RC310xx ITUT-T G.8262, ITU-T G.8262.1

This report describes the results for the compliance testing of the Renesas RC310xx's (VersaClock7) PLL to ITU-T G.8262, ITU-T G.8262.1 standards for phase transient due to synchronization rearrangement operations, phase transient tolerance, wander transfer, wander generation, and holdover. DPLL lock time was also tested.

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1. Description of Tests and Setup

This report discusses the results for the compliance testing of Renesas VersaClock7® PLL RC31012 GUI profile presets. For more information see VersaClock® 7 Programmable Jitter Attenuator Family. PLL configurations were tested for conformity to ITU-T G.8262, ITU-T G.8262.1 standards for phase transient due to synchronization rearrangement operations, phase transient tolerance, wander transfer, wander generation, and holdover. DPLL lock time was also tested.

While this was tested on the RC31012, the results also apply to the RC31008.

The synchronization rearrangement of the network is introduced through automatic reference switching between two clock inputs or through disconnecting the qualified reference clock input. A ClockMatrix generator board is used to introduce wander to and from the system as well as introduce phase transients. An Agilent 53230A Universal Frequency Counter the measurement of phase transients and wander. The Agilent 33250 Waveform Generator is used to produce stable reference for the generator board. The Symmetricom TimeProvider acts as a stable and accurate clock source locked to GPS. Its 10MHz clock output serves as the 10MHz reference clock for the Agilent 33250A waveform generator.

Figure 1 shows a diagram of the test setup.

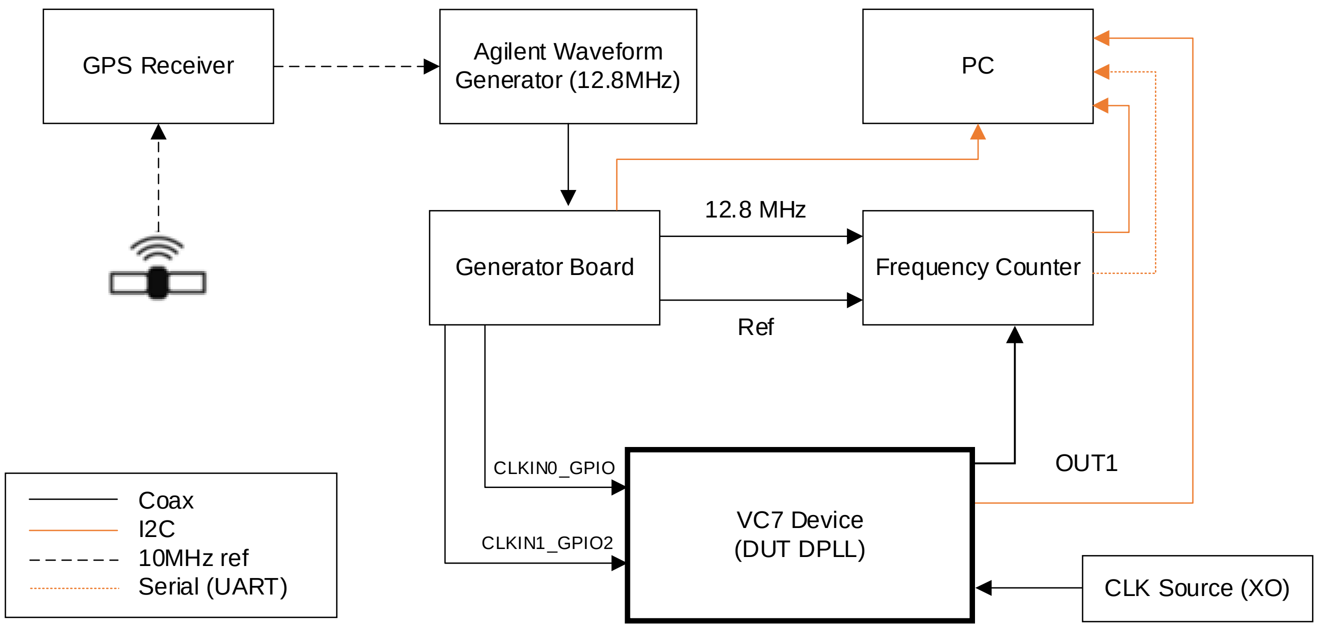

Figure 1. Complete Test Setup

The DUT locks to a reference clock provided by the generation board. The clock source (XO) for the DUT is an ideal oscillator. A Rohde & Schwarz SMA100B is used in place of an XO or XTAL. VersaClock7 supports digital low-pass filter whose bandwidth and phase slope limit is set based on the standard ITU-T G.8262 Opt1/Opt2, ITU-T G8262.1 to test their compliances. Fractional Frequency Offset (FFO), Time Interval Error (TIE), Maximum Time Interval Error (MTIE), and Time Deviation (TDEV) plots are calculated from the measurements taken by the measurement board. The objective maximum FFO, MTIE, and TDEV plots for each test have the mask specified in the applicable standard.

2. Test Equipment Calibration Information

Table 1. Test Equipment and Calibration

Test Equipment Description	Model	Corresponding Block in Figure 1
Symmetricom TimeProvider	TP5000	GPS Receiver
Agilent 80MHz function / arbitrary waveform generator	33250A	Agilent Waveform Generator (12.8MHz)
Agilent DC Power supply	E3631A	N/A
ClockMatrix Generator Board	144BGA EVB	Generator Board
Agilent Universal Frequency Counter	53230A	Frequency Counter
Rohde & Schwarz Signal Generator	SMA100B	CLK Source (XO)

3. PLL Settings Information

Table 2. PLL Settings used for Compliance Testing

Compliance Std. No.	ITUT-G.8262 Option [1]	ITUT-G.8262 Option [2]	ITUT-G.8262.1 eEEC	Register Name in RICBox
Input	25 MHz	25 MHz	25 MHz	Input_freq_clkin0 [1]
Output Frequency	25 MHz	25 MHz	25 MHz	Output_bank_freq_goal_bank6[2]
Mode	Jitter Attenuator	Jitter Attenuator	Jitter Attenuator	Operation_mode
PLL Bandwidth (Hz)	1.3[3] / 10	0.1	1.3[3]/3	Dpll_normal_bandwidth_goal
Phase Slope limit (µs/s)	7.5	0.885	7.5	dpll_phase_slope_limit_goal
Lock Criteria (ns)	250[4]	600[5]	250	dpll_lock_threshold_goal
Lock Duration (s)	1	1	1	TOP.DPLL.DPLL_LOCK.dpll_lock_timer
Holdover Bandwidth (mHz)	100	10	100	dpll_holdover_bandwidth_goal

1. Exact register depends on input used.
2. Exact register depends on output used.
3. The data in this report is labelled as 1.2Hz because due to the granularity of the dpll bandwidth setting, dpll_normal_bandwidth_goal = 1.3Hz results in the actual bandwidth to be ~1.2Hz. Setting the goal bandwidth to 1.2Hz would result in an actual bandwidth of ~1Hz.
4. Data in this report was captured using a lock criteria of 120ns, but in practice, a lock criteria of 250ns is recommended.
5. Data in this report was captured using a lock criteria of 120ns, but in practice, a lock criteria of 600ns is recommended.

Compliance Std. No.	ITUT-G.8262 Option [1]	ITUT-G.8262 Option [2]	ITUT-G.8262.1 eEEC	Register Name in RICBox
Advanced Holdover History	9 seconds	9 seconds	9 seconds	TOP.DPLL.HOLDOVER_CNFG.holdover_history
Fastlock Fast Acquisition[6]	Always use Normal Operation settings	Use Locking settings when the DPLL is in the Acquire state	Always use Normal Operation settings	TOP.DPLL.DPLL_MODE.bw_damp_sw
FastLock Bandwidth (Hz)	N/A	1	N/A	dpll_acquire_bandwidth_goal
Fast Lock Damping (dB)	N/A	0.2	N/A	dpll_acquire_gain_peaking_goal
Hitless Switching	Disabled	Disabled	Enabled	TOP.DPLL.DPLL_REF_FB_CNFG.dpll_hitless_en
DPLL Normal Operation Loop Filter Gain Peaking (dB)	0.2	0.2	0.2	Dpll_normal_gain_peaking_goal
Reference Monitoring LOS	Enabled	Enabled	Enabled	Los_mon_enable_clkin 0 1
Reference Monitoring FFO	Enabled	Enabled	Enabled	freq_mon_enable_clkin 0 1

4. Compliance Summary

Table 3 summarizes the results of the compliance testing.

Table 3. Compliance Results

Test	ITU-T-G.8262 Option 1	ITU-T-G.8262 Option 2	ITU-T-G.8262.1	GNSS Up-Convert
Phase Discontinuity	Pass	Pass	Pass	Pass
Phase Transient	Pass	Pass	Pass	Pass
Short Term Phase Transient	Pass	Pass	Pass	Pass
Wander Transfer	Pass	Pass	Pass	Pass
Wander Generation	Pass	Pass	Pass	Pass
Holdover Performance	Pass	Pass	Pass	Pass

[6] For Lock Recovery and Lock Acquisition

5. Frequency Accuracy

Frequency accuracy at free-run is determined by the system oscillator used. For more information, see AN-807 Recommended Crystal Oscillators for Network Synchronization.

Note: The DUT only contributes to the initial frequency offset (a_1) and transition phase shift (c) on entry into holdover. The drift (b) and frequency offset due to temperature (a_2) comes from the local oscillator.

5.1 Option 1

Refer to section G.813 Option 1 / G.8262 Option 1 (see Table 8 in AN-807).

5.2 Option 2

Refer to section GR-1244-CORE and GR-253-CORE Stratum 3 / G.812 Type IV / G.8262 Option 2 (see Table 7 in AN-807).

5.3 Enhanced or For Both Options 1/2

Refer to section G.8262.1 Enhanced Synchronous Ethernet/OTN Equipment Clock (see Table 6 in AN-807).

6. Wander Generation and Long-Term Phase Transient Response (Holdover)

The wander generation requirement checks for the noise generated by the DUT, while the PLL is locked to an input clock signal that is wander free, it should not generate any wander that exceeds the MTIE mask as given by the standard being tested. See Figure 1 for the equipment configuration.

The wander generation and holdover test is carried out by providing a reference clock from an Agilent waveform generator on IN_A. The PLL should not produce/add any wander to the output beyond standard allowed value. The test is run for 3 hours with a stable no wander input, and the output from OUT_1 is monitored for phase error on the measurement board. The clock signal on IN_A is then turned OFF for 20 minutes and the PLL goes into holdover state once the input is removed. The phase error between the output OUT_1 and a second signal (reference signal from the generator board) is measured on the counter. The TIE and MTIE plots show the response of DUT in these conditions.

Note: The DUT only contributes to the initial frequency offset (a_1) and transition phase shift (c) on entry into holdover. The drift (b) and frequency offset due to temperature (a_2) comes from the local oscillator.

6.1 Wander Generation – G8262 EEC Option 1 1Hz

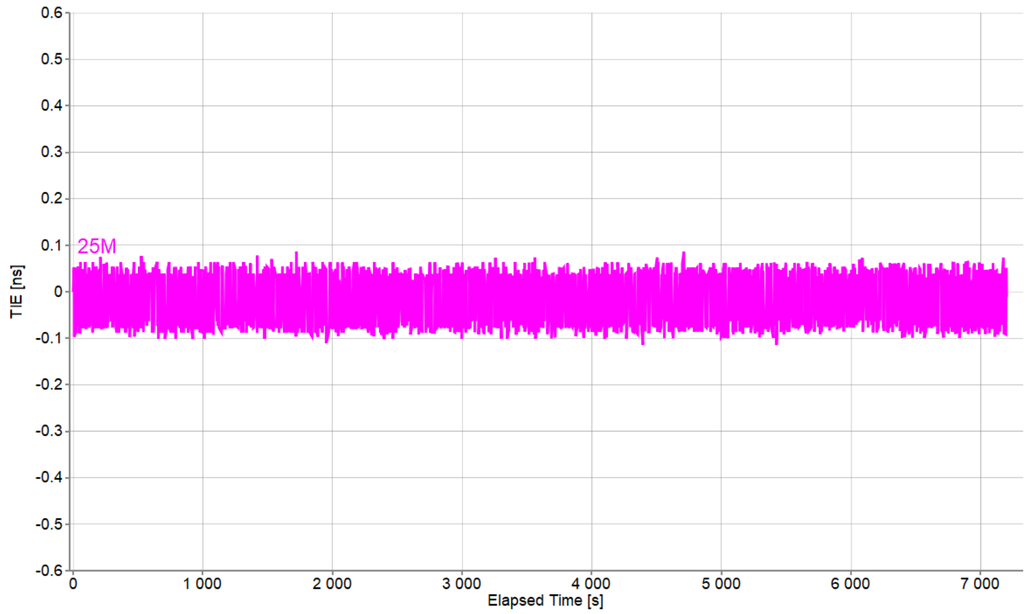

Figure 2. Wander Generation – G8262OPT1 (TIE)

Mean [ns]	-0.019
Min [ns]	-0.114
Max [ns]	0.086
Max-Min [ns]	0.201

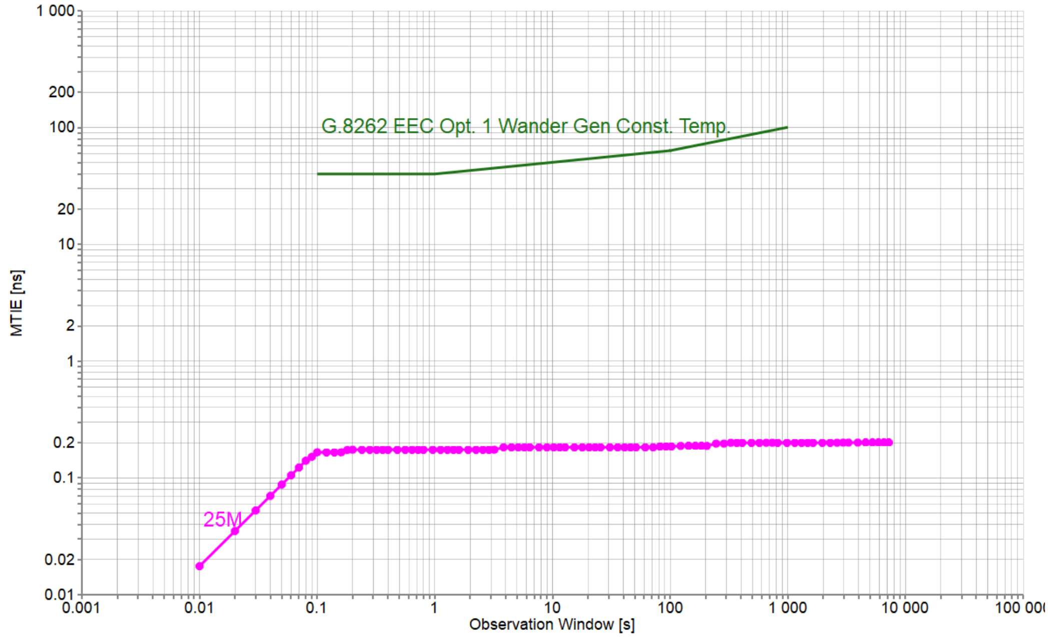

Figure 3. Wander Generation – G8262OPT1 (MTIE)

Min [ns]	0.018
Max [ns]	0.201
Max-Min [ns]	0.183

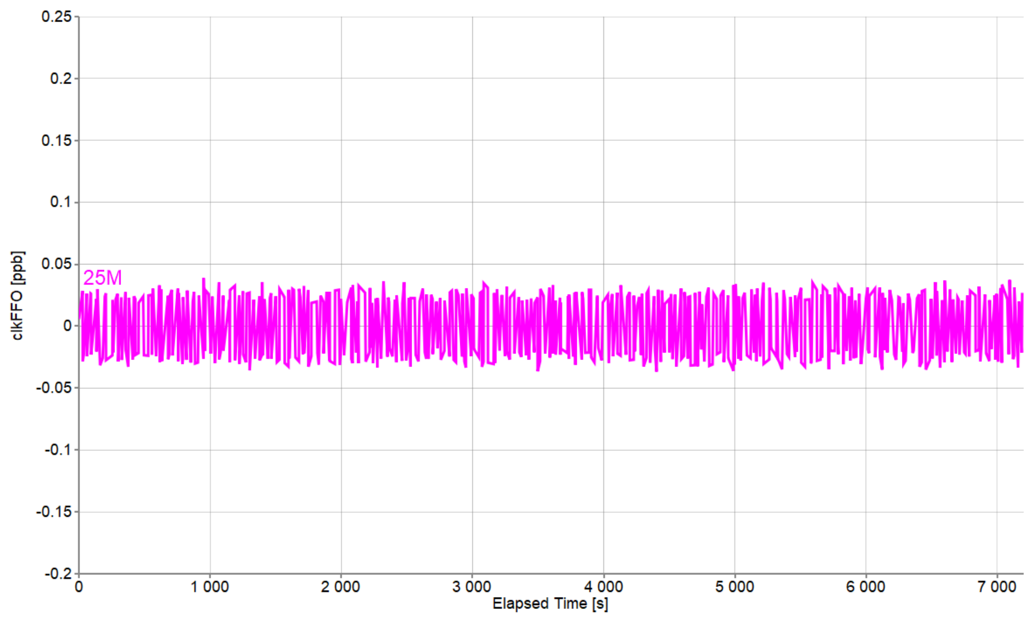

Figure 4. Wander Generation – G8262OPT1 (FFO)

Mean [ppb]	0
Min [ppb]	-0.037
Max [ppb]	0.039
Max-Min [ppb]	0.076

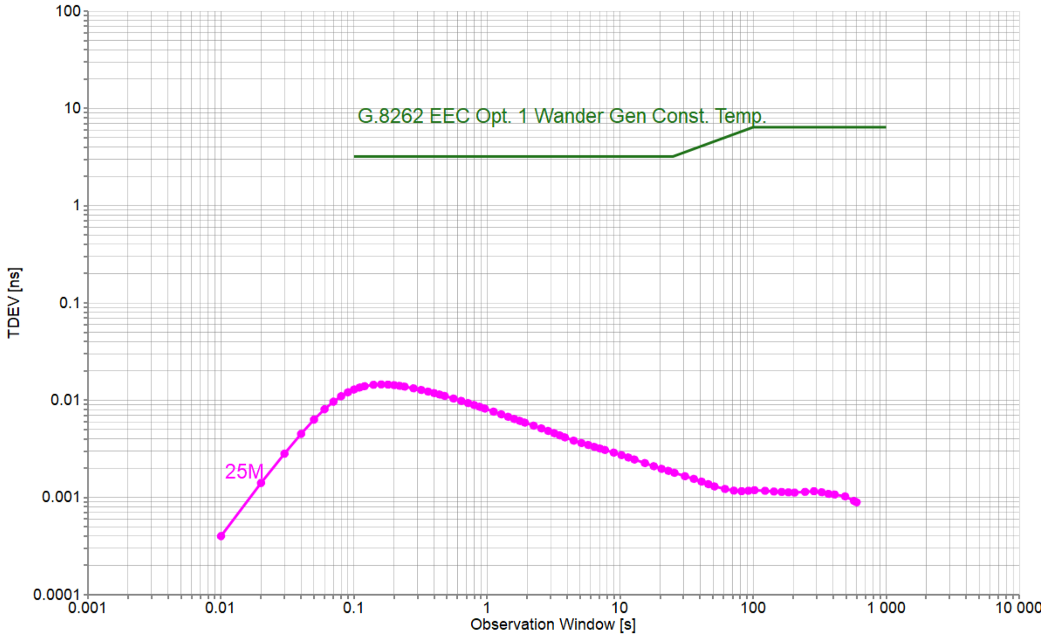

Figure 5. Wander Generation – G8262OPT1 (TDEV)

Min [ns]	0
Max [ns]	0.015
Max-Min [ns]	0.014

6.2 Holdover – G8262 EEC Option 1 1Hz

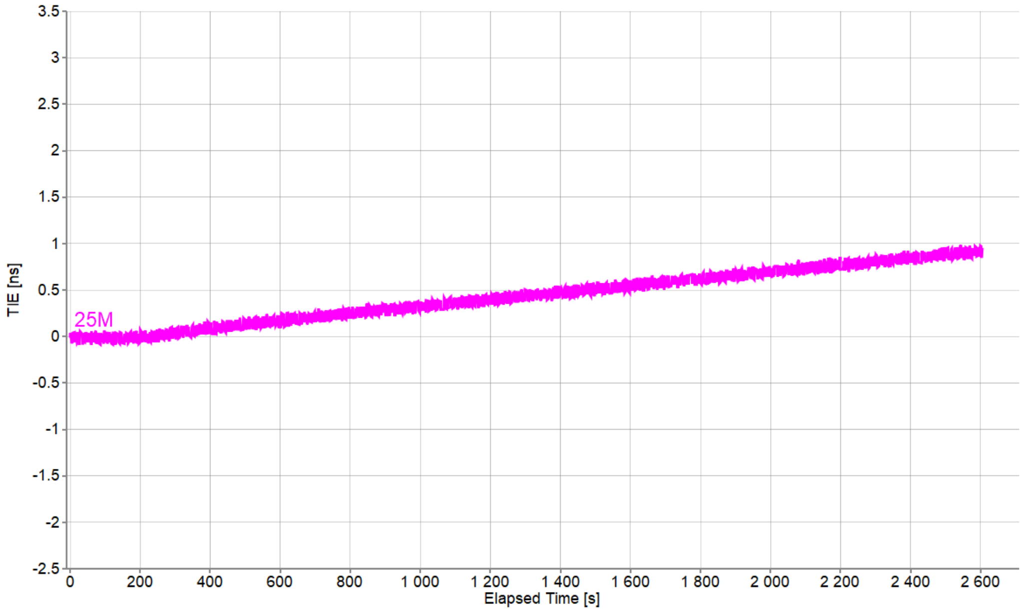

Figure 6. Holdover – G.8262 EEC Option 1 1.2Hz (TIE_no_mask)

Mean [ns]	0.43
Min [ns]	-0.091
Max [ns]	0.984
Max-Min [ns]	1.074

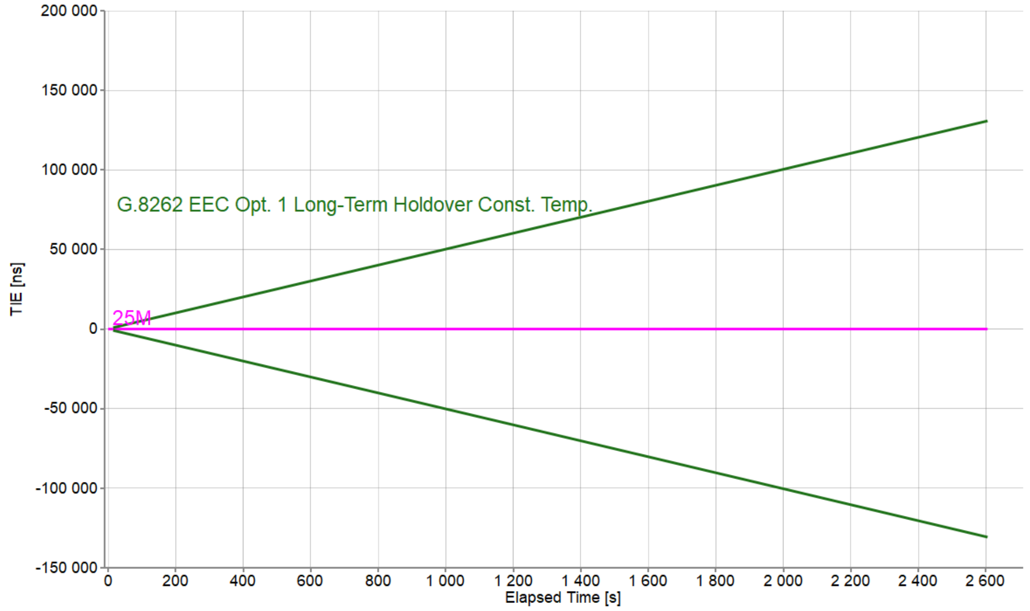

Figure 7. Holdover – G.8262 EEC Option 1 1.2Hz (TIE)

Mean [ns]	0.43
Min [ns]	-0.091
Max [ns]	0.984
Max-Min [ns]	1.074

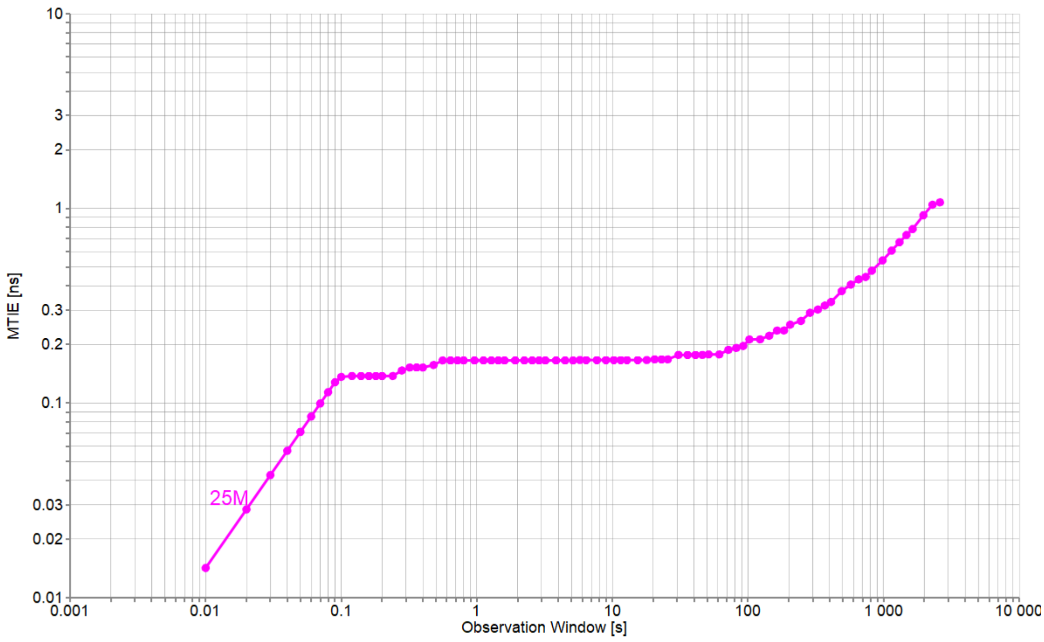

Figure 8. Holdover – G.8262 EEC Option 1 1.2Hz (MTIE)

Min [ns]	0.014
Max [ns]	1.074
Max-Min [ns]	1.06

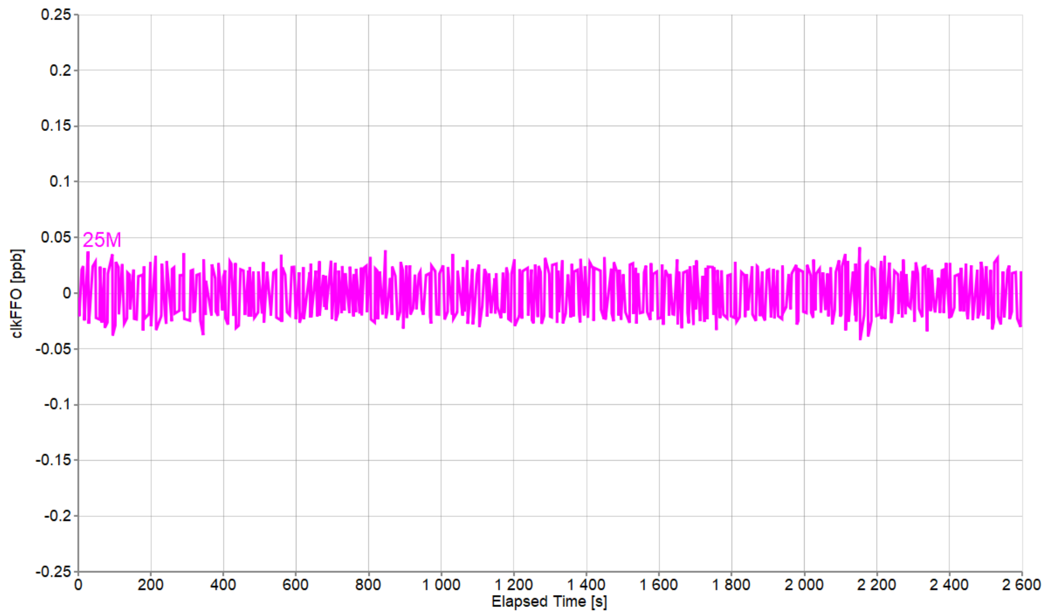

Figure 9. Holdover – G.8262 EEC Option 1 1.2Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.042
Max [ppb]	0.041
Max-Min [ppb]	0.083

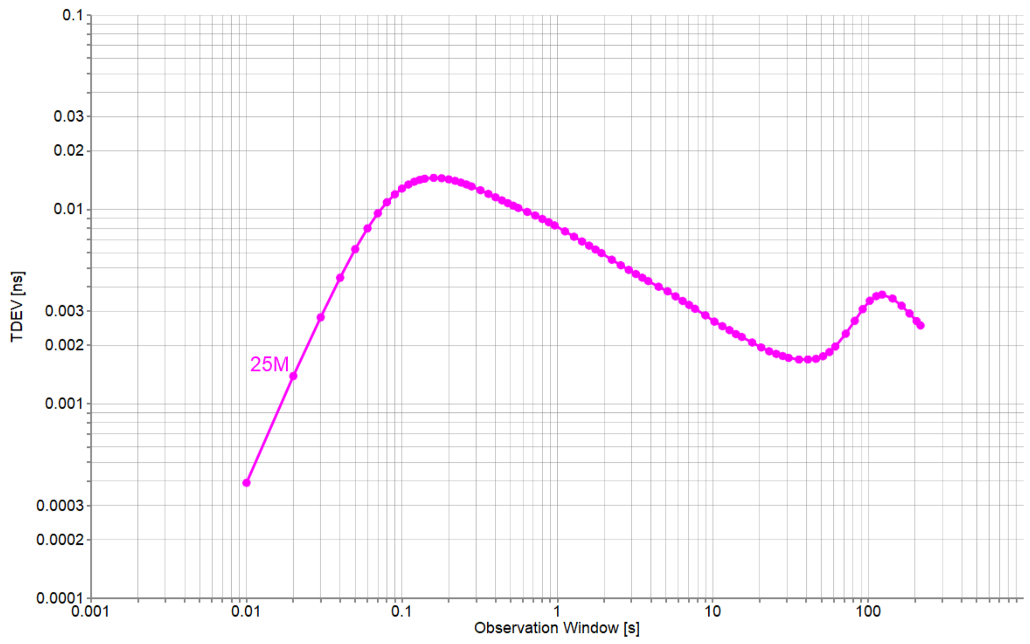

Figure 10. Holdover – G.8262 EEC Option 1 1.2Hz (TDEV)

Min [ns]	0
Max [ns]	0.013
Max-Min [ns]	0.012
Max-Min [ppb]	0.075

6.3 Wander Generation – G8262.1 eEEC 3Hz

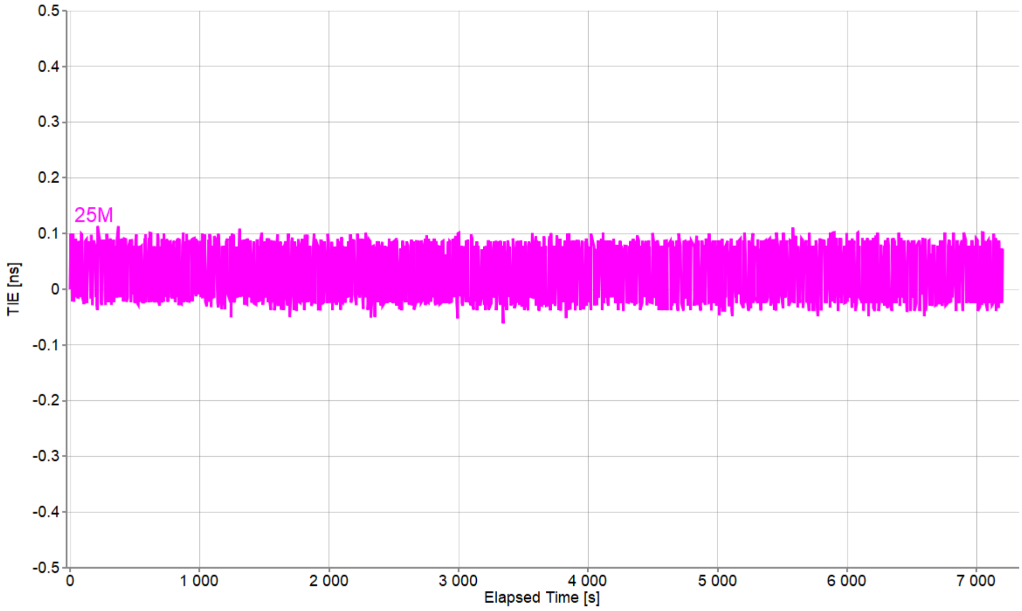

Figure 11. Wander Generation – G82621 (TIE)

Mean [ns]	0.031
Min [ns]	-0.061
Max[ns]	0.113
Max-Min [ns]	0.175

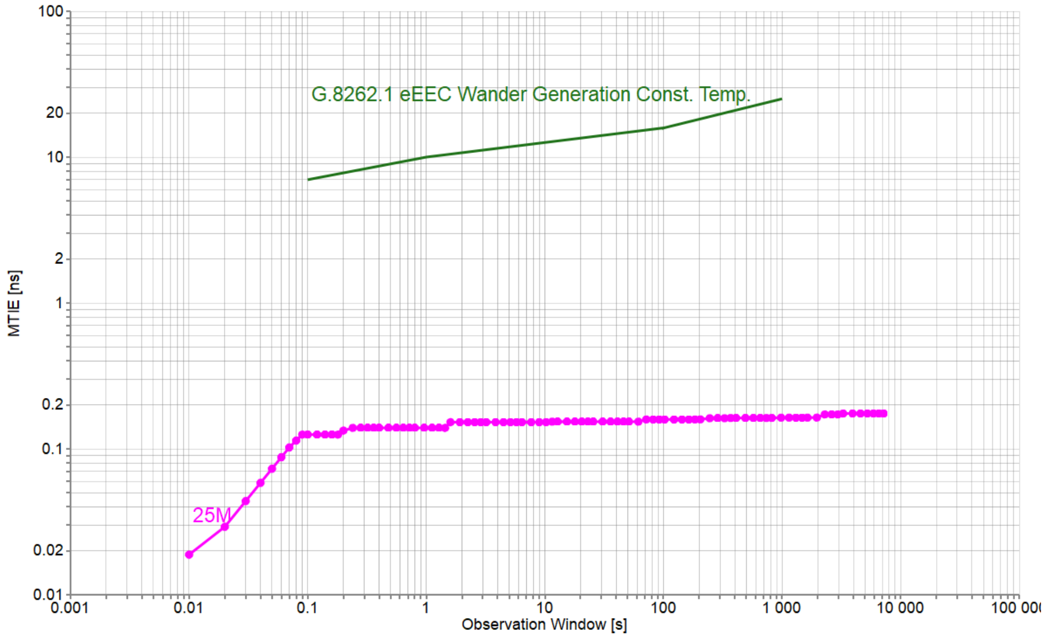

Figure 12. Wander Generation – G82621 (MTIE)

Min [ns]	0.019
Max [ns]	0.175
Max-Min [ns]	0.156

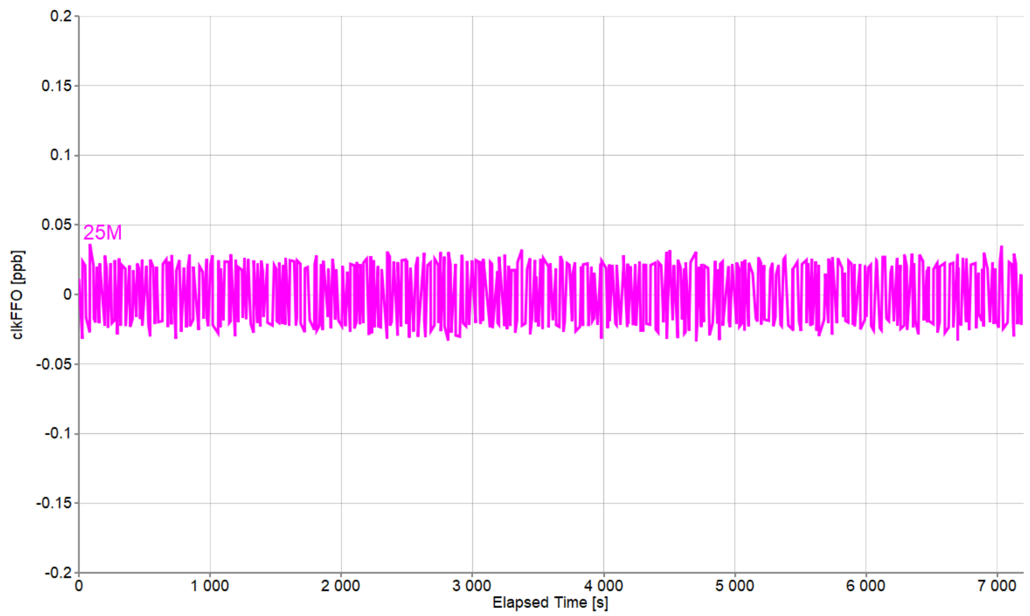

Figure 13. Wander Generation – G82621 (FFO)

Mean [ppb]	0
Min [ppb]	-0.034
Max [ppb]	0.036
Max-Min [ppb]	0.07

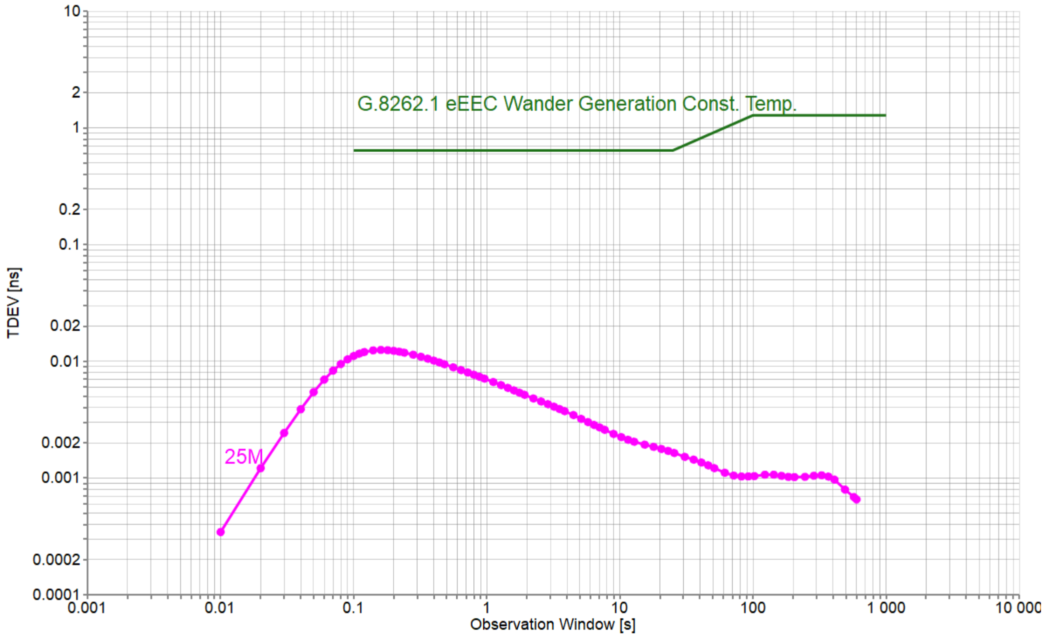

Figure 14. Wander Generation – G82621 (TDEV)

Min [ns]	0
Max [ns]	0.013
Max-Min [ns]	0.012

6.4 Holdover – G8262.1 eEEC 3Hz

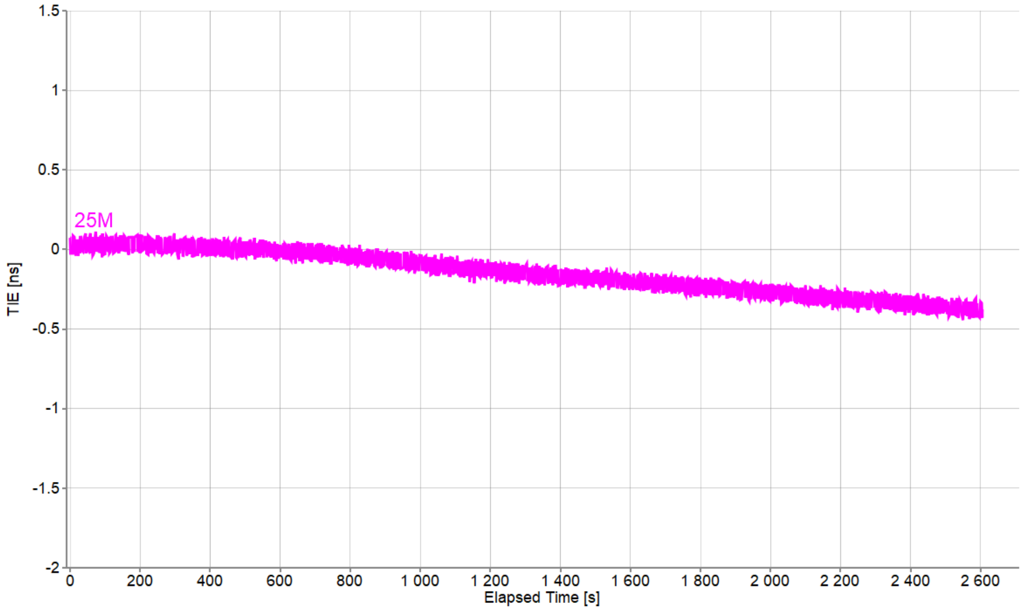

Figure 15. Holdover – G.8262.1 eEEC 3Hz (TIE_no_mask)

Mean [ns]	-0.148
Min [ns]	-0.443
Max [ns]	0.112
Max-Min [ns]	0.555

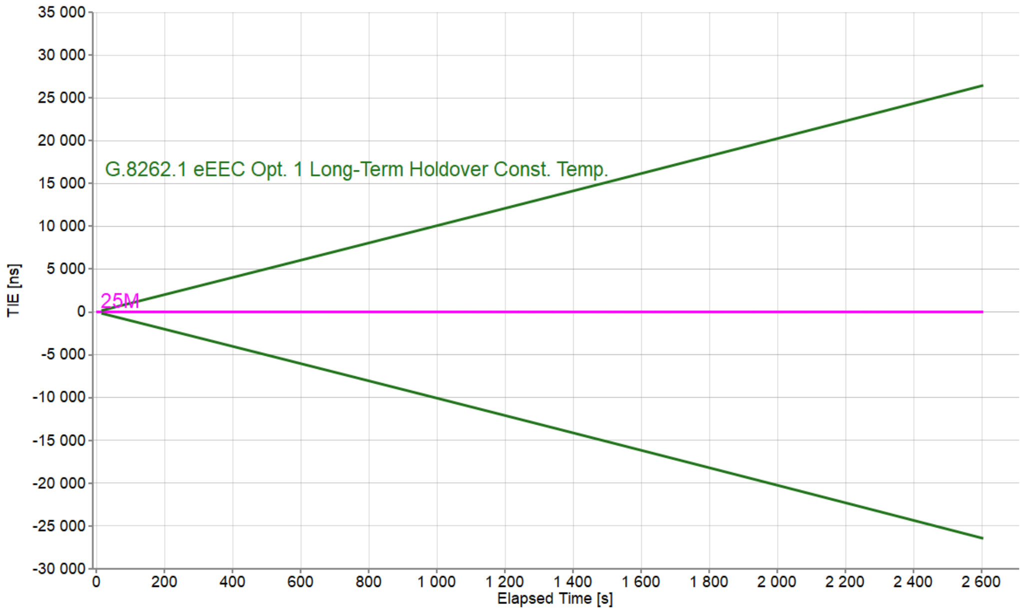

Figure 16. Holdover – G.8262.1 eEEC 3Hz (TIE)

Mean [ns]	-0.148
Min [ns]	-0.443
Max [ns]	0.112
Max-Min [ns]	0.555

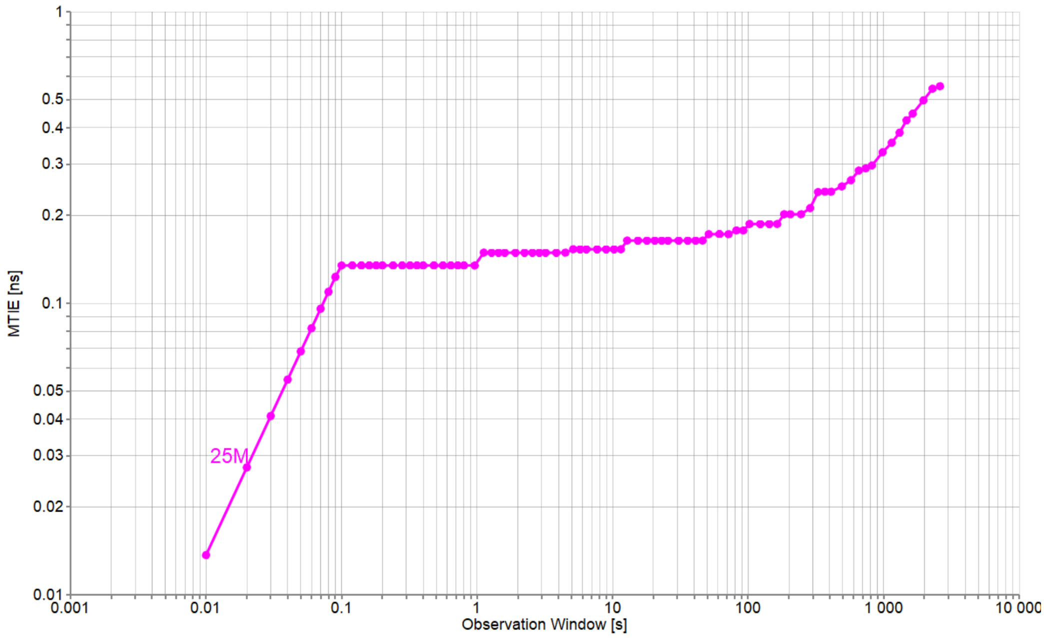

Figure 17. Holdover – G.8262.1 eEEC 3Hz (MTIE)

Min [ns]	0.014
Max [ns]	0.555
Max-Min [ns]	0.542

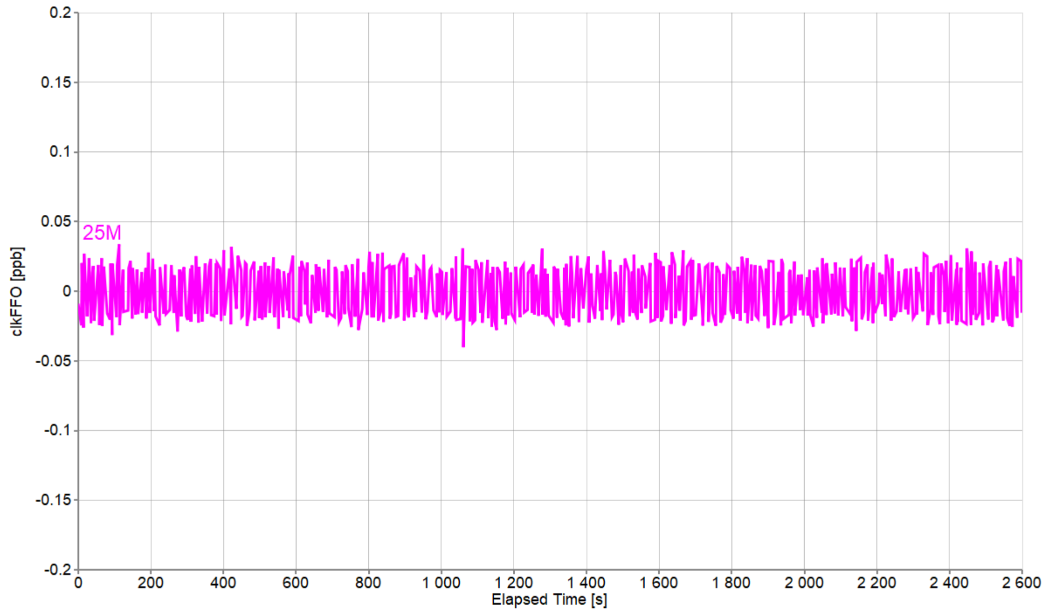

Figure 18. Holdover – G.8262.1 eEEC 3Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.04
Max [ppb]	0.034
Max-Min [ppb]	0.074

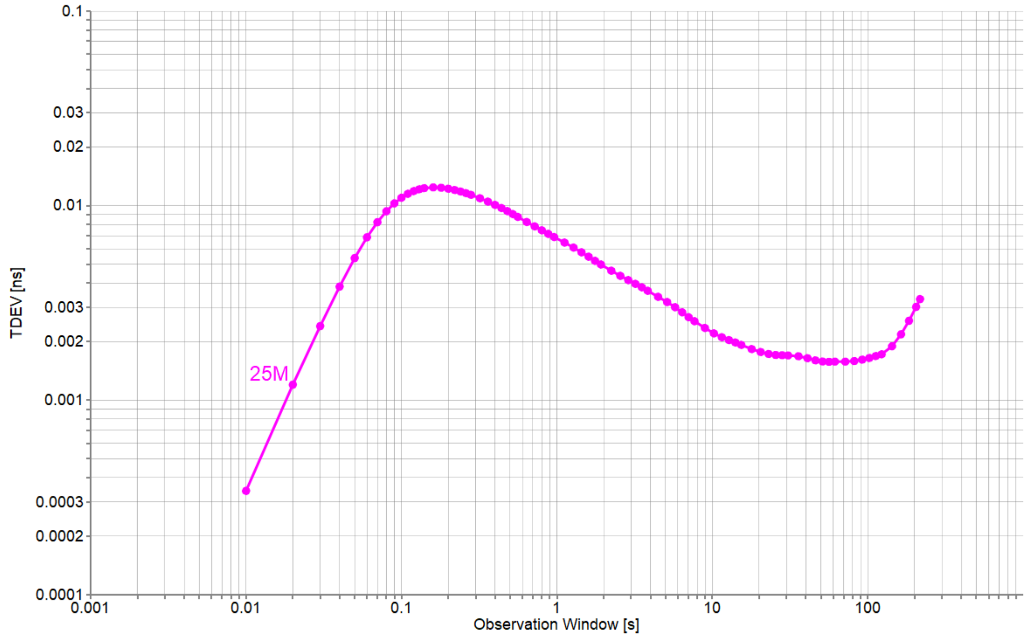

Figure 19. Holdover – G.8262.1 eEEC 3Hz (TDEV)

Min [ns]	0
Max [ns]	0.012
Max-Min [ns]	0.012

6.5 Wander Generation – G8262 EEC Option 1 10Hz

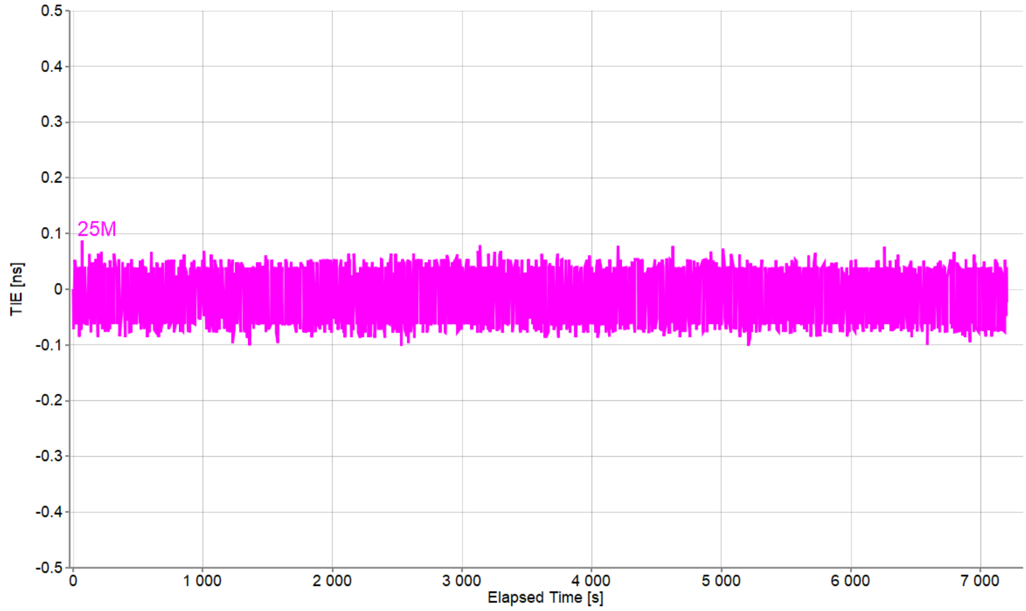

Figure 20. Wander Generation – G8262OPT1 (TIE)

Mean [ns]	-0.013
Min [ns]	-0.102
Max[ns]	0.087
Max-Min [ns]	0.189

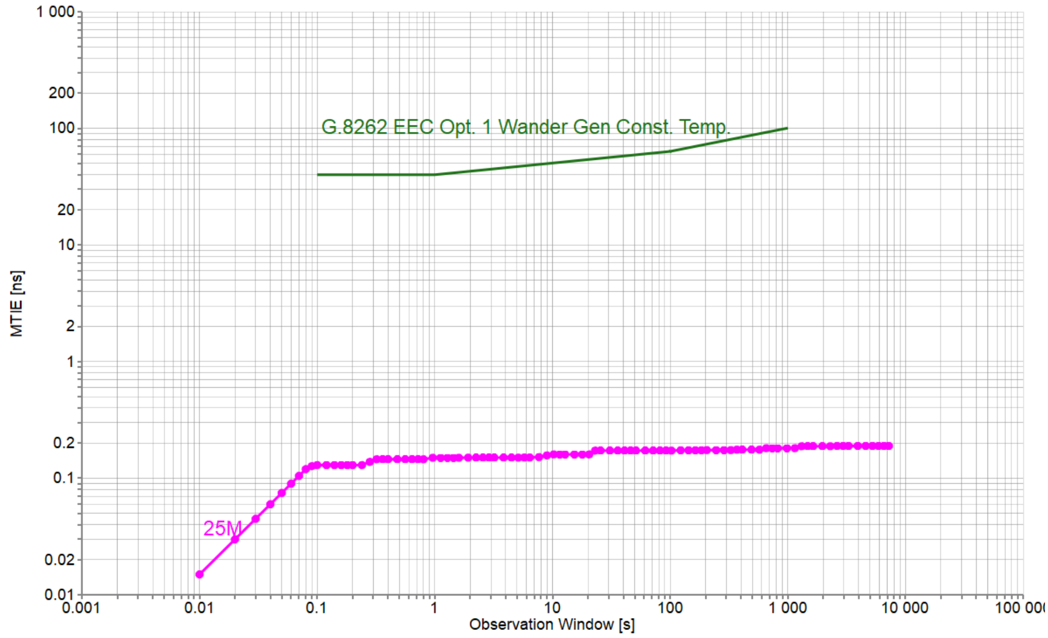

Figure 21. Wander Generation – G8262OPT1 (MTIE)

Min [ns]	0.015
Max [ns]	0.189
Max-Min [ns]	0.174

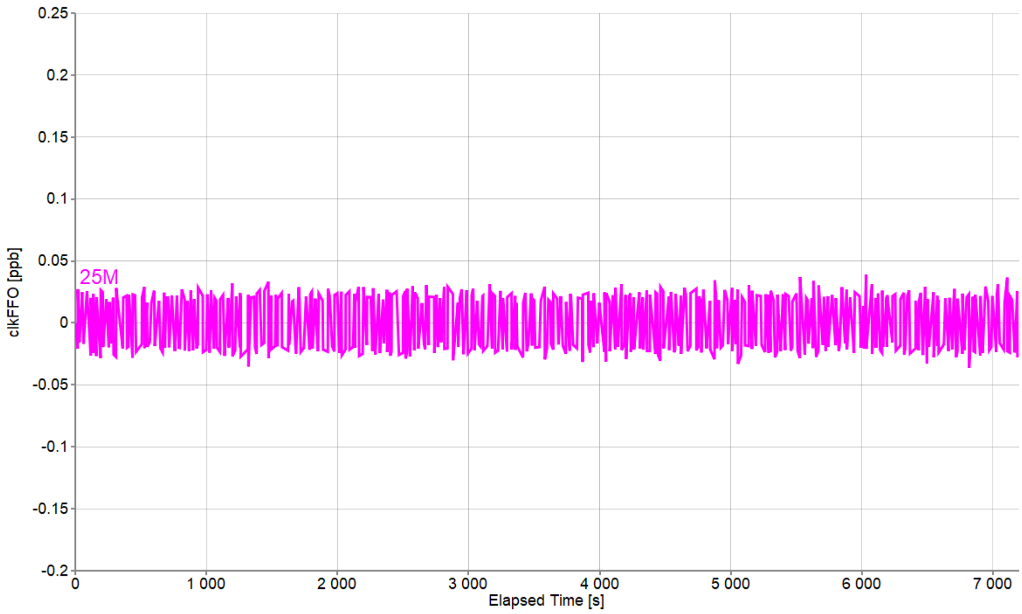

Figure 22. Wander Generation – G8262OPT1 (FFO)

Mean [ppb]	0
Min [ppb]	-0.036
Max [ppb]	0.039
Max-Min [ppb]	0.075

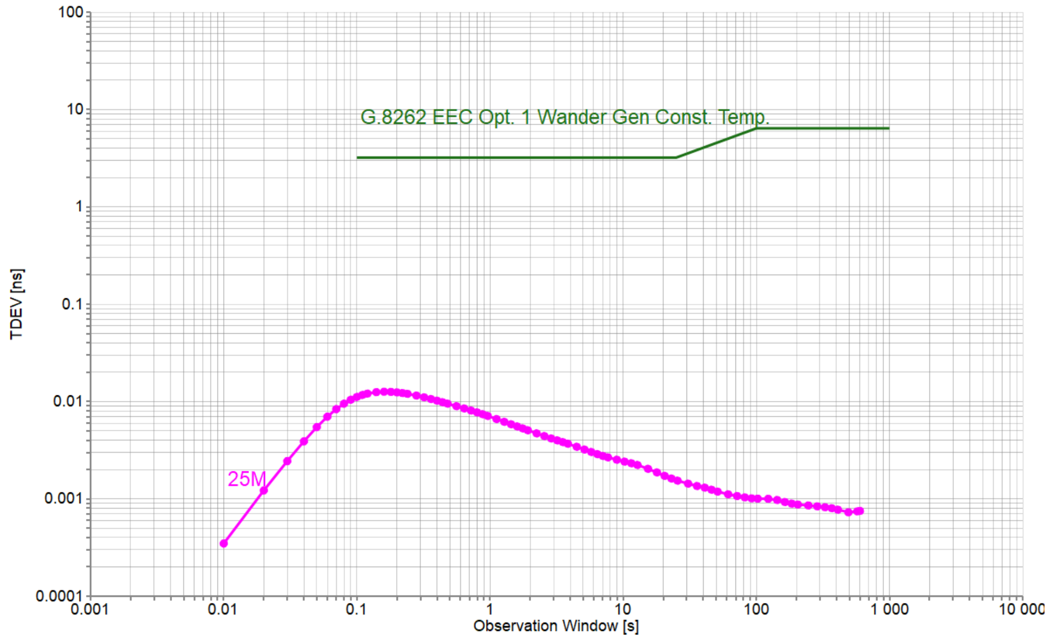

Figure 23. Wander Generation – G8262OPT1 (TDEV)

Min [ns]	0
Max [ns]	0.013
Max-Min [ns]	0.012

6.6 Holdover – G8262 EEC Option 1 10Hz

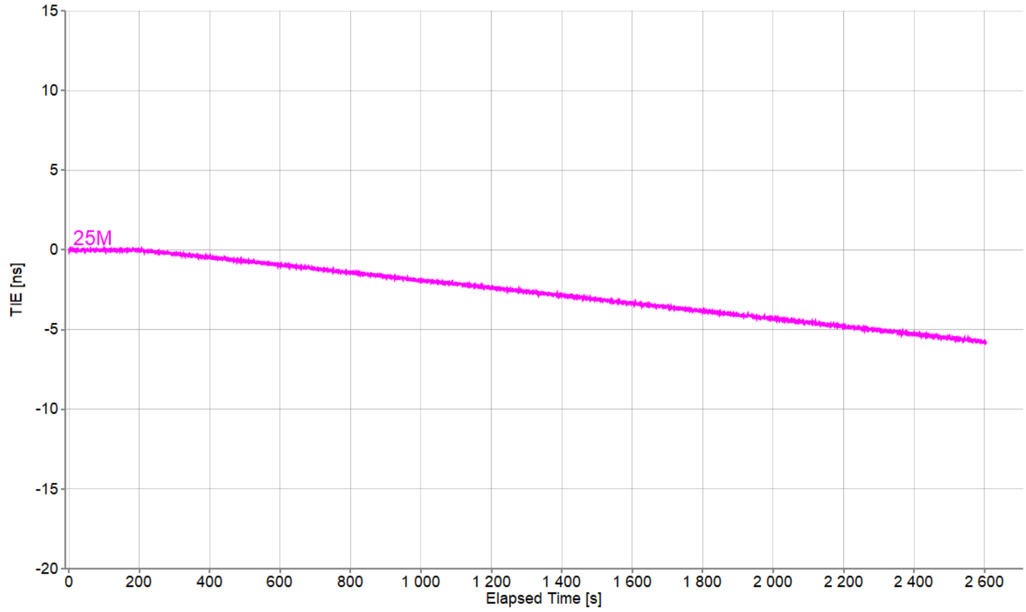

Figure 24. Holdover – G.8262 EEC Option 1 10Hz (TIE_no_mask)

Mean [ns]	-2.66
Min [ns]	-5.833
Max [ns]	0.051
Max-Min [ns]	5.885

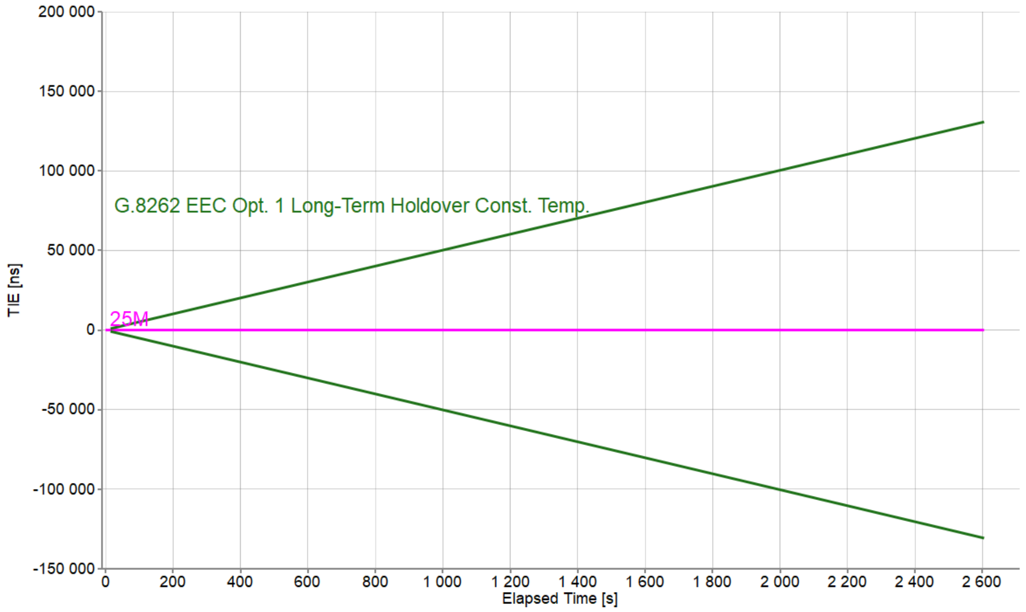

Figure 25. Holdover – G.8262 EEC Option 1 10Hz (TIE)

Mean [ns]	-2.66
Min [ns]	-5.833
Max [ns]	0.051
Max-Min [ns]	5.885

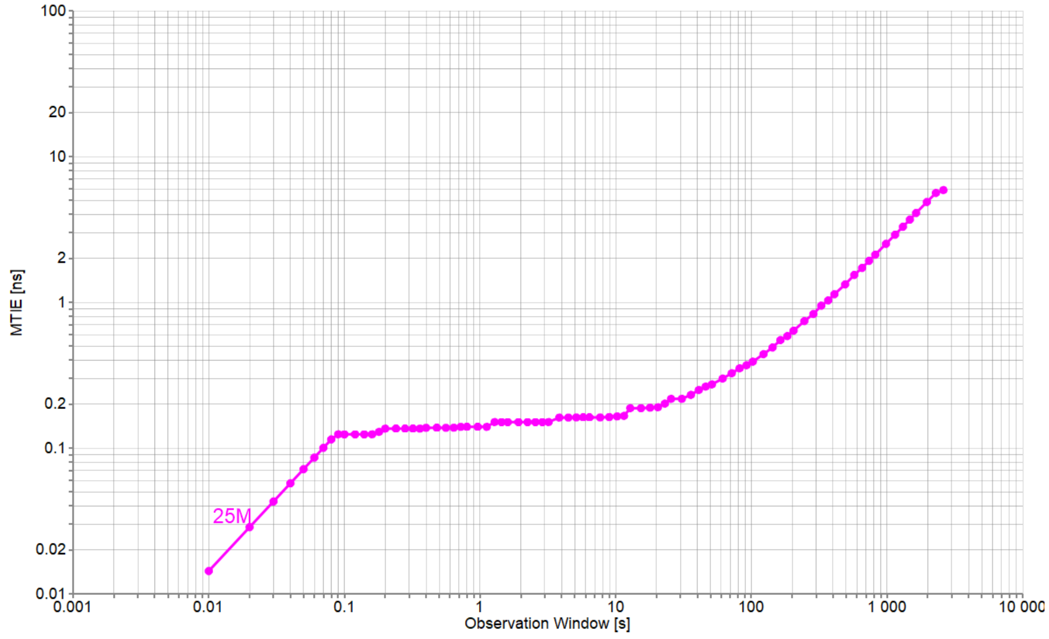

Figure 26. Holdover – G.8262 EEC Option 1 10Hz (MTIE)

Min [ns]	0.014
Max [ns]	5.885
Max-Min [ns]	5.87

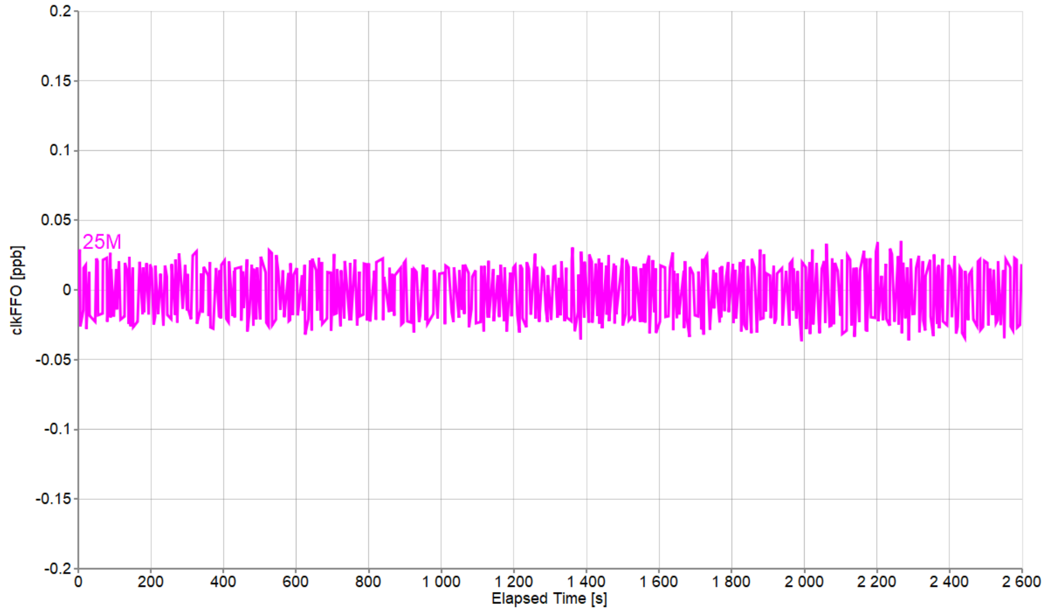

Figure 27. Holdover – G.8262 EEC Option 1 10Hz (FFO)

Mean [ppb]	-0.002
Min [ppb]	-0.037
Max [ppb]	0.035
Max-Min [ppb]	0.072

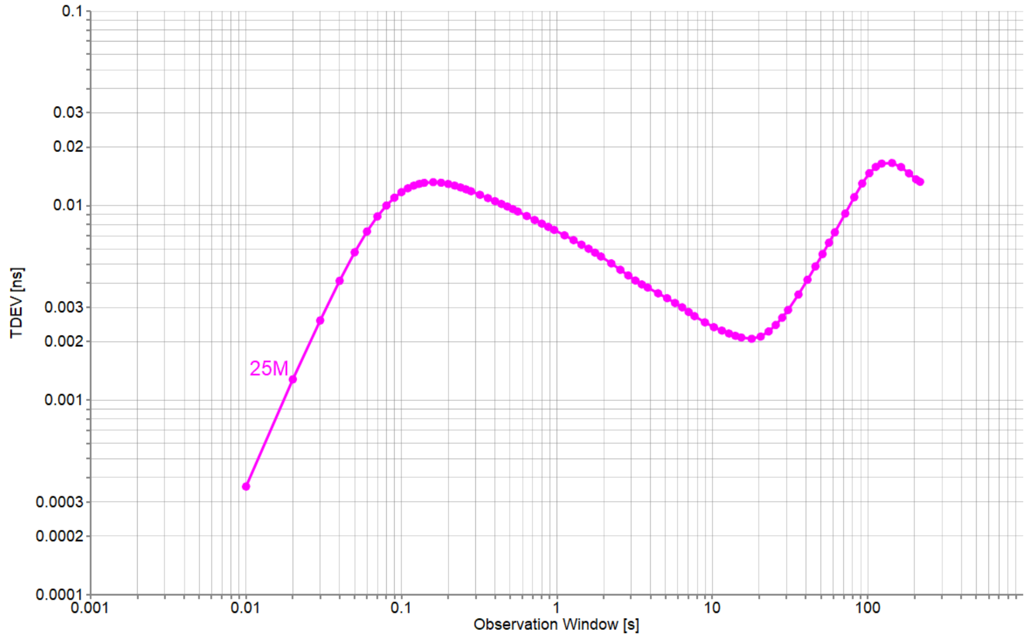

Figure 28. Holdover – G.8262 EEC Option 1 10Hz (TDEV)

Min [ns]	0
Max [ns]	0.014
Max-Min [ns]	0.014
Max-Min [ppb]	0.081

6.7 Wander Generation – G8262 EEC Option 2 0.1Hz

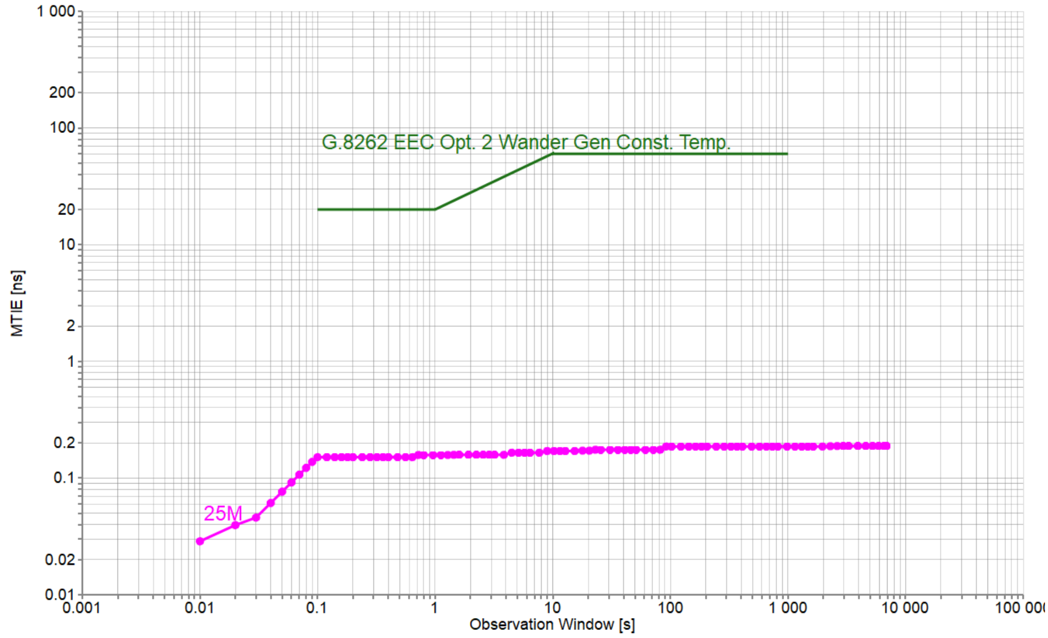

Figure 29. Wander Generation – G8262OPT2 (TIE)

Mean [ns]	-0.105
Min [ns]	-0.191
Max[ns]	-0.003
Max-Min [ns]	0.188

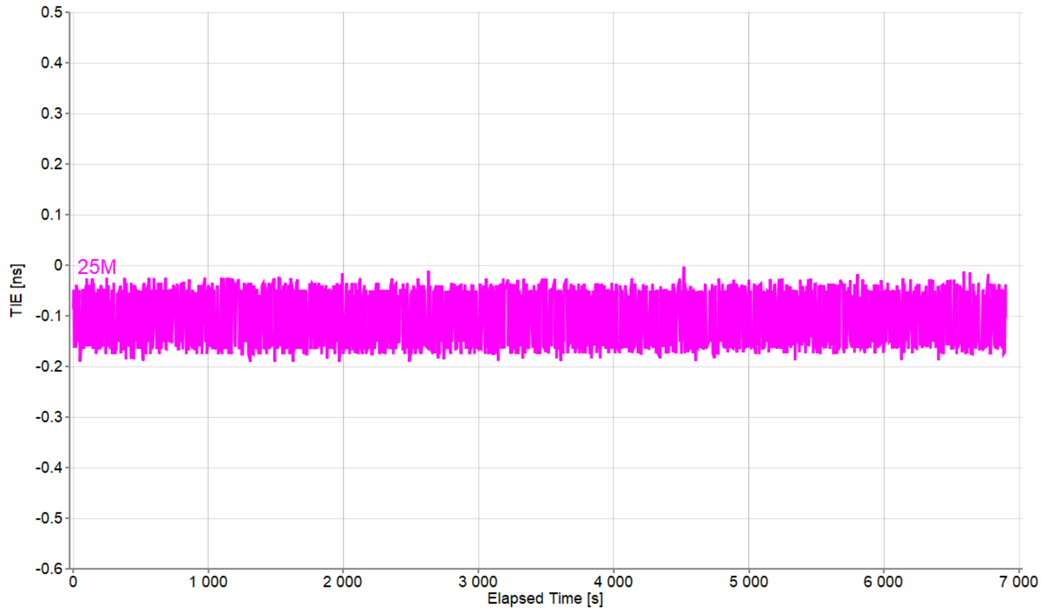

Figure 30. Wander Generation – G8262OPT2 (MTIE)

Min [ns]	0.029
Max [ns]	0.188
Max-Min [ns]	0.159

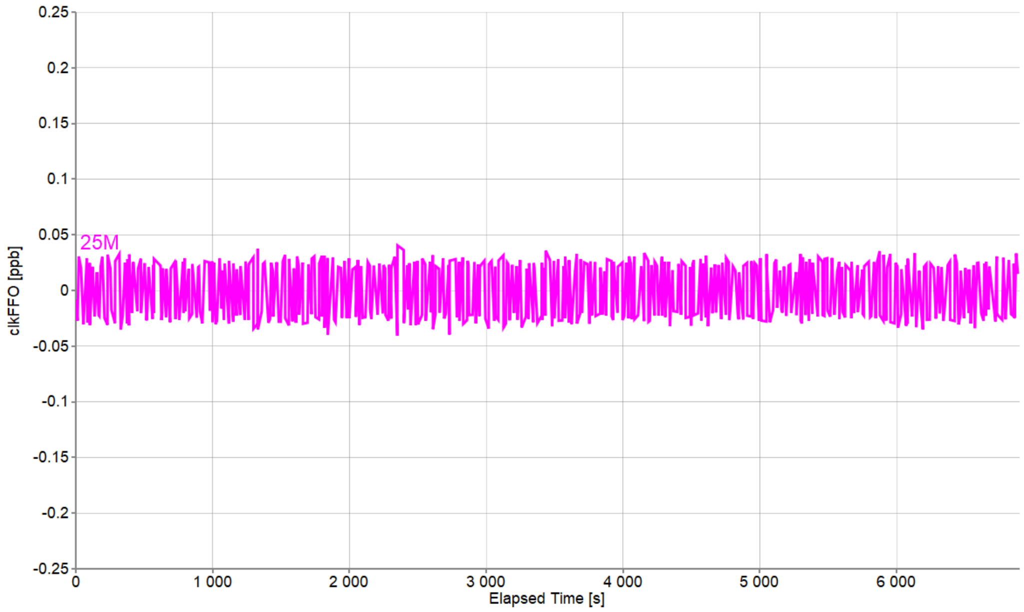

Figure 31. Wander Generation – G8262OPT2 (FFO)

Mean [ppb]	0
Min [ppb]	-0.041
Max [ppb]	0.04
Max-Min [ppb]	0.081

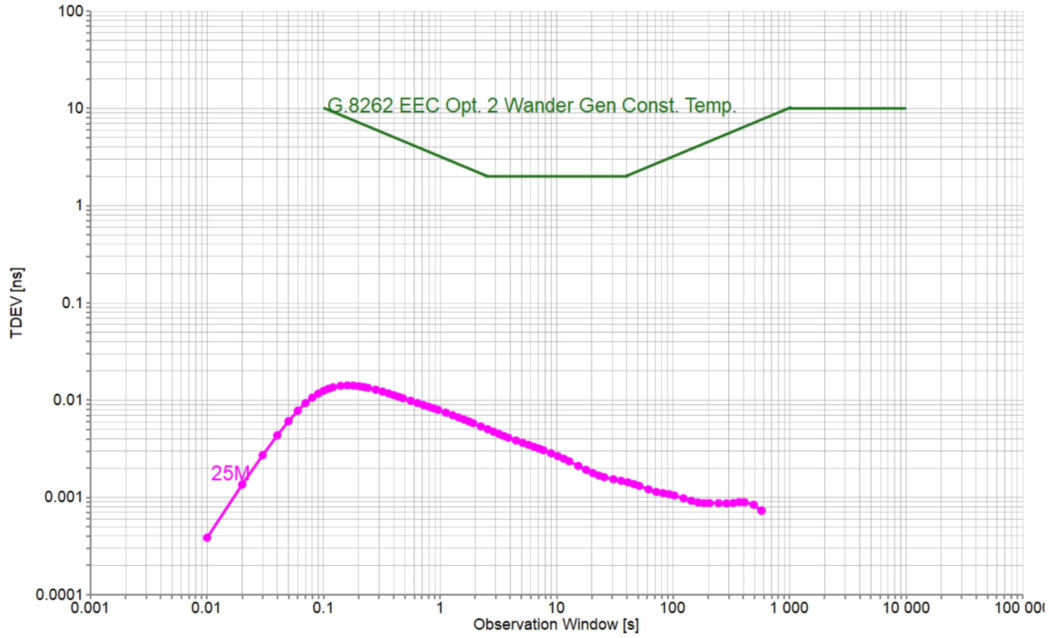

Figure 32. Wander Generation – G8262OPT2 (TDEV)

Min [ns]	0
Max [ns]	0.014
Max-Min [ns]	0.014

6.8 Holdover – G8262 EEC Option 2 0.1Hz

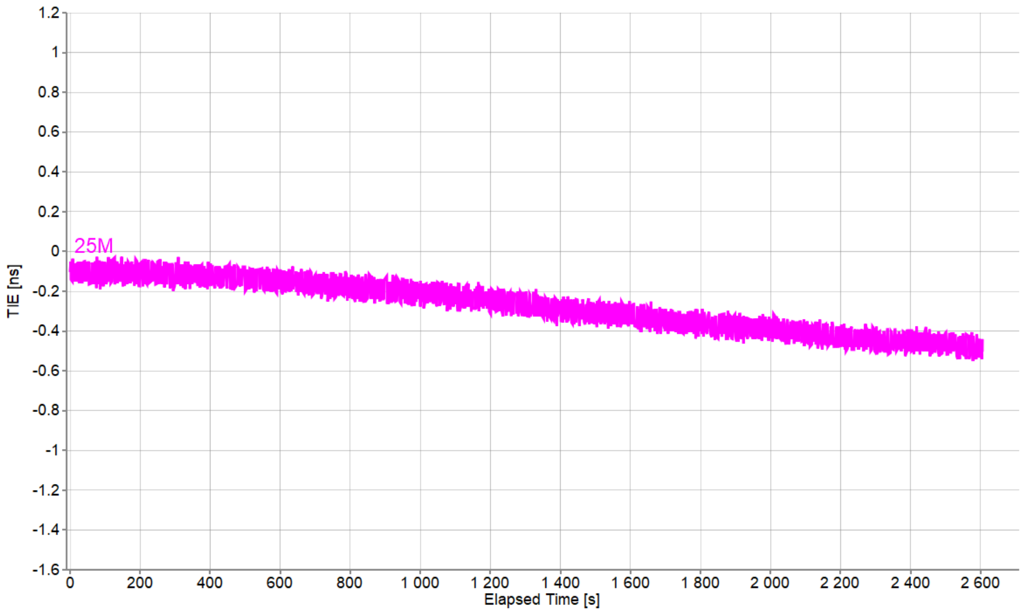

Figure 33. Holdover – G.8262 EEC Option 2 0.1Hz (TIE_no_mask)

Mean [ns]	-0.273
Min [ns]	-0.551
Max [ns]	-0.027
Max-Min [ns]	0.524

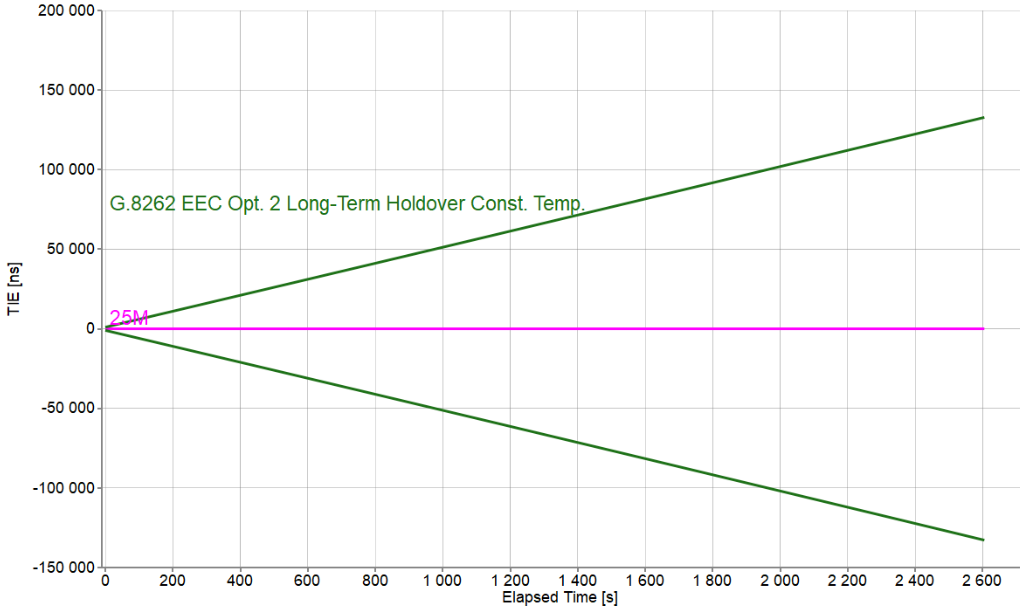

Figure 34. Holdover – G.8262 EEC Option 2 0.1Hz (TIE)

Mean [ns]	-0.273
Min [ns]	-0.551
Max [ns]	-0.027
Max-Min [ns]	0.524

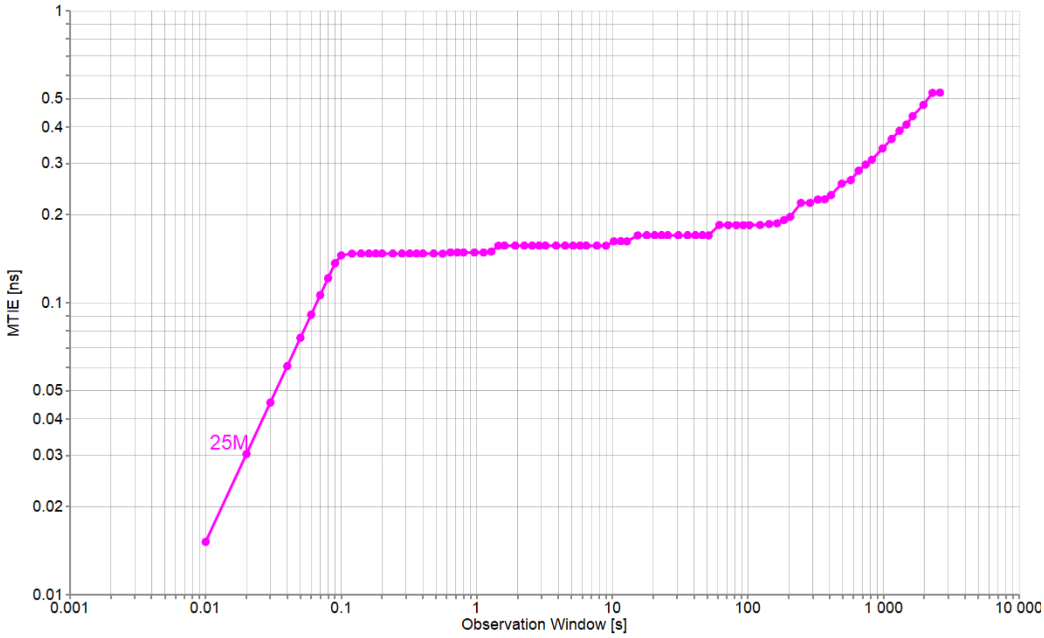

Figure 35. Holdover – G.8262 EEC Option 2 0.1Hz (MTIE)

Min [ns]	0.015
Max [ns]	0.524
Max-Min [ns]	0.509

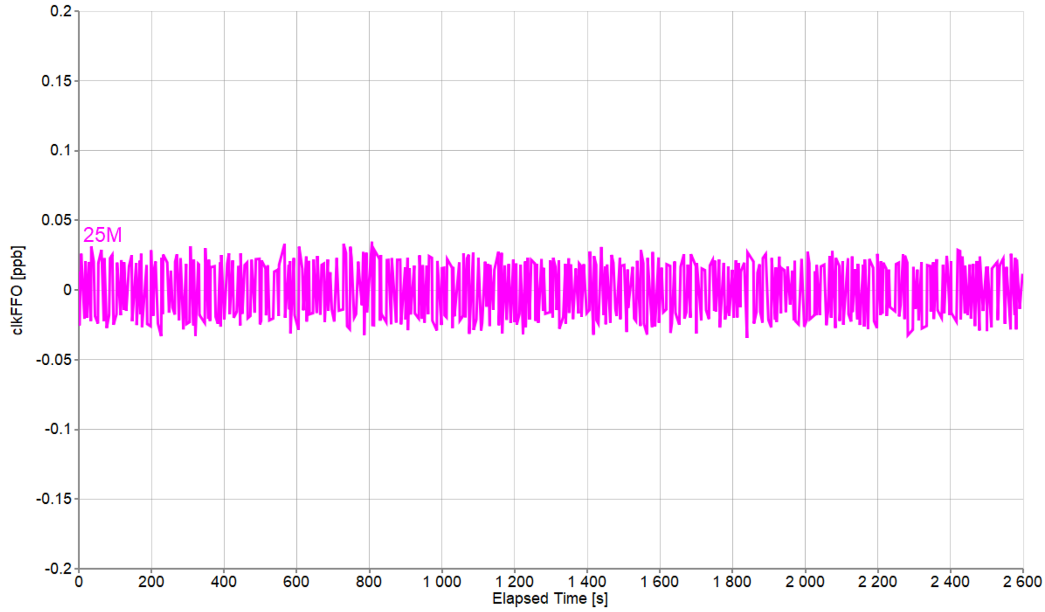

Figure 36. Holdover – G.8262 EEC Option 2 0.1Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.034
Max [ppb]	0.035
Max-Min [ppb]	0.069

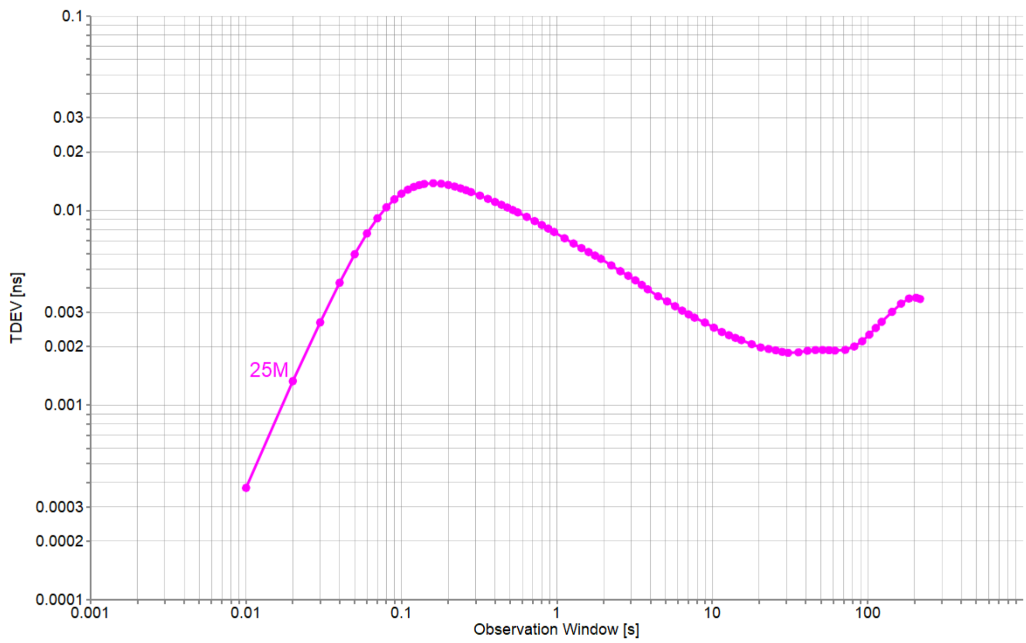

Figure 37. Holdover – G.8262 EEC Option 2 0.1Hz (TDEV)

Min [ns]	0
Max [ns]	0.013
Max-Min [ns]	0.012
Max-Min [ppb]	0.07

7. Short-term Phase Transient Response

Short-term transient response compliance checks the system response in situations where the input signal is lost due to a failure in the reference path and a second reference input signal, traceable to the same reference clock, is available simultaneously or shortly after the detection of the failure (for more information, see G.8262 Section 11.1 Short-term phase transient response). See Figure 1 for the equipment configuration.

In this test, the reference clock inputs are provided on IN_A and IN_B from the ClockMatrix Frequency Generator. The PLL is locked to the clock signal from IN_A for a period of time before producing a phase transient by turning off IN_A. The DPLL goes into holdover and tries to lock to any other qualified clocks. IN_B is simultaneously available from the ClockMatrix Frequency Generator, and the DPLL switches to this clock which is very close in phase alignment to the original clock. The output from the DUT is available on OUT_0 and the phase time error is captured using the ClockMatrix Frequency Counter. The results of the given transient are plotted against the applicable standard profiles.

7.1 Short-term Phase Transient – G.8262 EEC Option 1 1.2Hz

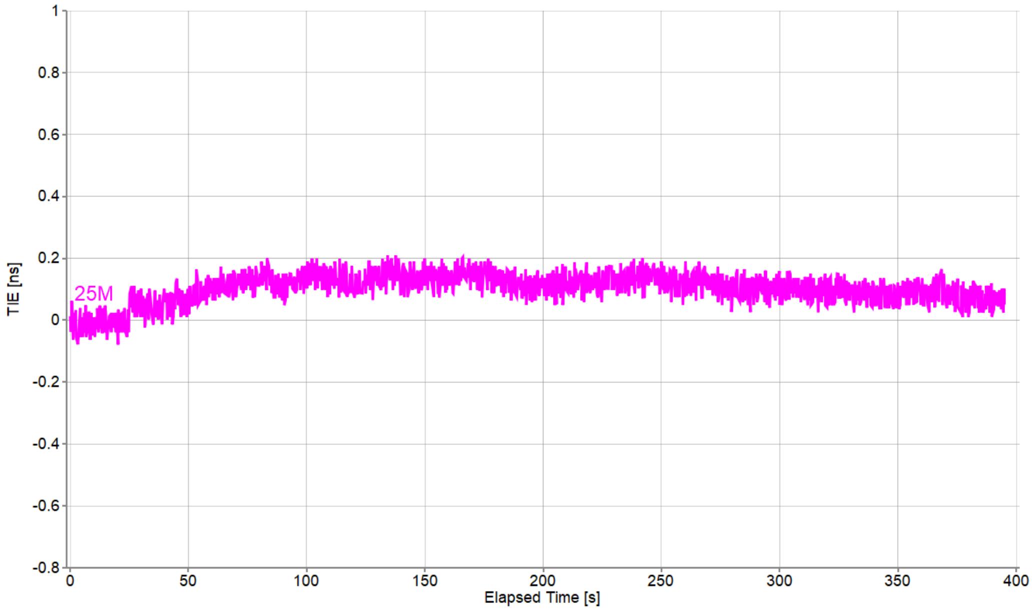

Figure 38. Short-term Phase Transient – G.8262 EEC Option 1 1.2Hz (TIE_no_mask)

Mean [ns]	0.103
Min [ns]	-0.079
Max [ns]	0.209
Max-Min [ns]	0.288

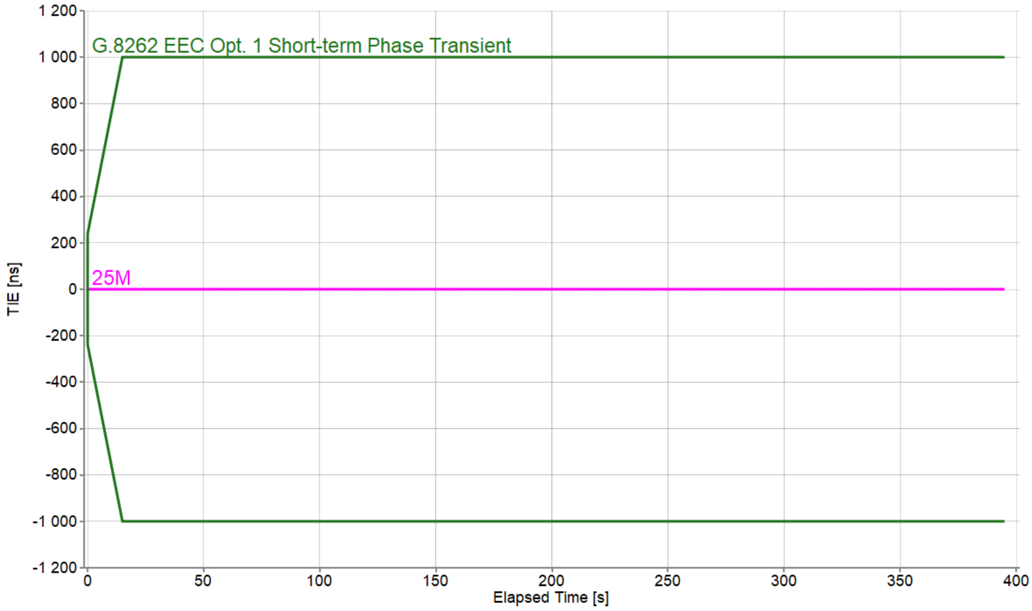

Figure 39. Short-term Phase Transient – G.8262 EEC Option 1 1.2Hz (TIE)

Mean [ns]	0.103
Min [ns]	-0.079
Max [ns]	0.209
Max-Min [ns]	0.288

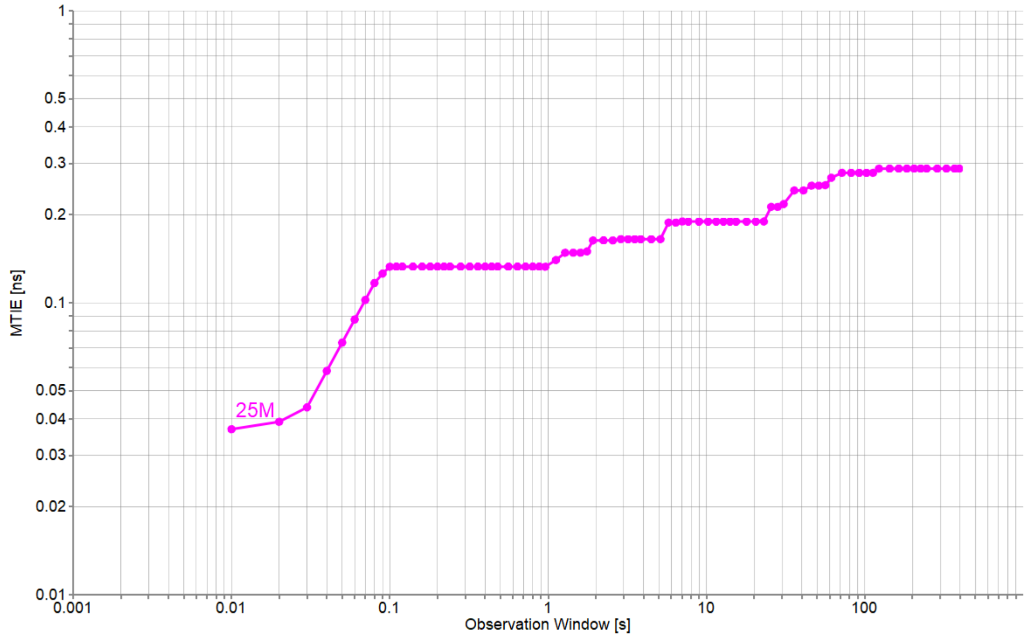

Figure 40. Short-term Phase Transient – G.8262 EEC Option 1 1.2Hz (MTIE)

Min [ns]	0.037
Max [ns]	0.288
Max-Min [ns]	0.251

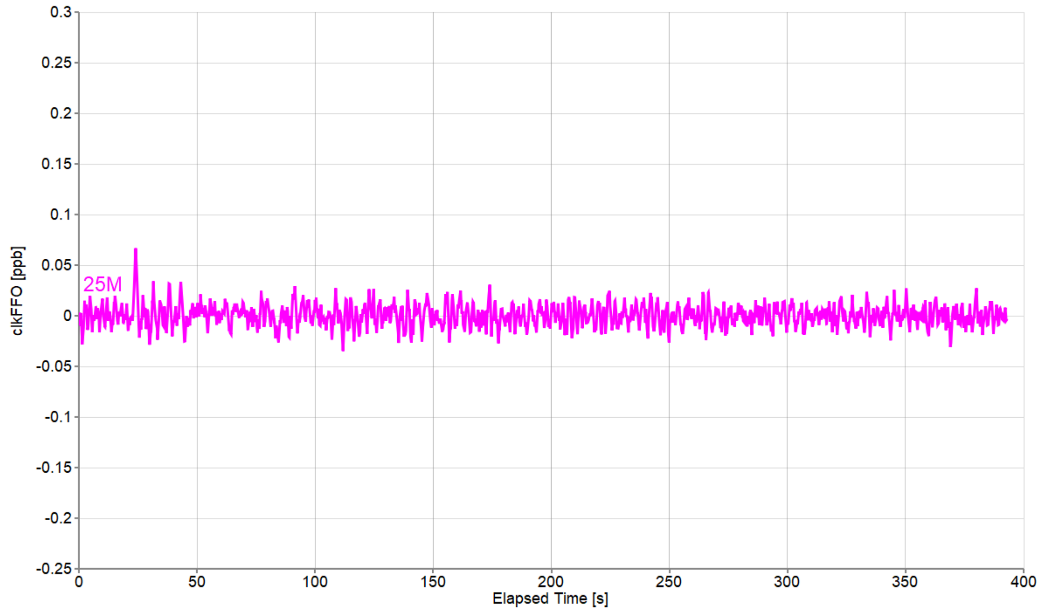

Figure 41. Short-term Phase Transient – G.8262 EEC Option 1 1.2Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.035
Max [ppb]	0.067
Max-Min [ppb]	0.101

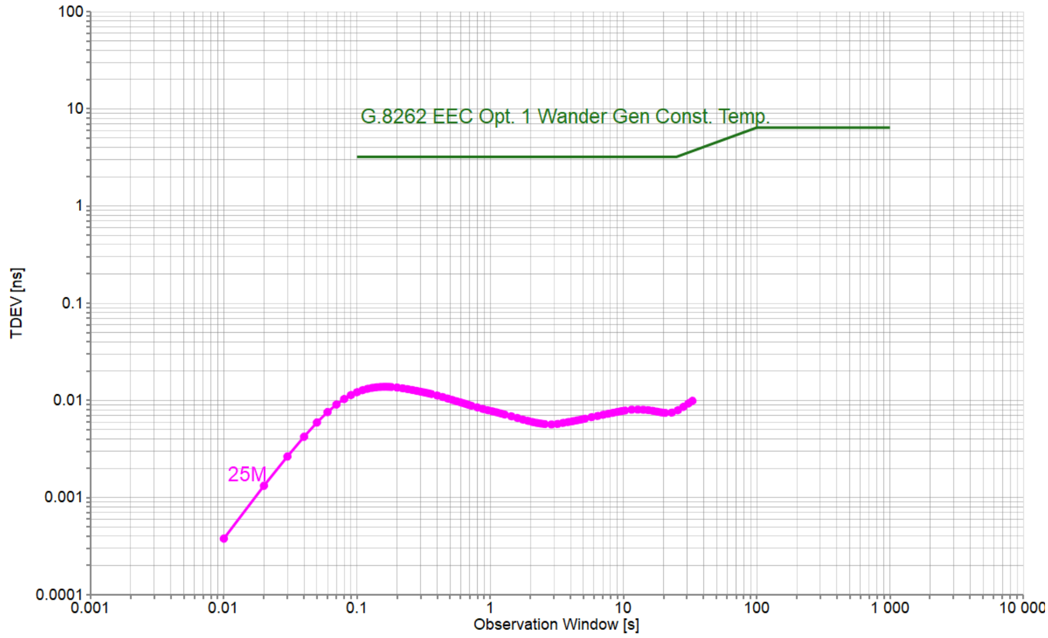

Figure 42. Short-term Phase Transient – G.8262 EEC Option 1 1.2Hz (TDEV)

Min [ns]	0
Max [ns]	0.014
Max-Min [ns]	0.013

7.2 Short-term Phase Transient – G8262.1 eEEC 3Hz

Hitless switching is enabled for this test as per the configuration defined in Table 2 for ITUT-G.8262.1 eEEC.

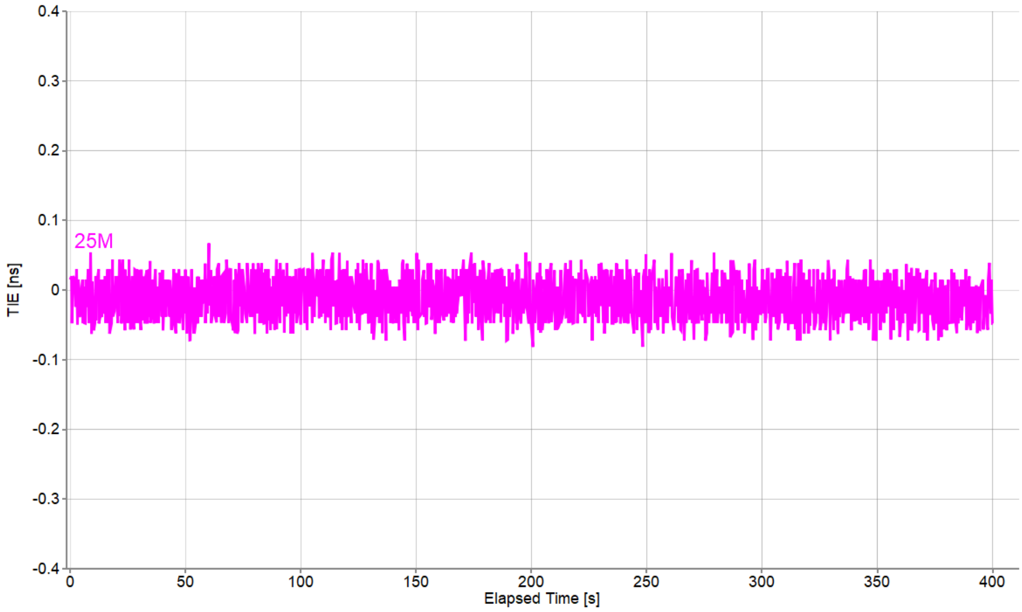

Figure 43. Short-term Phase Transient – G.8262.1 eEEC 3Hz (TIE_no_mask)

Mean [ns]	-0.012
Min [ns]	-0.082
Max [ns]	0.067
Max-Min [ns]	0.149

Figure 44. Short-term Phase Transient – G.8262.1 eEEC 3Hz (TIE)

Mean [ns]	-0.012
Min [ns]	-0.082
Max [ns]	0.067
Max-Min [ns]	0.149

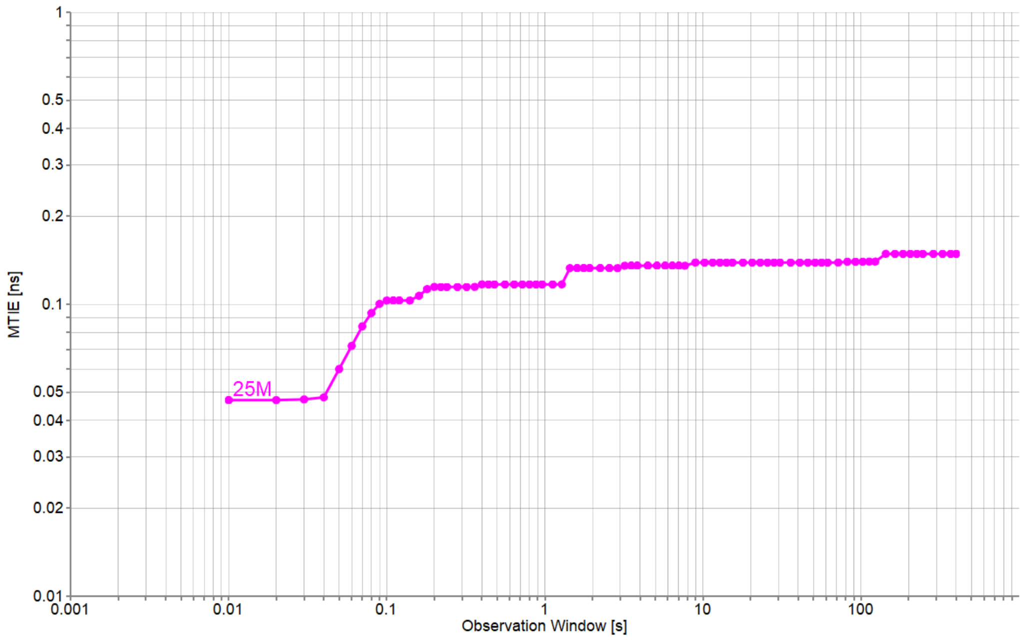

Figure 45. Short-term Phase Transient – G.8262.1 eEEC 3Hz (MTIE)

Min [ns]	0.047
Max [ns]	0.149
Max-Min [ns]	0.102

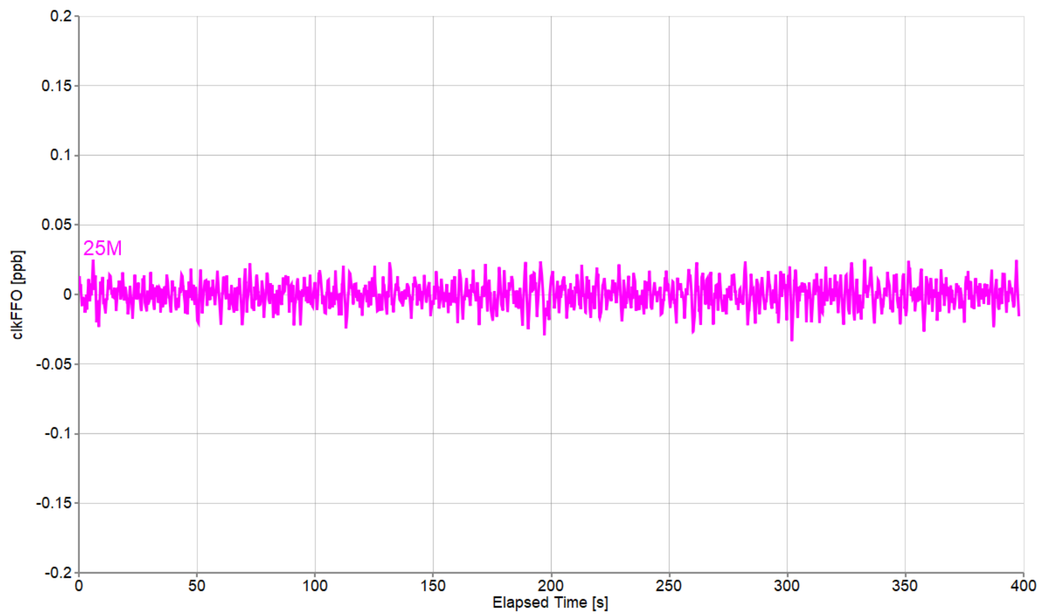

Figure 46. Short-term Phase Transient – G.8262.1 eEEC 3Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.033
Max [ppb]	0.025
Max-Min [ppb]	0.058

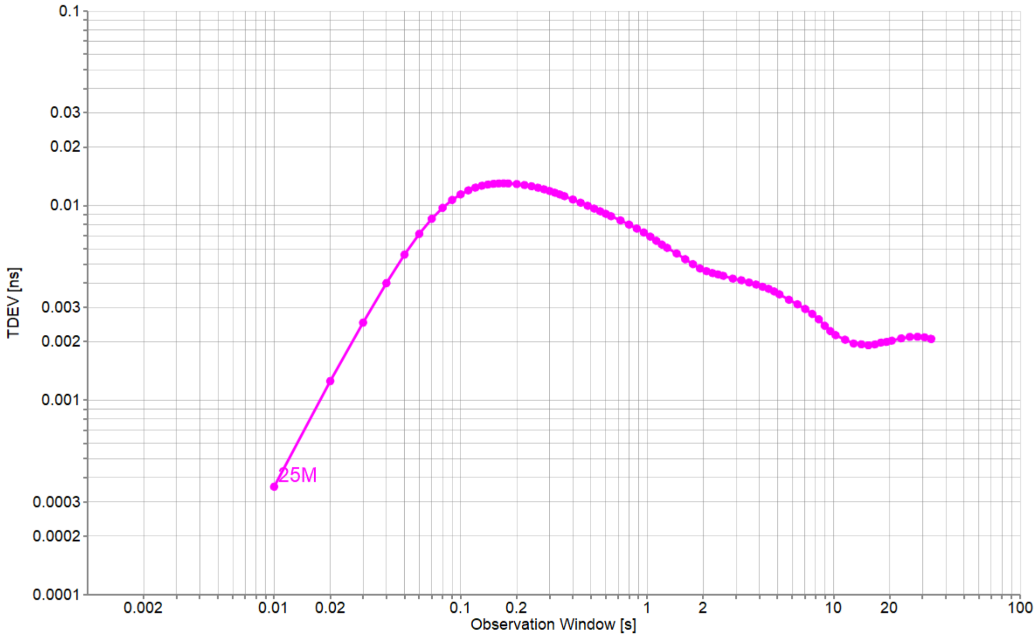

Figure 47. Short-term Phase Transient – G.8262.1 eEEC 3Hz (TDEV)

Min [ns]	0
Max [ns]	0.013
Max-Min [ns]	0.013

7.3 Short-term Phase Transient – G.8262 EEC Option 1 10Hz

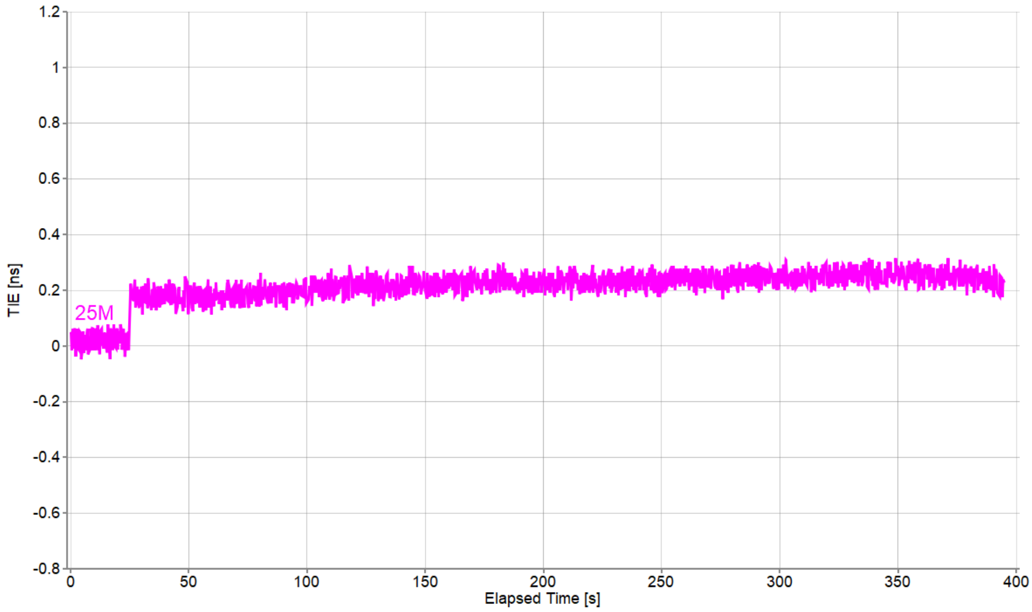

Figure 48. Short-term Phase Transient – G.8262 EEC Option 1 10Hz (TIE_no_mask)

Mean [ns]	0.212
Min [ns]	-0.048
Max [ns]	0.315
Max-Min [ns]	0.363

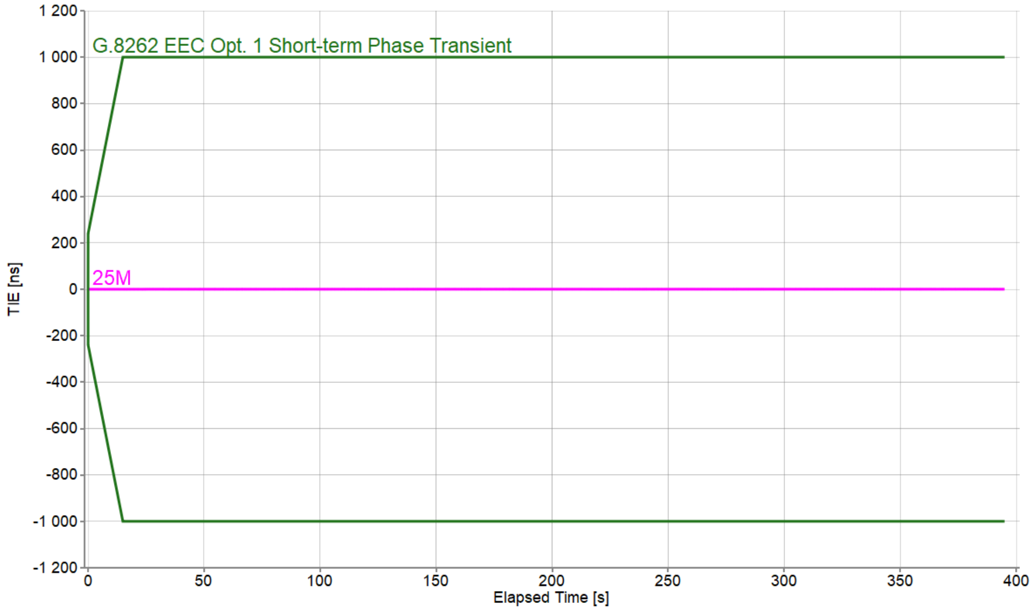

Figure 49. Short-term Phase Transient – G.8262 EEC Option 1 10Hz (TIE)

Mean [ns]	0.212
Min [ns]	-0.048
Max [ns]	0.315
Max-Min [ns]	0.363

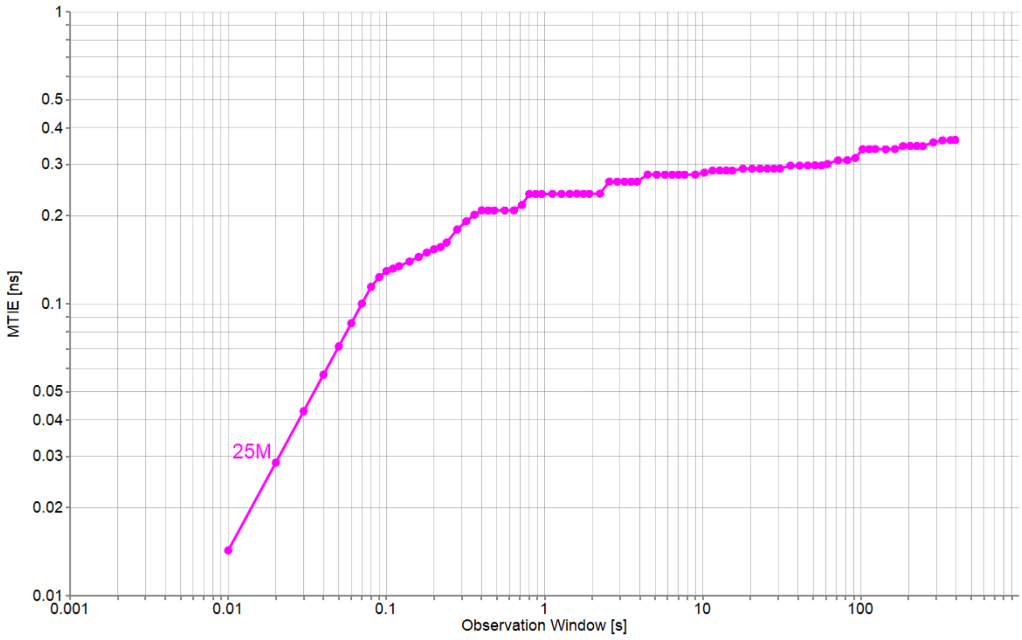

Figure 50. Short-term Phase Transient – G.8262 EEC Option 1 10Hz (MTIE)

Min [ns]	0.014
Max [ns]	0.363
Max-Min [ns]	0.349

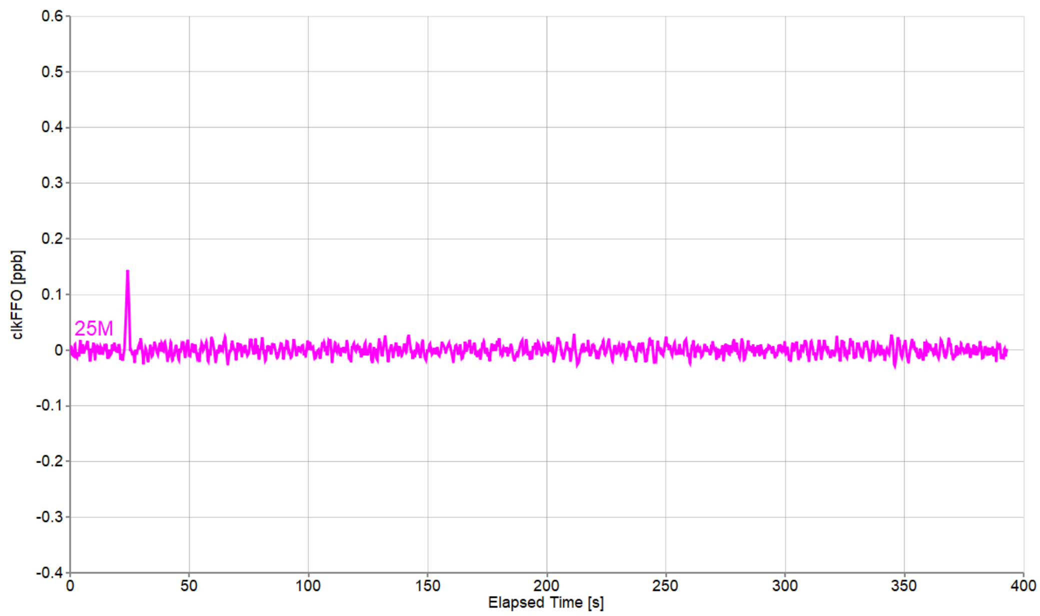

Figure 51. Short-term Phase Transient – G.8262 EEC Option 1 10Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.028
Max [ppb]	0.144
Max-Min [ppb]	0.172

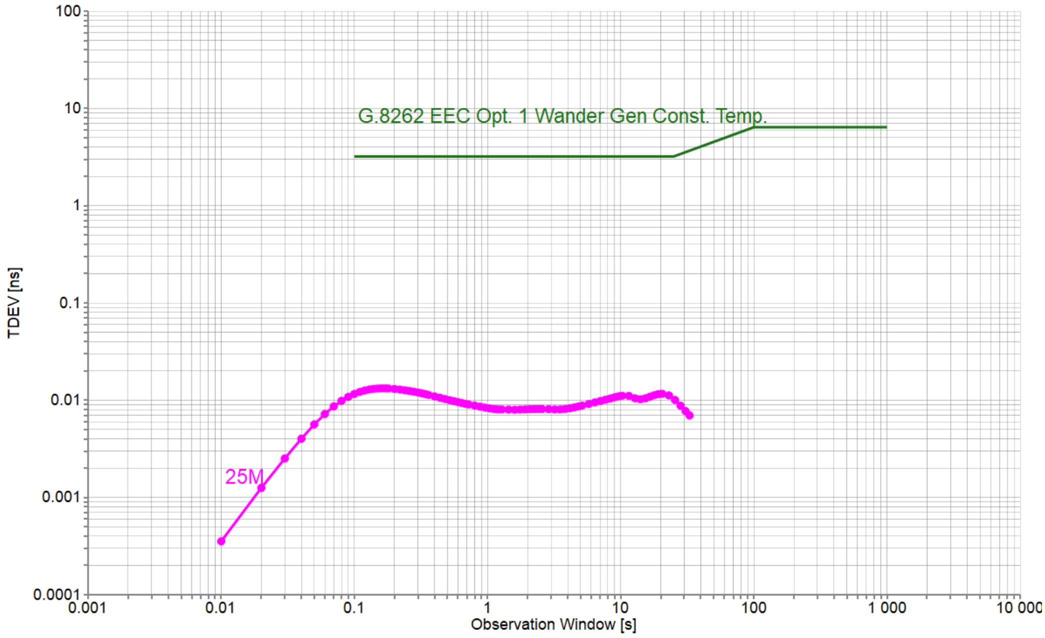

Figure 52. Short-term Phase Transient – G.8262 EEC Option 1 10Hz (TDEV)

Min [ns]	0
Max [ns]	0.013
Max-Min [ns]	0.013

7.4 Short-term Phase Transient – G.8262 EEC Option 2 0.1Hz

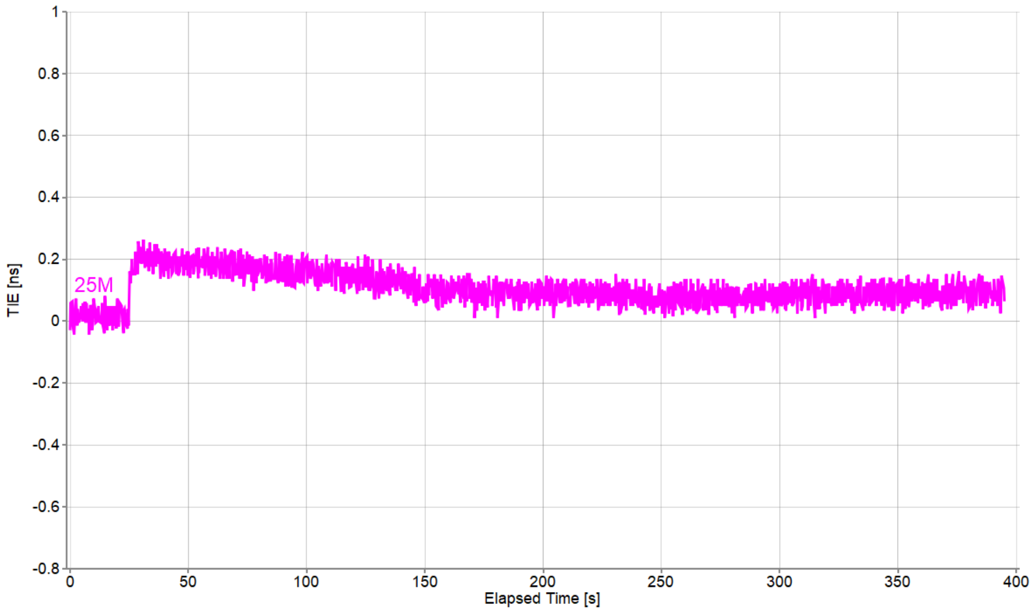

Figure 53. Short-term Phase Transient – G.8262 EEC Option 2 0.1Hz (TIE_no_mask)

Mean [ns]	0.107
Min [ns]	-0.043
Max [ns]	0.264
Max-Min [ns]	0.307

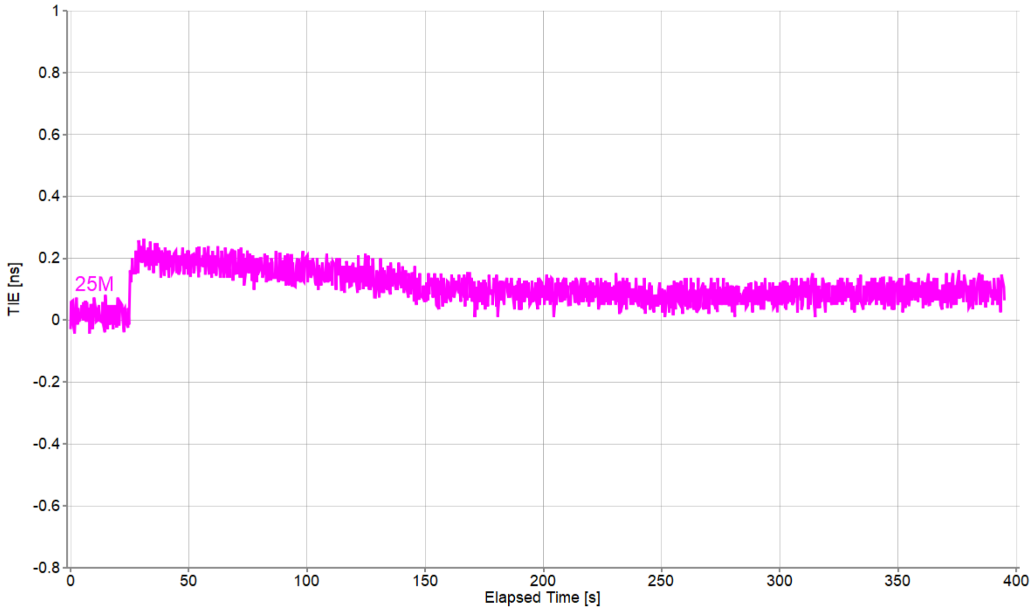

Figure 54. Short-term Phase Transient – G.8262 EEC Option 2 0.1Hz (TIE)

Mean [ns]	0.107
Min [ns]	-0.043
Max [ns]	0.264
Max-Min [ns]	0.307

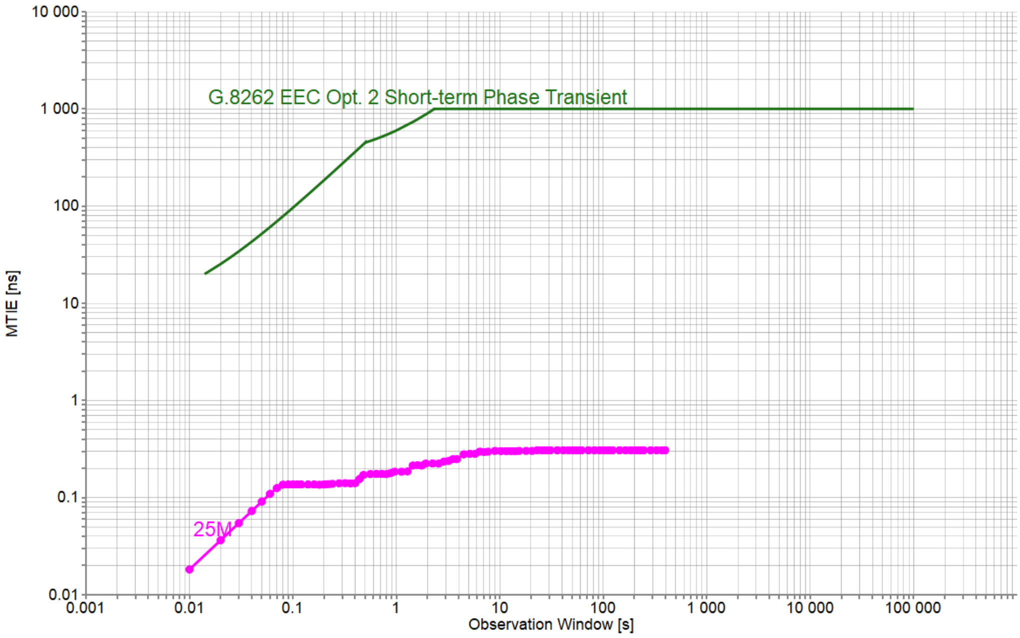

Figure 55. Short-term Phase Transient – G.8262 EEC Option 2 0.1Hz (MTIE)

Min [ns]	0.018
Max [ns]	0.307
Max-Min [ns]	0.289

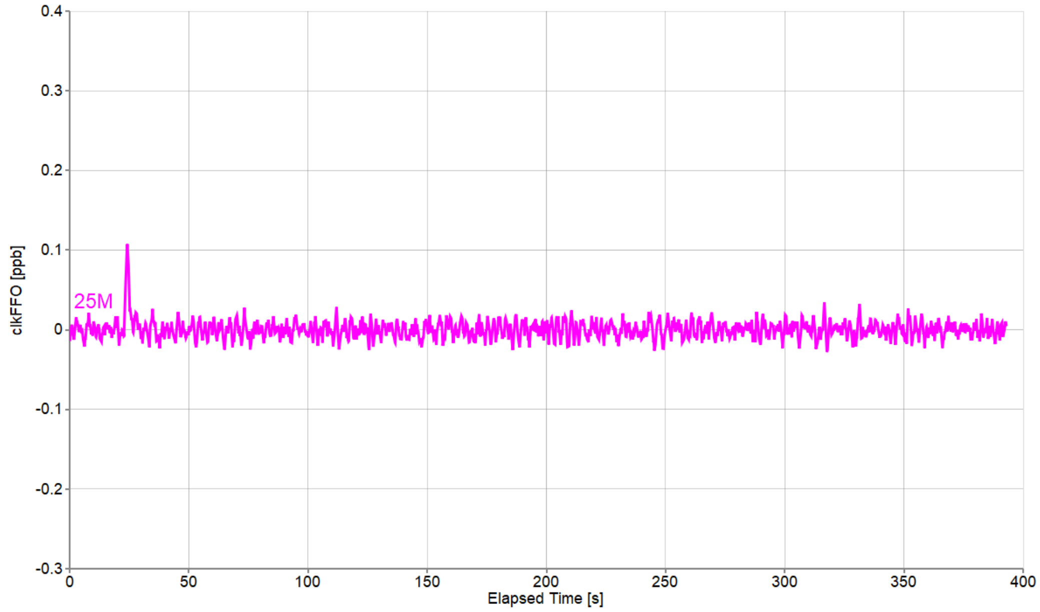

Figure 56. Short-term Phase Transient – G.8262 EEC Option 2 0.1Hz (FFO)

Mean [ppb]	0
Min [ppb]	-0.028
Max [ppb]	0.107
Max-Min [ppb]	0.135

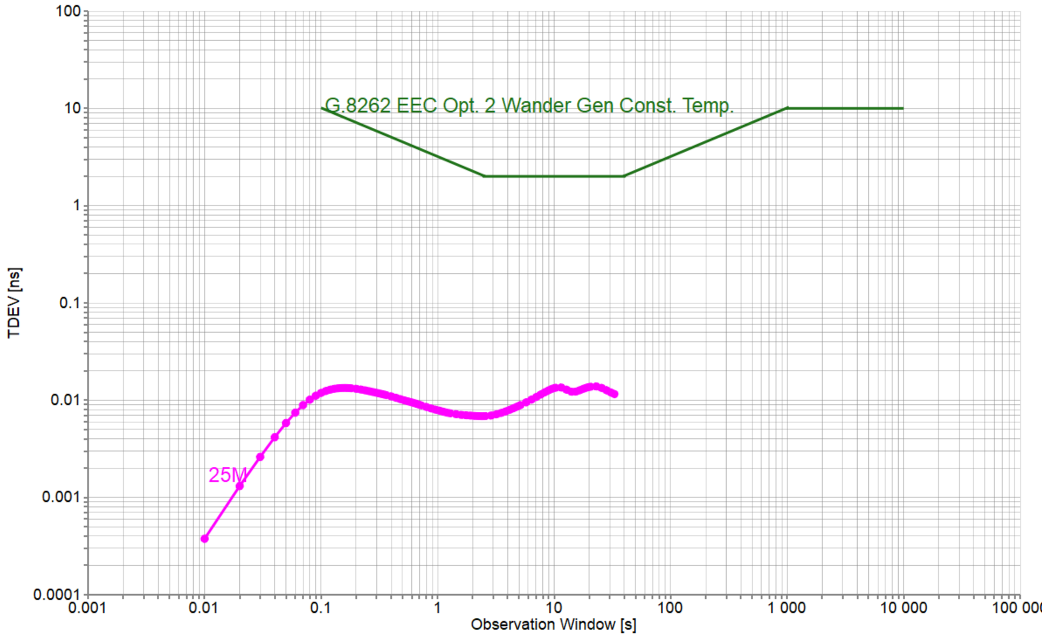

Figure 57. Short-term Phase Transient – G.8262 EEC Option 2 0.1Hz (TDEV)

Min [ns]	0
Max [ns]	0.014
Max-Min [ns]	0.013

8. Wander Tolerance and Transfer

Wander Transfer is a test that requires a PLL to receive a clock containing varying amounts of wander and suppressing that wander based on the damping factor of the PLL. See Figure 1 for the equipment configuration.

The PLL can be viewed as a low pass filter for the difference between the actual input phase and the idea input phase of the reference. The bandwidths for this filter are defined in the applicable standard. For ITU-T G.8262 EEC Option 1 clocks and ITU-T G.8262.1 eEEC clocks, the wander transfer characteristics are evaluated by applying sinusoidal wander to the input clock at various amplitudes and frequencies from a table defined in the standard. This requirement simultaneously checks the wander tolerance requirement. The wander tolerance requirement is passed if during the wander transfer test:

- There are no alarms
- The clock does not switch reference
- The clock does not go into holdover

8.1 Wander Transfer – G8262 EEC Option 1 1.2Hz

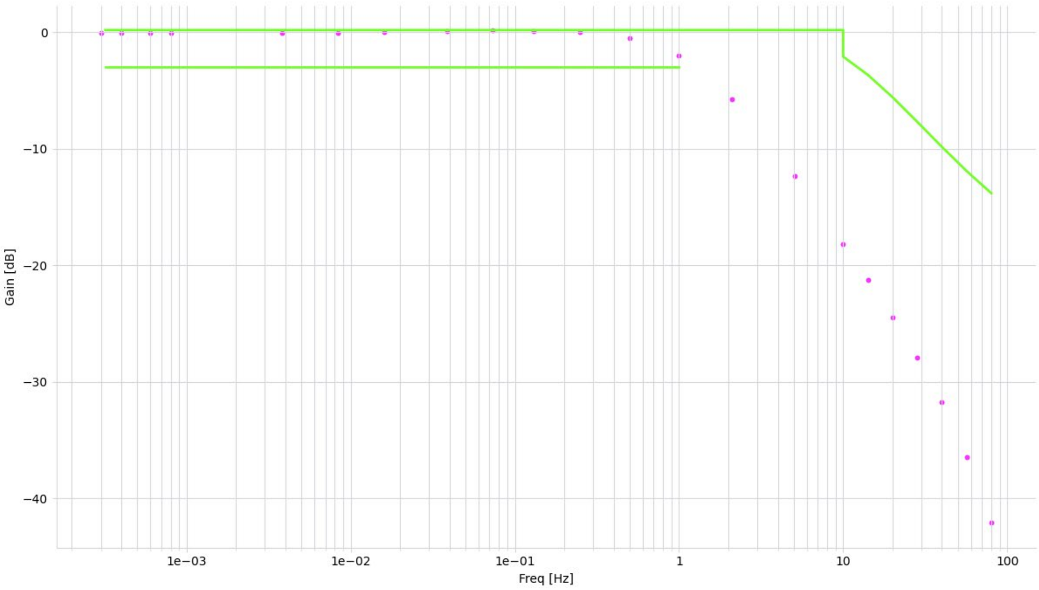

Figure 58. Wander Transfer - G.8262 EEC Option 1 1.2Hz - Phase_Gain

Table 4. Wander Transfer Gain Peaking for Standard – G.8262 EEC Option 1 1.2Hz

Point #	Freq (Hz)	Amplitude (ns)	Pk-Pk Output (ns)	Gain (dB)	Upper Gain Limit (dB)	Lower Gain Limit (dB)
1	80.000	250	1.963	-42.1	-13.8	-
2	56.569	250	3.751	-36.476	-11.9	-
3	40.000	250	6.455	-31.761	-9.8	-
4	28.284	250	10.017	-27.944	-7.7	-
5	20.000	250	14.929	-24.478	-5.6	-
6	14.140	250	21.579	-21.278	-3.6	-
7	10.000	250	30.892	-18.162	-2.1	-
8	5.0650	250	60.22	-12.364	0.2	-
9	2.1040	250	129.223	-5.732	0.2	-
10	1.0000	250	198.719	-1.994	0.2	-3.0
11	0.5000	250	237.159	-0.458	0.2	-3.0
12	0.2500	250	250.721	0.025	0.2	-3.0
13	0.1300	250	254.091	0.141	0.2	-3.0
14	0.0730	438	445.476	0.147	0.2	-3.0
15	0.0388	825	834.265	0.097	0.2	-3.0
16	0.0160	2000	2001.612	0.007	0.2	-3.0
17	0.0084	2000	1994.711	-0.023	0.2	-3.0
18	0.0038	2000	1992.187	-0.034	0.2	-3.0
19	0.0008	2000	1992.875	-0.031	0.2	-3.0
20	0.0006	2860	2845.511	-0.035	0.2	-3.0
21	0.0004	3850	3837.154	-0.02	0.2	-3.0
22	0.0003	5000	4988.5	-0.02	0.2	-3.0

8.2 Wander Transfer – G8262.1 eEEC 3Hz

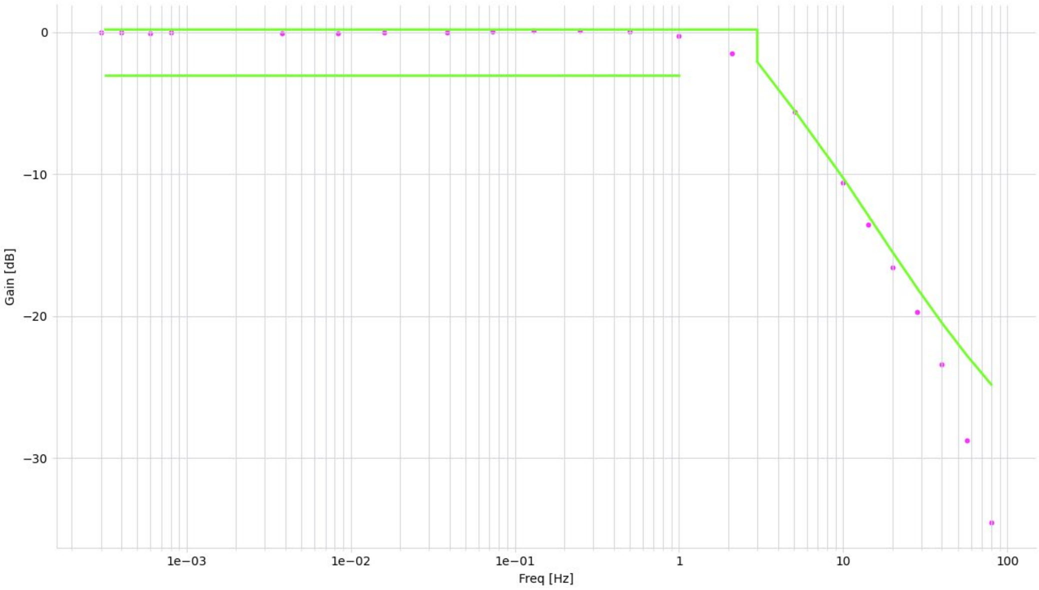

Figure 59. Wander Transfer – G.8262.1 eEEC 3Hz (Phase_Gain)

Table 5. Wander Transfer Gain Peaking for standard – G.8262.1 eEEC 3Hz

Point #	Freq (Hz)	Amplitude (ns)	Pk-Pk Output (ns)	Gain (dB)	Upper Gain Limit (dB)	Lower Gain Limit (dB)
1	80.000	250	4.679	-34.556	-24.8	-
2	56.569	250	9.131	-28.748	-22.7	-
3	40.000	250	16.937	-23.382	-20.5	-
4	28.284	250	25.813	-19.722	-18	-
5	20.000	250	37.187	-16.551	-15.5	-
6	14.140	250	52.637	-13.533	-12.9	-
7	10.000	250	73.678	-10.612	-10.2	-
8	5.0650	250	131.459	-5.583	-5.5	-
9	2.1040	250	210.373	-1.499	0.2	-
10	1.0000	250	242.711	-0.257	0.2	-3.0
11	0.5000	250	252.459	0.085	0.2	-3.0
12	0.2500	250	253.799	0.131	0.2	-3.0
13	0.1300	250	253.858	0.133	0.2	-3.0
14	0.0730	438	441.697	0.073	0.2	-3.0
15	0.0388	825	826.236	0.013	0.2	-3.0
16	0.0160	2000	1993.793	-0.027	0.2	-3.0
17	0.0084	2000	1992.187	-0.034	0.2	-3.0

Point #	Freq (Hz)	Amplitude (ns)	Pk-Pk Output (ns)	Gain (dB)	Upper Gain Limit (dB)	Lower Gain Limit (dB)
18	0.0038	2000	1991.728	-0.036	0.2	-3.0
19	0.0008	2000	1992.875	-0.031	0.2	-3.0
20	0.0006	2860	2845.183	-0.036	0.2	-3.0
21	0.0004	3850	3837.596	-0.019	0.2	-3.0
22	0.0003	5000	4988.5	-0.02	0.2	-3.0

8.3 Wander Transfer – G8262 EEC Option 1 10Hz

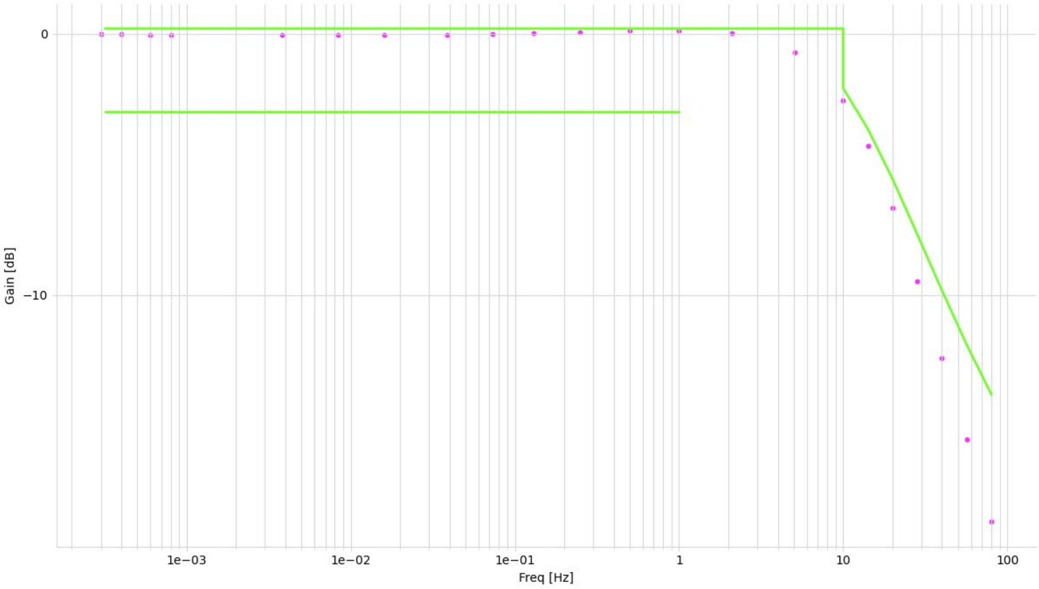

Figure 60. Wander Transfer – G.8262 EEC Option 1 10Hz (Phase_Gain)

Table 6. Wander Transfer Gain Peaking for Standard – G.8262 EEC Option 1 10Hz

Point #	Freq (Hz)	Amplitude (ns)	Pk-Pk Output (ns)	Gain (dB)	Upper Gain Limit (dB)	Lower Gain Limit (dB)
1	80.000	250	29.076	-18.688	-13.8	-
2	56.569	250	41.869	-15.521	-11.9	-
3	40.000	250	59.888	-12.412	-9.8	-
4	28.284	250	84.138	-9.459	-7.7	-
5	20.000	250	116.049	-6.666	-5.6	-
6	14.140	250	152.683	-4.283	-3.6	-
7	10.000	250	186.14	-2.562	-2.1	-
8	5.0650	250	230.457	-0.707	0.2	-
9	2.1040	250	250.605	0.021	0.2	-

Point #	Freq (Hz)	Amplitude (ns)	Pk-Pk Output (ns)	Gain (dB)	Upper Gain Limit (dB)	Lower Gain Limit (dB)
10	1.0000	250	253.945	0.136	0.2	-3.0
11	0.5000	250	253.945	0.136	0.2	-3.0
12	0.2500	250	252.11	0.073	0.2	-3.0
13	0.1300	250	250.346	0.012	0.2	-3.0
14	0.0730	438	437.093	-0.018	0.2	-3.0
15	0.0388	825	822.439	-0.027	0.2	-3.0
16	0.0160	2000	1991.728	-0.036	0.2	-3.0
17	0.0084	2000	1991.499	-0.037	0.2	-3.0
18	0.0038	2000	1991.499	-0.037	0.2	-3.0
19	0.0008	2000	1992.875	-0.031	0.2	-3.0
20	0.0006	2860	2845.511	-0.035	0.2	-3.0
21	0.0004	3850	3838.038	-0.018	0.2	-3.0
22	0.0003	5000	4989.075	-0.019	0.2	-3.0

8.4 Wander Transfer – G8262 EEC Option 2 0.1Hz

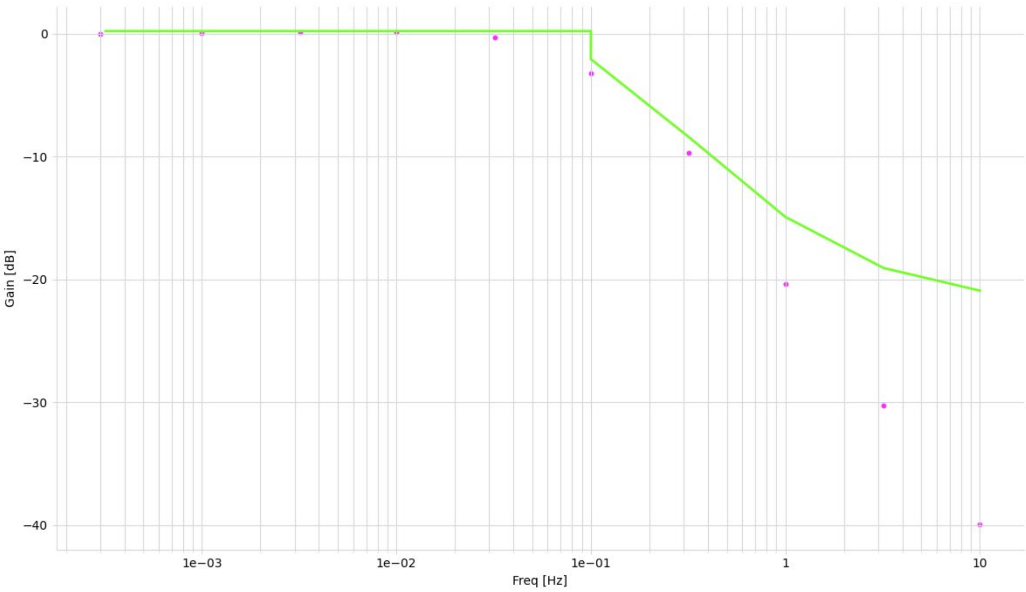

Figure 61. Wander Transfer – G.8262 EEC Option 2 0.1Hz (Phase_Gain)

Table 7. Wander Transfer Gain Peaking for Standard – G.8262 EEC Option 2 0.1Hz

Point #	Freq (Hz)	Amplitude (ns)	Pk-Pk Output (ns)	Gain (dB)	Upper Gain Limit (dB)
1	10.000	300	3.01	-39.971	-20.9
2	3.2000	300	9.202	-30.265	-19.1
3	1.0000	301	28.838	-20.372	-14.9
4	0.3200	303	99.356	-9.685	-8.4
5	0.1000	308	212.423	-3.227	-2.1
6	0.0320	325	313.317	-0.318	0.2
7	0.0100	380	385.908	0.134	0.2
8	0.0032	550	556.753	0.106	0.2
9	0.0010	1000	1000.576	0.005	0.2
10	0.0003	1007	1005.147	-0.016	0.2

9. Phase Noise and RMS Jitter

The data in this section displays phase noise plots and RMS jitter for RC310xx when using the G.8262 option 1, G.8262 option 2, and G.8262.1 eEEC register settings in Table 2. For these measurements, a TCXO was mounted to pad Y4 of a 72QFN ClockMatrix EVK. The short SMA cable is used to connect the SMA connector from CLK_OSC on ClockMatrix to the XIN_REFIN SMA connector on a RC31012 EVK. A 25MHz LVDS reference input Clock is provided to the RC31012 EVK from a Rohde & Schwarz SMA100B. A 156.25MHz LVDS output from the RC31012 EVK is connected through a Prodyn BIB-100F Balun to a Keysight E5052B signal source analyzer.

Measurements were taken using SyncE compliant TCXOs with frequencies of 40MHz and 76.8MHz.

Note: 76.8MHz is not an ideal TCXO frequency for ethernet use cases. The use of a 76.8MHz TCXO is included to illustrate the benefit in RMS jitter that higher frequency TCXOs (>40MHz) can produce; however, it is recommended to contact Renesas when selecting a TCXO frequency to help meet reference clock phase noise targets and to manage spurs.

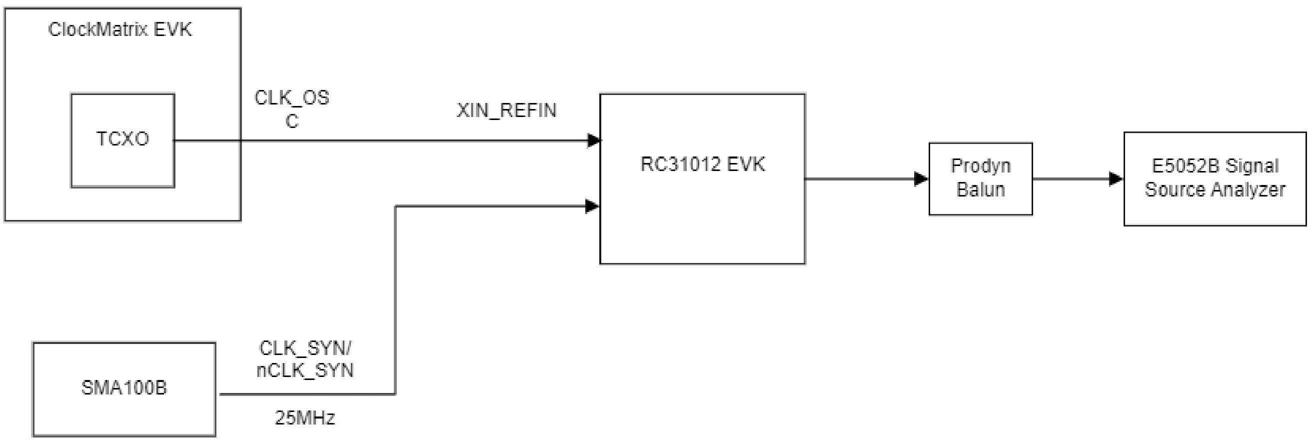

Figure 62. Phase Noise and RMS Jitter Measurement Setup

Table 8. Summary of RMS Jitter Measurements

TCXO Frequency	Profile	Bandwidth	RMS Jitter
40MHz	G.8262 EEC Option 1	1.2Hz	280.5fs
	G.8262 EEC Option 1	10Hz	282.6fs
	G.8262 EEC Option 2	0.1Hz	283.5fs
	G.8262.1 eEEC	3Hz	283.8fs
76.8MHz	G.8262 EEC Option 1	1.2Hz	212.0fs
	G.8262 EEC Option 1	10Hz	211.8fs
	G.8262 EEC Option 2	0.1Hz	207.6fs
	G.8262.1 eEEC	3Hz	207.9fs

9.1 Phase Noise and RMS Jitter – G8262 EEC Option 1 1.2Hz, 40MHz TXCO

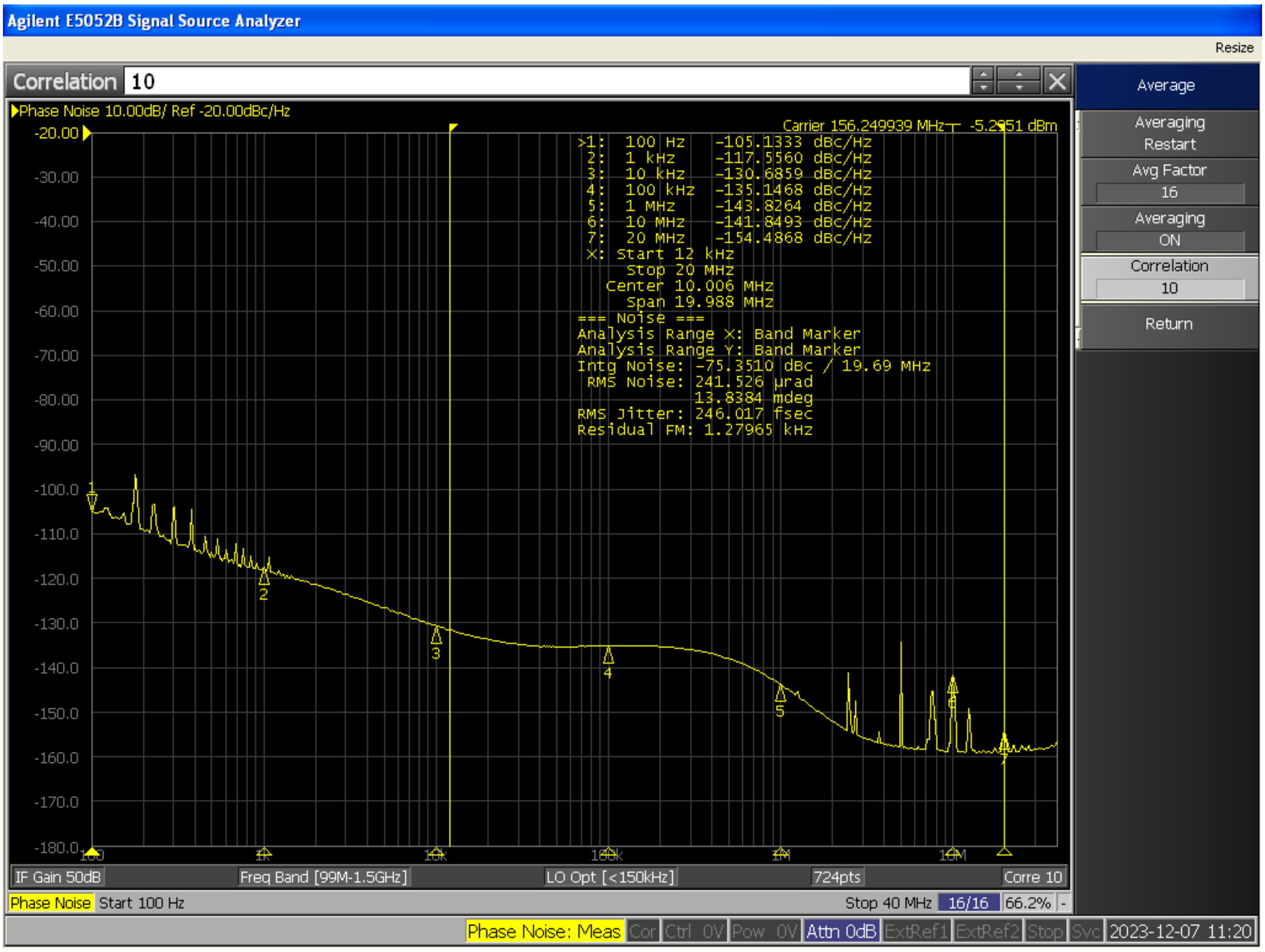

Figure 63. Phase Noise and RMS Jitter for G.8262 EEC Option 1, 1.2Hz, 156.25MHz Output, Using a 40MHz TCXO

9.2 Phase Noise and RMS Jitter – G8262.1 eEEC 3Hz, 40MHz TXCO

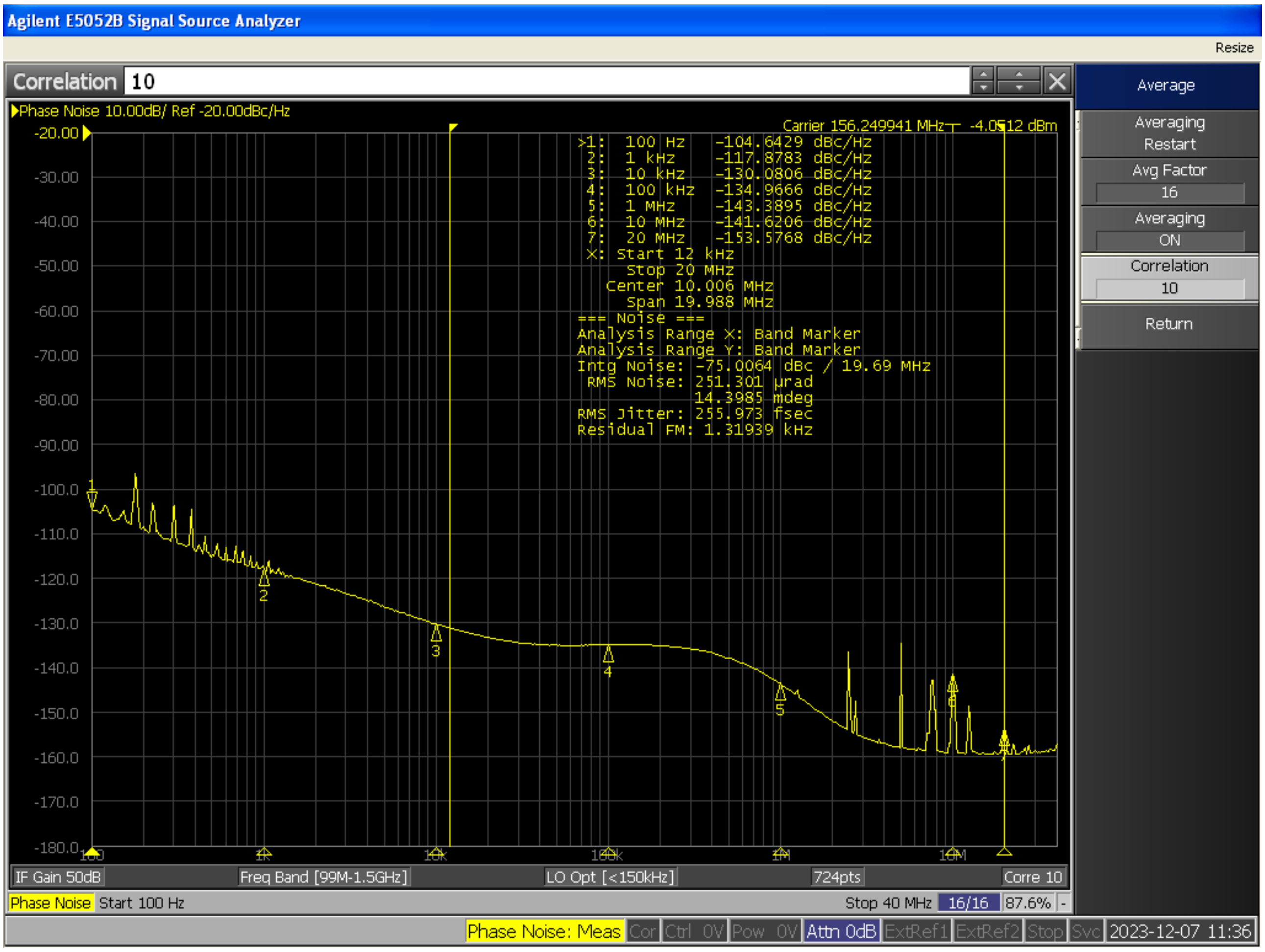

Figure 64. Phase Noise and RMS Jitter for G.8262.1 eEEC, 3Hz, 156.25MHz Output, Using a 40MHz TCXO

9.3 Phase Noise and RMS Jitter – G8262 EEC Option 1 10Hz, 40MHz TCXO

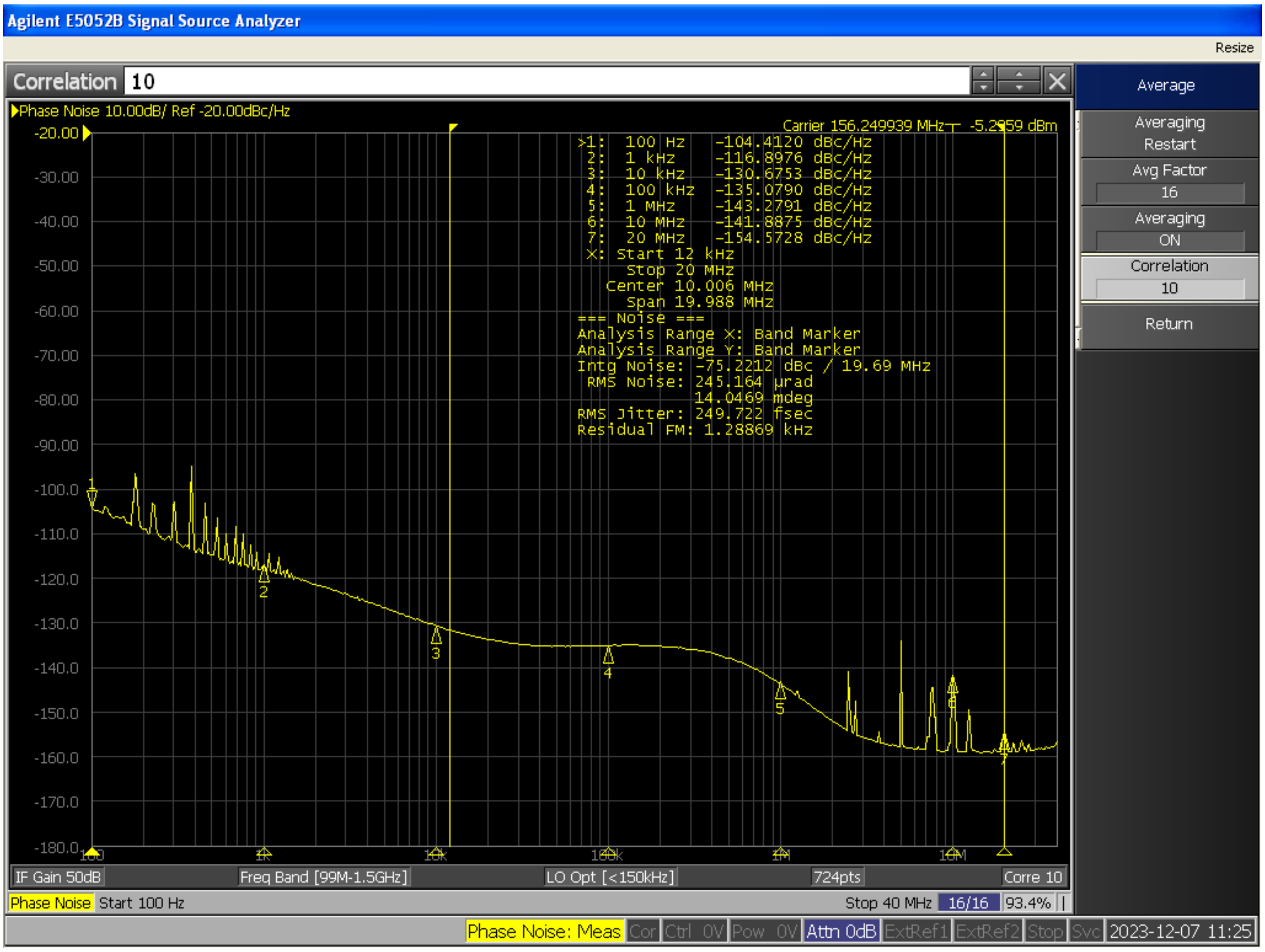

Figure 65. Phase Noise and RMS Jitter for G.8262 EEC Option 1, 10Hz, 156.25MHz Output, Using a 40MHz TCXO

9.4 Phase Noise and RMS Jitter – G8262 EEC Option 2 0.1Hz, 40MHz TCXO

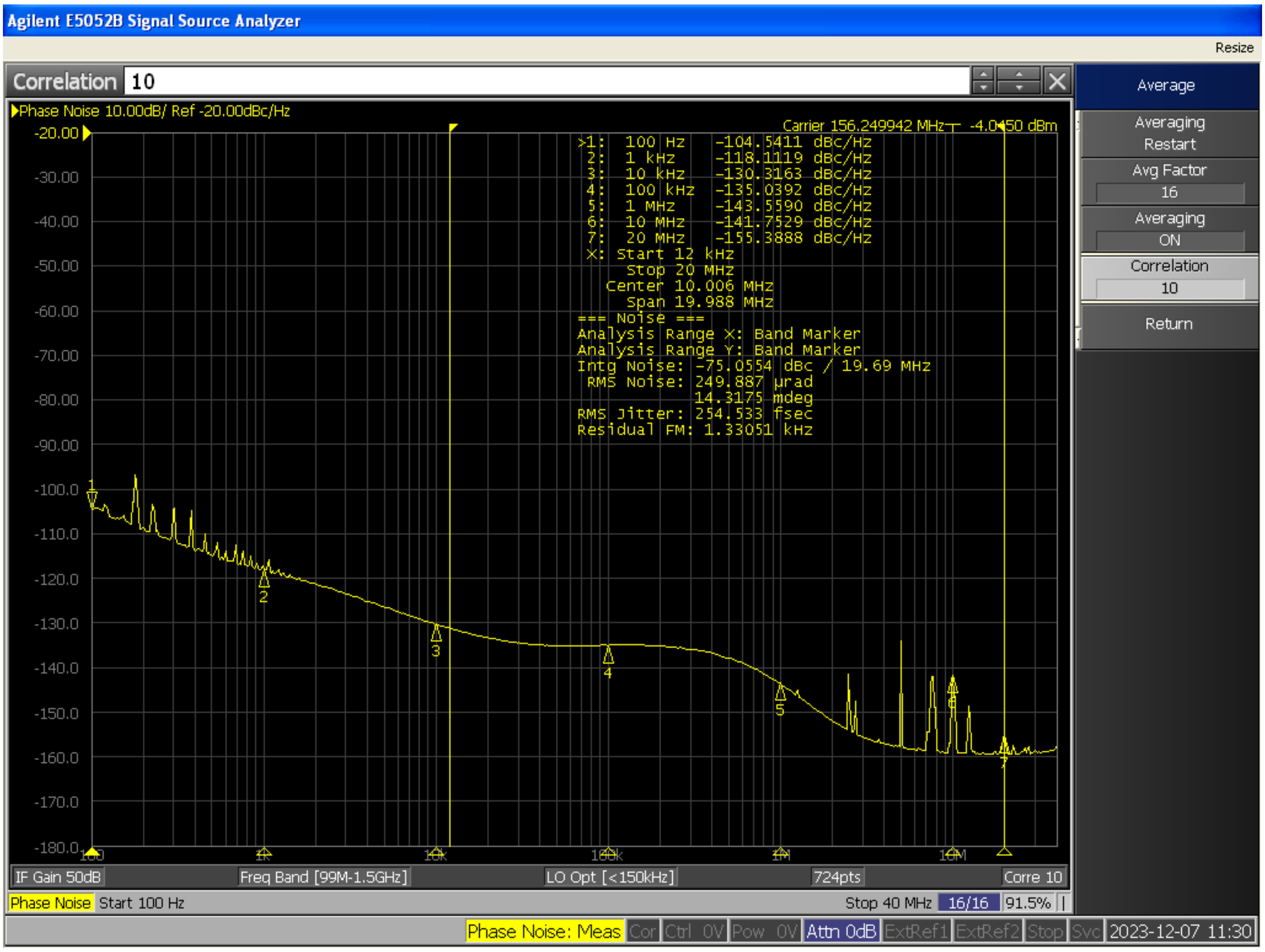

Figure 66. Phase Noise and RMS Jitter for G.8262 EEC Option 2, 0.1Hz, 156.25MHz Output, Using a 40MHz TCXO

9.5 Phase Noise and RMS Jitter – G8262 EEC Option 1 1.2Hz, 76.8 MHz TXCO

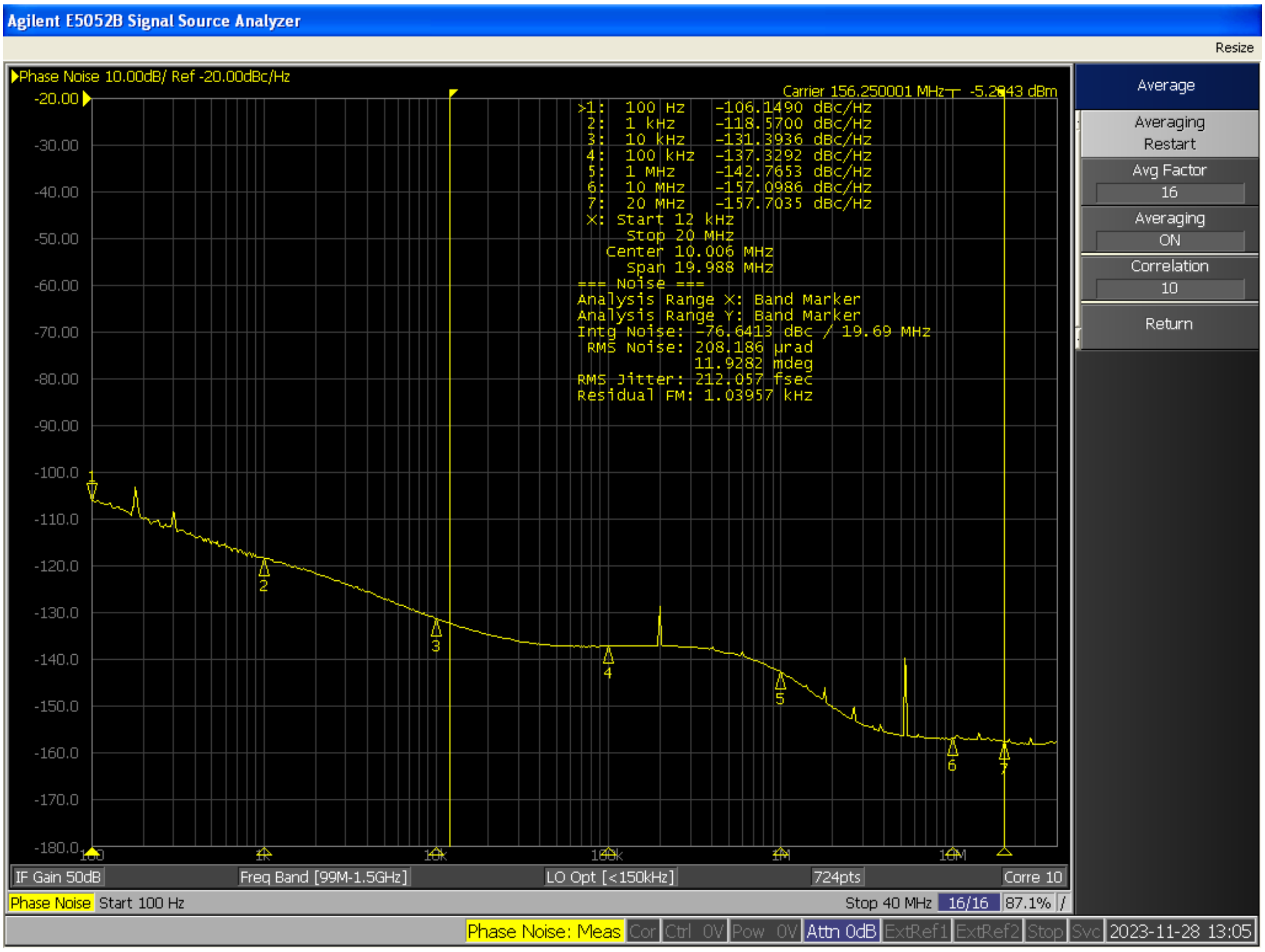

Figure 67. Phase Noise and RMS Jitter for G.8262 EEC Option 1, 1.2Hz, 156.25MHz Output, Using a 76.8MHz TCXO

9.6 Phase Noise and RMS Jitter – G8262.1 eEEC 3Hz, 76.8MHz TXCO

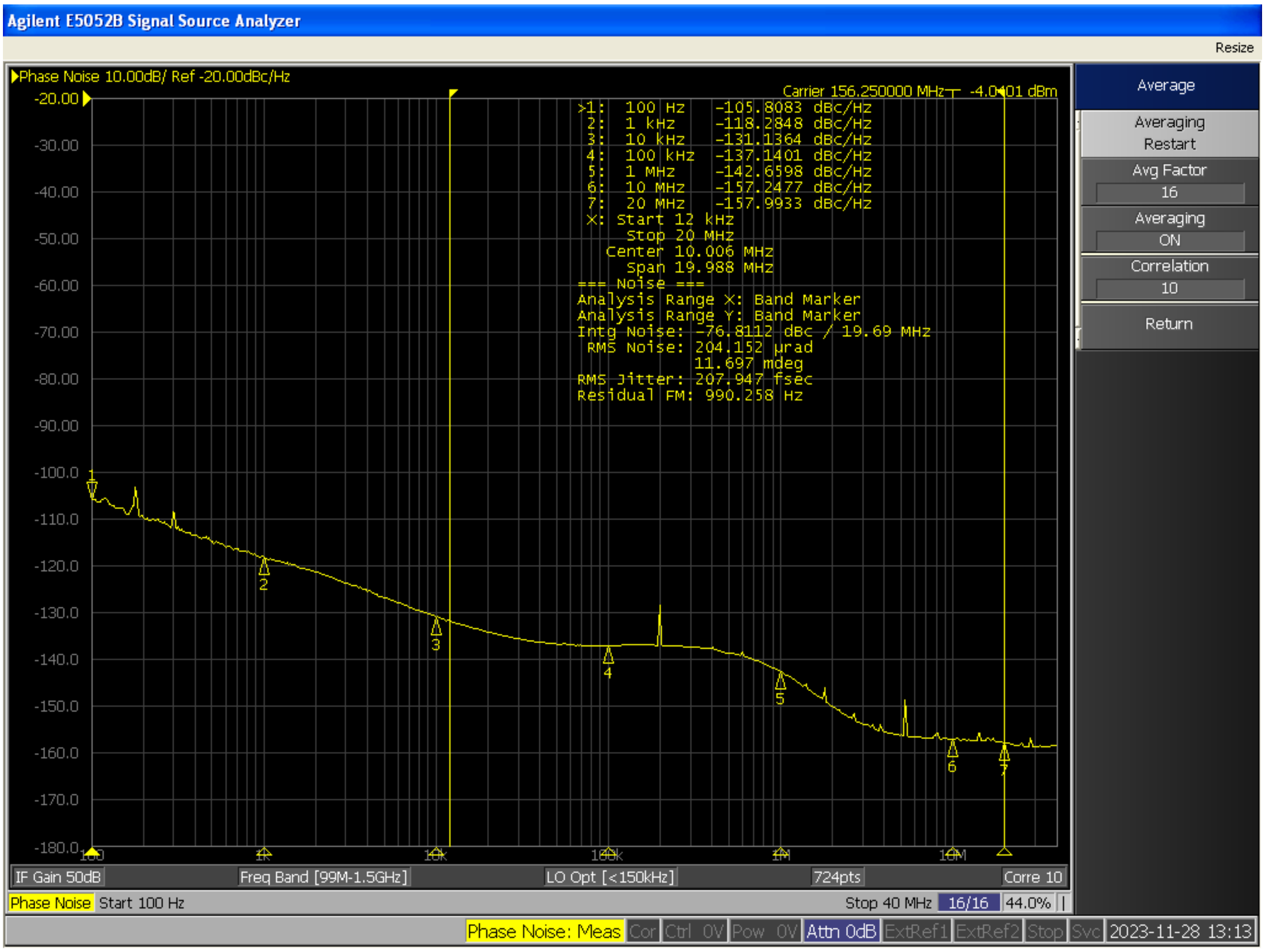

Figure 68. Phase Noise and RMS Jitter for G.8262.1 eEEC, 3Hz, 156.25MHz Output, Using a 76.8MHz TCXO

9.7 Phase Noise and RMS Jitter – G8262 EEC Option 1 10Hz, 76.8MHz TCXO

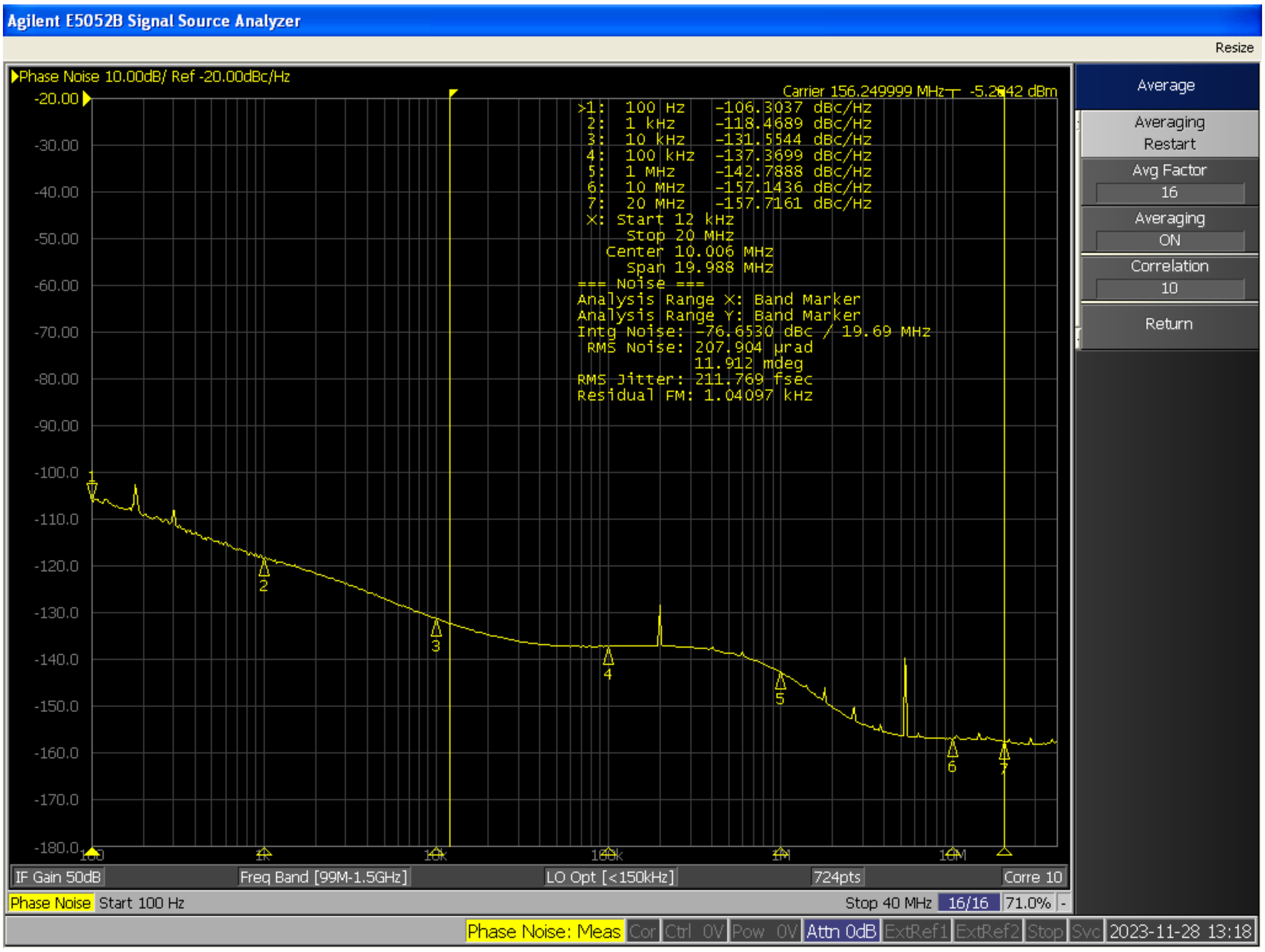

Figure 69. Phase Noise and RMS Jitter for G.8262 EEC Option 2, 10Hz, 156.25MHz Output, Using a 76.8MHz TCXO

9.8 Phase Noise and RMS Jitter – G8262 EEC Option 2 0.1Hz, 76.8MHz TCXO

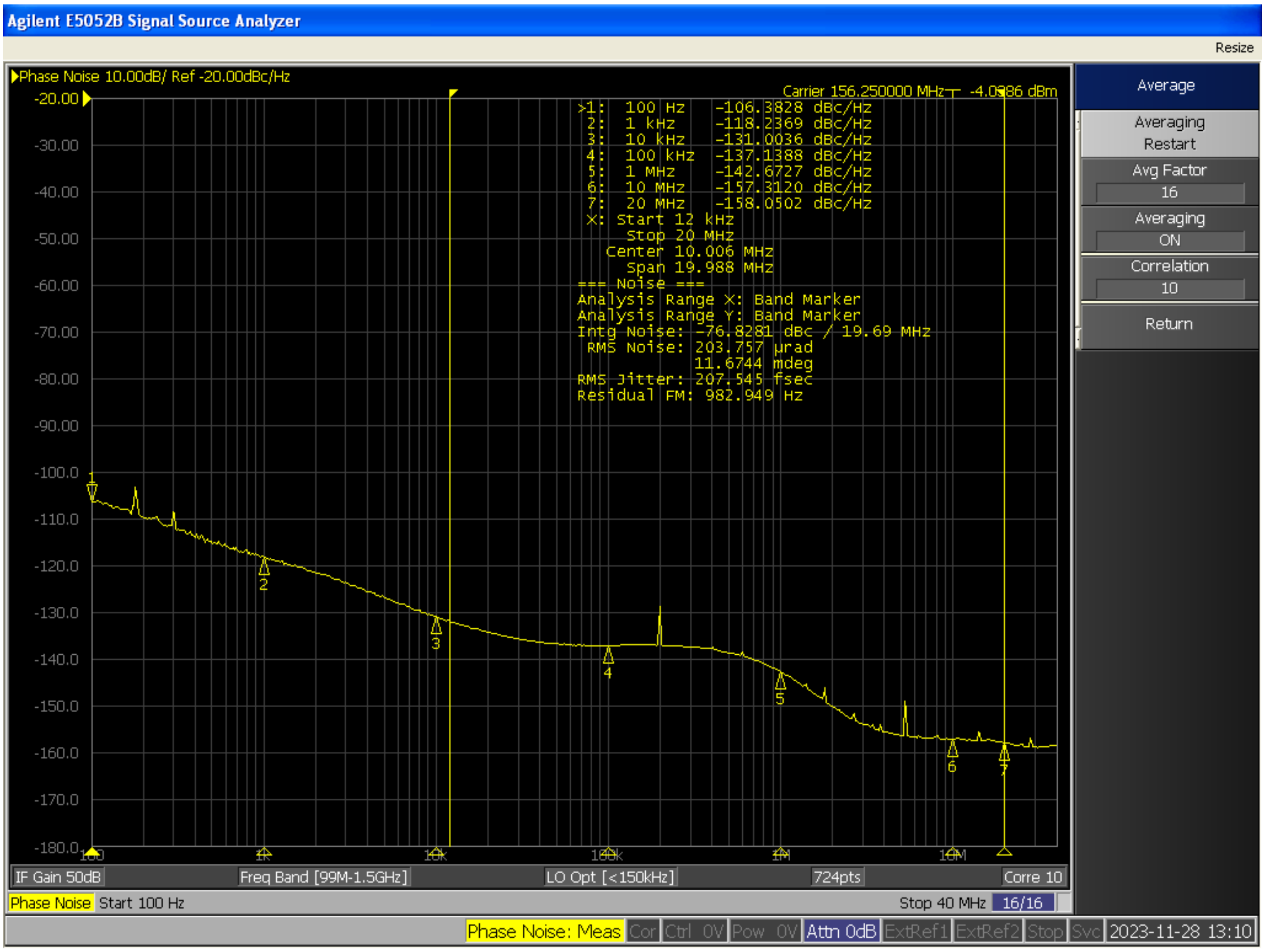

Figure 70. Phase Noise and RMS Jitter for G.8262 EEC Option 2, 0.1Hz, 156.25MHz Output, Using a 76.8MHz TCXO

10. Revision History

Revision	Date	Description
1.00	Dec 18, 2023	Initial release.

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