WAVECREST Corporation

CORRELATION RESULTS BETWEEN *WAVECREST* 'S DTS 2075™ WITH *VIRTUAL INSTRUMENTS™* V2.27 AND THE CSA803A SAMPLING OSCILLOSCOPE

Technical Bulletin No. 6

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Contents

Introduction

This technical bulletin summarizes the tests performed to validate the measurement and algorithm performance of *WAVECREST*'s DTS 2075™ (DTS) and *Virtual Instruments™* (VI) – Datacom software, v2.27. The validation was done using the CSA803A Sampling Oscilloscope. The scope was triggered using the TX clock output at the back of the SJ-300. This same TX clock was applied to Channel 1 of the DTS to use as a reference for SPECTRUM tool TPD++ measurements. The modulated clock or data was applied to Channel 1 of the scope or Channel 2 of the DTS respectively.

The purpose of these tests was to see how well the DTS and VI-Datacom software could correlate to the scope for Total Jitter and Periodic Jitter where the BIT CLOCK is NOT used, except in the SPECTRUM TPD++ tests where the BIT CLOCK is used as the measurement reference.

The test results for all of the following tests were put into a spreadsheet format for comparison in Appendices A through D.

Three test setups are documented in this paper:

1. The DTS is compared with the CSA803A for Total Jitter and Periodic Jitter correlation. The SJ-300 is used as the signal source and is running at 622MHz. The internal modulation source is used in the SJ-300 to generate frequency modulation on the clock signal and see how well the DTS and CSA803A could measure this modulation. Auto Arming is used for all of these tests in VI-Datacom v2.27.
2. The same setup is used here as was used in test setup one, except that the scope and DTS are measuring Data instead of Clock. The pattern used is a PRBS 2^7-1. The modulation source is the same as in test setup one and Auto arming is being used with VI-Datacom v2.27.
3. Test setup three is using the *WAVECREST* DTS 550™ pattern generator as the signal source. The signal is running at 1.0 GB/s and a PRBS 2^5-1 pattern is being used. Modulation at the same 3MHz frequency is being generated by the 550 for the tests. Two test setups are used during the 550 tests. One is <u>with</u> the pattern marker generated by the 550 and the other is <u>without</u> the pattern marker being supplied to the DTS2075.

A. Correlation results between CSA803A & DTS2075™ with Virtual Instruments™ - Datacom v2.27, Clock pattern at 622MHz from SJ-300 generator

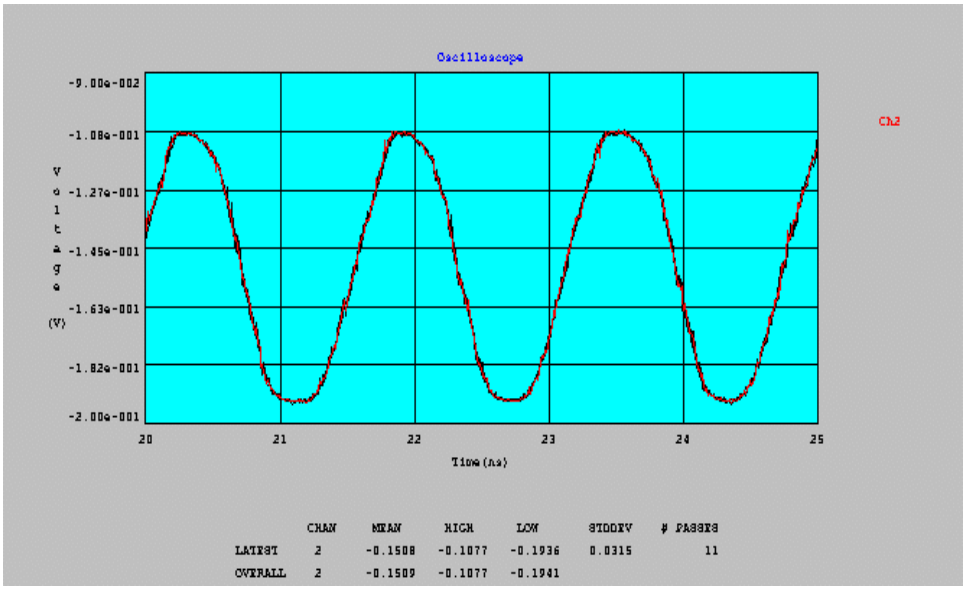


Figure 1A

Figure 1A is a graph of the clock waveform generated by the SJ-300 at 622MHz.

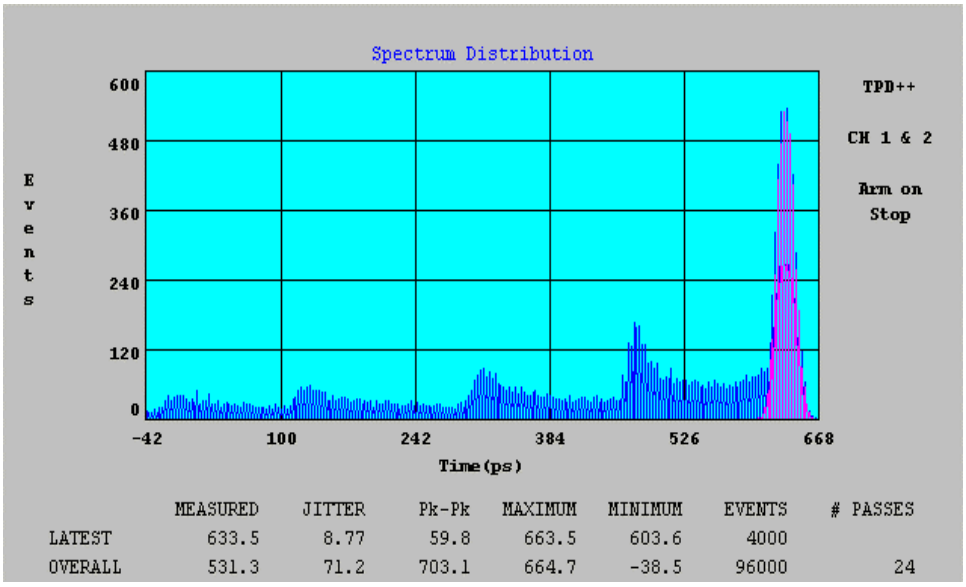


Figure 2A

Figure 2A shows the five different modulation settings of the generator: 0.0, 0.1, 0.2, 0.3 and 0.4 UI. Figure 2A also shows the five tests overlaid on top of each other. The SPECTRUM tests are using the BIT CLOCK as the reference for the measurements shown. In this mode the DTS is taking date measurements the same way the oscilloscope does. Correlation in this mode should be, and is, very good. (The DTS takes measurements many times faster than the scope is able to.)

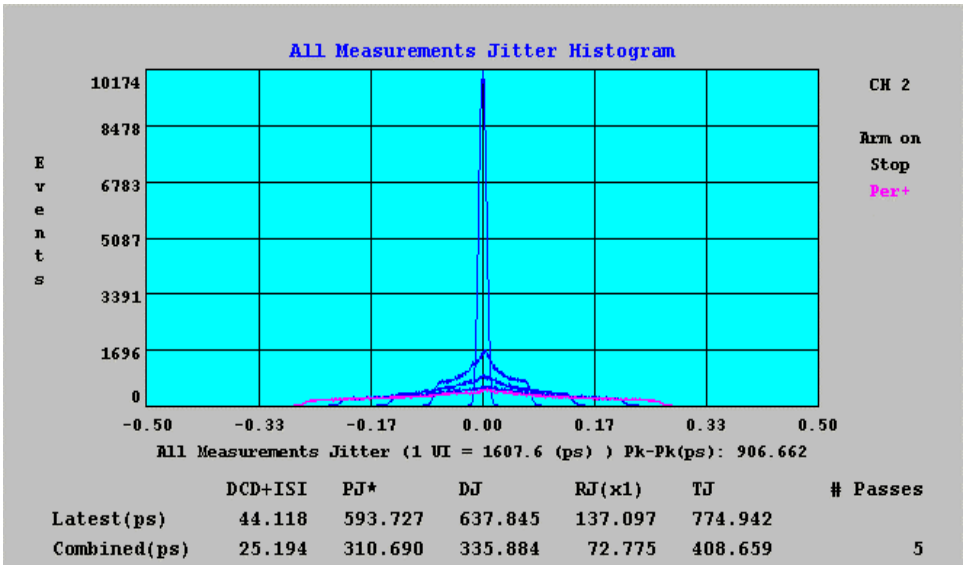


Figure 3A

In Figure 3A we are showing all of the measurements taken for each of the five modulation settings overlaid on one another using VI-Datacom v2.27.

DataCom Setup for section A is as follows:

1. Sample size.....1000
2. Stop count 200
3. UI 1.60756
4. Rj filter .....0.0 to Nyquist
5. Rj mult.....x1
6. Arming .....Auto

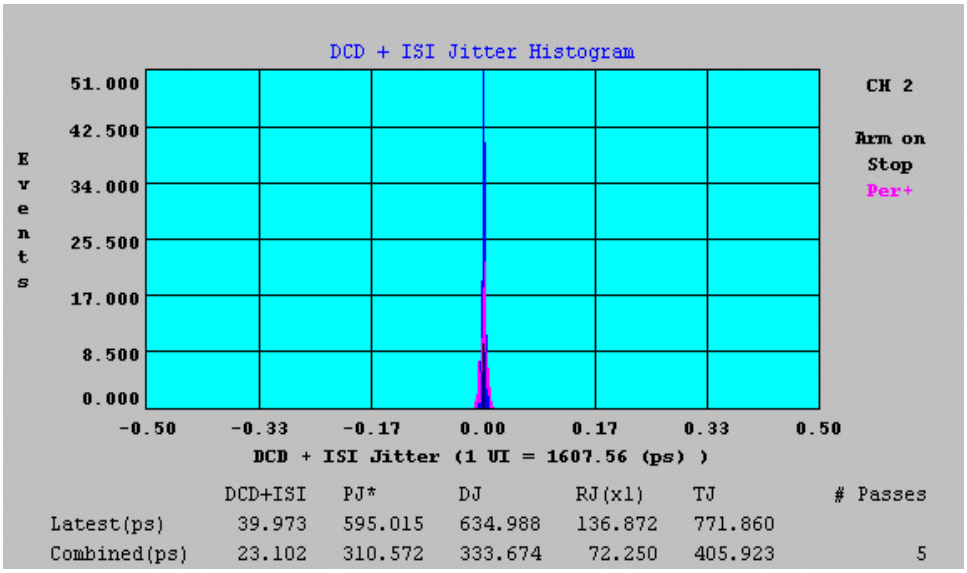


Figure 4A

Figure 4A is showing the DCD+ISI measurement data only. Also, when comparing Figures 3A and 4A, Figure 4A shows very little change as a function of periodic modulation.

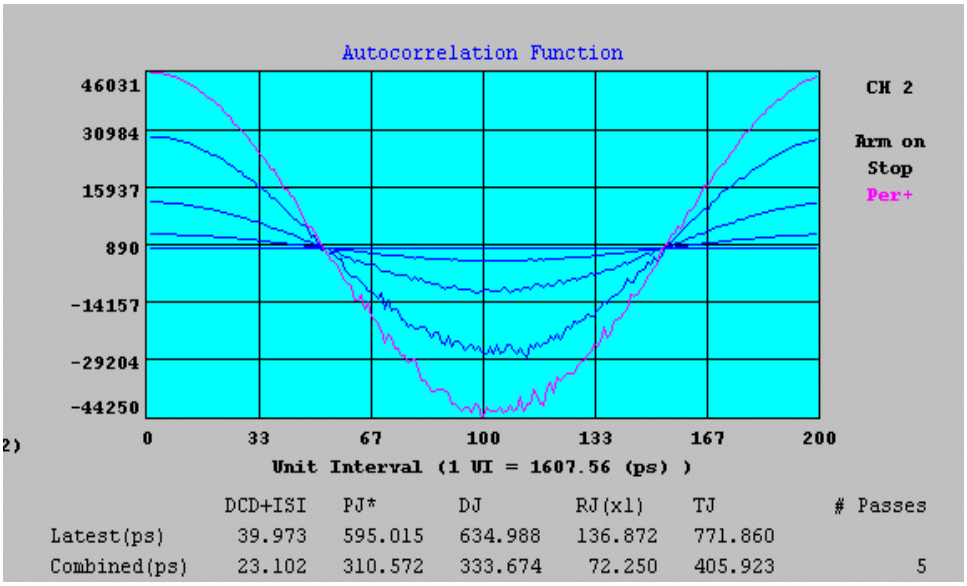


Figure 5A

Figure 5A we are shows the five different modulation steps overlaid together.

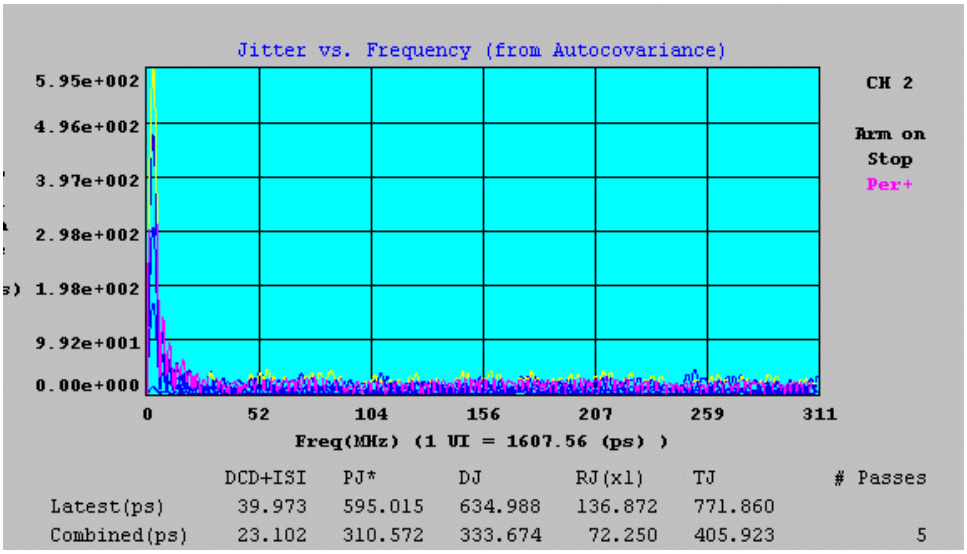


Figure 6A

Figure 6A is showing the FFT of the Autocorrelation in Figure 5A. Notice the periodic lines near the low end of the frequency scale.

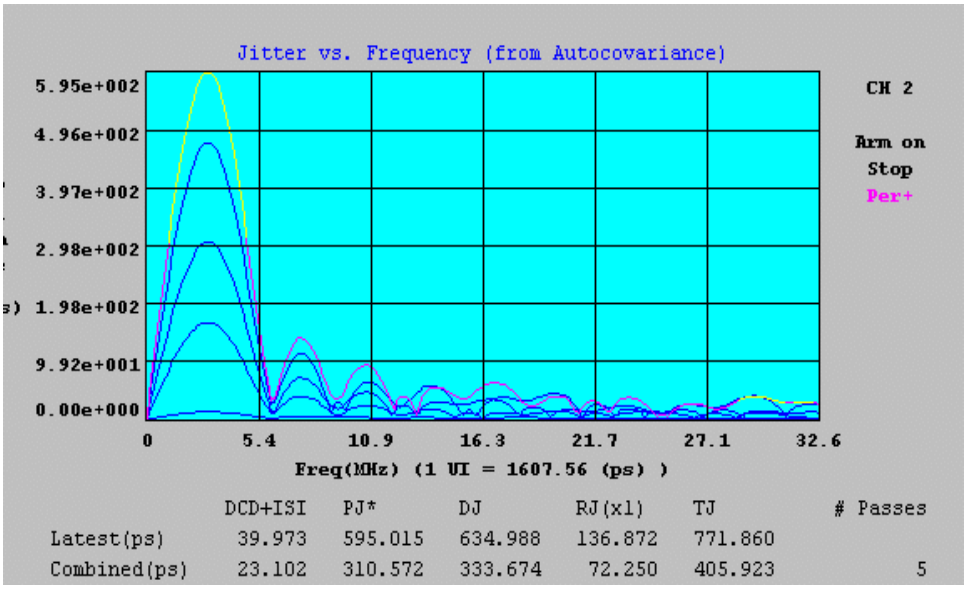


Figure 7A

Figure 7A is a ZOOMed view of the FFT from Figure 6A. Notice the five levels of modulation measured by the DTS.

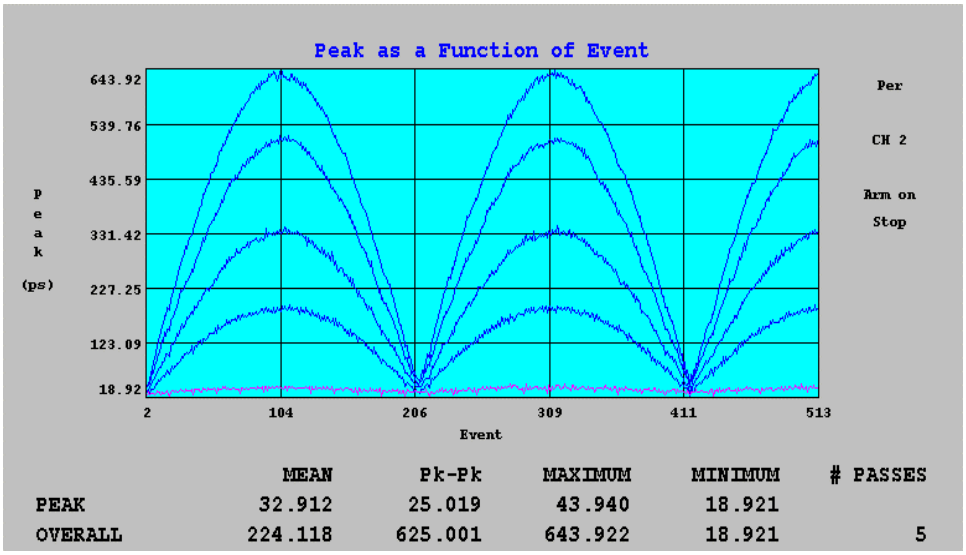


Figure 8A

Because the signal being looked at is clock like, we are able to use the VI - JITTER ANALYSIS tool as well as the SPECTRUM and DATACOM tools. Figure 8A shows an AUTOCORRELATION of the PEAK jitter modulation modulating the clock signal. Notice the five steps of modulation overlaid together. The Peak level achieved for each step correlates to the Pk-Pk measured by the scope or by the SPECTRUM tool.

B. Correlation results between CSA803A & DTS2075 with VI-Datacom v2.27 PRBS 2^5-1 Data pattern at 622 MB/s from SJ-300 generator

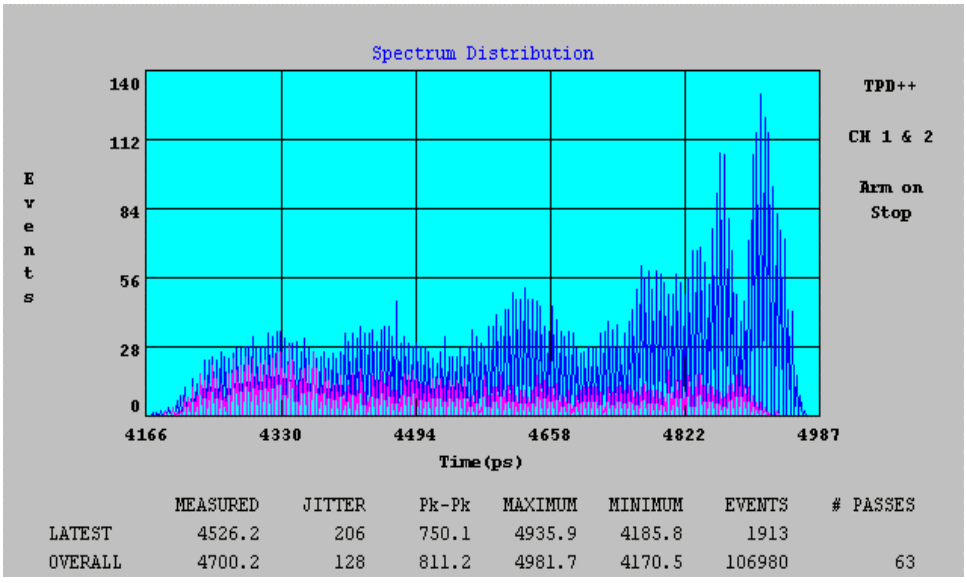


Figure 2B

Figure 2B is taken using the SPECTRUM tool in VI. As in Figure 2A, all five modulation steps are overlaid together. To take the data shown in Figure 2B of a data pattern, the FILTERs were used to select a data distribution near 5UI in the pattern. Any UI could have been selected; 5UI was selected for convenience.

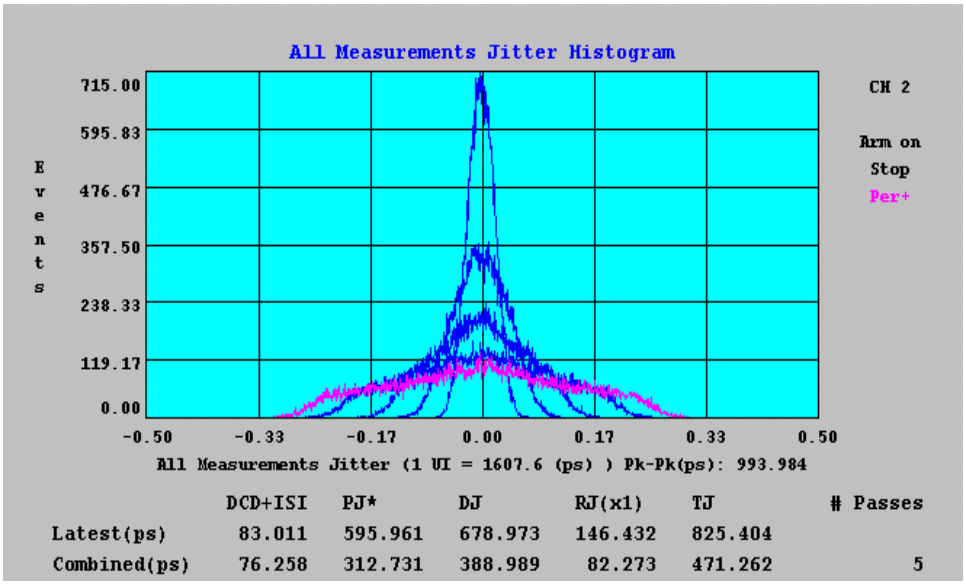


Figure 3B

Figure 3B with data compares to Figure 3A with a clock signal.

Datacom Setup for Section B is as follows:

1. Sample size.....1000
2. Stop count 50
3. UI 1.60756
4. Rj filter .....0.0 to Nyquist
5. Rj mult.....X1
6. Arming .....Auto

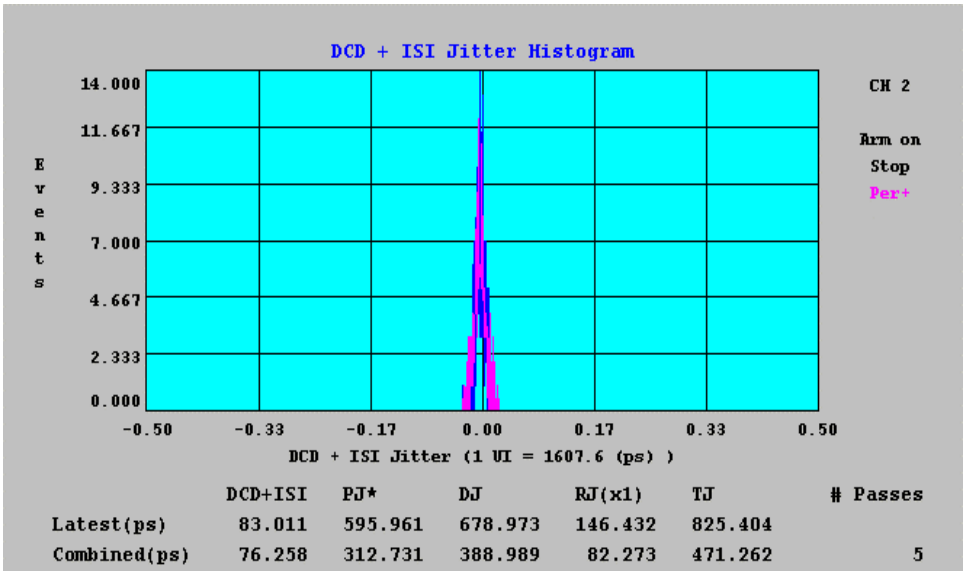


Figure 4B

Figure 4B compares with Figure 4A. Again, notice the small variation in DCD+ISI as the modulation is stepped from 0.0UI to 0.4UI.

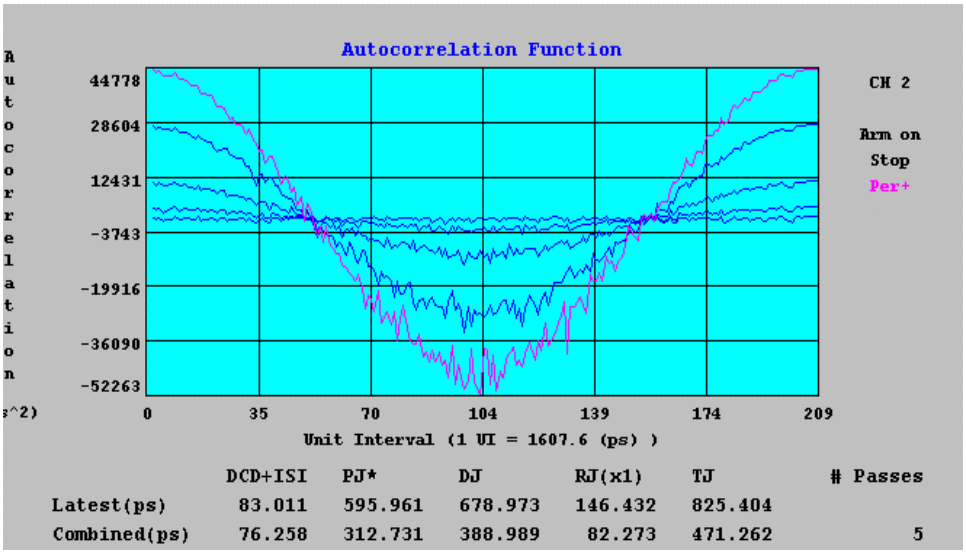


Figure 5B

Figure 5B and 5A compare together as before. Notice the ability of VI Datacom to pull the modulation waveform from a random data pattern.

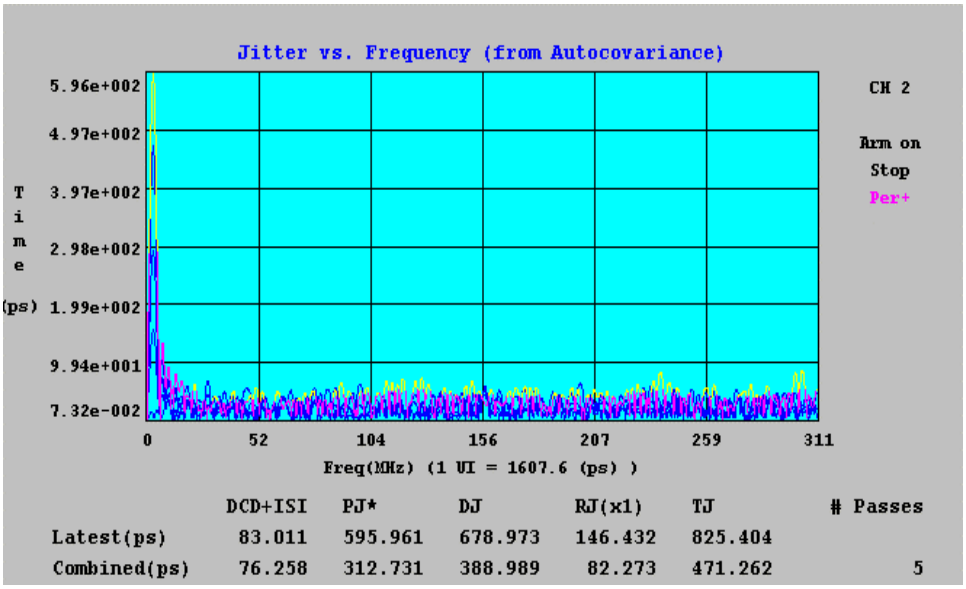


Figure 6B

Figure 6B and 6A compares as before. Notice the spectral lines showing up here as in Figure 6A.

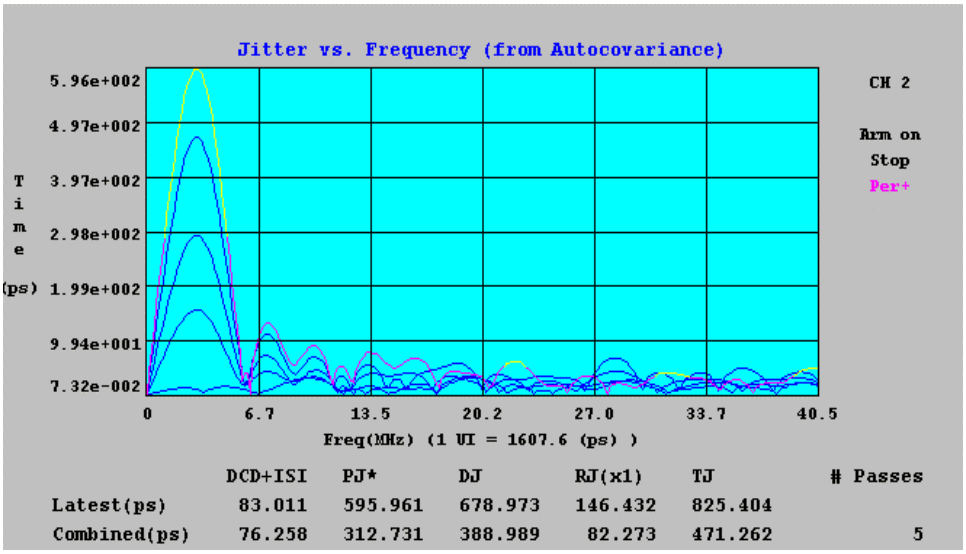


Figure 7B

Figure 7B and 7A compare as before. Notice the modulation amplitudes for each of the five modulation steps.

C. Correlation results between CSA803A & DTS2075 with VI-Datacom v2.27, DTS-550 1 GB/s PRBS 2^5-1 pattern (Auto Arm)

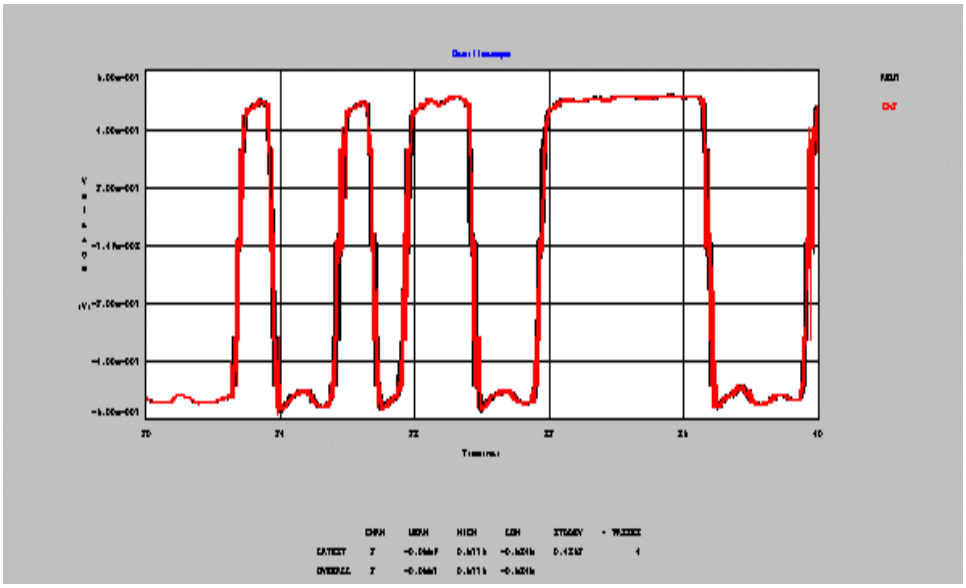


Figure 1C

Figure 1C is showing a waveform capture of part of the pattern being sent by the DTS-550 pattern generator. Notice the heavy modulation showing up on the signal transitions.

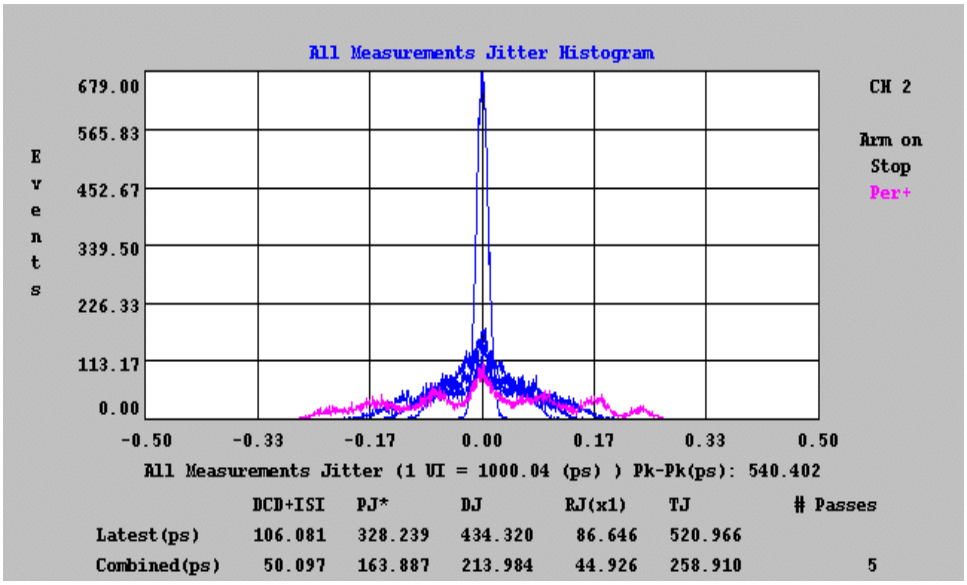


Figure 3C

Figure 3C compares with 3A and 3B in that all five modulation steps are shown overlaid on one another.

Datacom Setup for section C is as follows:

1. Sample size.....300
2. Stop count 69
3. UI 1.00004ns
4. Rj filter .....0.0 to Nyquist
5. Rj mult.....x1
6. Arming .....Auto

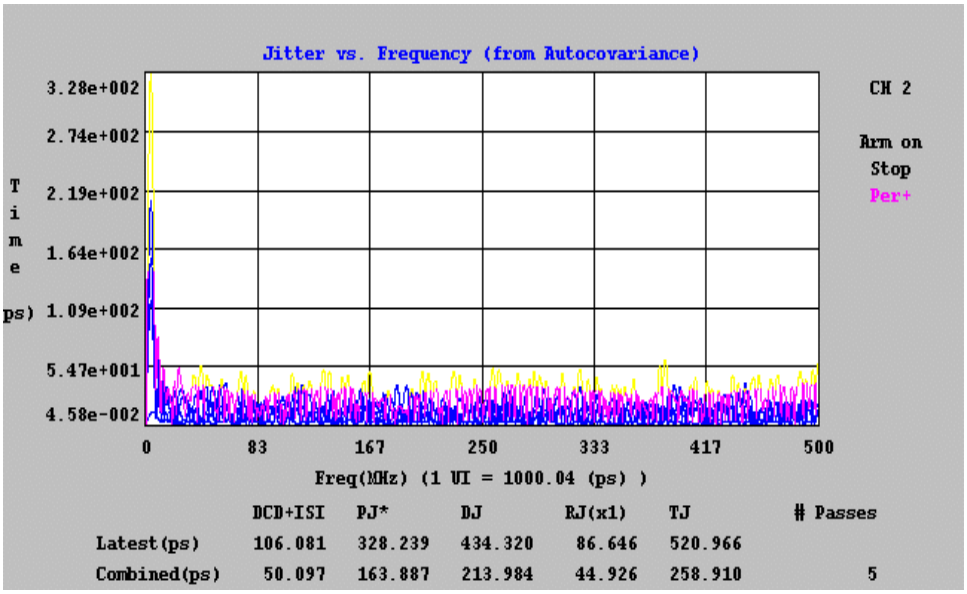


Figure 6C

As with Figures 6A and 6B, 6C shows an FFT of the auto-correlation. The auto-correlation plots were not saved.

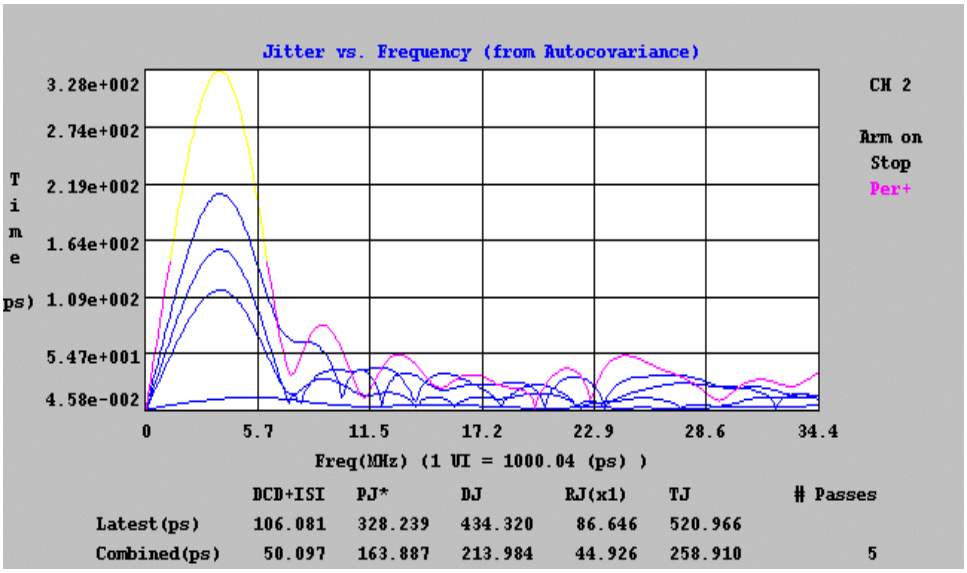


Figure 7C

Figure 7C is a ZOOMed view of Figure 6C.

D. Correlation results between CSA803A & DTS2075 with VI-Datacom v2.27, DTS-550 1GB/s PRBS 2^5-1 pattern (External Arm)

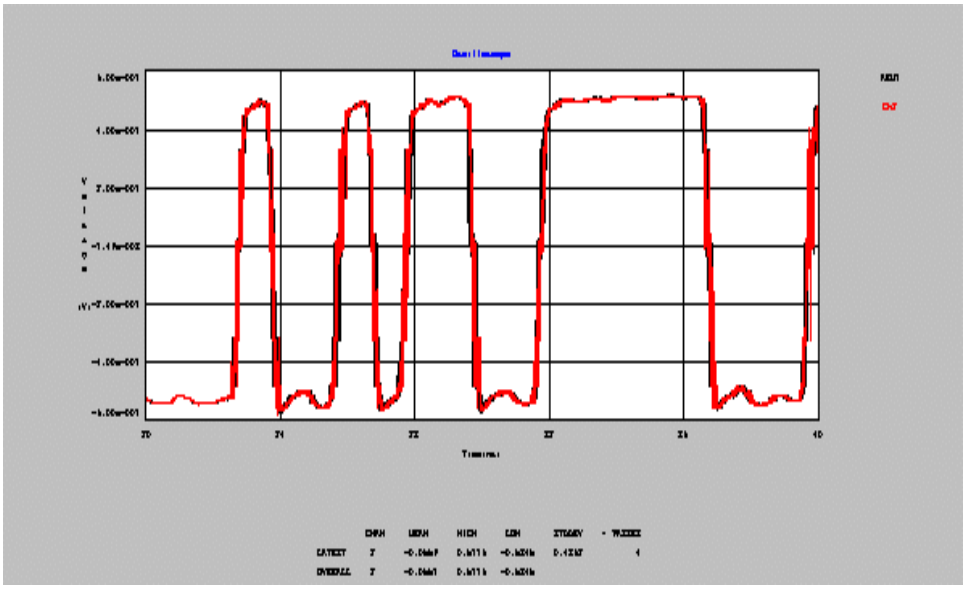


Figure 1D

This plot is the same shown in Figure 1C.

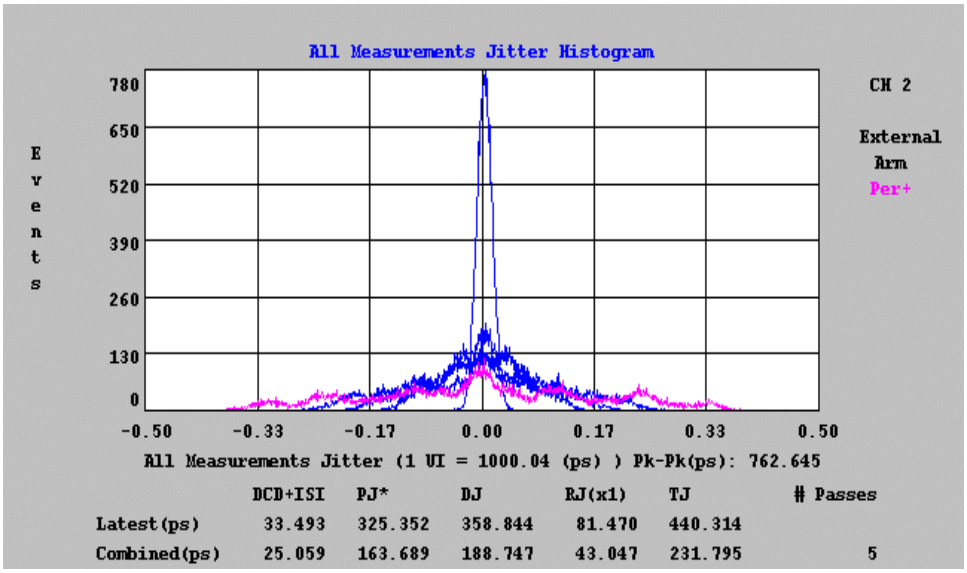


Figure 3D

This is the same view as Figure 3C except that EXTERNAL arming is used in Figure 3D.

Datacom Setup for Section D is as follows:

1. Sample size.....300
2. Stop count 72
3. UI 1.00004ns
4. Rj filter .....0.0 to Nyquist
5. Rj mult.....x1
6. Arming .....External

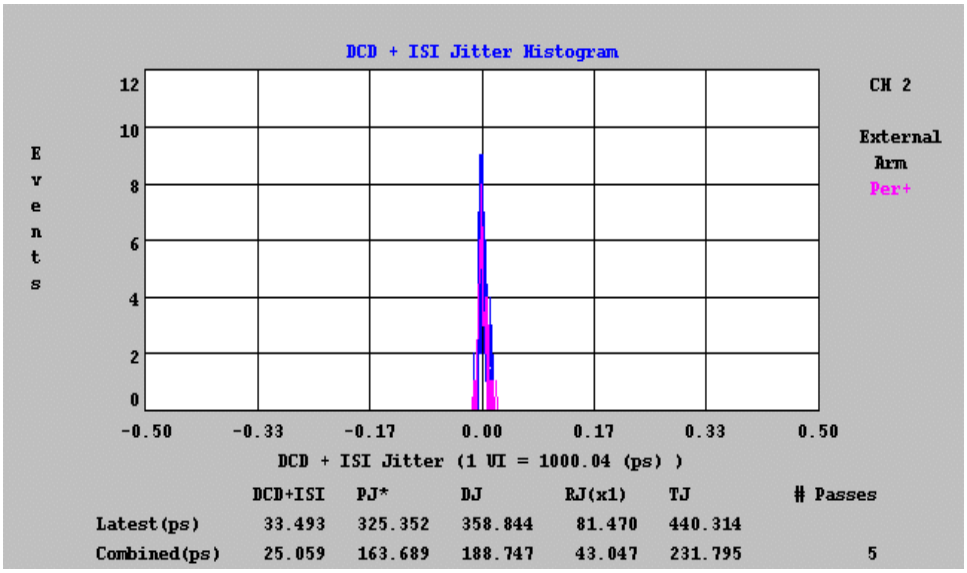


Figure 4D

As before, the DCD+ISI shown in Figure 4D varies very little as a function of modulation.

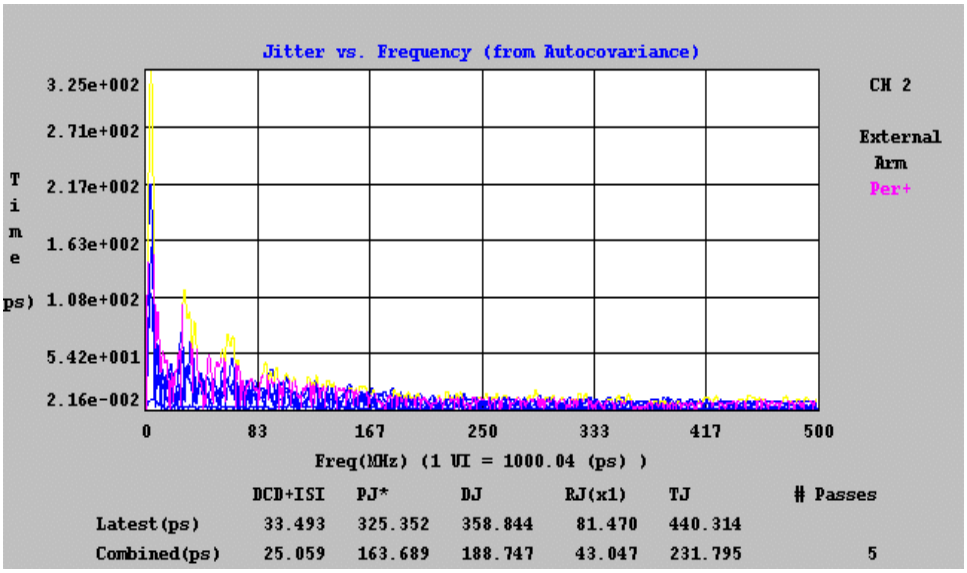


Figure 6D

This is a FFT of the data taken.

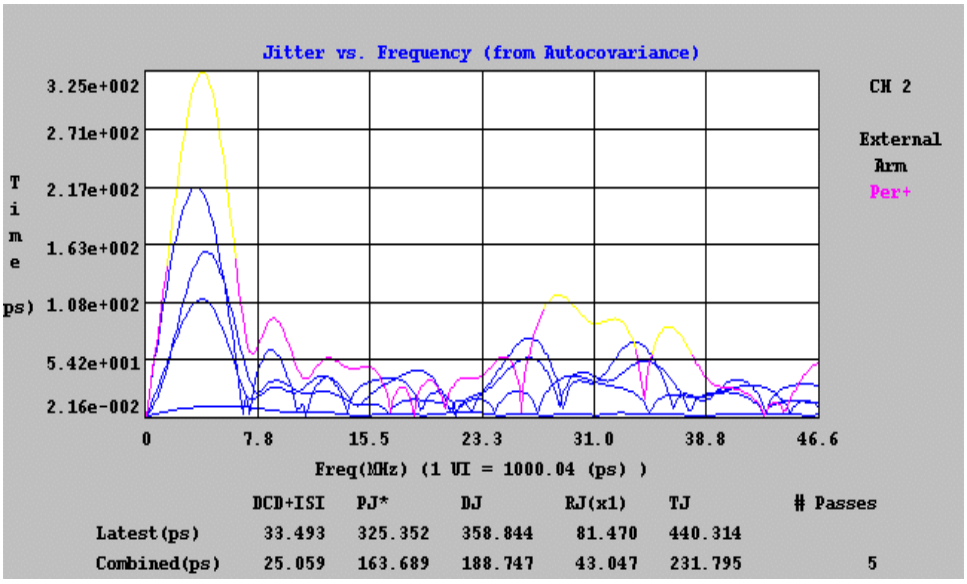


Figure 7D

This is a ZOOMed view of Figure 6D.

Appendix A

SJ-300 Clock data taken.

The “periodic” data entries for the scope and SPECTRUM were calculated using the following formula:

(= rms * 2 * 1.4142)

csa803	0	0.1	0.2	0.3	0.4
p-p	160	300	432	616	752
rms	27	60	106	166	209
periodic	76.4	169.7	299.8	469.5	591.1
tpd++ spectrum	0	0.1	0.2	0.3	0.4
p-p	158	293	444	633	747
rms	36.7	66.4	111	171	209
periodic	103.8	187.8	314.0	483.7	591.1
autoarm Datacom	0	0.1	0.2	0.3	0.4
all meas	216	392	578	825	1014
tj	142	274	439	671	830
dj	119	228	363	555	680
pj	50	153	289	467	590
dcd	69	75	74	88	90
rj(x1)	23	46	76	116	150

SJ-300 Data pattern, data taken.

The “periodic” data entries for the scope and SPECTRUM where calculated using the following formula:

(= rms * 2 * 1.4142)

csa803	0	0.1	0.2	0.3	0.4
p-p	68	212	364	536	660
rms	9.5	57	109	170	213
periodic	26.9	161.2	308.3	480.8	602.4
tpd++ spectrum	0	0.1	0.2	0.3	0.4
p-p	59	211	360	535	666
rms	8.7	60	109	170	210
periodic	24.6	169.7	308.3	480.8	594.0
autoarm Datacom	0	0.1	0.2	0.3	0.4
all meas	69	281	494	741	906
tj	25.6	227	402	623	787
dj	19.7	181	326	507	637
pj	13	167	304	474	593
dcd	6.7	14	22	33	44
rj(x1)	5.9	46	76	116	150

DTS-550 Data pattern, data taken.

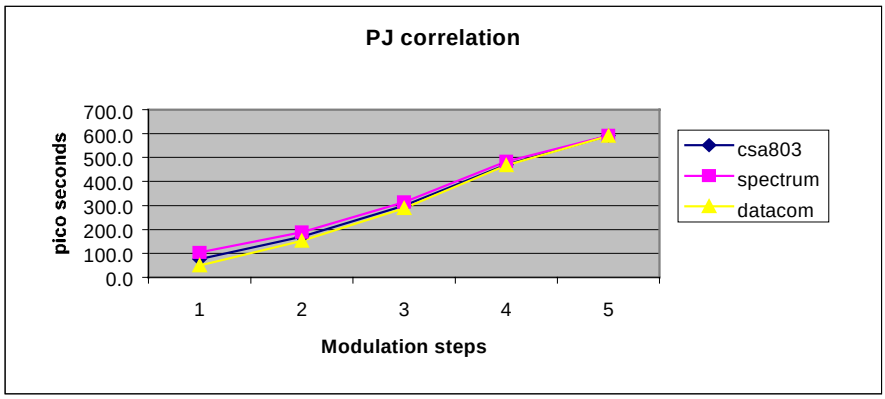
The “periodic” data entries for the scope and SPECTRUM where calculated using the following formula:

(= rms * 2 * 1.4142)

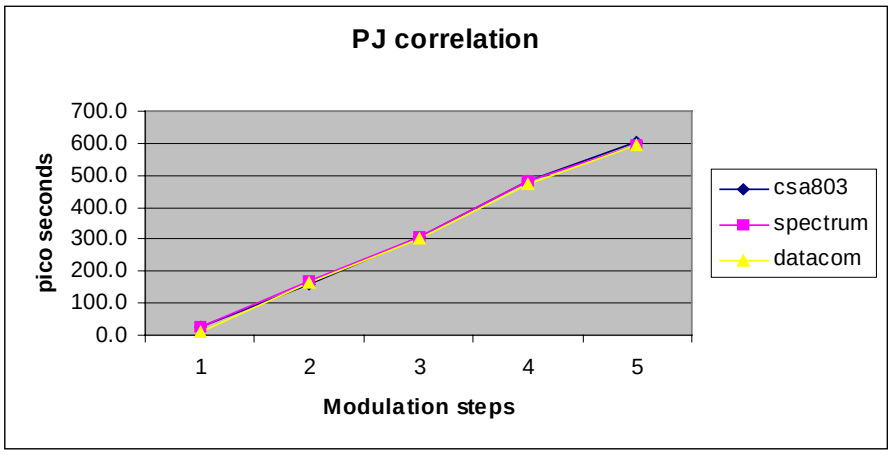
modulation UI	0	0.1	0.2	0.3	0.4
csa803 p-p	78	168	244	348	418
csa803 rms	12.6	33	58.6	86.4	114
csa803 periodic	35.6	93.3	165.7	244.4	322.4
tpd++					
spectrum p-p	83	165	237	337	418
spectrum rms	13.5	32.6	59	87	107
spectrum periodic	38.2	92.2	166.9	246.1	302.6
Datacom autoarm					
all meas	70	224	292	400	540
tj	30.5	182.0	230.0	327.0	521.0
dj	24	152	188	269	434
pj	12	115	155	208	328
dcd	12	37	33	61	106
rj (x1)	6.5	30	42	58	87
Datacom Extarm					
all meas	86	301	408	535	762
tj	38.6	161.0	222.0	293.0	439.0
dj	33.0	132.0	179.0	238.0	358.0
pj	10	110	155	216	325
dcd	23	22	24	22	33
rj (x1)	5.6	29	43	55	81

Appendix B

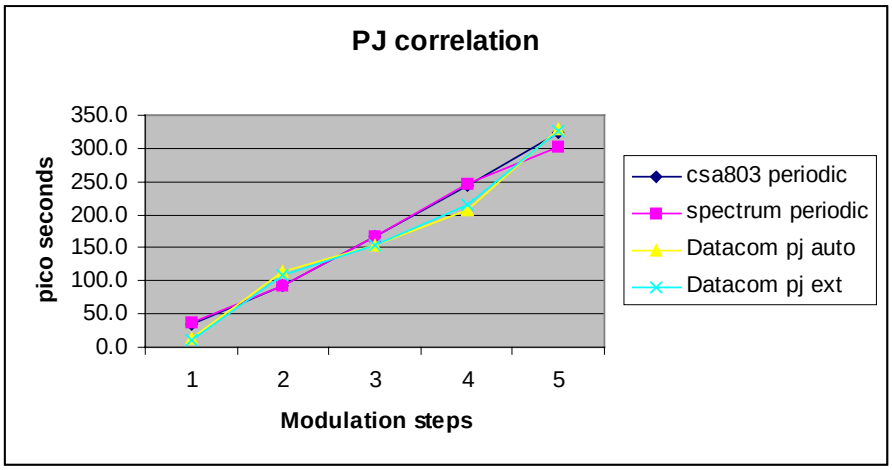
622 MB/s DATA



622MHz CLOCK



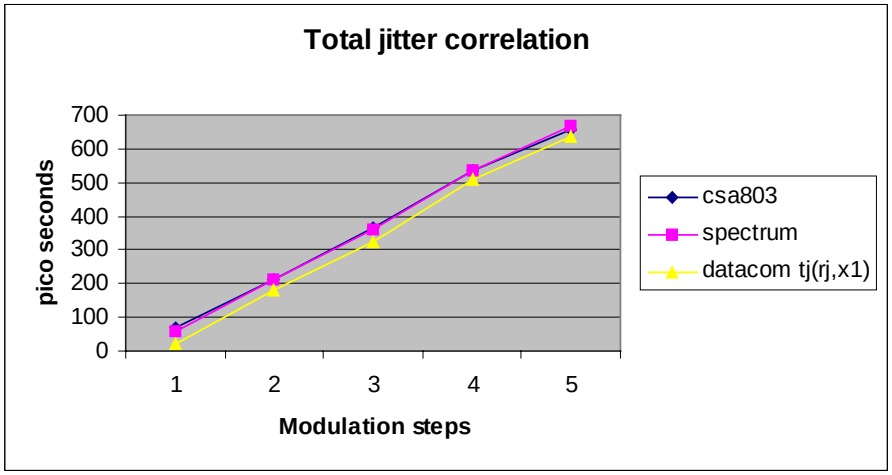
1GB/s DATA



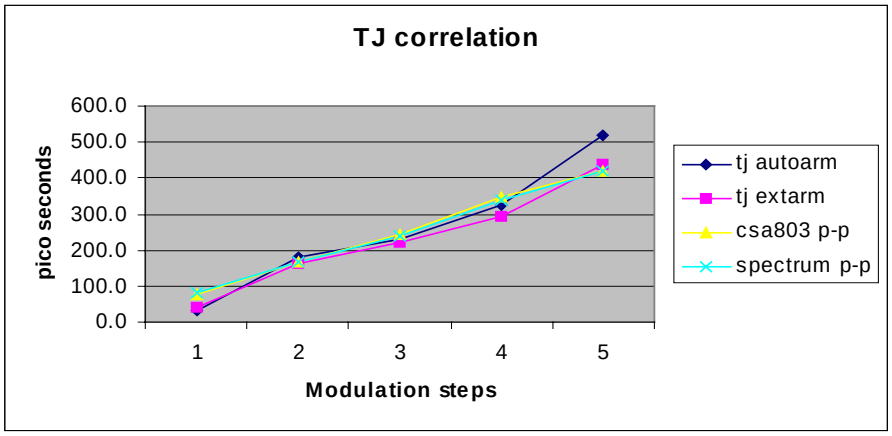
Appendix C

622 MB/s DATA

622 MHz CLOCK

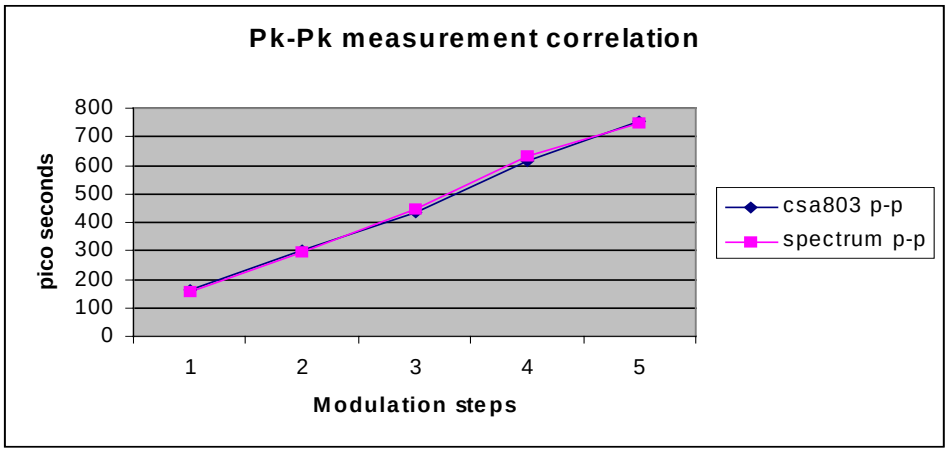


1 GB/s DATA

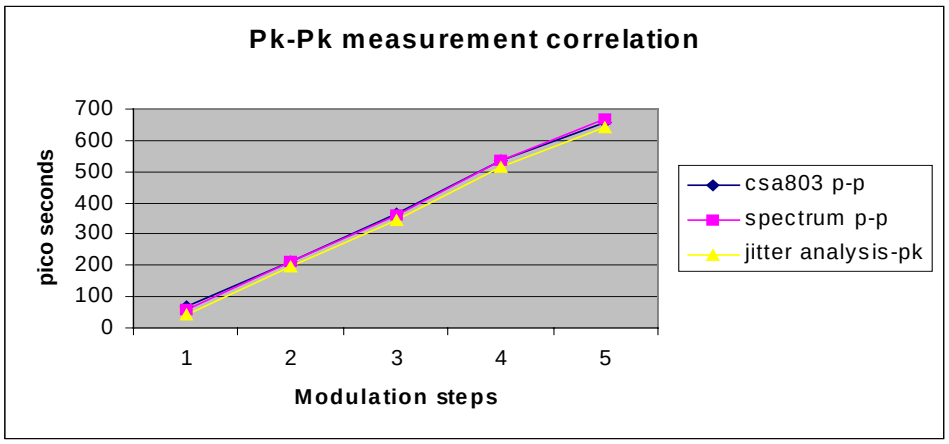


Appendix D

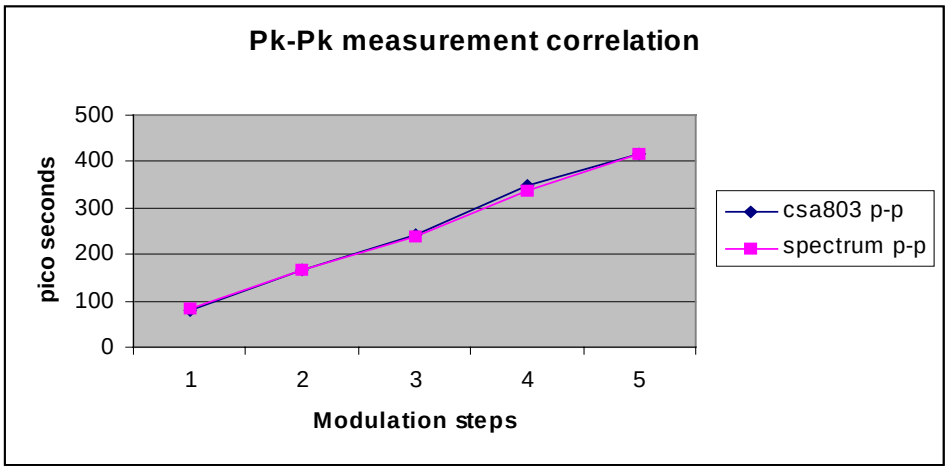
622 MB/s DATA



622 MHz CLOCK

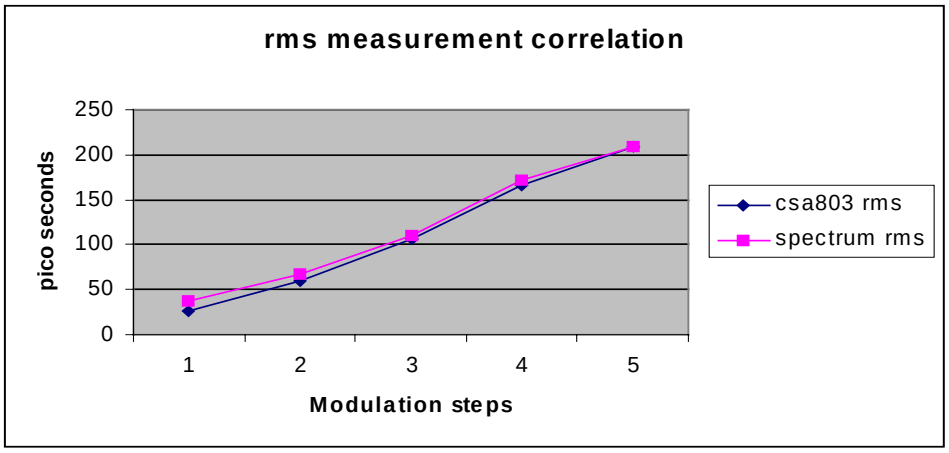


1 GB/s DATA

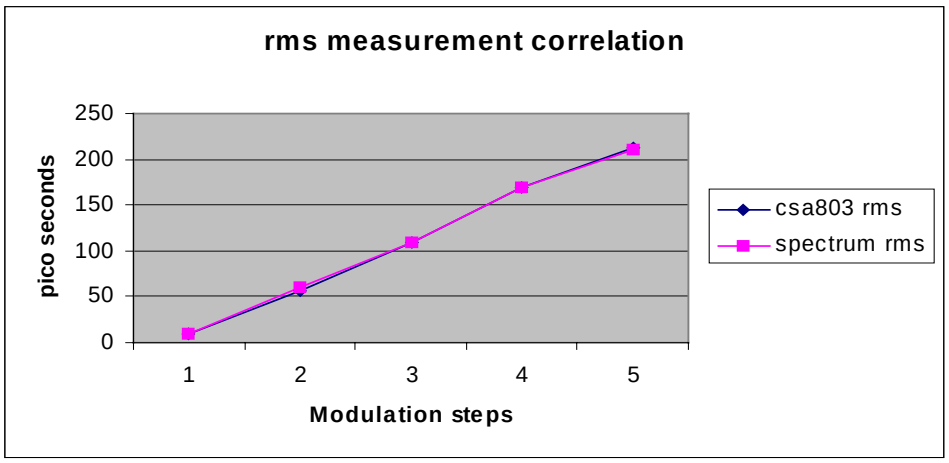


Appendix E

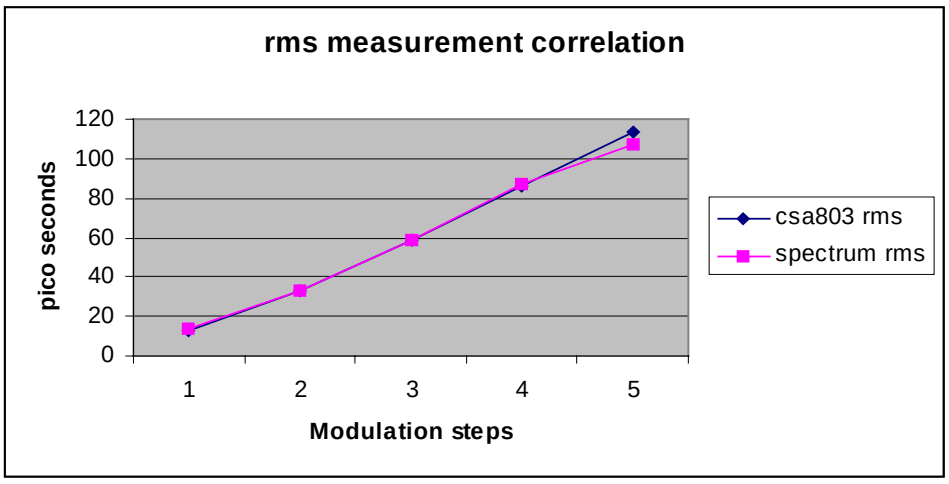
622 MB/s DATA



622 MHz CLOCK



1 GB/s DATA



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