GPS Receiver Test Bed at USNO

CNS Systems, Inc.
Communication, Navigation and Surveillance

Critical Evaluation of the Motorola M12+ GPS Timing Receiver vs. the Master Clock at the United States Naval Observatory, Washington DC.

Prepared for the

34th Annual Precise Time and Time Interval (PTTI) Systems and Applications Meeting

December 3-5, 2002, The Hyatt Regency, Reston Town Center, Reston, Virginia

by
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CNS Systems' Test Bed at USNO

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Tac32Plus software simultaneously processes data from four Time Interval Counters and four CNS Clocks, writing 12 logs continuously

Time Interval Counters compare the 1PPS from each CNS Clock (M12+) against the USNO's UTC time tick.

GPS Receiver Test Setup at USNO

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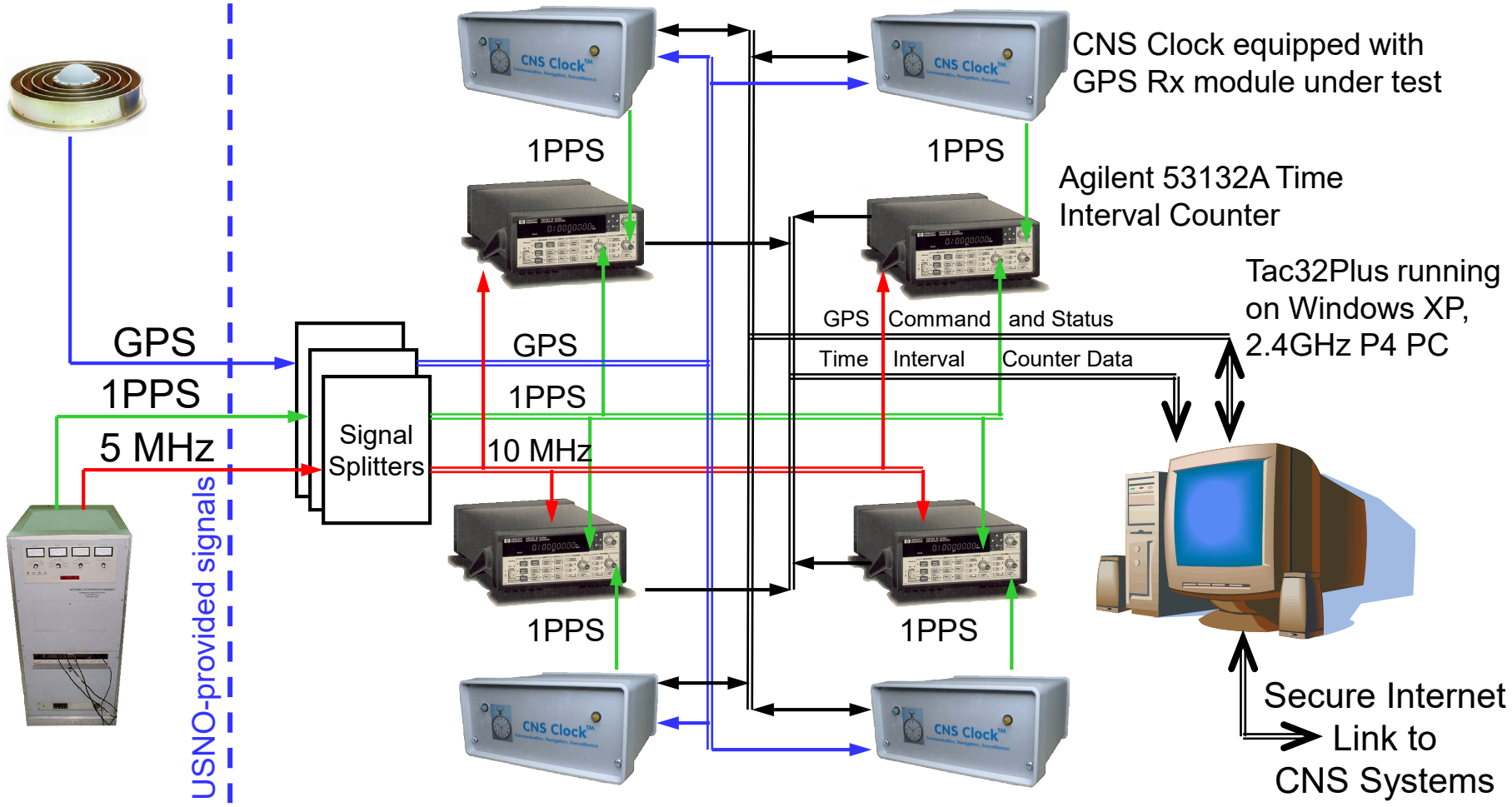

Delay Calibration Data

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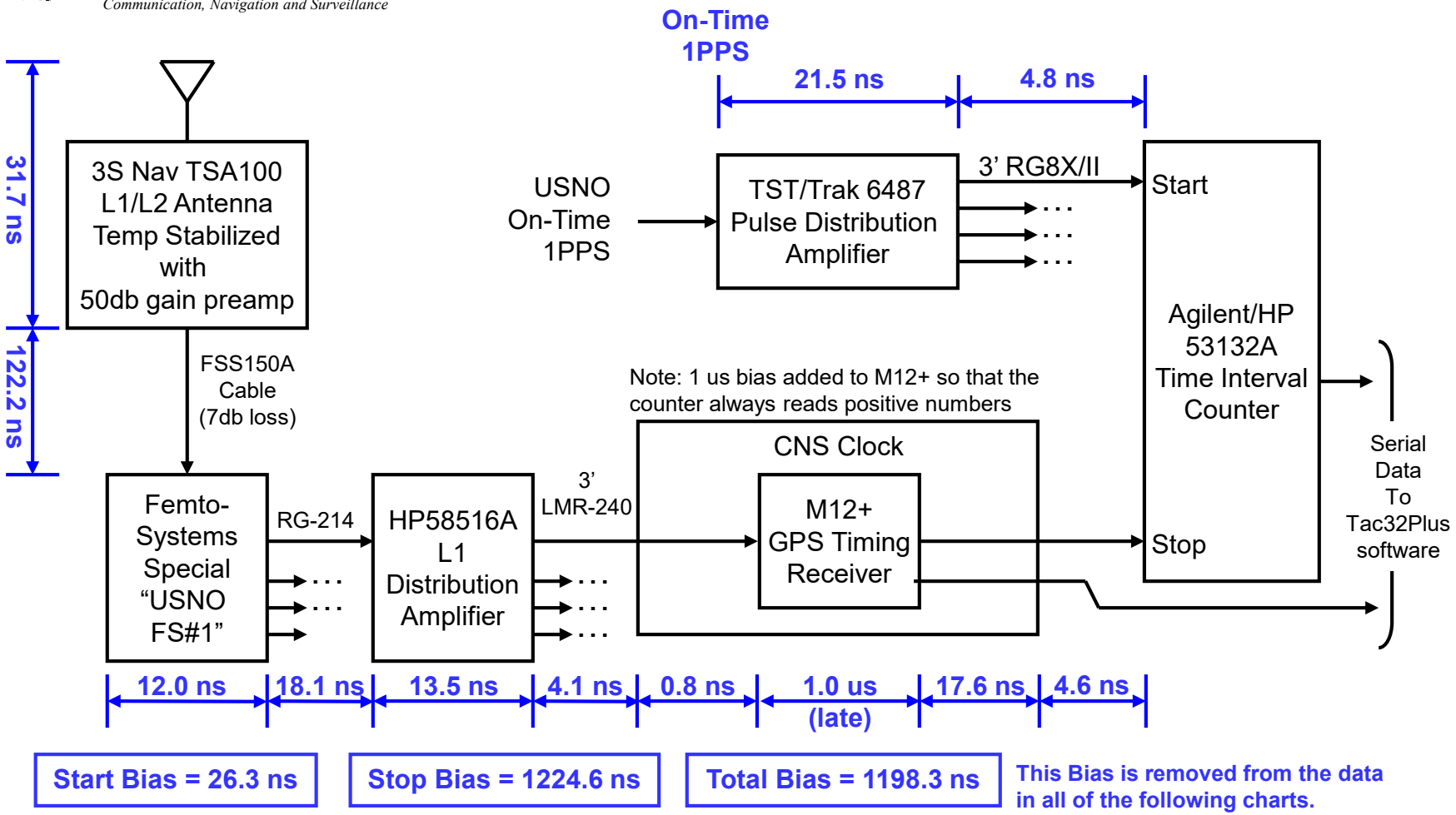

Pre-Calibration Data Sample, Rx A

Average = -84.3 ns

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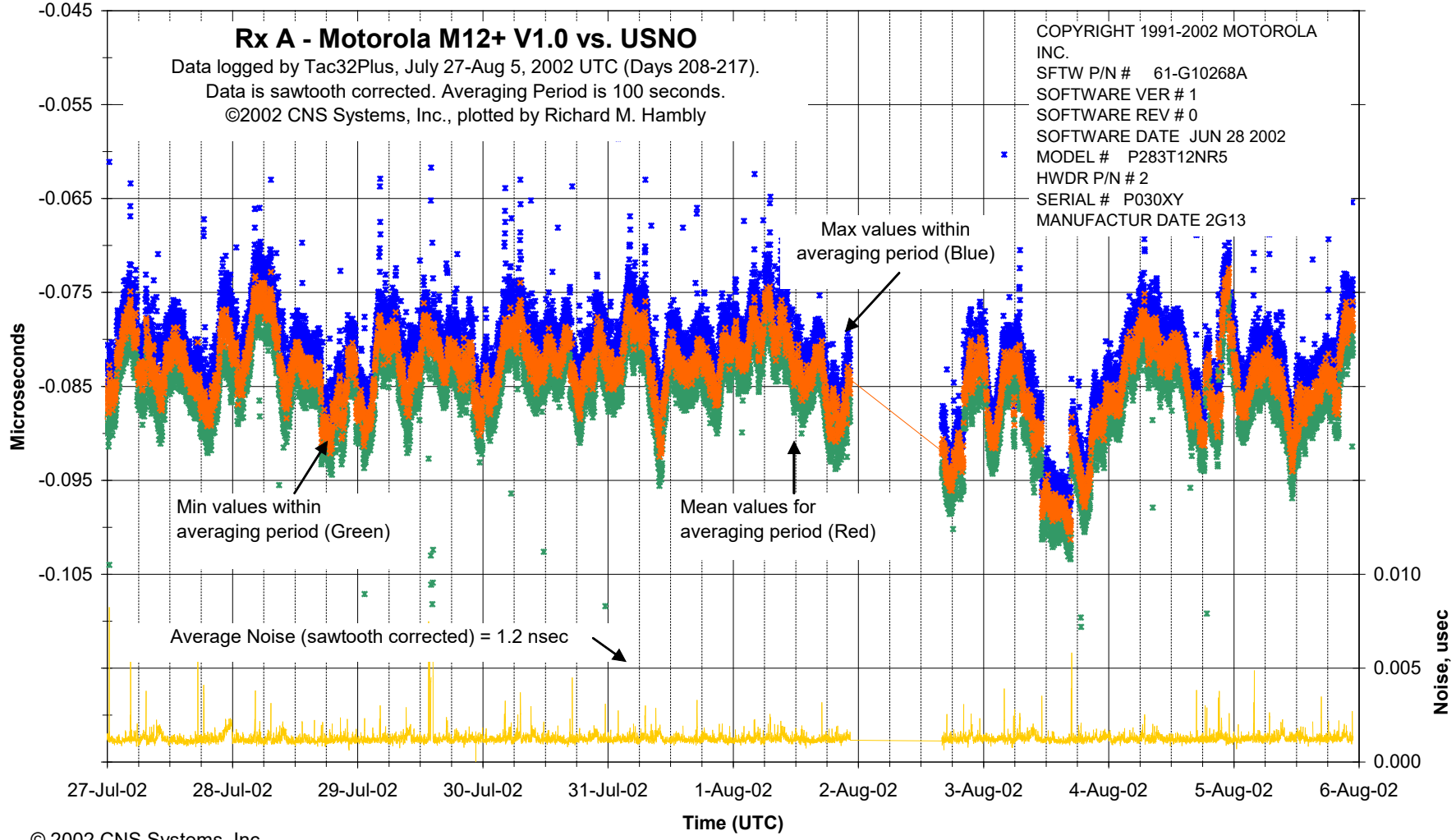

Individual M12 Clock Performance (A)

Average = -0.6 ns

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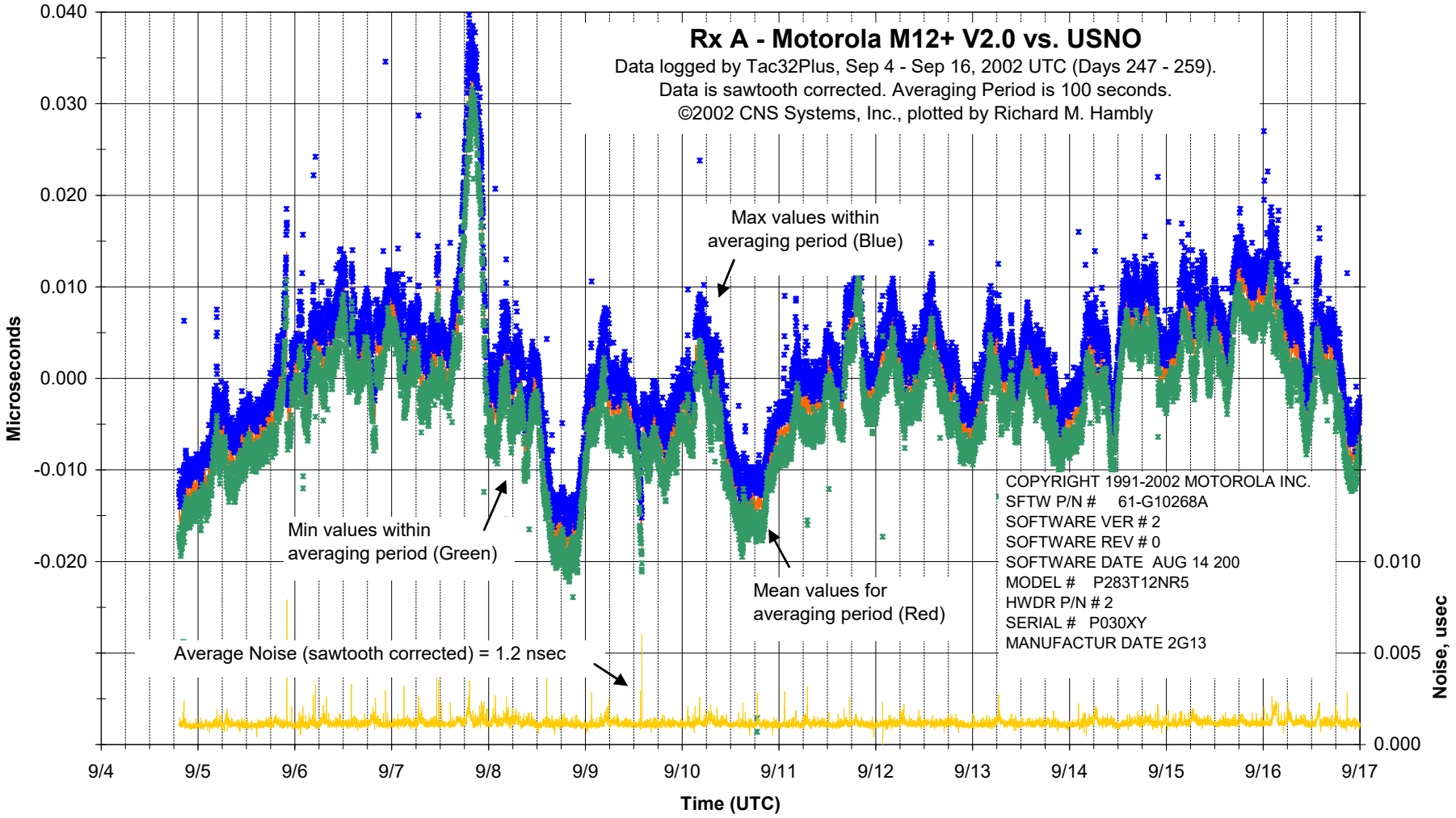

Individual M12 Clock Performance (B)

Average -0.2 ns

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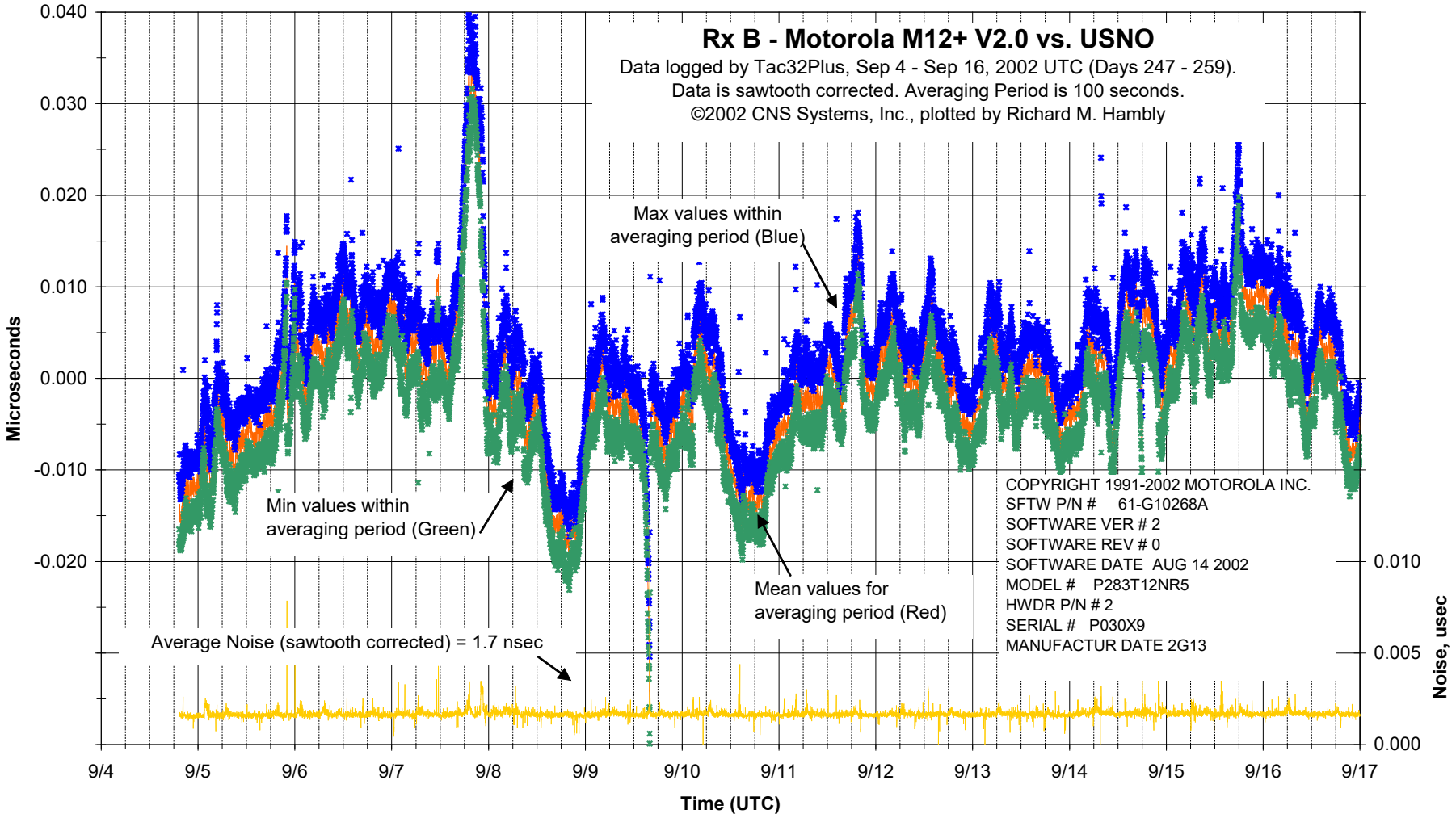

Individual M12 Clock Performance (C)

Average +5.3 ns

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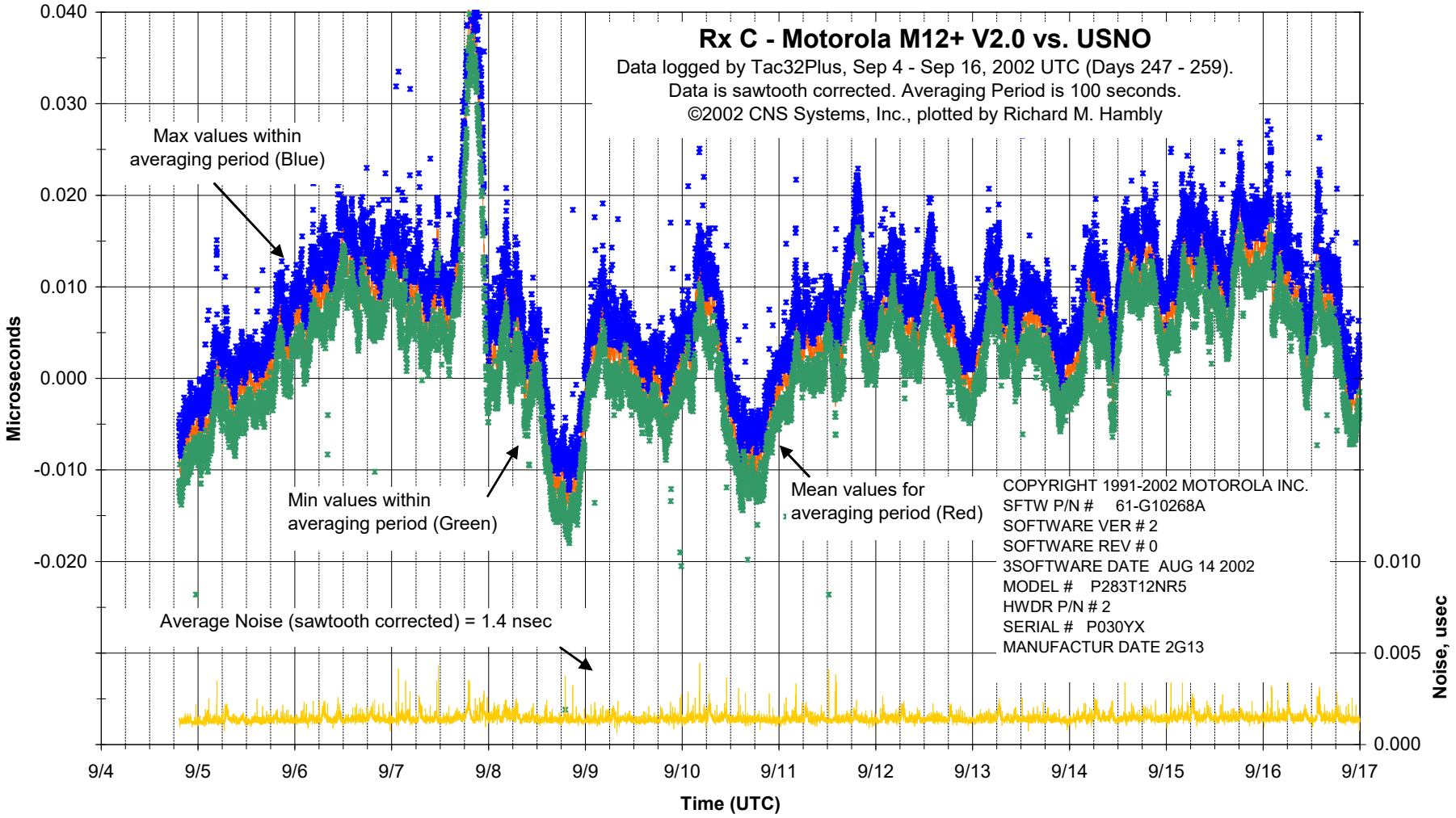

Individual M12 Clock Performance (D)

Average = +3.4 ns

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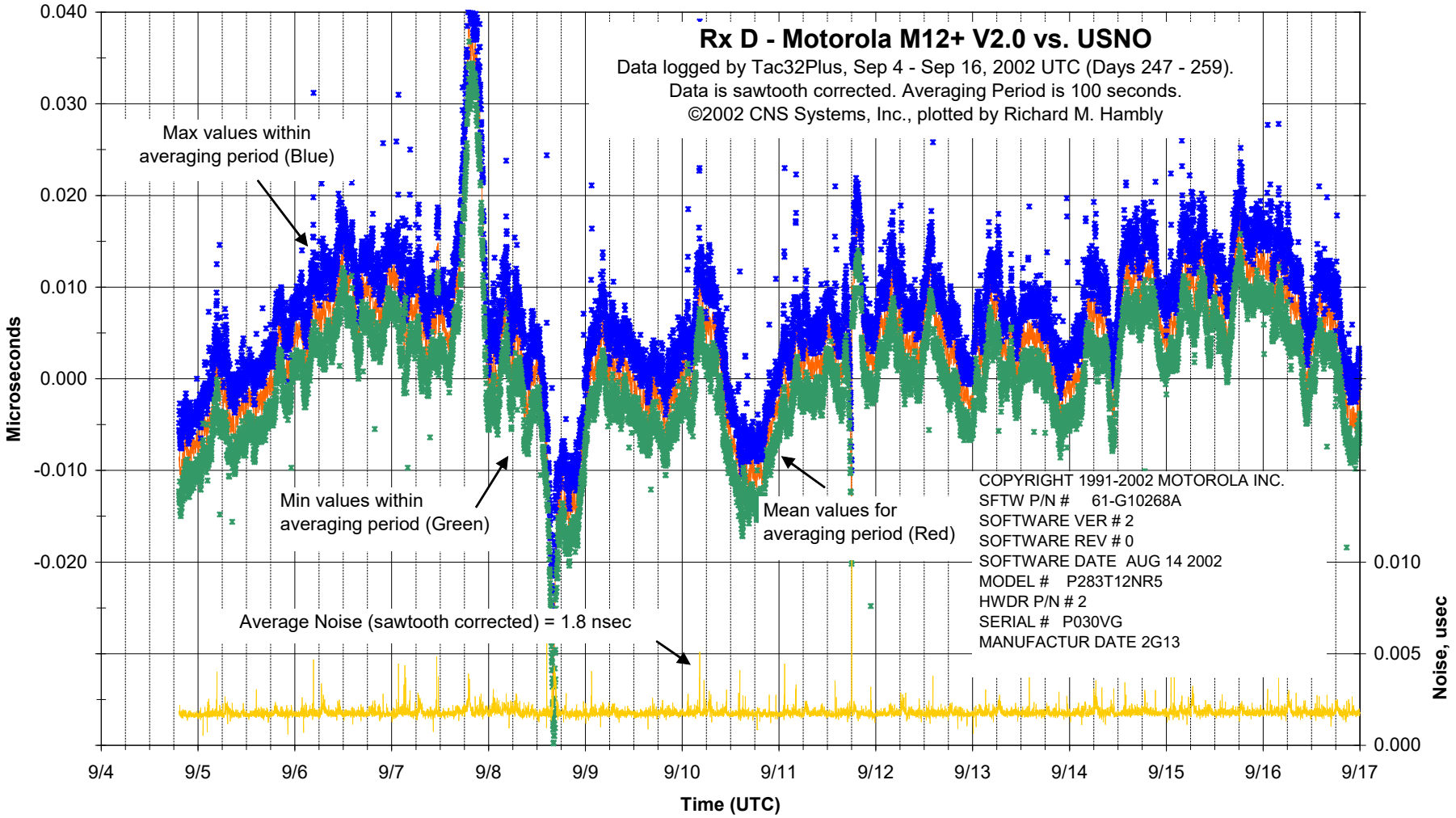

M12+ Timing Receiver Comparison Chart

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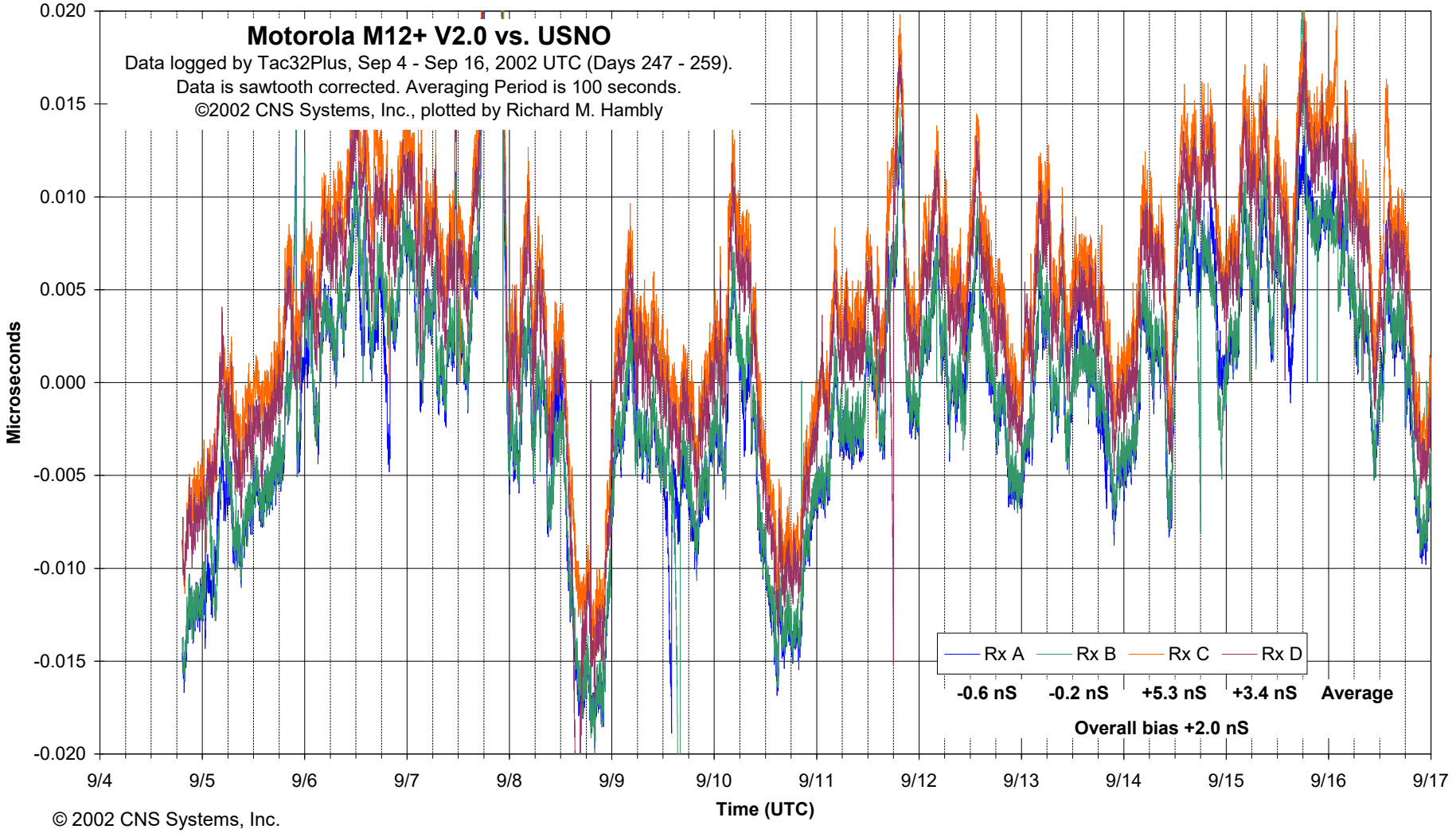

Comparisons - Reference to Rx A

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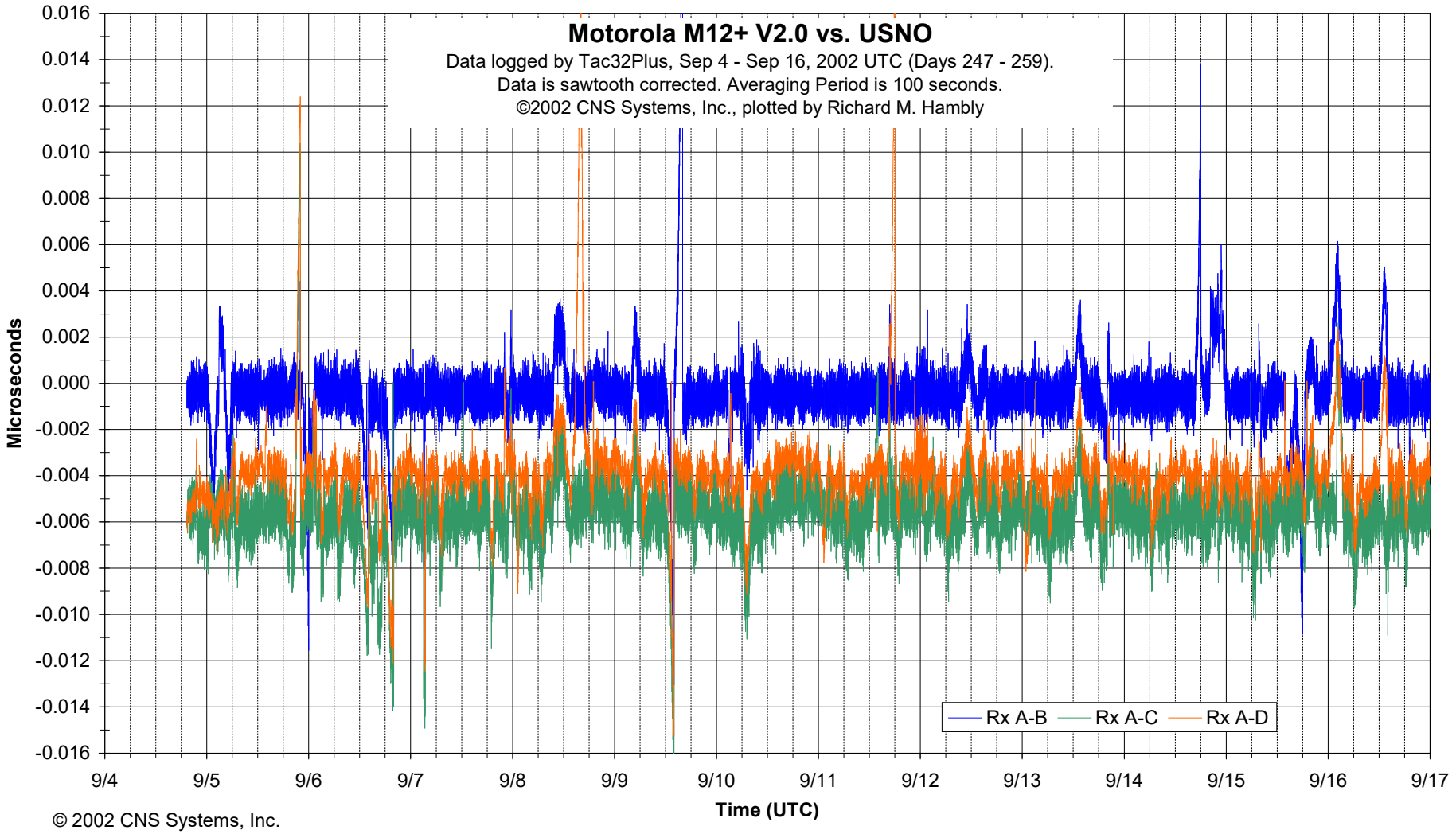

Comparisons - Reference to Rx B

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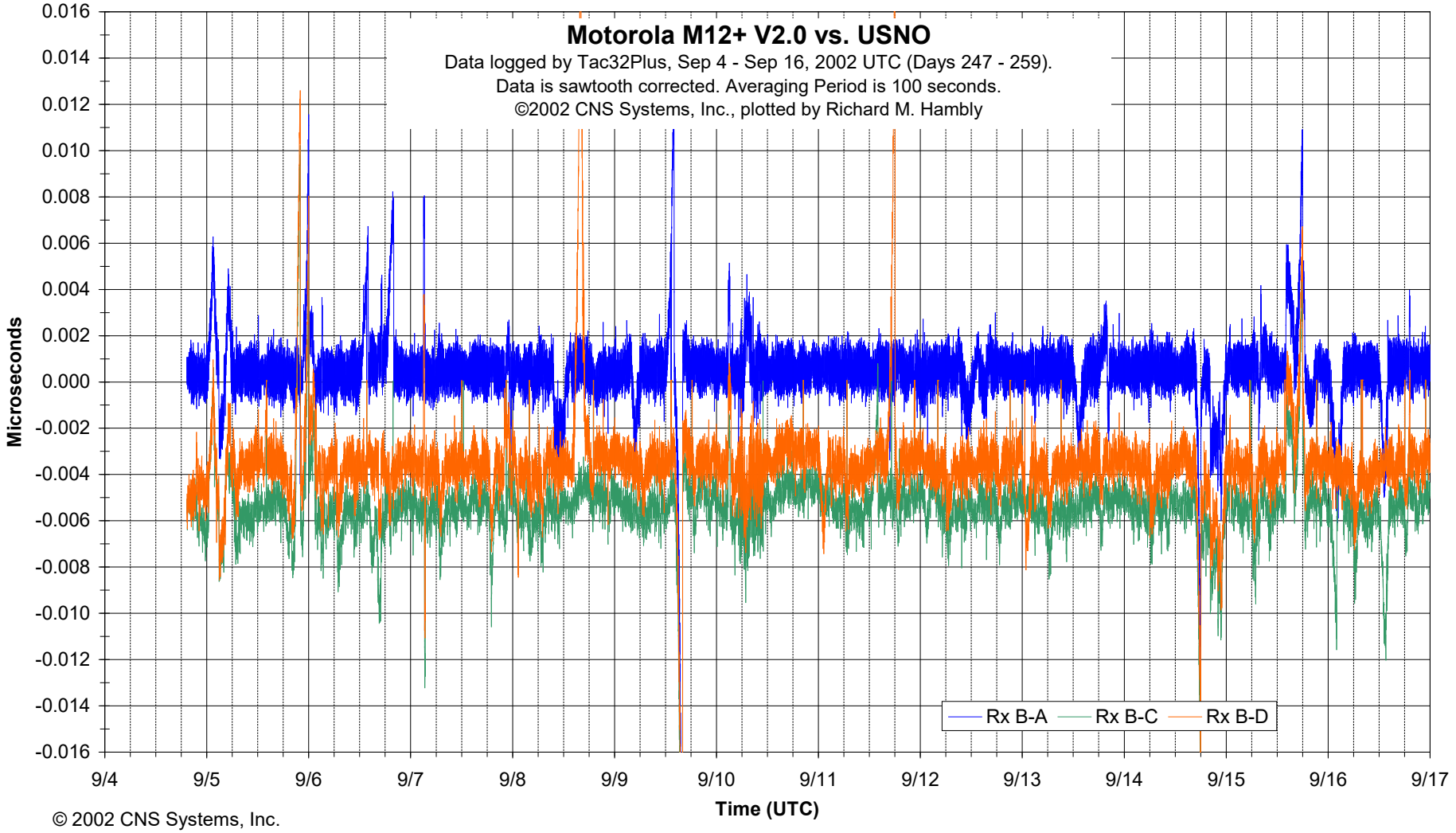

Comparisons - Reference to Rx C

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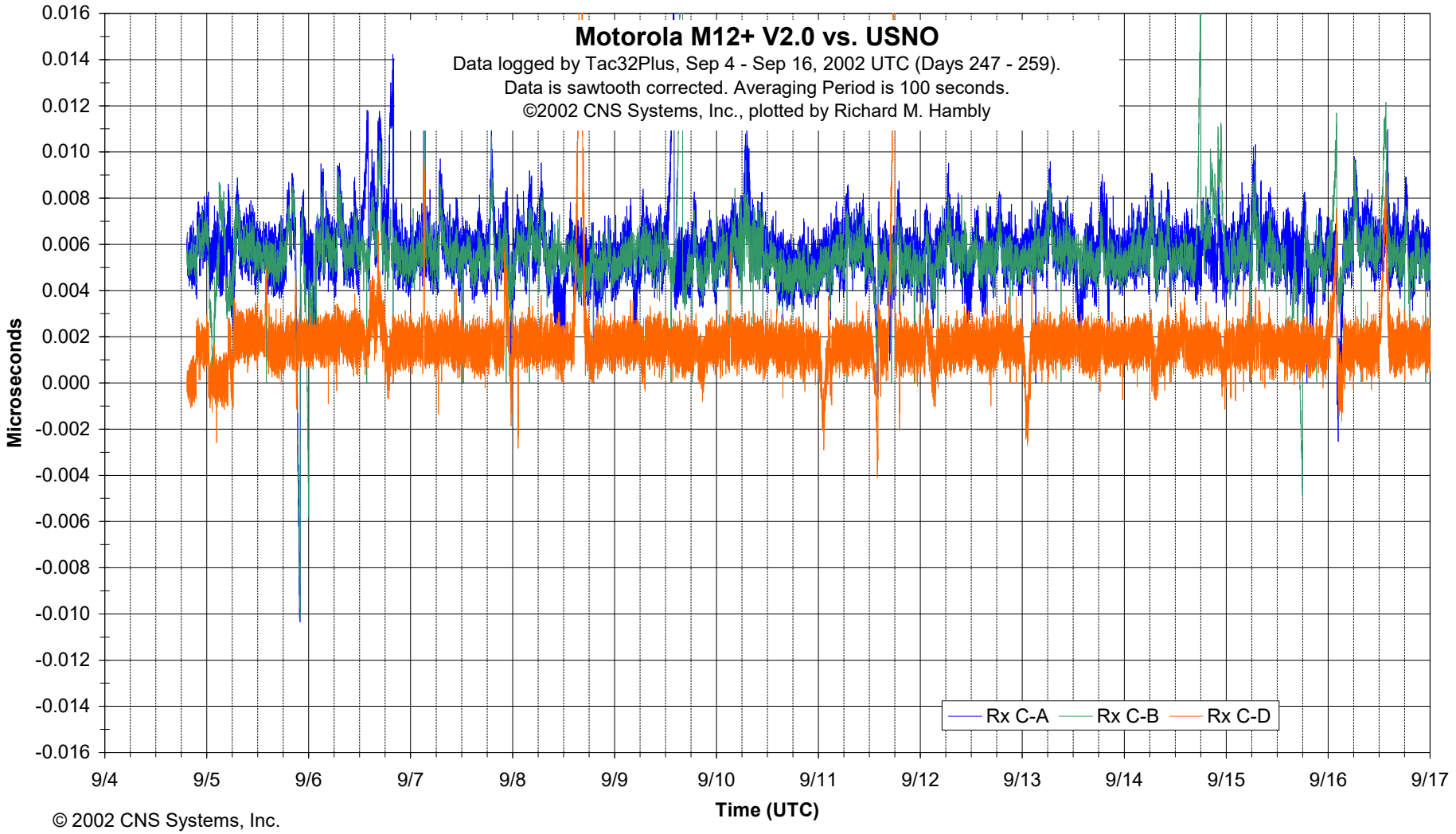

Comparisons - Reference to Rx D

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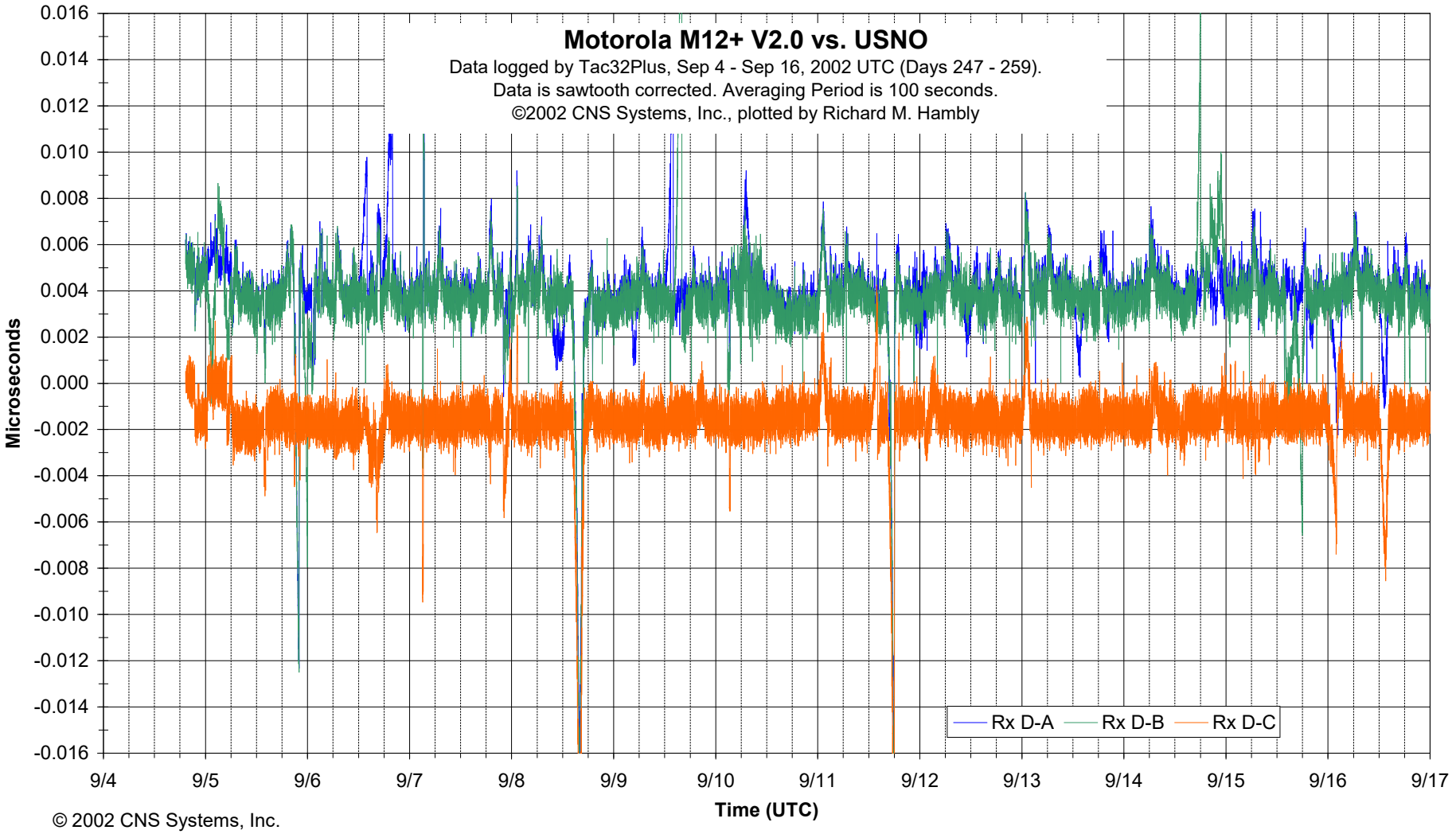

Raw Noise Charts – 1 Hour

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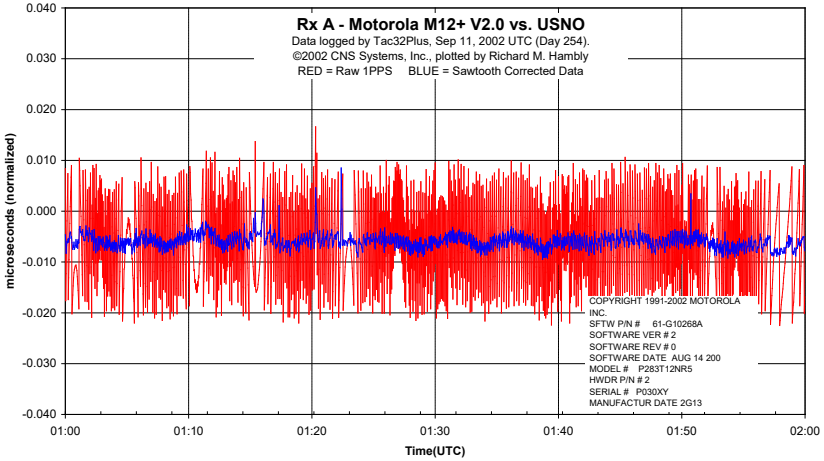

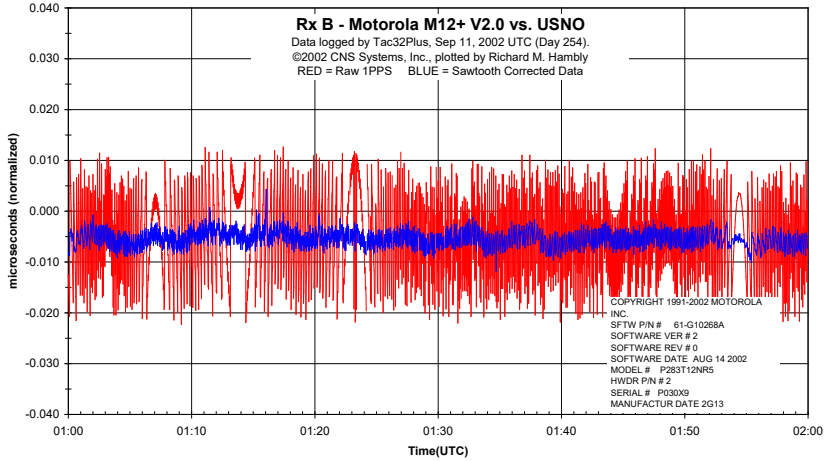

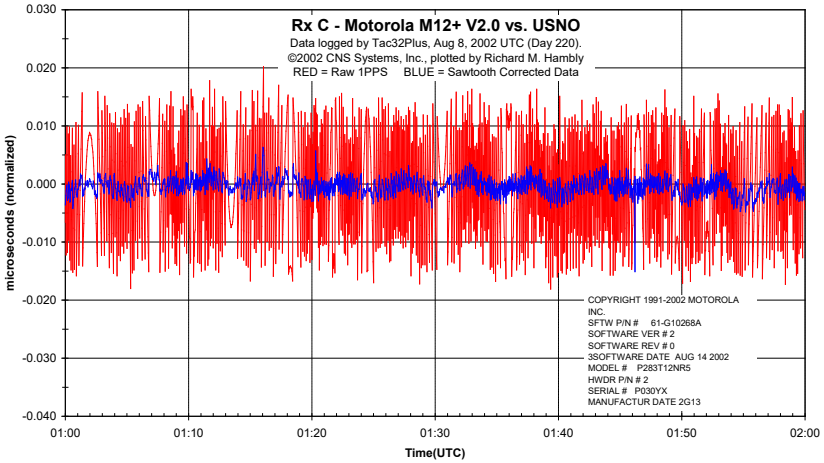

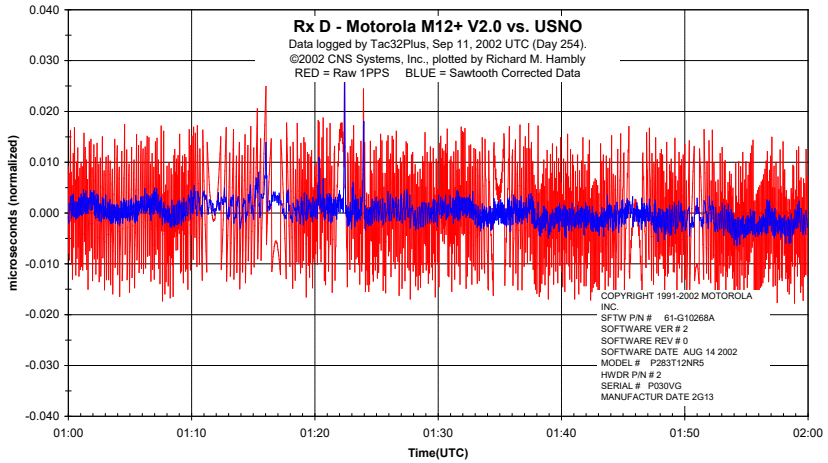

Raw Noise Charts – 10 Minute Detail

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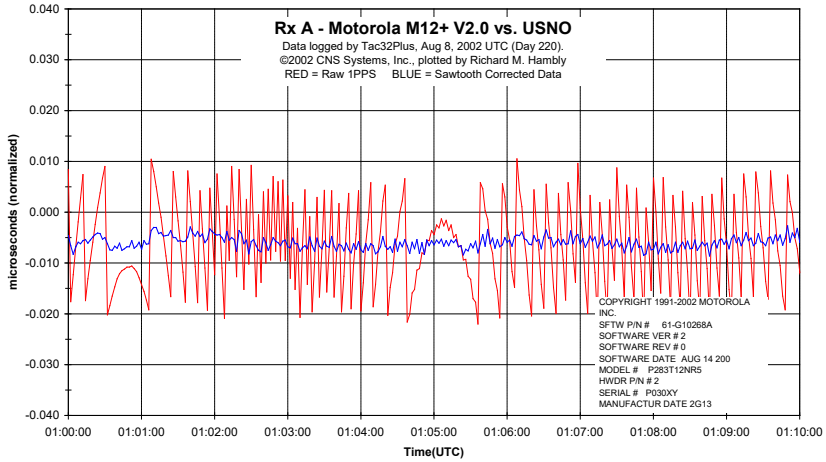

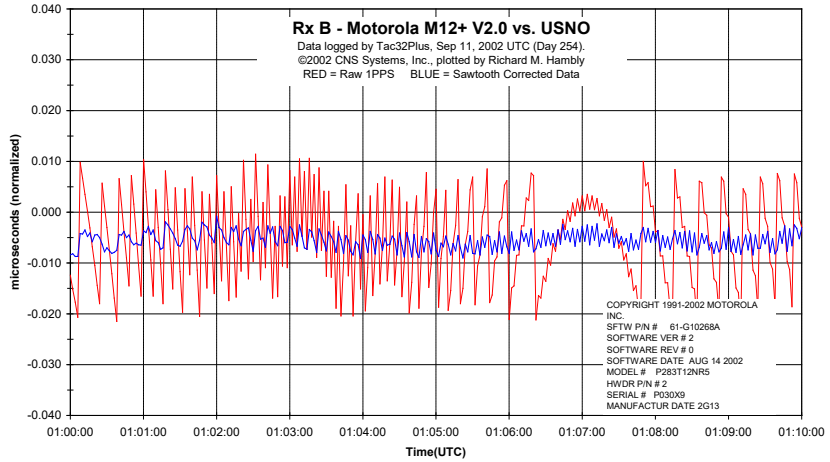

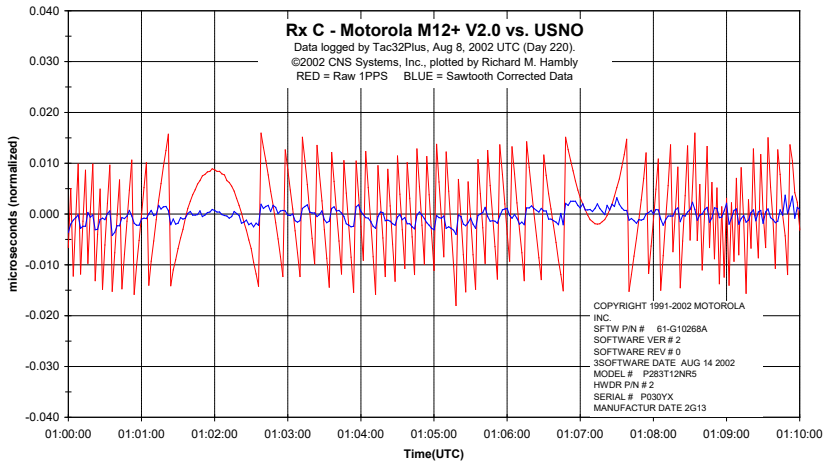

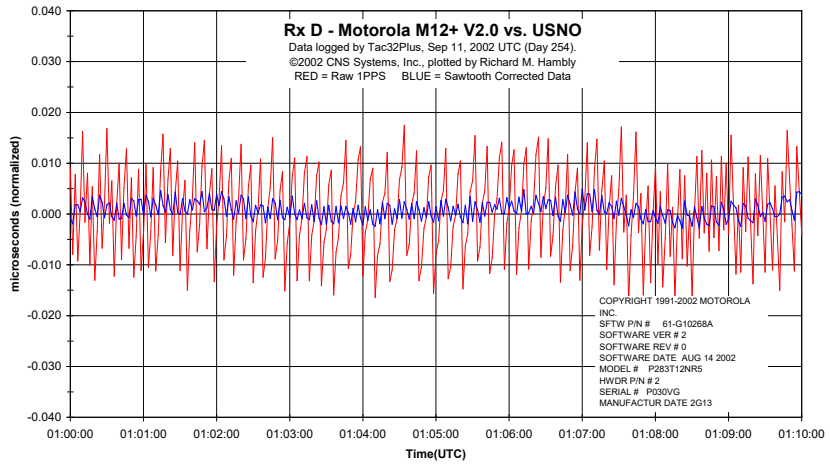

What Happened on 9/7/02 ?

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September 7, 2002.

This picture is a two hour composite of 85 different photos spanning 21:07 thru 23:10 EDT on Sept. 7th (01:07 thru 03:10 UTC Sep. 8).

September 8, 2002.

This picture is a four hour composite of 140 different photos spanning 20:00 thru 24:00 EDT on Sept. 8th (00:00 thru 04:00 UTC Sep. 9).

Pictures are © Dr. Thomas A. Clark

Each picture was an 87 second exposure with 3 seconds between frames. The trails on the picture are all due to airplanes. The bright loop is from a plane on final approach into BWI airport. Camera = Canon D60 shooting Hi Resolution JPEG at ISO 100 with TC-80 timer. Lens = Sigma f/2.8 20-40 mm set to 20 mm @ f/4.5

Short Baseline Test (USNO to NASA GGAO)

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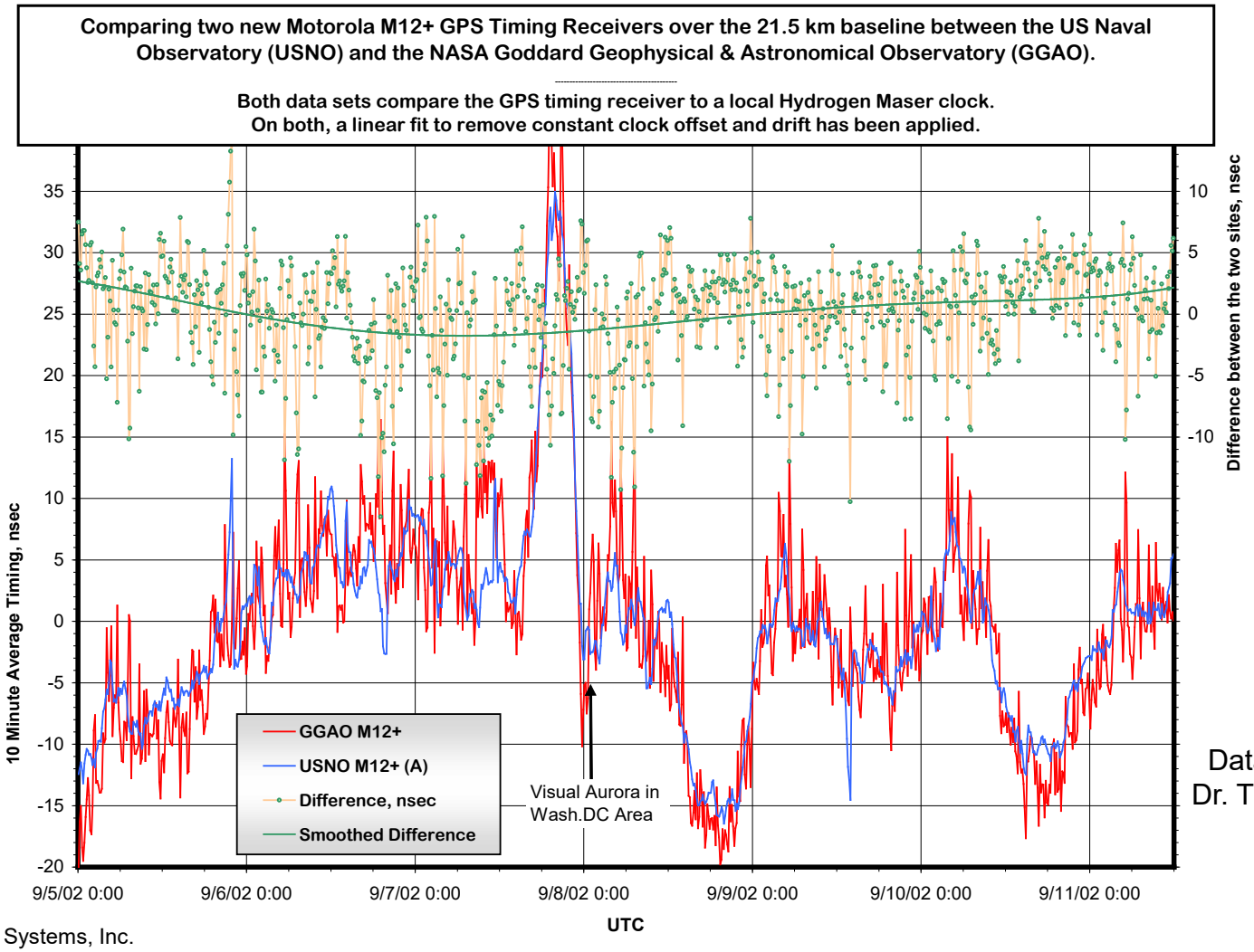

Data reduction by
Dr. Thomas A. Clark

A Longer Term View

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