Comparative Analysis between LEA-M8F Time & Frequency Reference and Jackson Labs Technologies, Inc. LTE-Lite™ GPS-Disciplined Oscillator

S. Jackson, Jackson Labs Technologies, Inc. – proprietary and confidential

1) Objective

Jackson Labs Technologies, Inc. designed the LTE-Lite™ GPS Disciplined reference module to provide a very low cost and high-volume frequency, timing, position, and velocity source for Small Cell applications. This document serves to compare the JLT LTE-Lite SMT module to a similar module from uBlox – the LEA-M8F and to point out advantages, disadvantages, and differences between the two products.

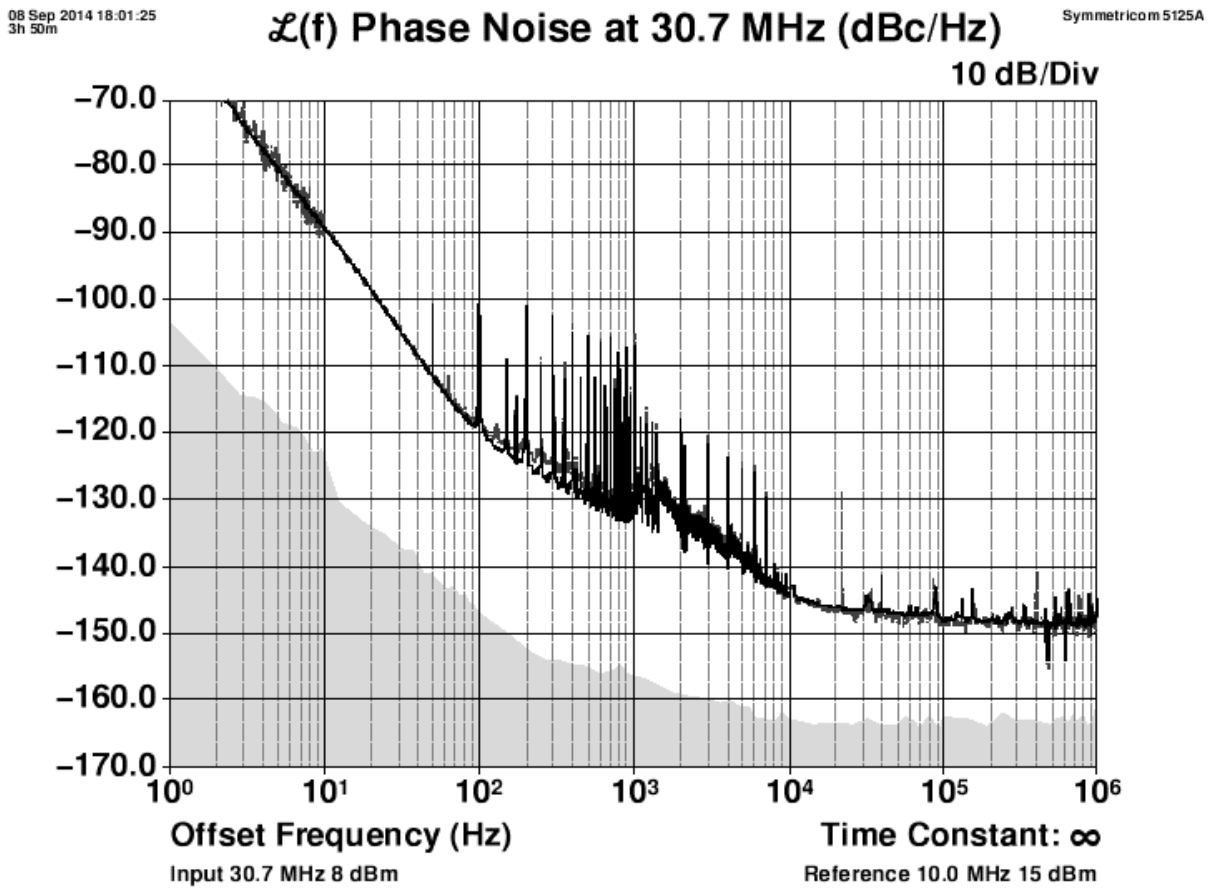
2) Comparison table (typical values, LTE-Lite vs. LEA-M8F)

Parameter	LTE-Lite™	LEA-M8F	Comments
GNSS Channels	65 acquisition, 167 channel engine	72	LEA-M8F supports Glonass and BeiDou, LTE-Lite supports GPS, and QZSS
GPS SBAS	WAAS/EGNOS/MSAS	WAAS/EGNOS/MSAS	
GPS Time To First Fix	<5 seconds (GPS)	29 seconds (GPS)	With recent Almanac stored in Flash on LTE-Lite
1PPS Stability (GPS)	6ns rms	20ns rms	After warmup period, clear sky
Frequency Stability	<1ppb rms	<5ppb rms	
24 hours Holdover	<25ppb	<100ppb	
Software Requirements	none	Requires binary-command setup of: external TCXO parameters, configuration of Position And Hold Mode, configuration of internal vs. external oscillator, and configuration of time-pulse-output	LTE-Lite uses TTL strap lines for all configuration, LEA-M8F requires extensive binary configuration software to operate properly
Oscillator Calibration and Frequency sensing	Automatic	Must be initiated manually through binary software commands (TIM-VCO-CAL and five other binary commands)	
External TCXO option	Connects gluelessly to external TCXO	Requires user-supplied 12 or 16 bit DAC, user supplied DAC Voltage reference, user-supplied Low Noise TCXO power supply, User supplied DAC bias circuit, and DAC Low Pass Filter	LTE-Lite includes TCXO Low-Noise power supply, 21 bit DAC, DAC reference, and DAC LP Filter supporting a true-glueless TCXO connection

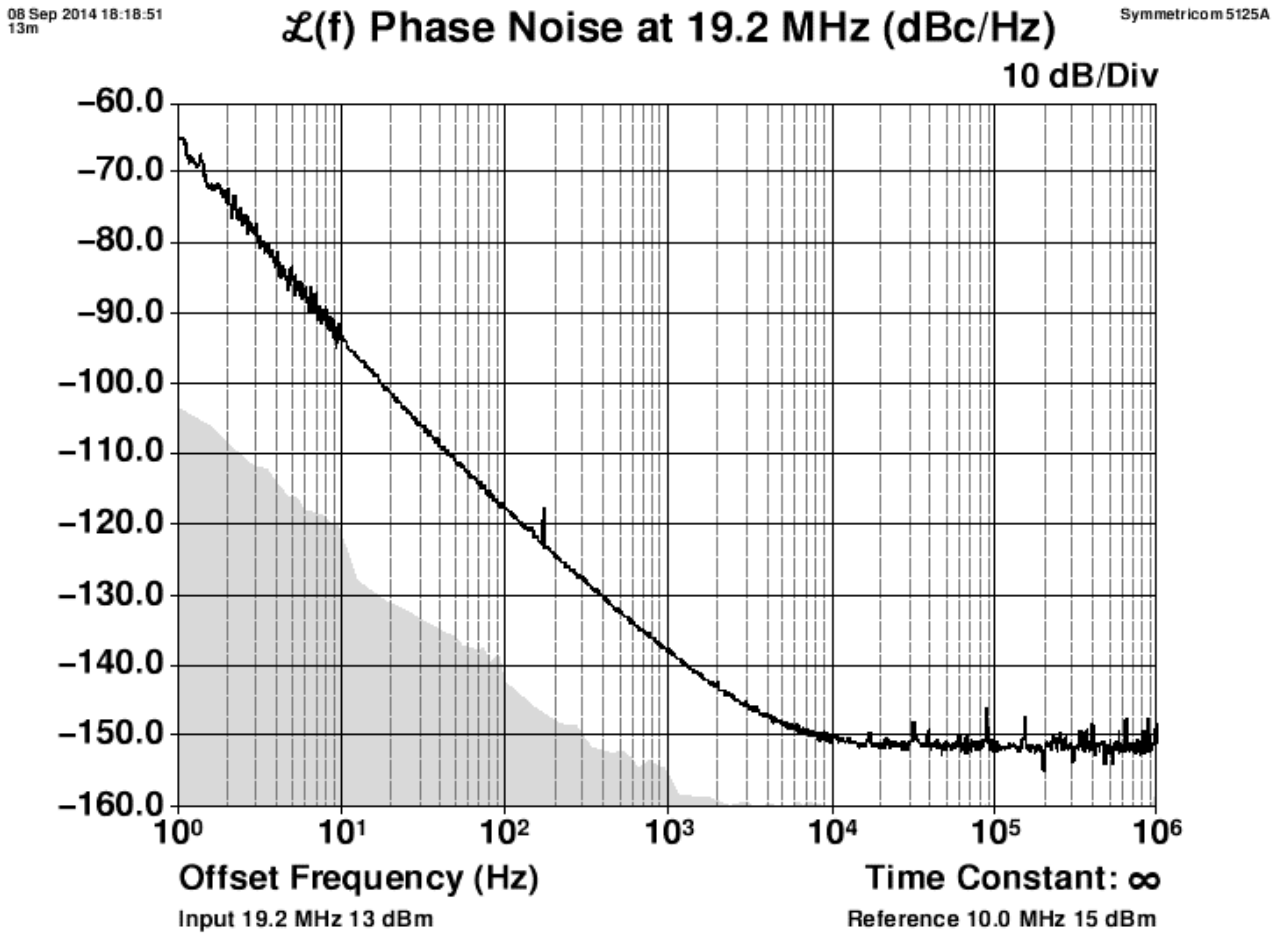
List of Available output frequencies (using only internal TCXO choice)	4.608, 4.8, 5, 9.6, 10, 10.24, 12.8, 13, 13.333, 15.36, 16, 20, 23.04, 25.6, 26, 26.6666, 30.72, 38.4, 39, 40, 46.08, 76.8, 80, 91, 92.16MHz	30.72MHz, other frequencies require external TCXO	LTE-Lite supports one direct crystal RF output, and one synthesized and phase-locked frequency output at the same time
RF Output 50 Ohms drive capable	Yes	No, requires external buffer	
Operating Current and Power max	60mA, 198mW	67mA, 221mW	
Size	0.14 cubic cm	0.15 cubic cm	LTE Lite has lower height
TTL Status outputs	Yes, TCXO lock status, Auto-Survey mode status, Alarm status, and customer-MCU RESET# outputs are supported	None	
LED	Yes, Power-On and GPS Fix status LED	None	
Antenna connection	Internal U.Fl coax connector, or user PCB-connected option	Must be connected on user PCB	
NMEA Oscillator Lock Status Output	Yes, oscillator lock status, UTC phase offset, and other status output in NMEA message, enabled by default	None	
Built-In 3.0V, 3.3V and 5V antenna support	Yes	No	
Fielded GPS Disciplined Oscillator Experience	Since 2005	Since December 2013	
Evaluation board available with configuration switches, status LED's power supply, USB, coax-connectors, and external TCXO socket	Yes	No	

3) Comparative analysis for Phase Noise and Allan Deviation (typical performance plots)

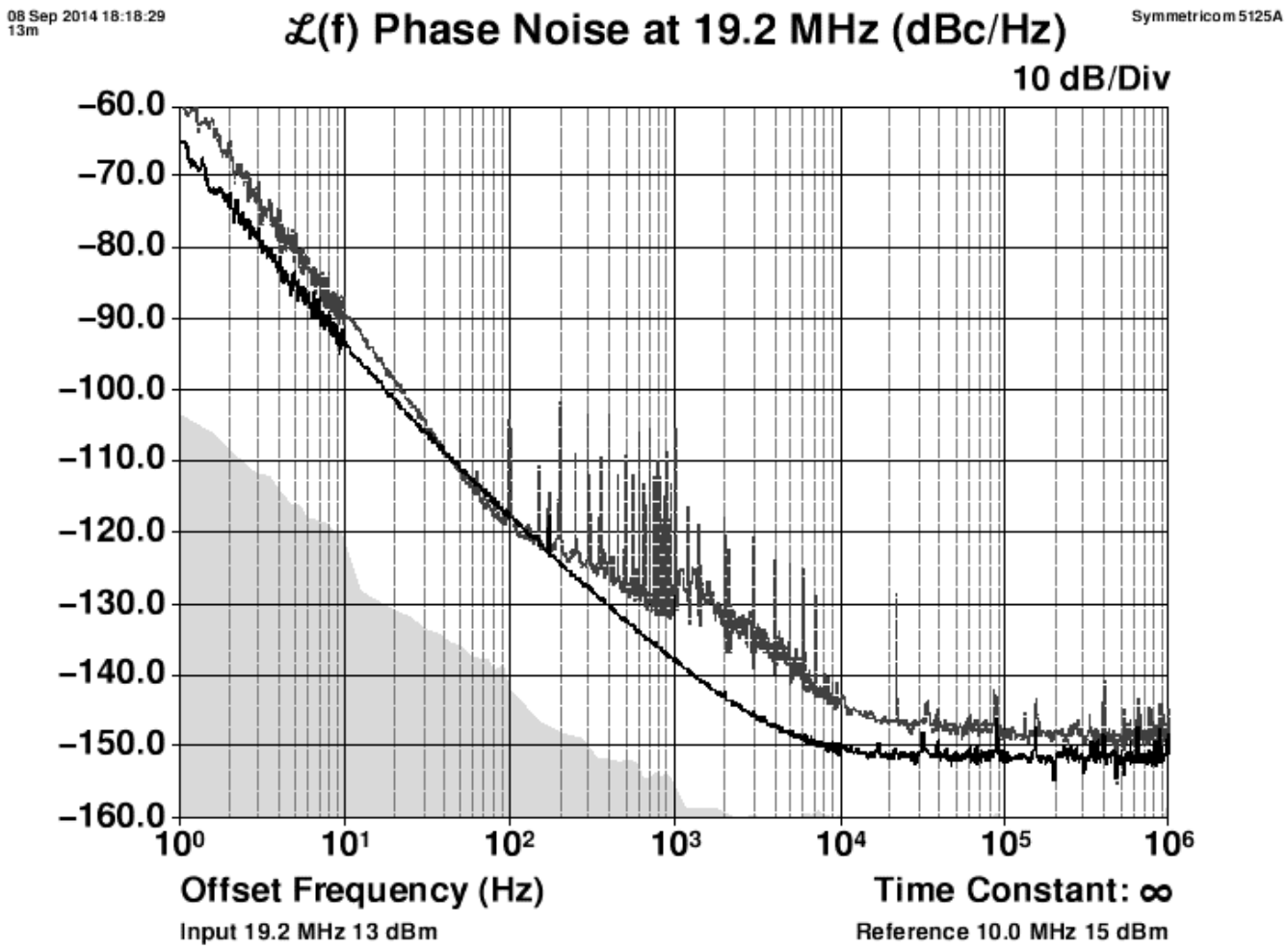
a. LEA-M8F Phase Noise:



b. LTE-Lite™ Phase Noise:

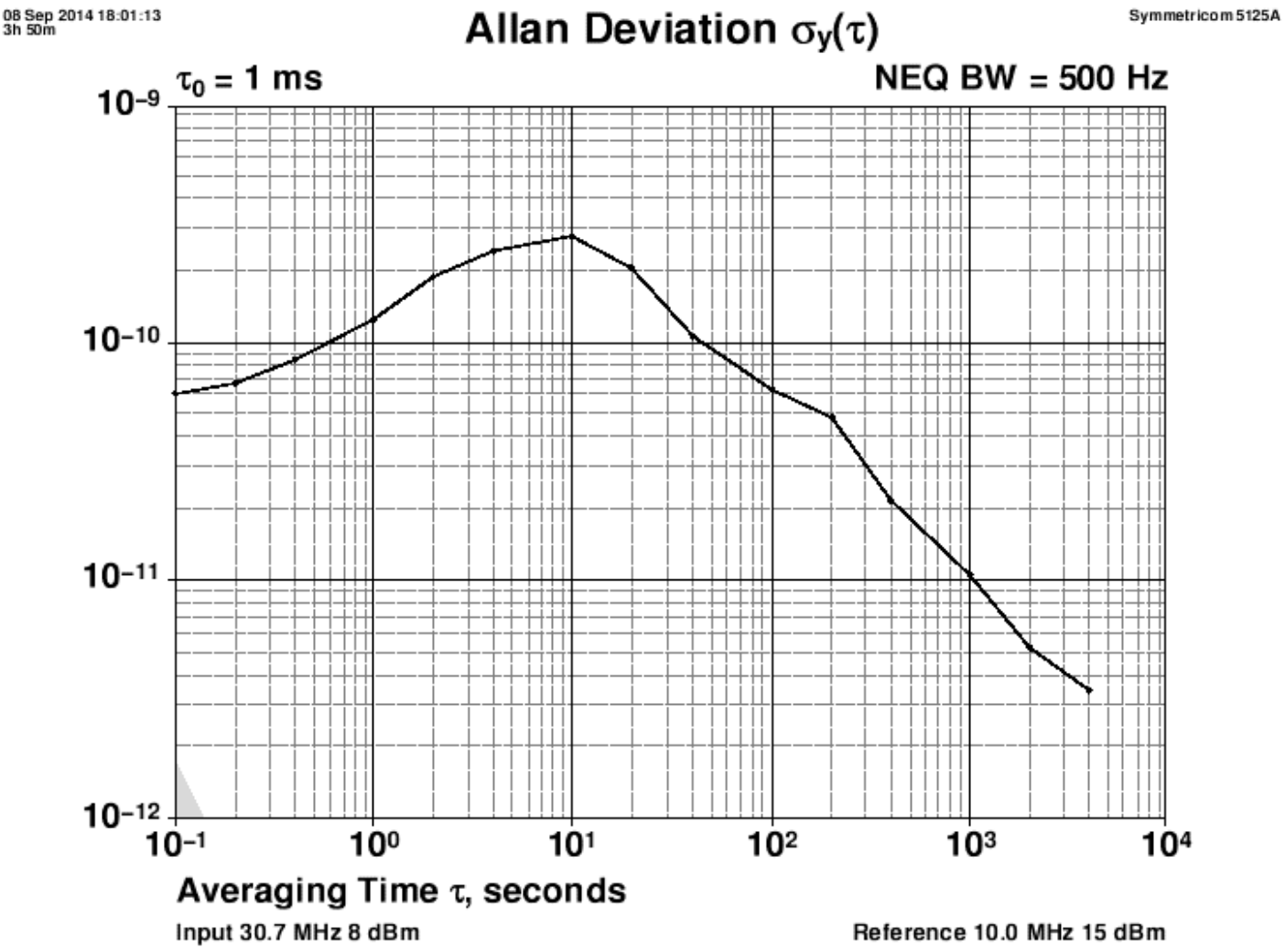


c. **Composite Phase Noise Plot:**

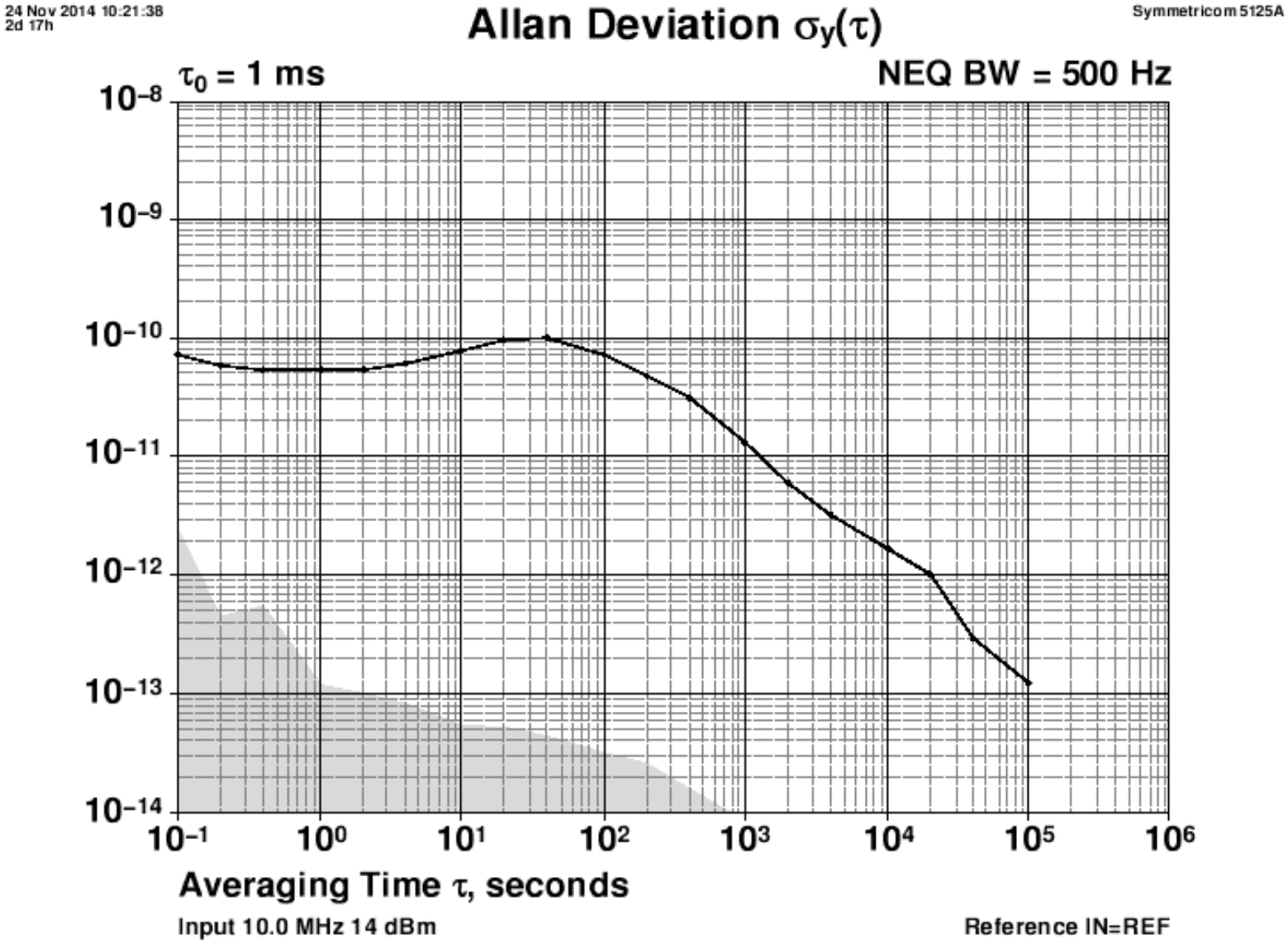


4) Comparative ADEV Performance (Clear View of Sky)

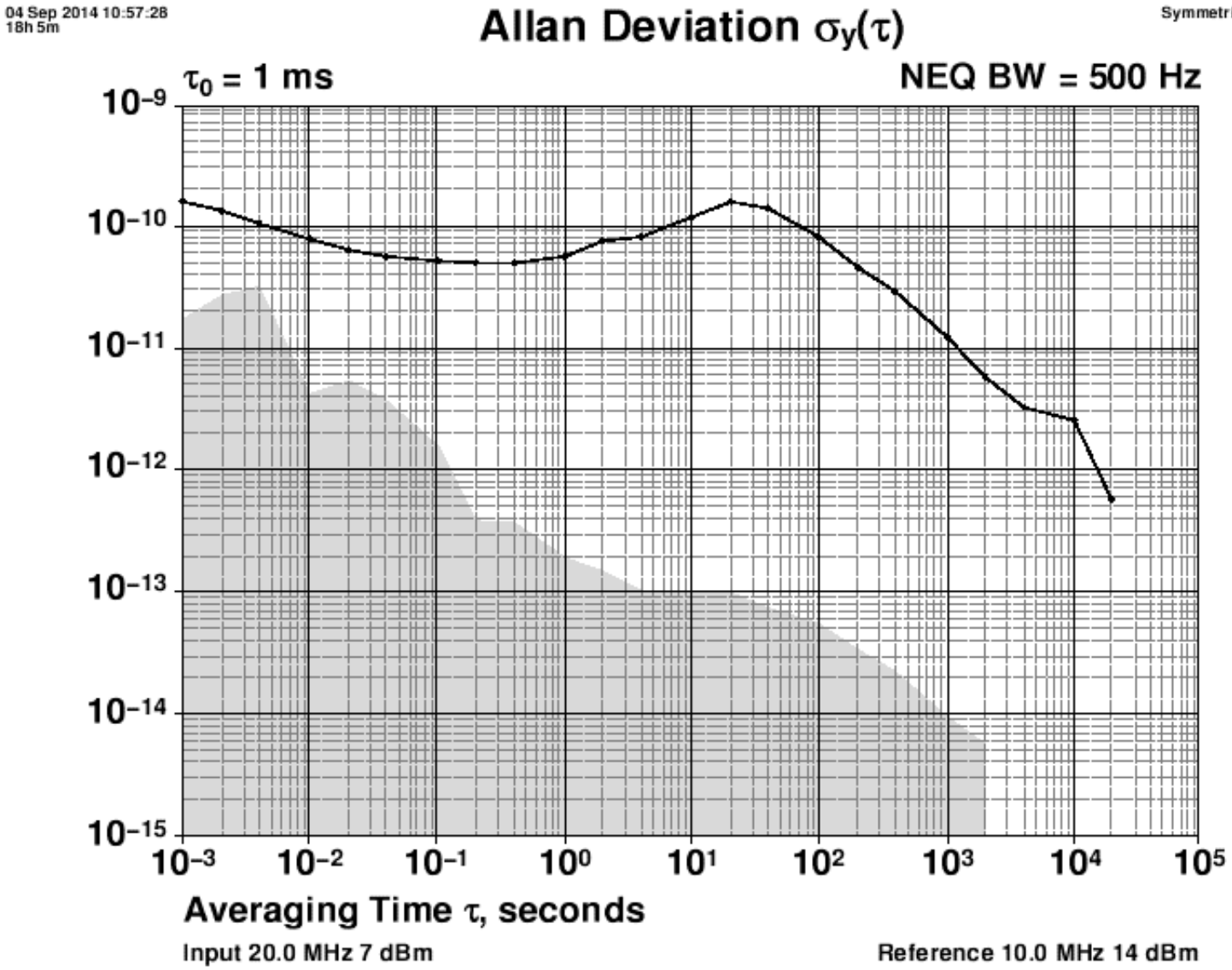
a) LEA-M8F ADEV:



b) LTE-Lite™ ADEV with external DIP-14 TCXO:

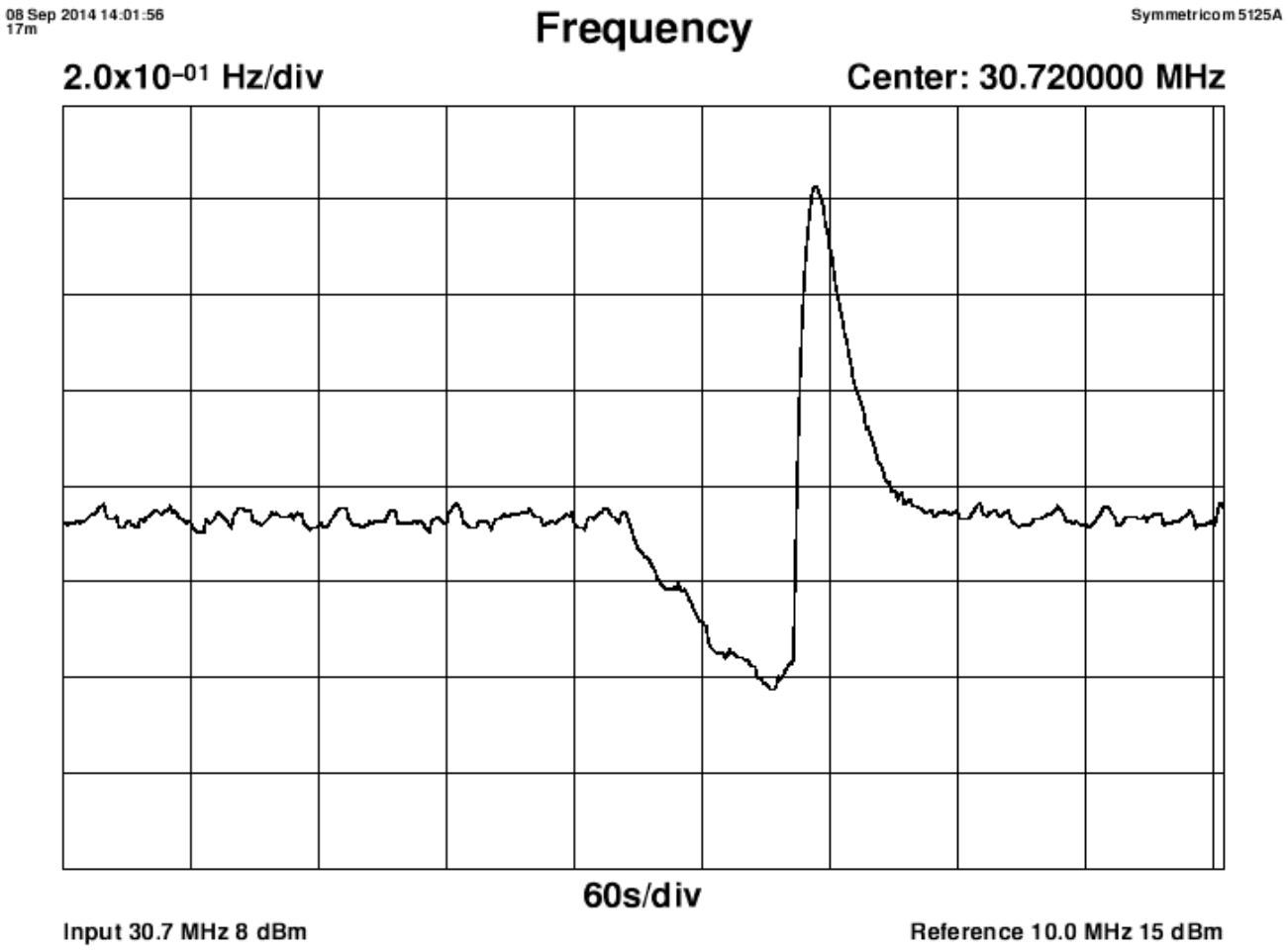


c) **LTE-Lite™ ADEV:**

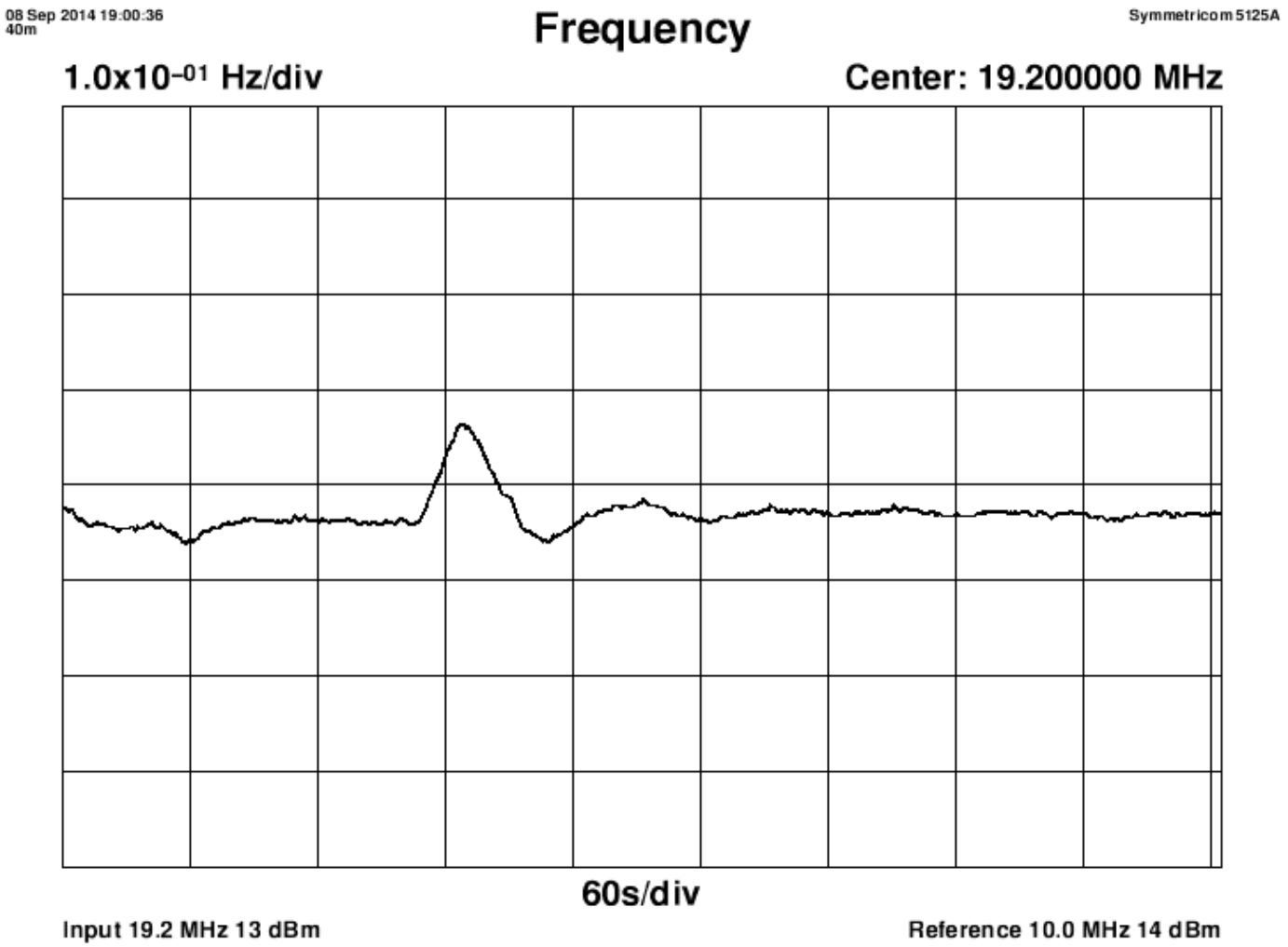


5) Comparative Behavior with 1 Minute loss of GNSS antenna signal (GNSS Antenna Feed removed at the antenna)

a) LEA-M8F Frequency jump: **(Max Frequency Error: 6.6E-08 = <u>66 parts per billion</u>)**

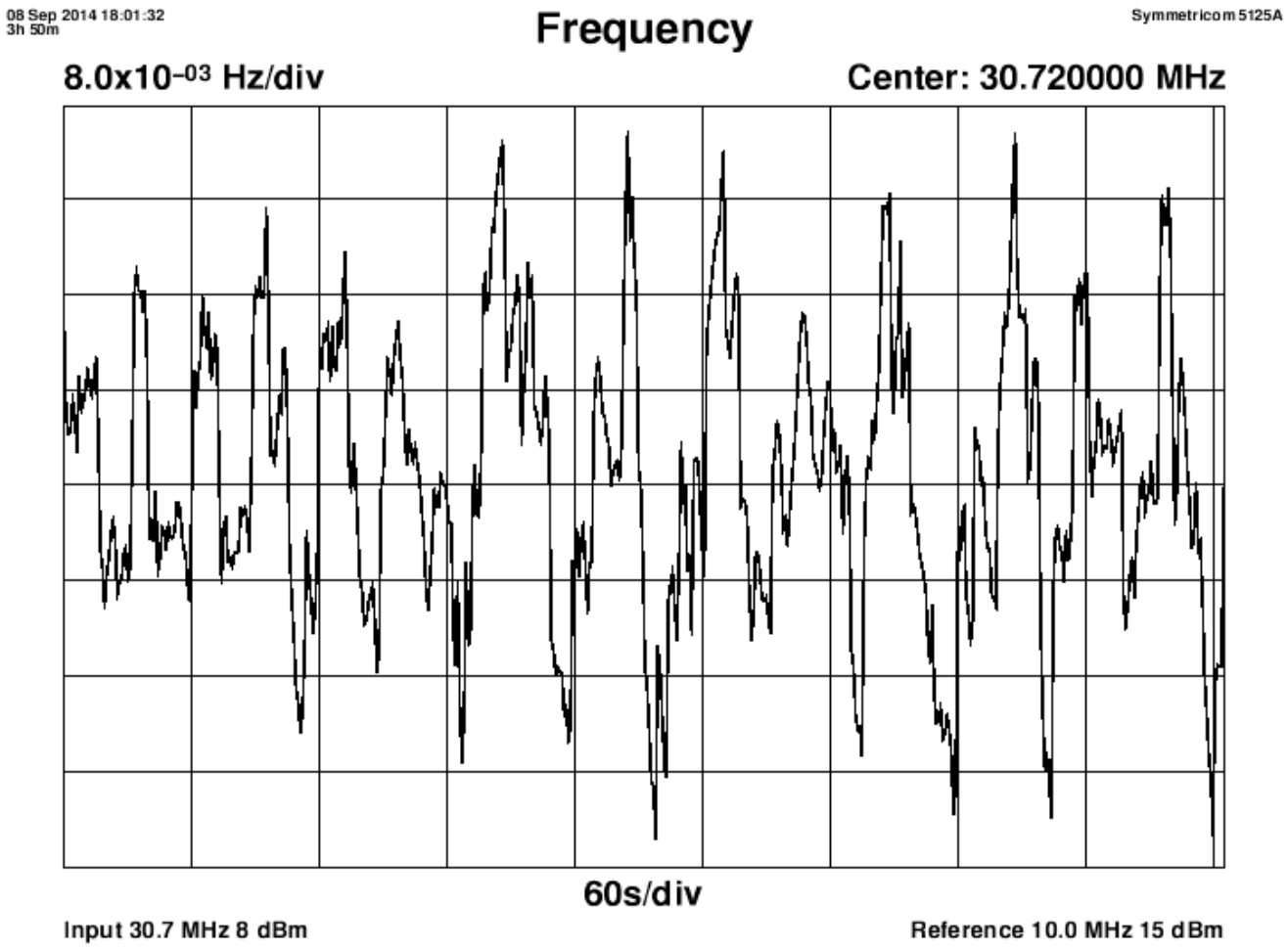


b) LTE-Lite™ Frequency jump: **(Max Frequency Error: 5.1E-09 = <u>5 parts per billion</u>)**

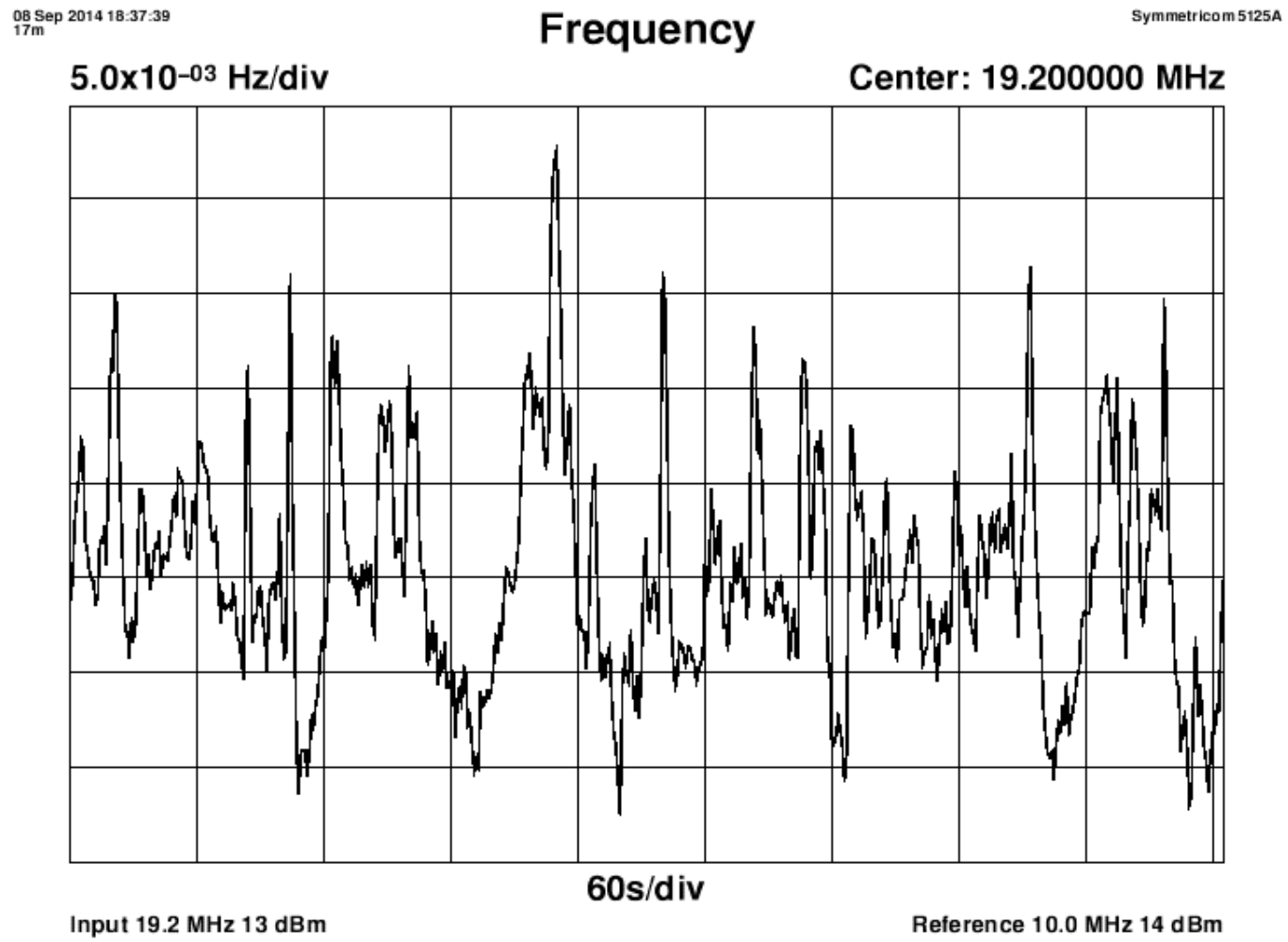


6) Comparative Frequency Plots (GPS Locked)

a) LEA-M8F Frequency: (2.6E-010 per vertical division)

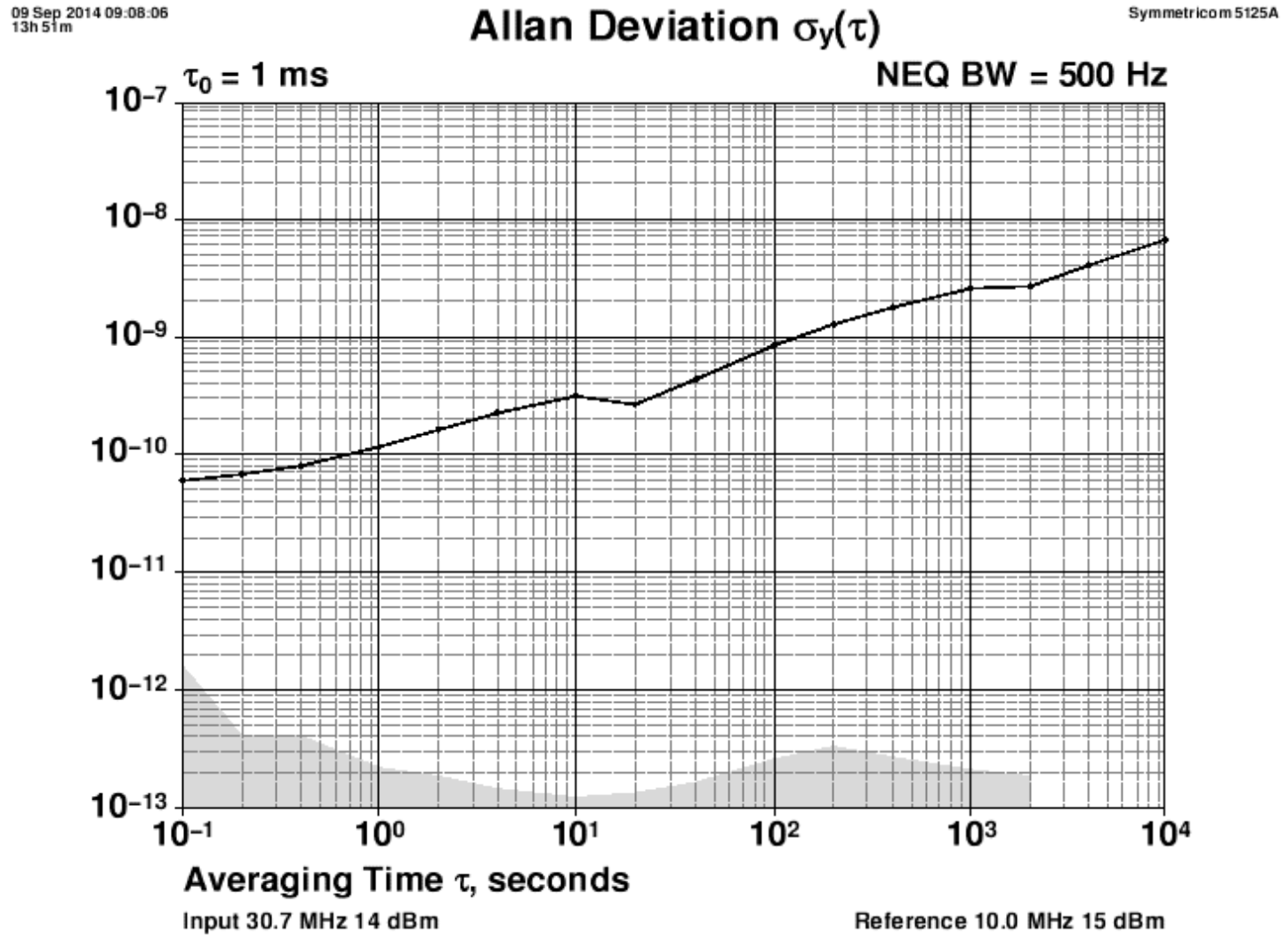


b) LTE-Lite Frequency Plot: (2.6E-010 per vertical division)



7) Comparative Frequency Plots (Flywheel mode without GNSS)

a) LEA-M8F ADEV Frequency Drift in holdover (no GNSS)



b) LTE-Lite™ ADEV Frequency Drift in holdover (no GNSS)