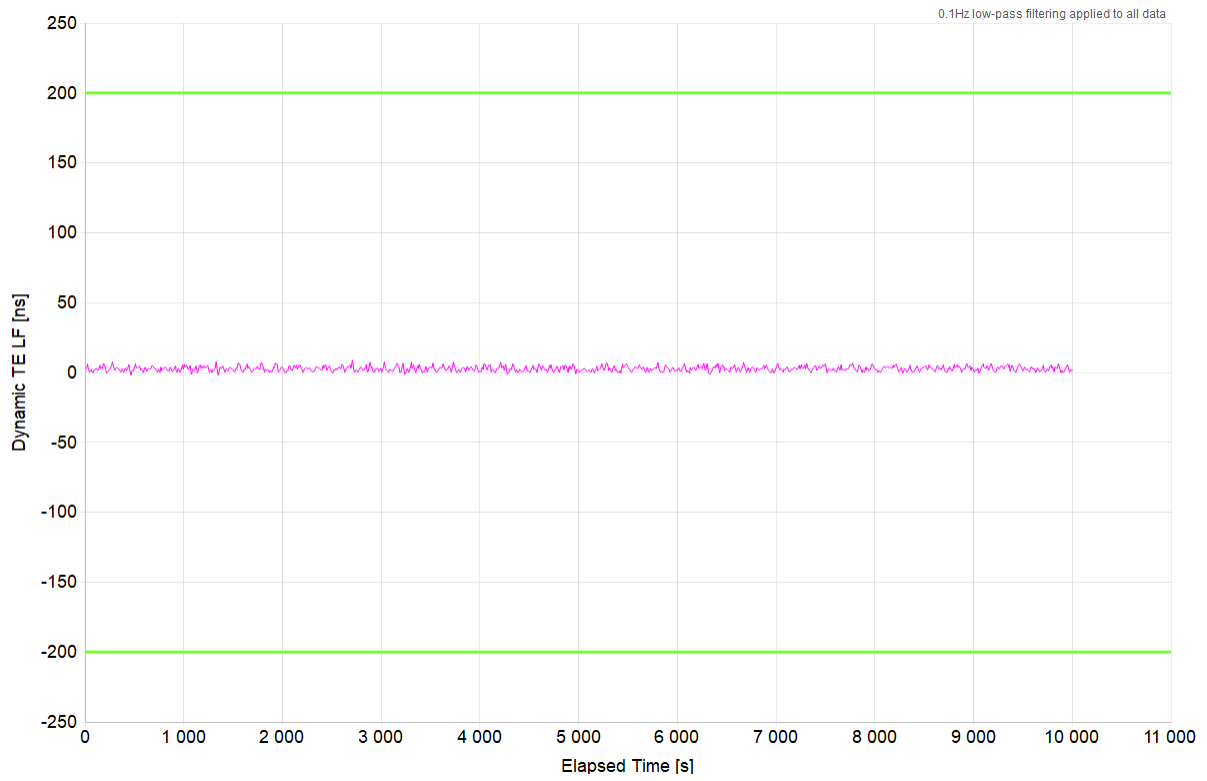
## 10.2 CTE Analysis

<b>Averaging Time (s)</b>	1000
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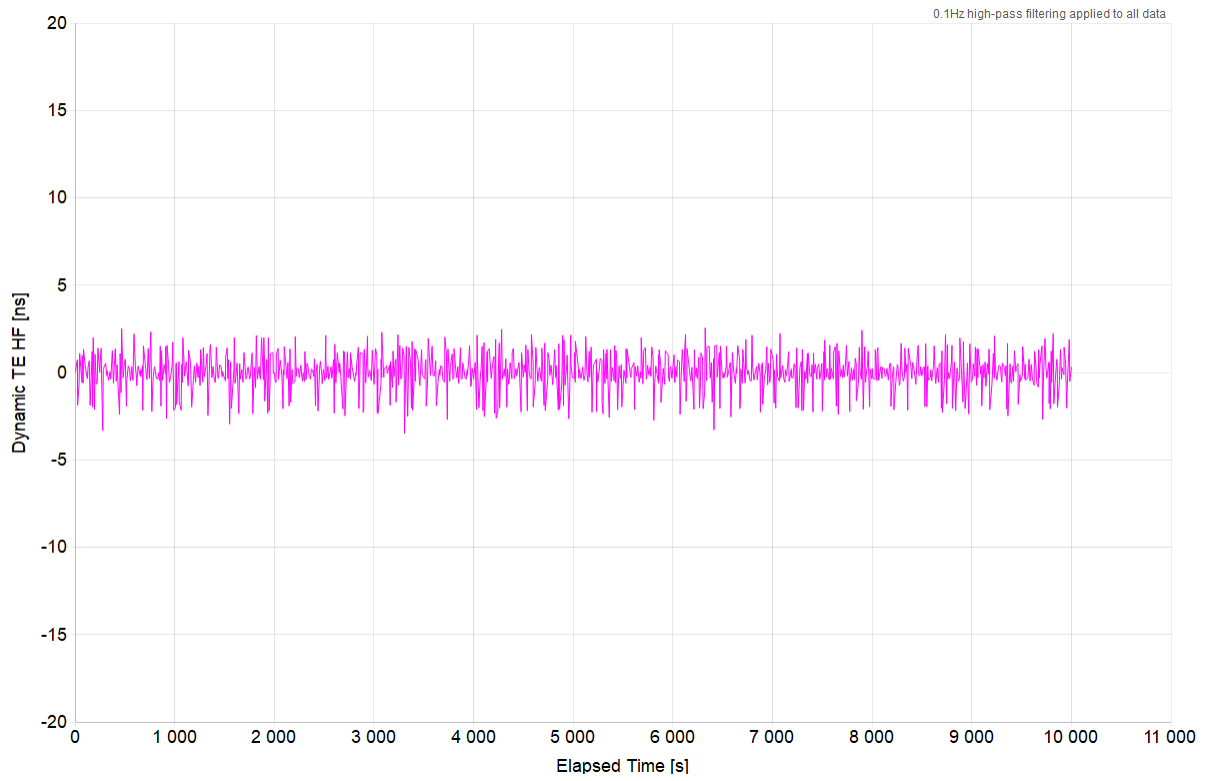
<b>Constant Time Error [ns]</b>	-3.301
<b>Min [ns]</b>	-3.666
<b>Max [ns]</b>	-2.822
<b>Max-Min [ns]</b>	0.845

### 10.3 DTE Analysis



<b>Mean [ns]</b>	2.638
<b>Min [ns]</b>	-2.008
<b>Max [ns]</b>	8.816
<b>Max-Min [ns]</b>	10.824

## 10.4 DTEHF Analysis



<b>Mean [ns]</b>	0
<b>Min [ns]</b>	-3.492
<b>Max [ns]</b>	2.551
<b>Max-Min [ns]</b>	6.042



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

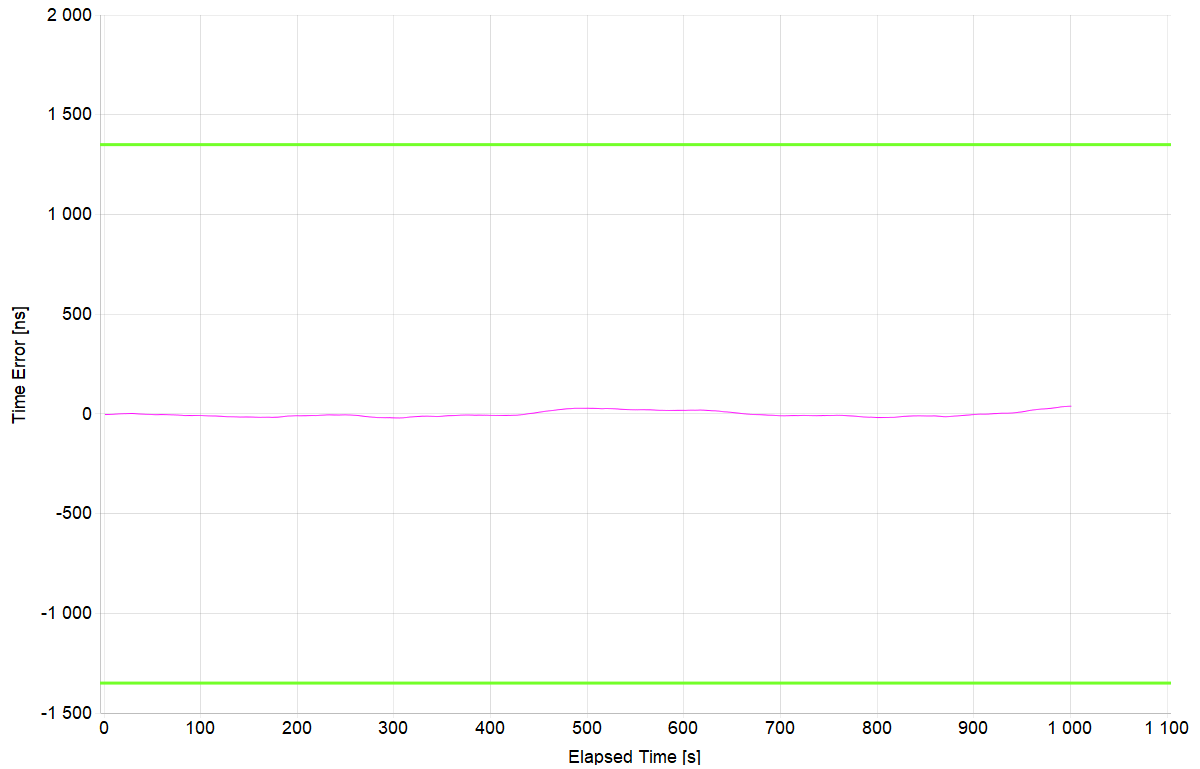
<b>Test Description</b>	Holdover (with Oscillator)
<b>Report Date</b>	22-04-29_10-17-08
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	00:16:40
<b>Time to Phase Lock (s)</b>	N/A

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask MTIE</b>	G.8273.4 APTS Holdover (PTP) Const. Temp.
<b>Mask MTIE Result</b>	<b>Pass</b>

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.

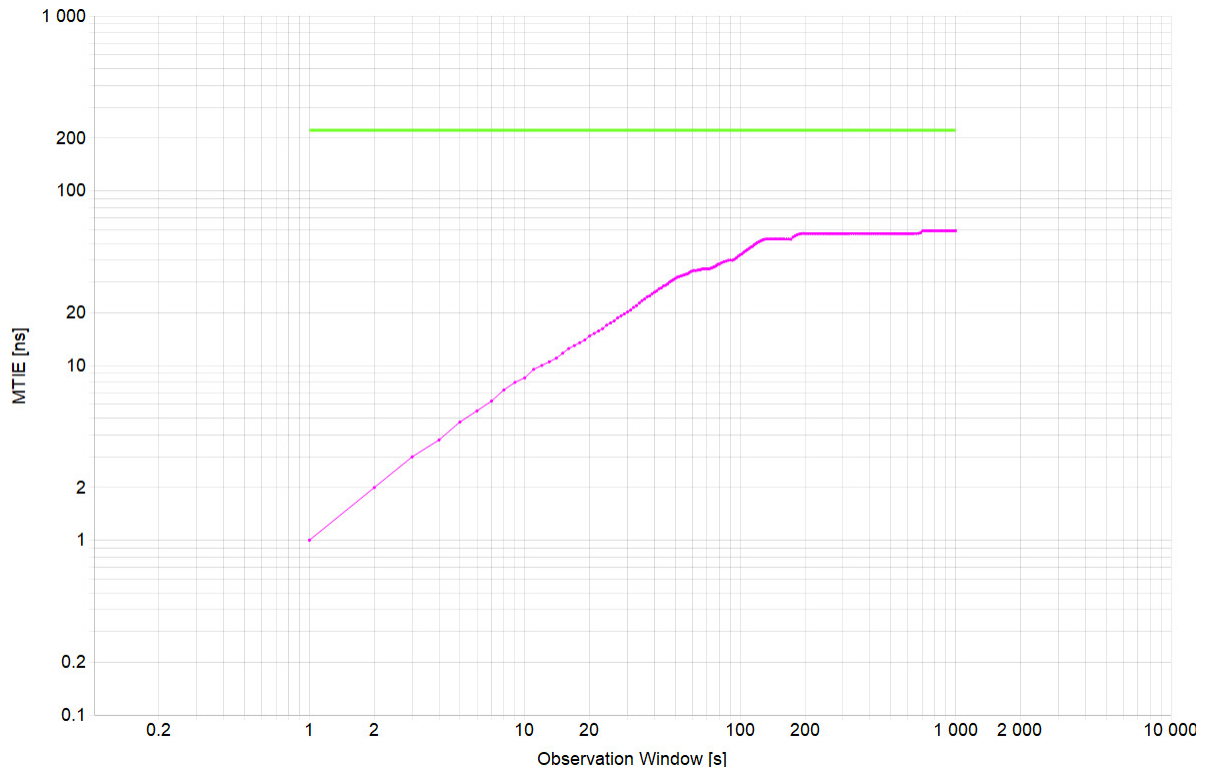
### 11.1 ONEPPS Analysis

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



<b>Min [ns]</b>	1
<b>Max [ns]</b>	59
<b>Max-Min [ns]</b>	58

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

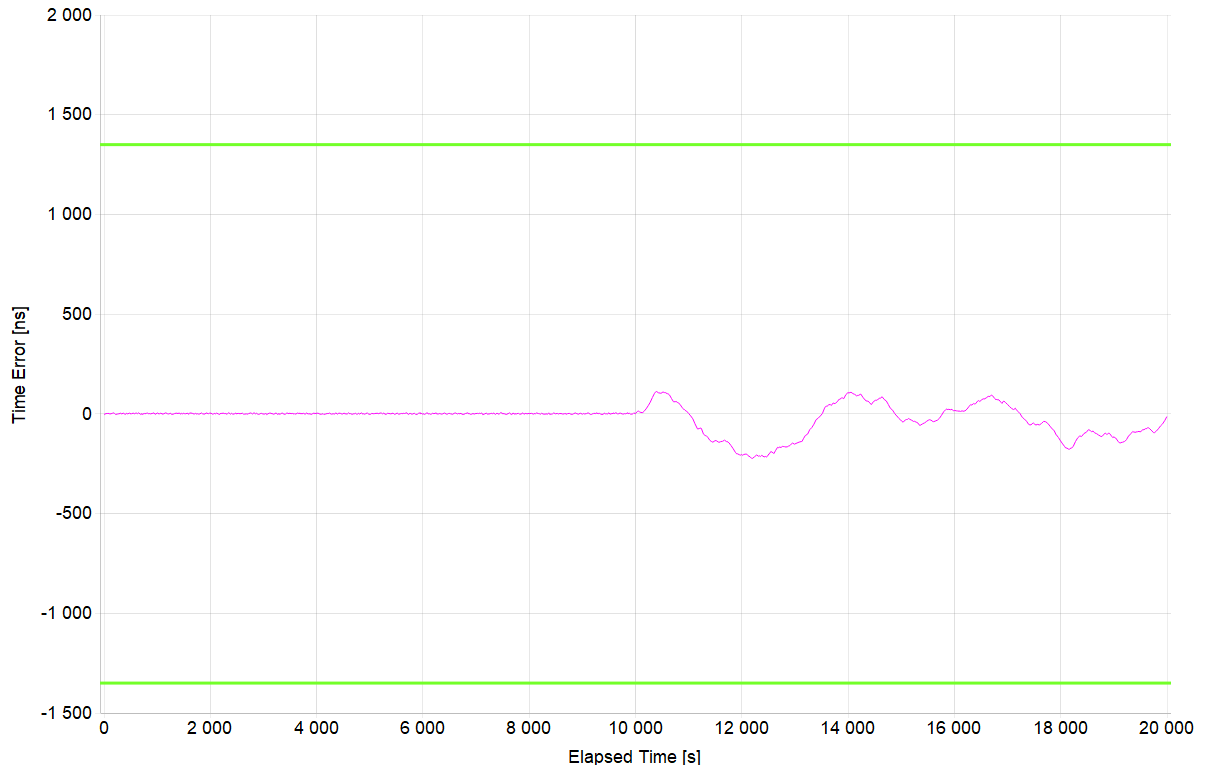
<b>Test Description</b>	Noise Tolerance – No BC’s High Stability PDV
<b>Report Date</b>	22-04-28_17-01-53
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	3

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>

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

<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	-1.203ns



<b>Mean [ns]</b>	-20.993
<b>Min [ns]</b>	-223.453
<b>Max [ns]</b>	112.547
<b>Max-Min [ns]</b>	336

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

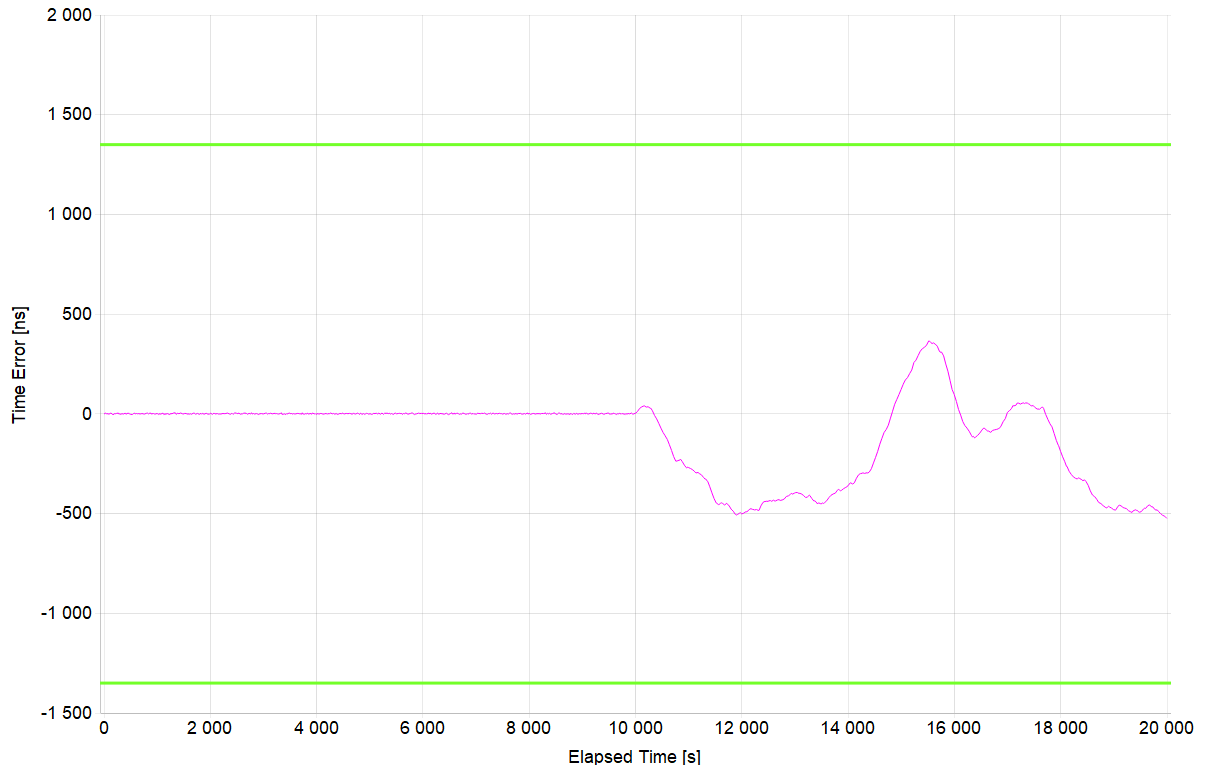
<b>Test Description</b>	Noise Tolerance – No BC’s Normal Stability PDV
<b>Report Date</b>	22-04-28_17-01-53
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	4

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>

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

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

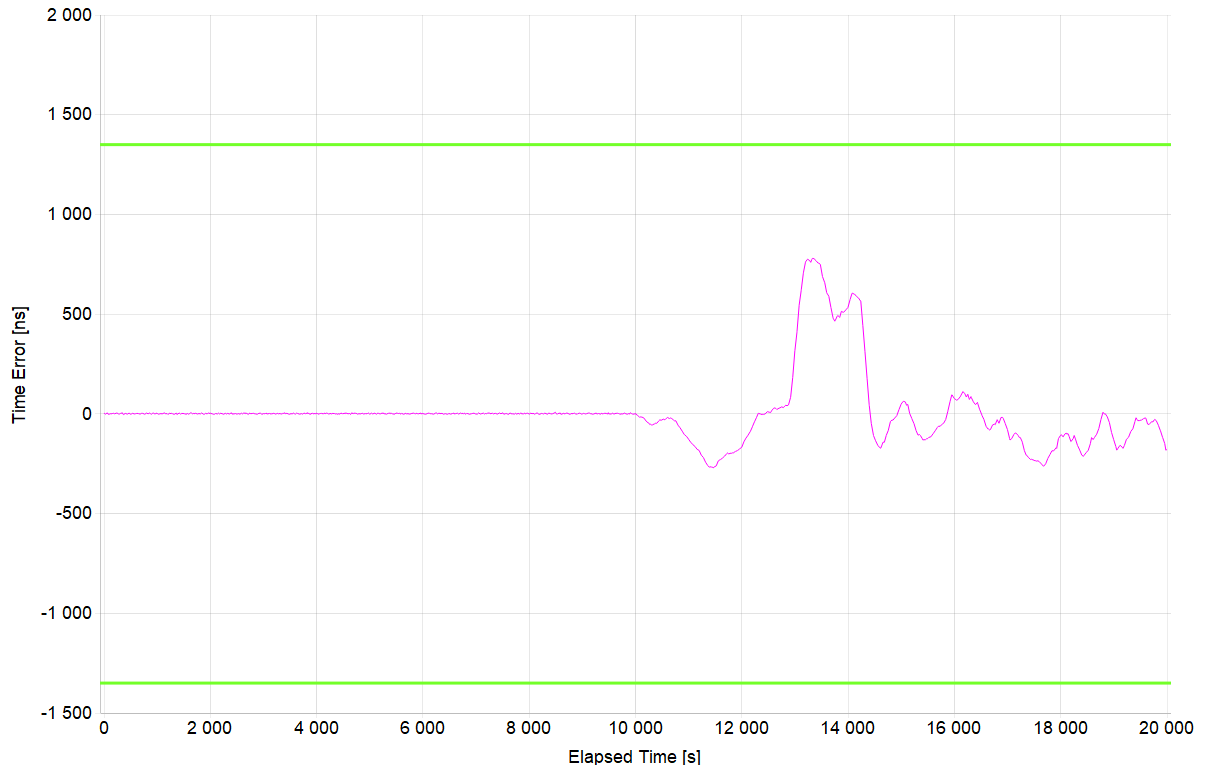
<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>

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

<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	3.297ns



<b>Mean [ns]</b>	5.459
<b>Min [ns]</b>	-270.953
<b>Max [ns]</b>	779.547
<b>Max-Min [ns]</b>	1050.5

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

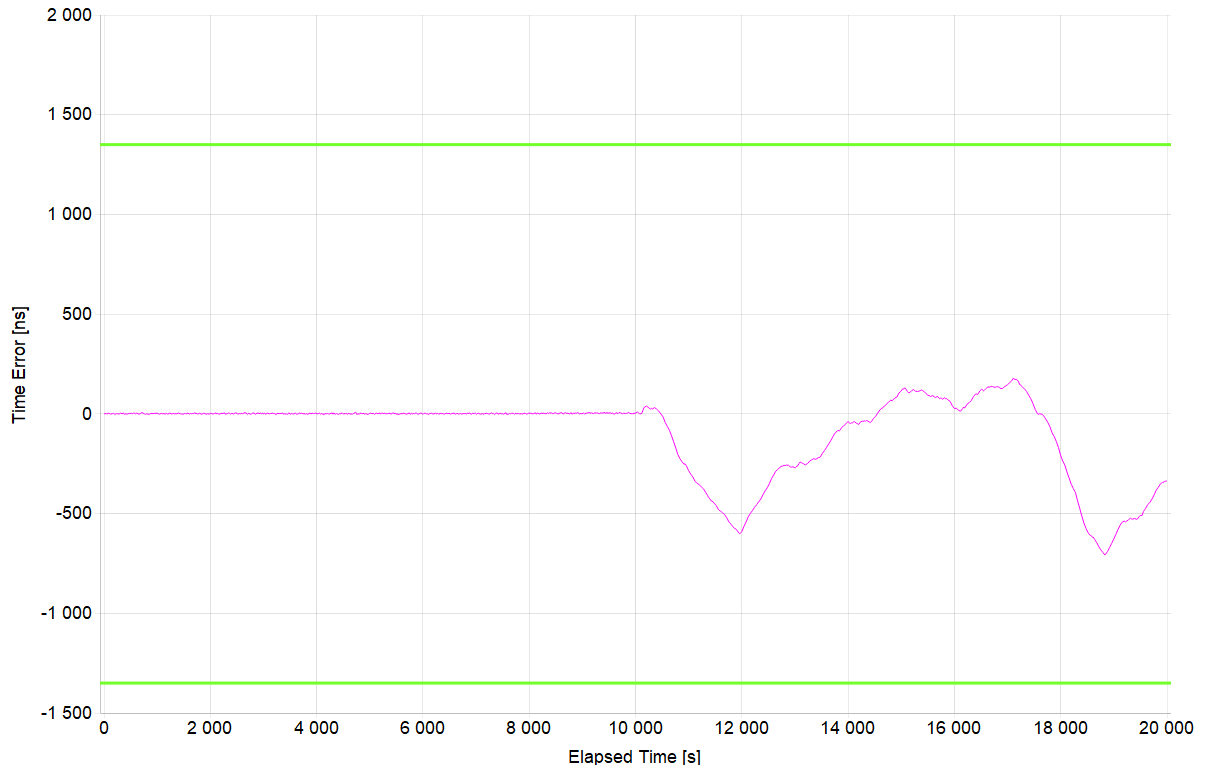
<b>Test Description</b>	Noise Tolerance – With BC’s Normal Stability PDV
<b>Report Date</b>	22-04-28_17-01-53
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	3

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>

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

<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	-0.203ns



<b>Mean [ns]</b>	-91.43
<b>Min [ns]</b>	-708.203
<b>Max [ns]</b>	179.297
<b>Max-Min [ns]</b>	887.5

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

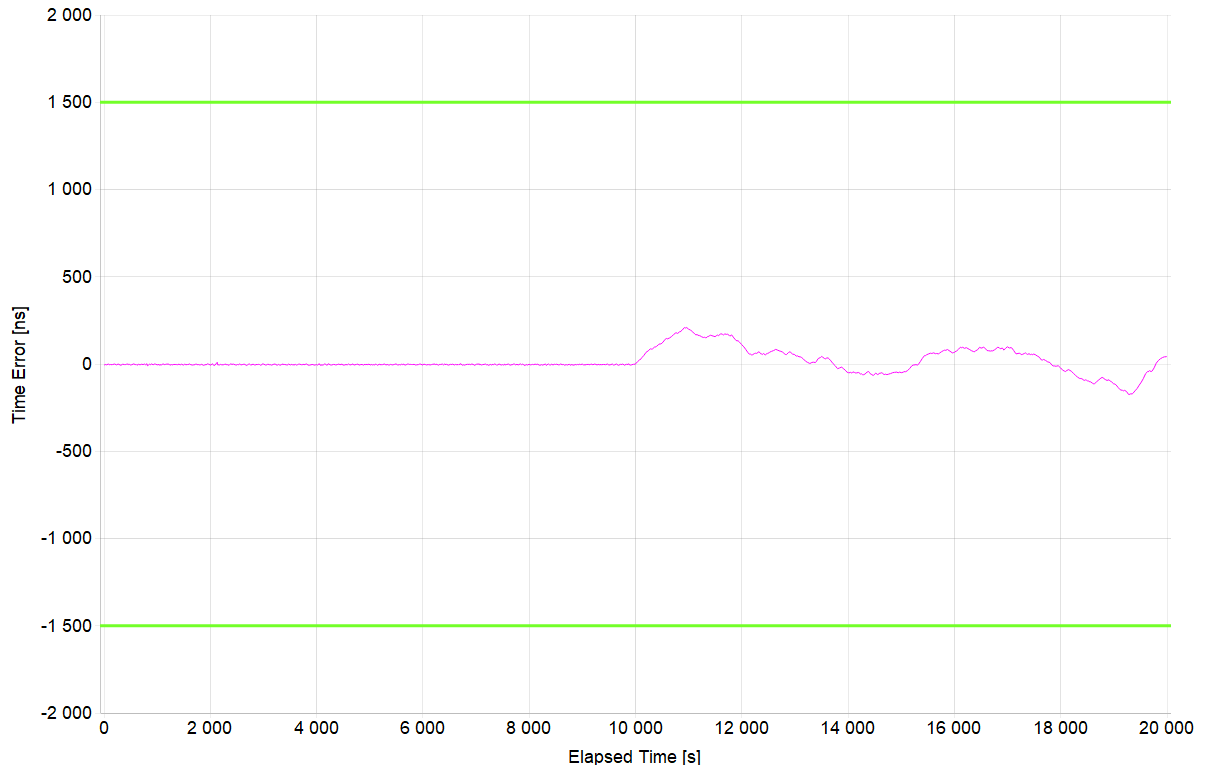
<b>Test Description</b>	Noise Tolerance – ITU-T G.8271.2 PDV Pattern
<b>Report Date</b>	22-04-28_17-01-53
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	3

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.5µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask FILTEREDTIMEERROR</b>	1.35µs
<b>Mask FILTEREDTIMEERROR Result</b>	<b>Pass</b>

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.

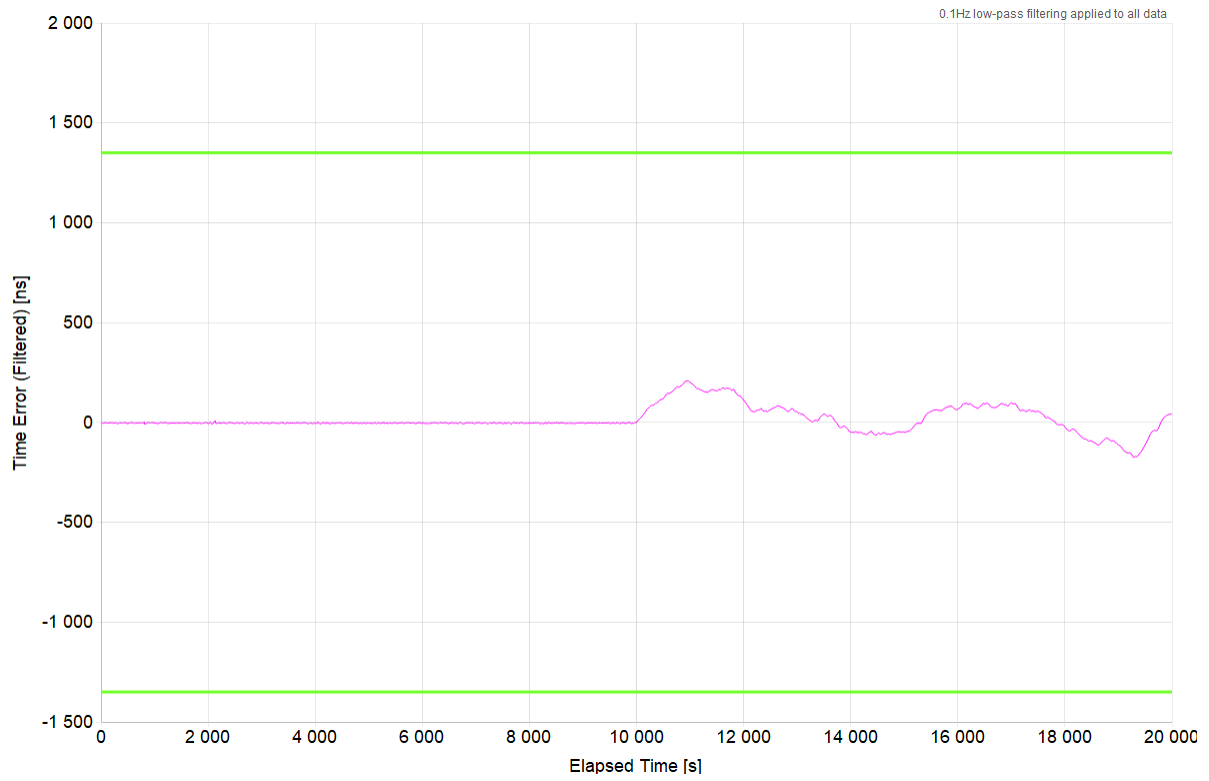
### 16.1 ONEPPS Analysis

<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	-3.703ns



<b>Mean [ns]</b>	13.451
<b>Min [ns]</b>	-174.953
<b>Max [ns]</b>	208.797
<b>Max-Min [ns]</b>	383.75

## 16.2 FILTEREDTIMEERROR Analysis



<b>Mean [ns]</b>	13.461
<b>Min [ns]</b>	-174.752
<b>Max [ns]</b>	208.646
<b>Max-Min [ns]</b>	383.398

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

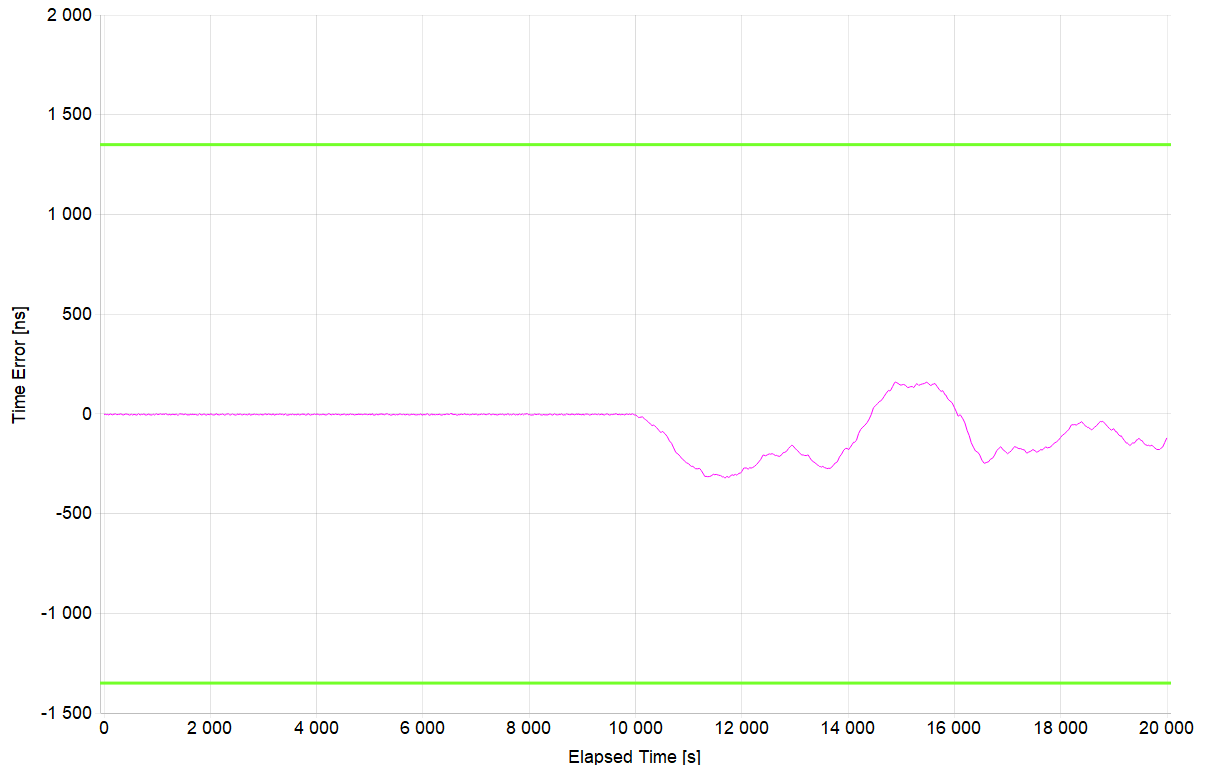
<b>Test Description</b>	Noise Tolerance – No BC’s High Stability PDV
<b>Report Date</b>	22-04-29_10-17-08
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	4

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>

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

<b>Offset Removal Applied</b>	Off
<b>Zero Offset</b>	-3.203ns



<b>Mean [ns]</b>	-64.038
<b>Min [ns]</b>	-321.953
<b>Max [ns]</b>	159.047
<b>Max-Min [ns]</b>	481



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

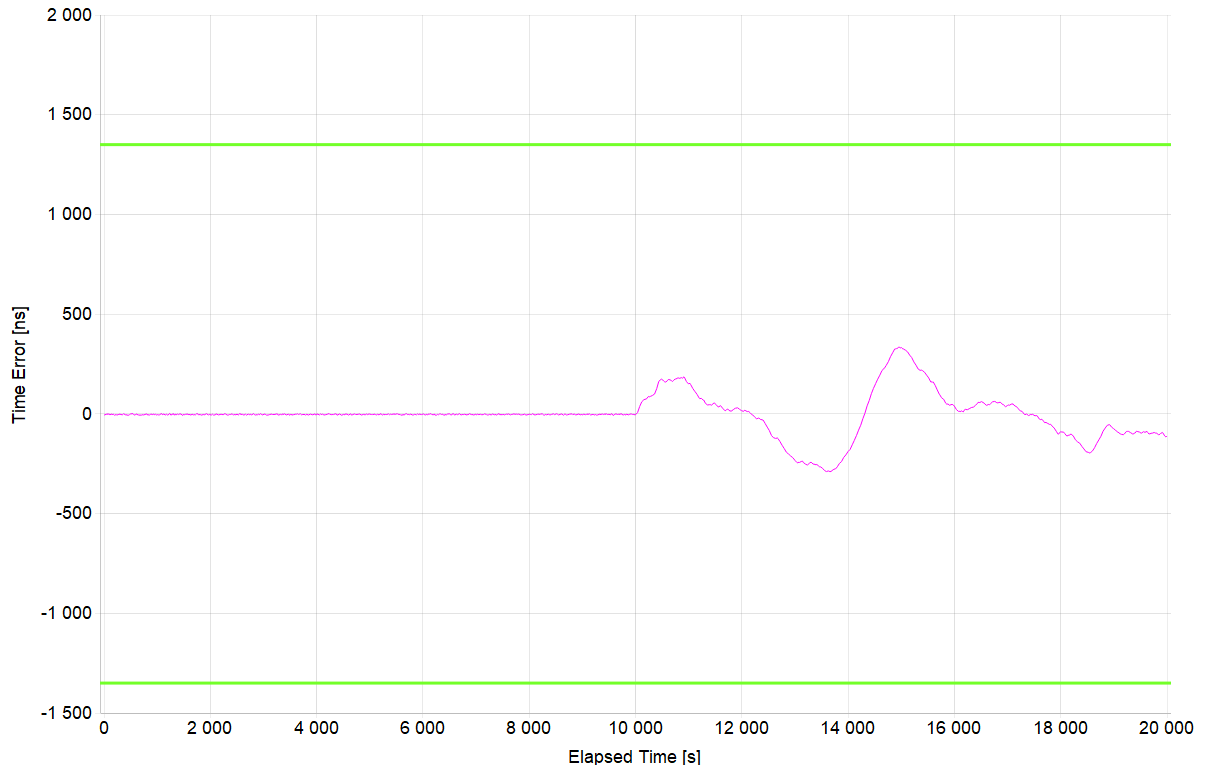
<b>Test Description</b>	Noise Tolerance – No BC’s Normal Stability PDV
<b>Report Date</b>	22-04-29_10-17-08
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	4

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.35µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>

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

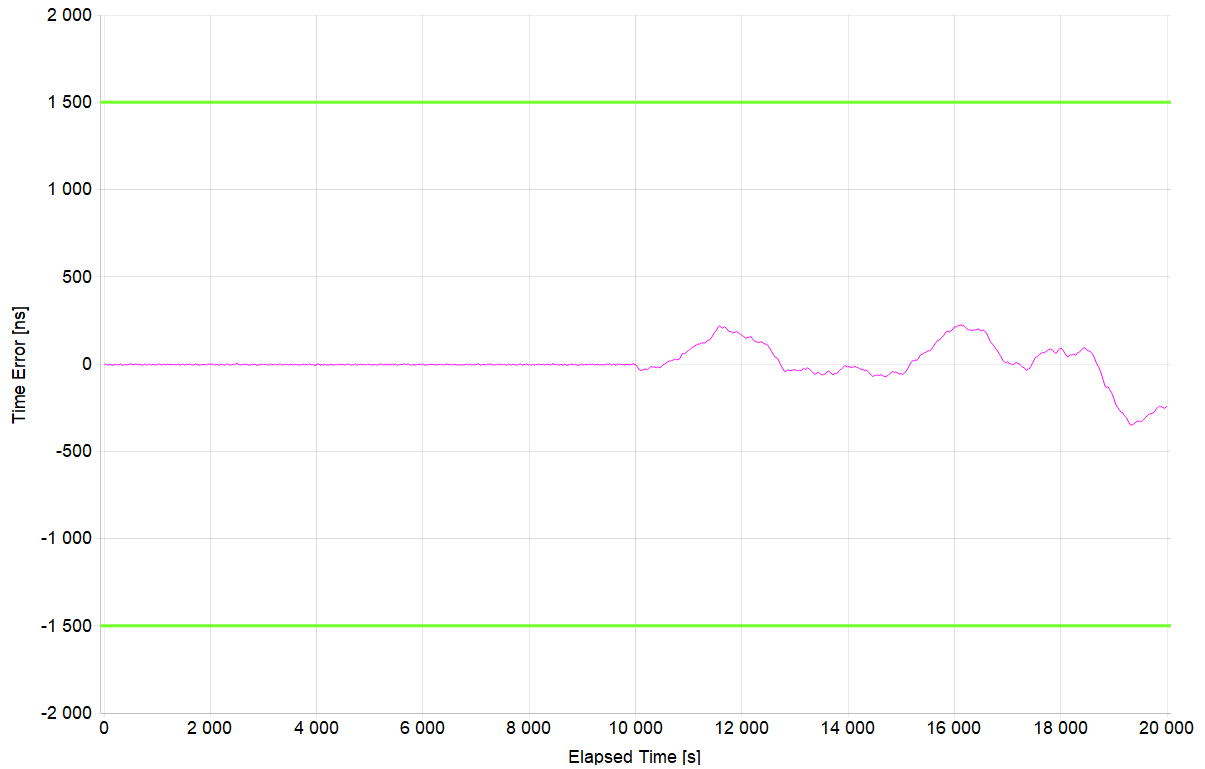
<b>Test Description</b>	Noise Tolerance – ITU-T G.8271.2 PDV Pattern
<b>Report Date</b>	22-04-29_10-17-08
<b>Packet Rate (pkt/s)</b>	16
<b>Test Duration</b>	05:33:17
<b>Time to Phase Lock (s)</b>	4

<b>All Mask Results</b>	<b>Pass</b>
<b>Mask ONEPPS</b>	1.5µs
<b>Mask ONEPPS Result</b>	<b>Pass</b>
<b>Mask FILTEREDTIMEERROR</b>	1.35µs
<b>Mask FILTEREDTIMEERROR Result</b>	<b>Pass</b>

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.

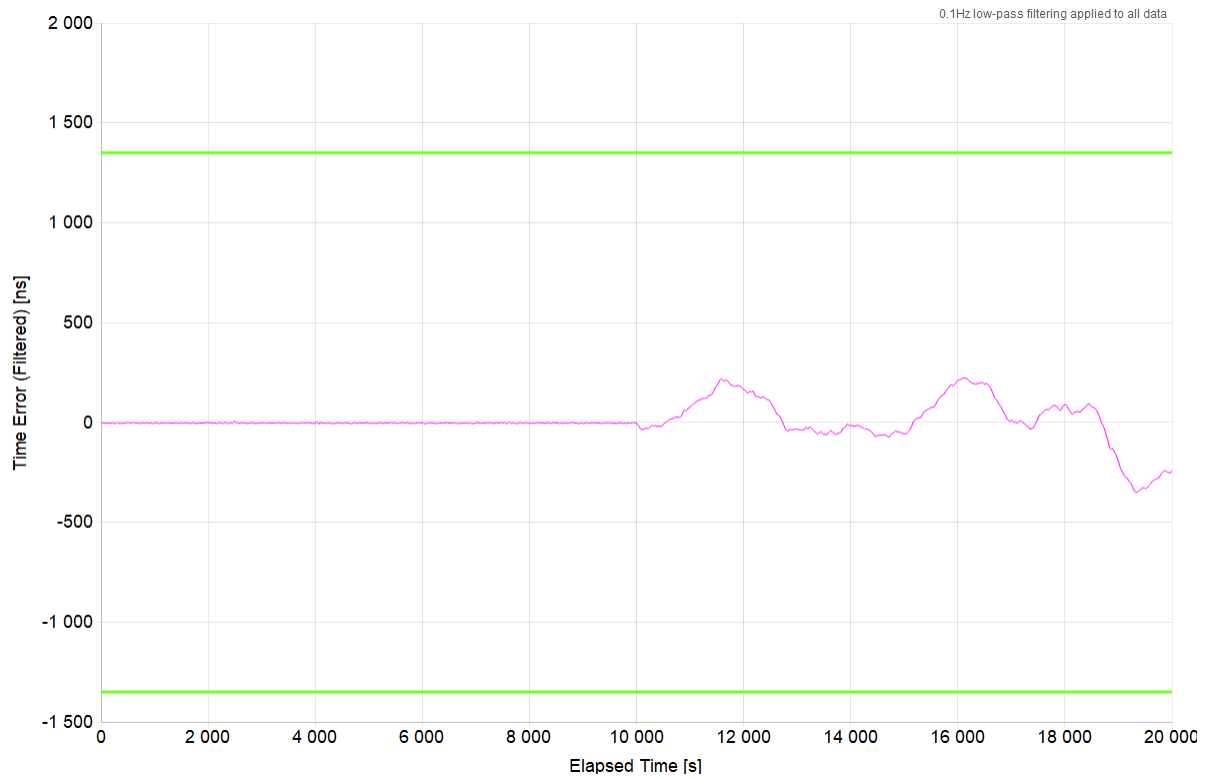
### 19.1 ONEPPS Analysis

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



<b>Mean [ns]</b>	4.673
<b>Min [ns]</b>	-350.296
<b>Max [ns]</b>	223.296
<b>Max-Min [ns]</b>	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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