Kentech Instruments Ltd.

Notes on the use of

CPS3/S special

s/n

Last Modified 18-10-19

PLEASE READ THIS MANUAL CAREFULLY BEFORE USING THE UNIT

Kentech Instruments Ltd.,
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Contents

1 DECLARATION OF CONFORMITY

Declaration of Conformity

We:- Kentech Instruments Ltd.
The Isis Building
Howbery Park
Wallingford
Oxfordshire OX10 8BD, UK

Certify that this apparatus:-

Kentech CPS3/S Special Pulse Generator
serial no.

Conform with the protection requirements of European Community Directives:-

73/23/EEC	Low Voltage Directive
89/336/EEC	Electromagnetic Compatibility Directive
93/68/EEC	CE Marking Directive

The following harmonised standards have been applied:-

BS EN55011 Emissions Specification (Group 2 Class A) Industrial, Scientific and Medical equipment

BS EN50082-2 Generic Immunity Standard

Part 2 Industrial

BS EN 61010-1 Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

The following documents contain additional relevant information:-

Kentech file reference

Signature: Name: A.K.L. Dymoke-Bradshaw

On behalf of Kentech Instruments Ltd.

Position: Director

Issued: 18-10-19

2 DISCLAIMER

There are high voltage power supplies present in this instrument when the unit is operating. Do not remove any covers from the unit or expose any part of its circuitry. In the event of malfunction, the unit must be returned to Kentech Instruments Ltd. or its appointed agent for repair.

The accessible terminals of this instrument are protected from hazardous voltages by basic insulation and protective grounding via the power input connector. It is essential that the ground terminal of this connector is connected to the local earth/screened enclosure via the power lead to maintain this protection.

Kentech Instruments Ltd. accepts no responsibility for any electric shock or injury arising from use or misuse of this product. It is the responsibility of the user to exercise care and common sense with this highly versatile equipment.

Read this manual before unpacking and using the instrument. If cleaning is necessary this should be performed with a soft dry cloth or tissue only.

3 EMC CAUTION

This equipment includes circuits intentionally designed to generate short high energy electromagnetic pulses and the EM emissions will be sensitive to the details of the experimental set up.

In practice emissions may exceed E55011 and the unit may cause interference with other equipment in its immediate environment. It is therefore suitable for use only in a laboratory or a sealed electromagnetic environment, unless it is used in a system that has been verified by the system builder to comply with EC directive 89/336/EEC. Use of this apparatus outside the laboratory or sealed electromagnetic environment invalidates conformity with the EMC Directive and could lead to prosecution.

We believe that with this type of unit it has to be the system builders responsibility to verify that his pulser/load system complies with the EC directive unless the system is used in a screened electromagnetic environment.

We are not able to guarantee compliance with arbitrary loads but to minimise emissions we recommend:-

1) That any load is fully contained within a conductive metal screened box, with all joint surfaces gasketed or fitted with conductive fasteners at less than 5cm intervals.

2) That the load is connected to the pulser output with semi-rigid cable, the cable outer must be carefully connected to the N type output connector at one end, and must be connected directly to the screened box containing the load at the point of entry. Flexible cables should only be used with caution, in particular RG303 type cable will need additional screening to control emissions. The use of semi rigid cables or conformable semi rigid cables will deliver lower EM radiation from the cabling than any flexible types.

Pockels cells will radiate through the optical windows and if this is an issue the laser system should be enclosed in a suitable EMC enclosure.

4 ABBREVIATIONS

EHT or eht	Extra High Tension (high voltage)
EMC	Electromagentic Compatibility
f.w.h.m.	full width at half maximum amplitude
PRF	Pulse Repetition Frequency
PSU or psu	power supply unit
SD	Standard Deviation
w.r.t.	With Respect To

5 CAUTION

With an appropriate load, this unit is safe for use by an educated user in a laboratory environment. You are warned, however, that the radiation from the system with an antenna or inappropriate load attached, can damage sensitive equipment and corrupt data stored in computer and microprocessor based systems. It can cause terminal failure of vital medical electronic systems, such as pacemakers. This equipment is supplied on the understanding that the user will analyse these risks, accept responsibility for them, and take appropriate precautions in the use of this instrument.
The output from this pulse generator will destroy many types of power attenuators and electronic test equipment. It is the user's responsibility to ensure that any apparatus connected to the output is suitably rated.
Kentech Instruments Ltd. accepts no responsibility for any damage or liabilities incurred in the operation of this equipment.

Please read the manual before applying power.

6 INTRODUCTION

Our range of solid state pulsers (ASG, CPS, HMPS and PBG series) allows very high voltage, fast rising pulses to be obtained from compact bench top units. Voltage pulses as short as 100ps FWHM, in excess of 4kV peak voltage into 50Ω, and with a pulse repetition frequency (PRF) >1kHz can be produced. The performance of our compact, convenient and reliable pulsers is to our knowledge exceeded only by laser driven photoconductive switches in terms of voltage switching speeds. These pulsers will find applications in many fields such as high speed camera research, electro-optic switching, triggering systems and radar.

A large range of output pulse lengths can be provided by the incorporation of internal passive pulse forming networks. There is very little jitter in the output of the pulsers and two independent pulsers can be used in parallel to drive low impedances. This aspect makes the pulsers particularly useful for driving microchannel plate systems. Transformers with output impedances as low as 5 are available.

The standard drivers have a life of $>10^{10}$ pulses.

The pulsers can feed into a short circuit load without damage. This allows them to be used in sub-nanosecond pulse chopping systems by feeding through a pockels cell into a shorting stub. Variations on the standard driver are available.

7 OPERATION OF THE PULSER

1.1 GENERAL OPERATION

The pulser requires A.C. power and a trigger signal to operate. The trigger signal applied to the front panel trigger input (BNC) should be >2V and <6V into 50Ω with a fast rising edge (<5ns) to maintain the low jitter of the system. When triggered the triggered light on the front panel will flash.
The output of the unit is a nominal 600V positive pulse which appears on each of the 10 output front panel connectors (SMA). The pulse width is fixed at ~1ns.
If it is necessary to monitor or characterise the pulse output then suitable attenuators should be used.

CAUTION

The output of this unit will damage or destroy many types of high voltage and high power attenuators. We only recommend the use of a high voltage, high speed attenuator manufactured by Barth™ as the first in a series. Consult the attenuator manufacturer before using any other configuration.
The output may be observed with a high bandwidth oscilloscope. This may either be a fast (>3GHz) direct access type or a sampling type.
The trigger delay from trigger input BNC to main output is approximately 26ns. The jitter is ~20ps peak to peak with a suitably reproducible and fast rising trigger signal.

1.2 CARE OF CONNECTORS

SMA connectors have a limited lifetime if mated repeatedly. Typically the manufactures rate them at 500 mate and unmate cycles. In addition do not exceed the recomended tightening torque of ~ 0.5 Nm. Use of a torque wrench is advised. Occasional light greasing of the threads is also recommended.

The SMA connectors are attached to the front panel with anti rotation protection. This misiminses the risk of damaging the internal cabling by overtightening the connector.

1.3 TERMINATORS

The nature of the pulse generation and the method of generating 10 outputs with zero cross channel jitter means that there is significant coupling between the outputs.Consequently if ouputs are not terminated correctly into 50 Ω reflections from the load wil eventually arrive back at the other ouputs albeit some what diminished.

To stop reflcetions from unused outputs 10 terminators are supplied (chained to the front panel). In order to meet the specification for post pulse singal it is necessary to fit the terminators to any unused ouput. In addition used outputs should present a 50 Ω load to the pulse generator.

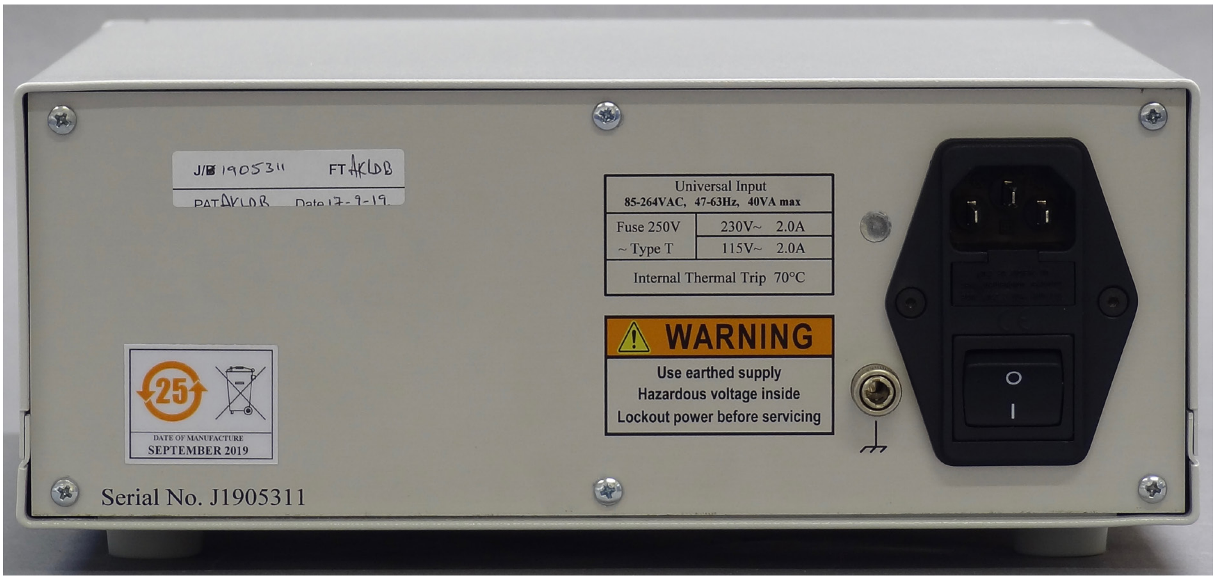
The effet of not using the terminators on unused outputs is shown in the data section.

8 SPECIFICATIONS

These are general specifications. Data on individual units is available on the CD that accompanies this manual.

Output voltage	~0.6kV minimum into 50Ω (Measured value 648 volts).
Output polarity	Positive.
Pulse shape	Nominally rectangular
Pulse width	<=1.0 ns f.w.h.m. See section 9 on page 9
Rise time	<500ps See Section 9 on page 9
Fall time	<500ps See Section 9 on page 9
Post pulse noise	approximately ±10% of peak for approximately 10ns See section15 on page 25
Trigger	~5V into 50Ω, <5ns rise time to achieve the specified jitter. <2ns rise time may result in improved jitter. Pulse length > 20ns
Jitter	<20ps peak to peak. See section 14 on page 24.
Trigger delay	nominally 26ns (BNC trigger input to output). See section 16 on page 26
Maximum repetition rate	≥30Hz.
Power supply	100 to 230 VAC.
Maximum power	<15W
Outputs:	
Pulse output	10 x SMA female, 0.6kV pulse.
Inputs:	
Trigger input	BNC (jack) >2V and <6V into 50Ω, .
Indicators:	
Power	Shows that DC power is applied.
Triggered	Illuminates while the unit is being triggered.
Environmental:	
Ambient temperature	5 to 35°C
Humidity	< 95% non-condensing
Altitude	< 300 m
Pulser:	
Dimensions	305mm deep (excluding connectors), 97.55mm high (including feet), 234.84mm wide
Weight:	~6.2kg

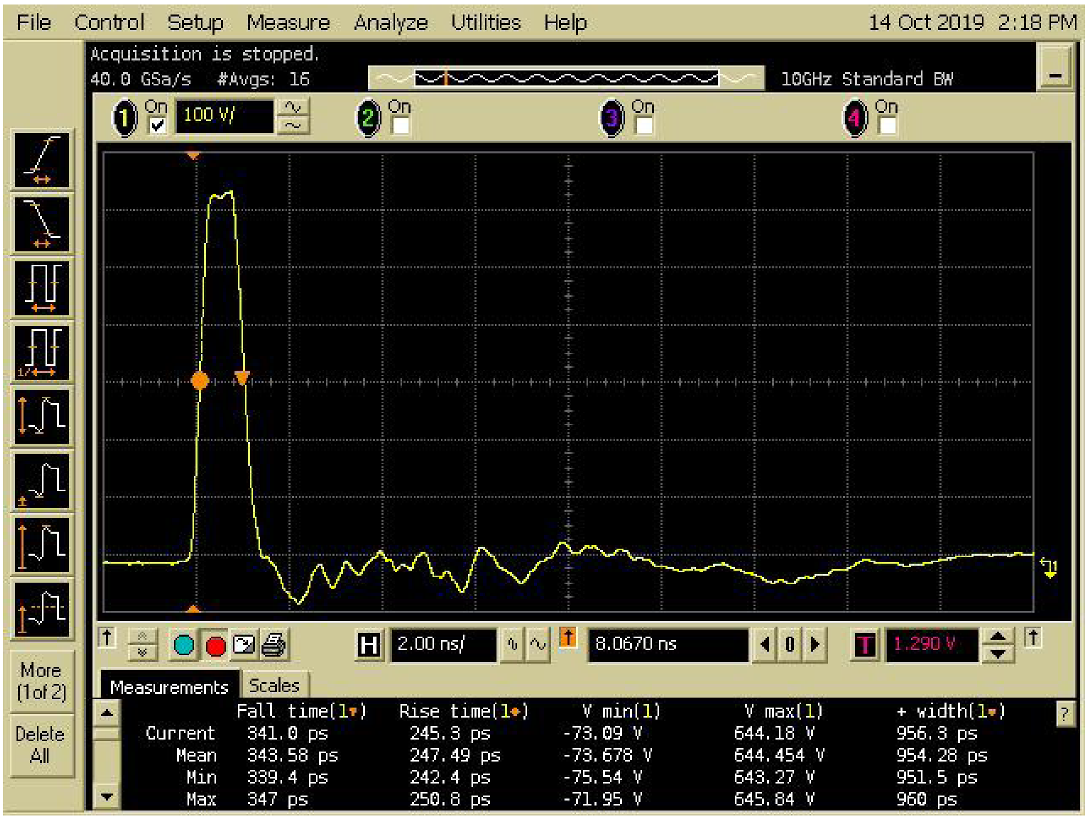

Kentech Instruments Ltd.
Model: CPS3/S
Made in England
www.kentech.co.uk
Trigger input 5V, 50Ω
Power
Triggered


Universal Input
85-264VAC, 47-63Hz, 40VA max
Fuse 250V
~ Type T
230V~ 2.0A
115V~ 2.0A
Internal Thermal Trip 70°C
WARNING
Use earthed supply
Hazardous voltage inside
Lockout power before servicing
DATE OF MANUFACTURE
SEPTEMBER 2019
Serial No. J1905311

9 OUTPUT WAVEFORM

Channel 1 (top left output)

Note that this data is in average mode over 16 waveforms.



Acquisition — Sampling mode real time Hi resolution
Memory depth automatic 1000 pts
Sampling rate automatic Sampling rate 40.0 GSa/s
Averaging on # of averages 16 Interpolation on

Channel 1 — Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms

Channel 4 — Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms

Time base — Scale 2.00 ns/ Position 8.0670 ns Reference center

Trigger — Mode edge Sweep triggered
Sensitivity high Holdoff time 100 ns
Source channel 4 Trigger level 1.290 V Slope rising

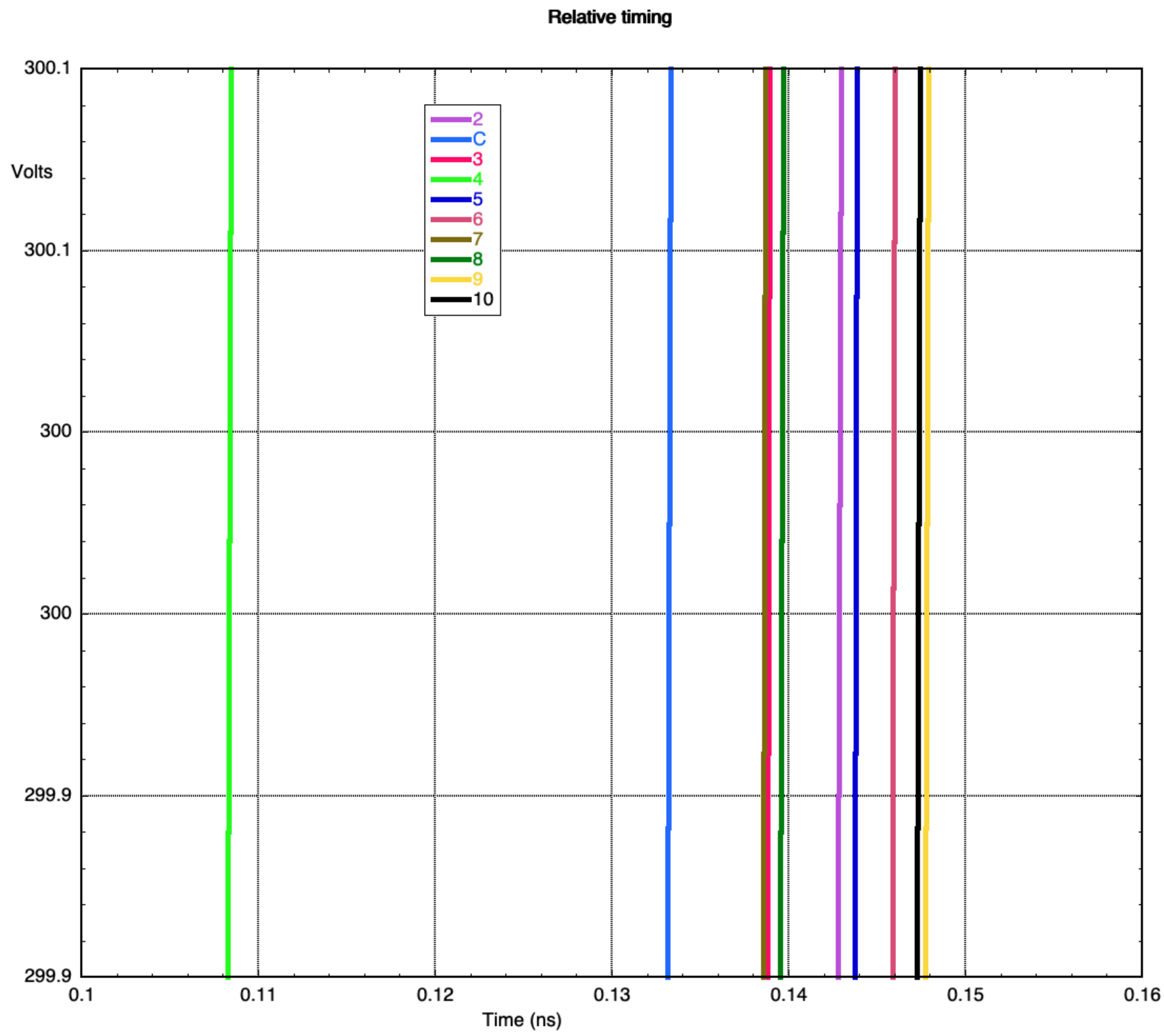
Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	341.0 ps	245.3 ps	-73.09 V	644.18 V	956.3 ps
Mean	343.58 ps	247.49 ps	-73.678 V	644.454 V	954.28 ps
Min	339.4 ps	242.4 ps	-75.54 V	643.27 V	951.5 ps
Max	347 ps	250.8 ps	-71.95 V	645.84 V	960 ps
Range	7.6 ps	8.4 ps	3.60 V	2.57 V	8.4 ps
Std Dev	1.58 ps	1.97 ps	570 mV	475 mV	1.84 ps
# of Meas	770	770	770	770	770
Edge Dir	Falling	Rising			

10 CROSS TIMING OF OUTPUT CHANNELS

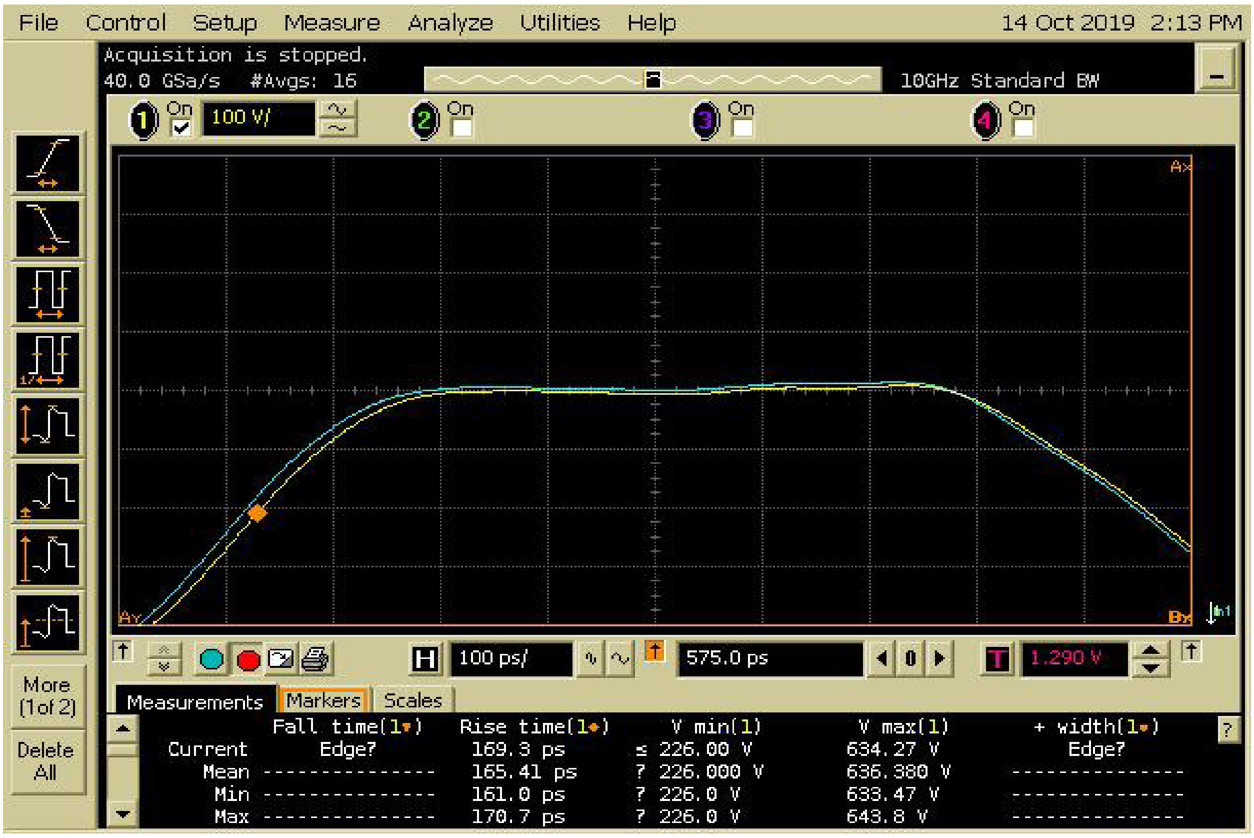
All 10 channels plotted to show the variation in timing to each output showing a peak to peak variation of <30ps.

Numbering of channels is 1 through 5 left to right across the top row and 6 through 10 on the lower row.



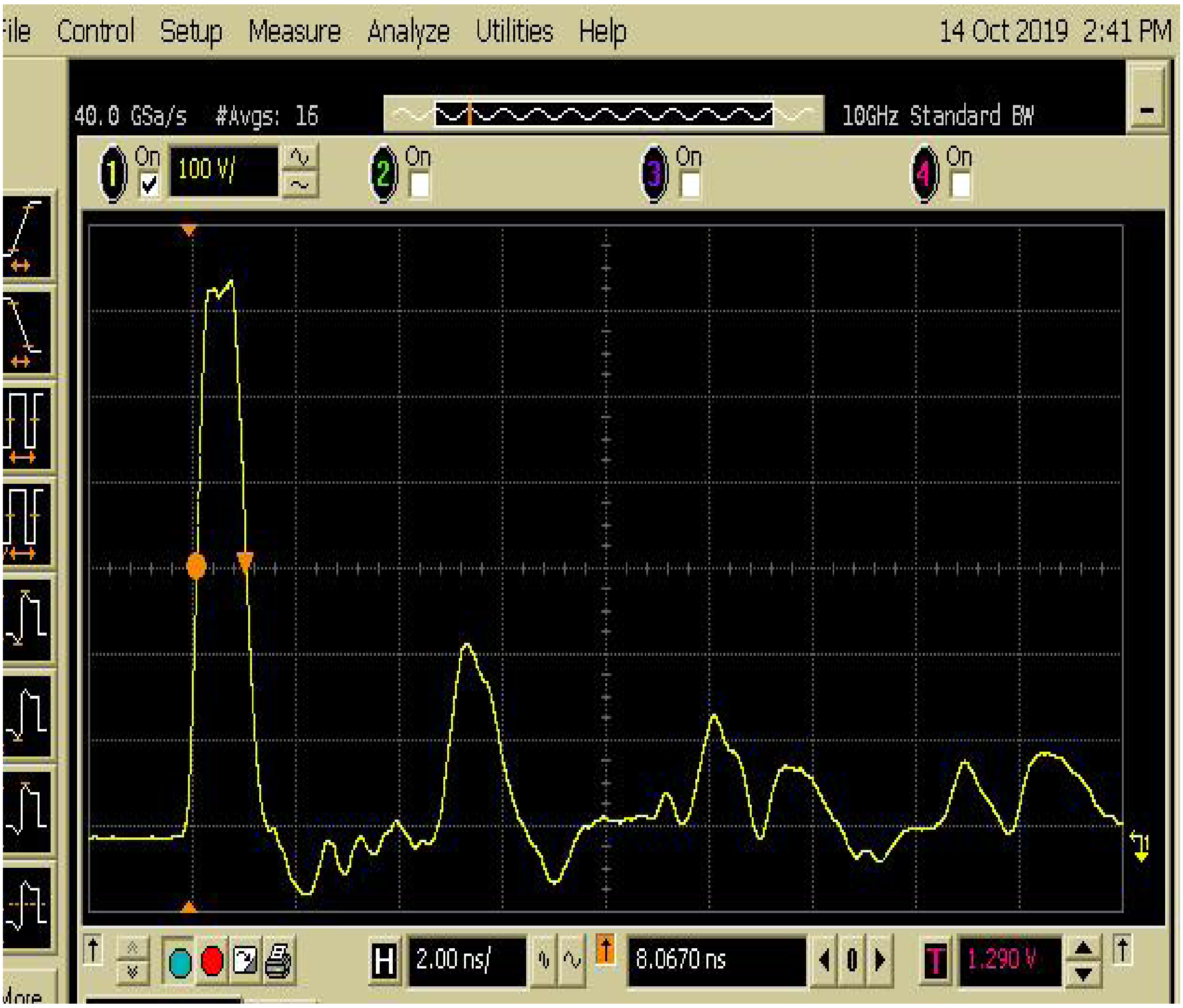
11 CHANGE IN WAVEFORM ABOVE 51HZ

The blue trace is 51Hz and the yellow 61Hz, showing the limit of the repetition rate.

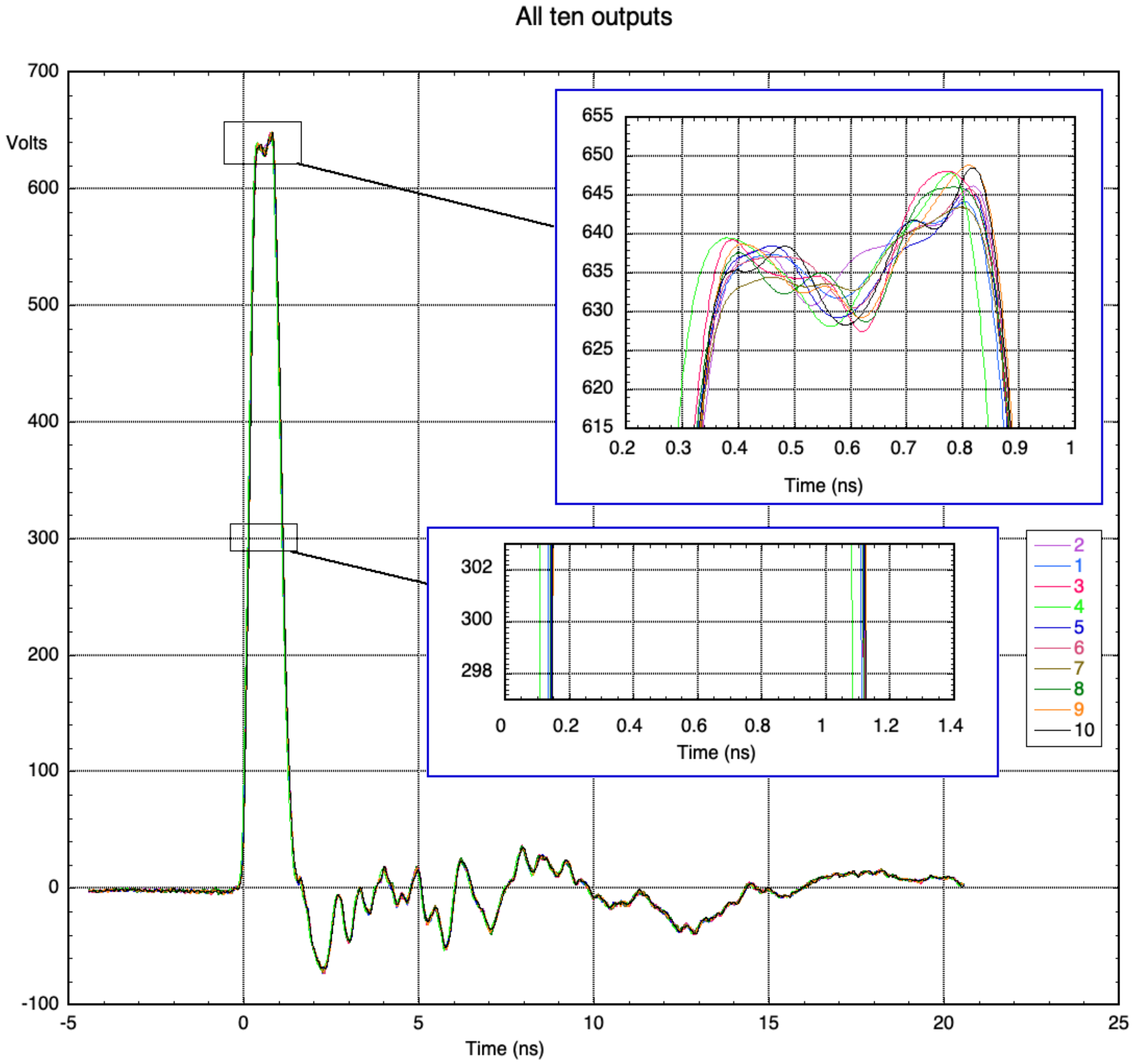


12 EFFECT OF NOT TERMINATING UNUSED OUTPUTS

Here is shown the effect of not fitting terminators to 9 unused outputs. The remaining output has significant post pulse signals.



13 SUPERPOSITION OF ALL 10 OUTPUTS



Channel 1

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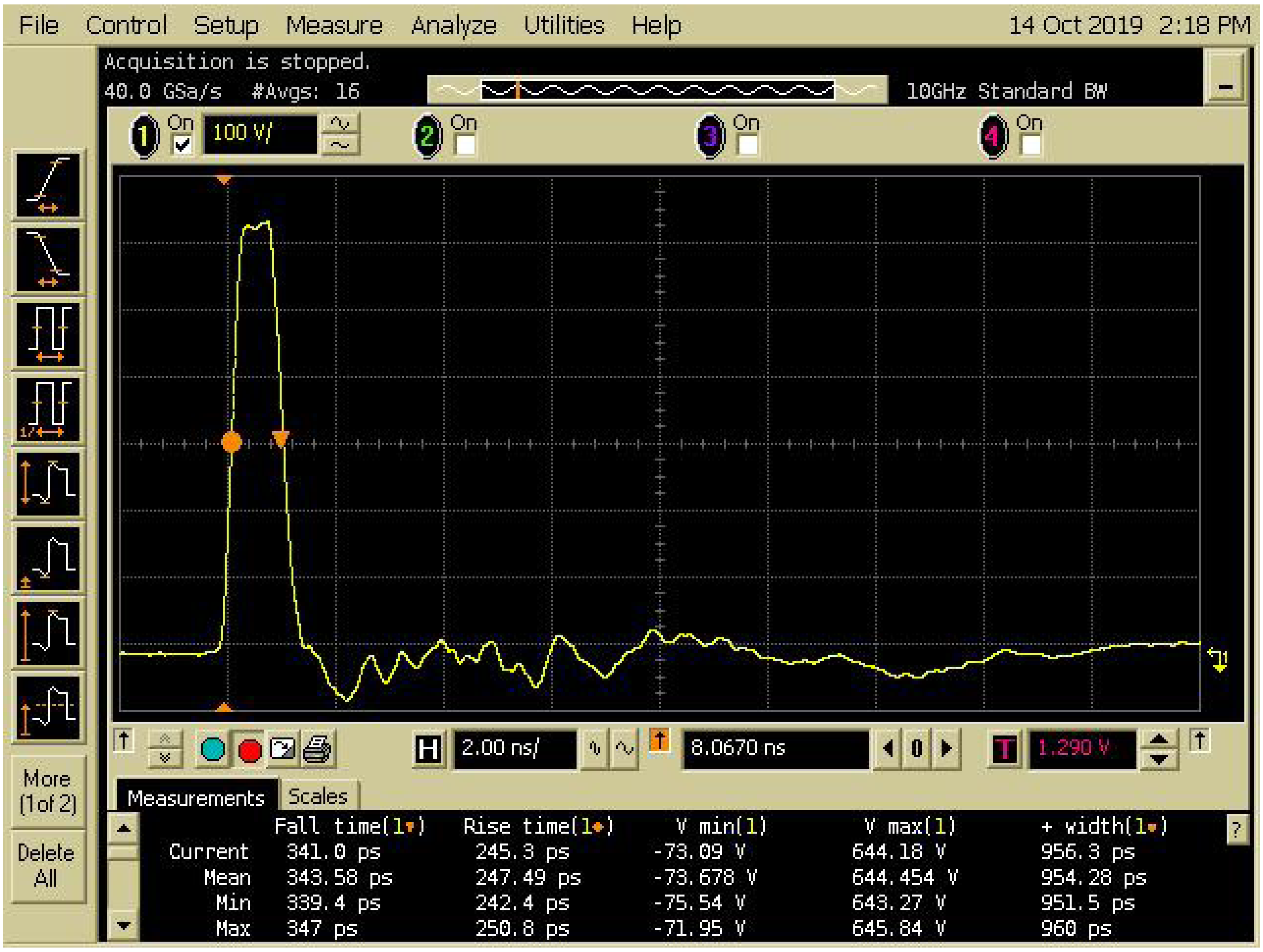

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1•)	V min(1)	V max(1)	+ width(1•)
Current	341.0 ps	245.3 ps	-73.09 V	644.18 V	956.3 ps
Mean	343.58 ps	247.49 ps	-73.678 V	644.454 V	954.28 ps
Min	339.4 ps	242.4 ps	-75.54 V	643.27 V	951.5 ps
Max	347 ps	250.8 ps	-71.95 V	645.84 V	960 ps
Range	7.6 ps	8.4 ps	3.60 V	2.57 V	8.4 ps
Std Dev	1.58 ps	1.97 ps	570 mV	475 mV	1.84 ps
# of Meas	770	770	770	770	770
Edge Dir	Falling	Rising			

Channel 2

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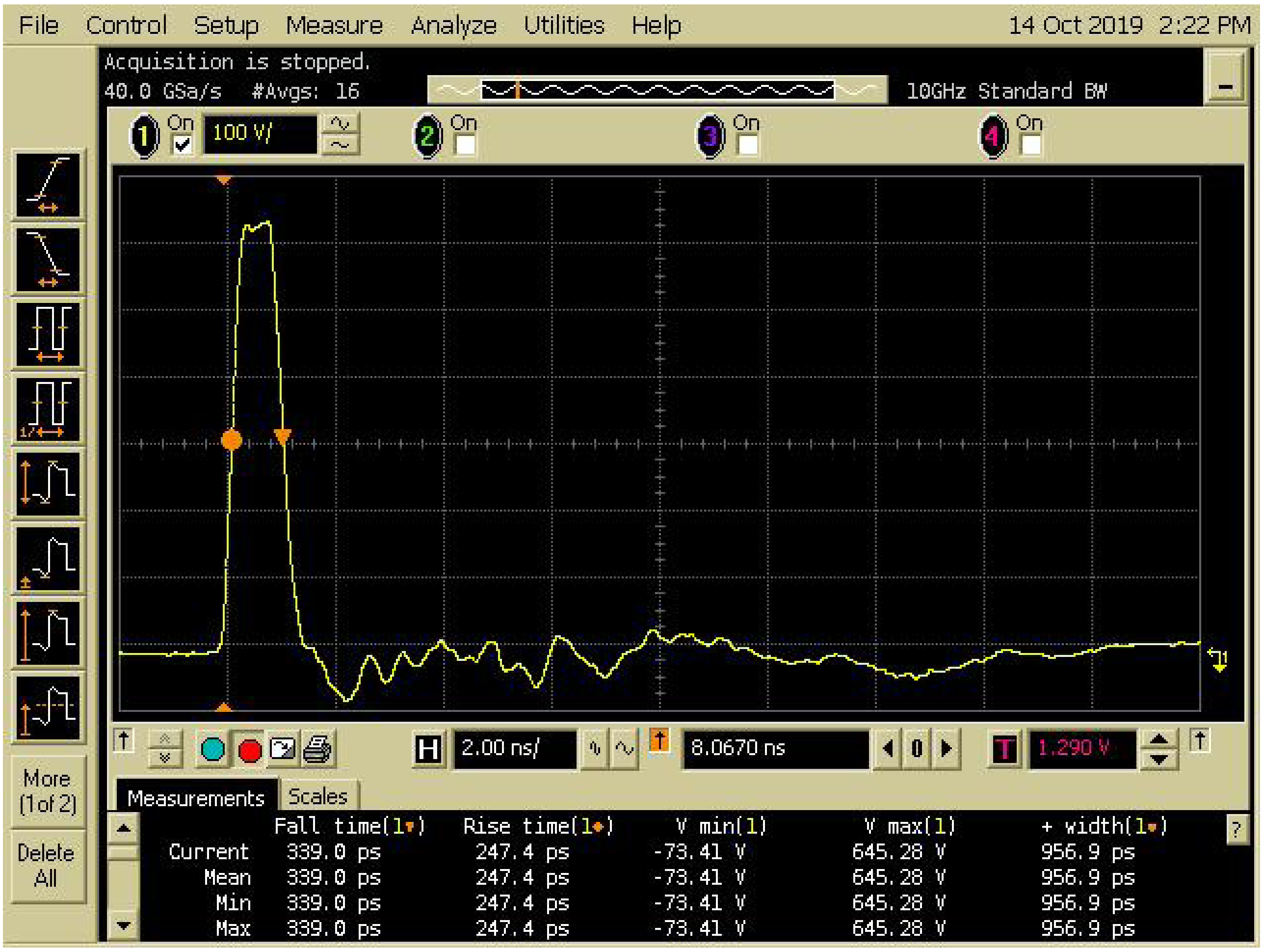

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	339.0 ps	247.4 ps	-73.41 V	645.28 V	956.9 ps
Mean	339.0 ps	247.4 ps	-73.41 V	645.28 V	956.9 ps
Min	339.0 ps	247.4 ps	-73.41 V	645.28 V	956.9 ps
Max	339.0 ps	247.4 ps	-73.41 V	645.28 V	956.9 ps
Range	0.0 s	0.0 s	0.0 V	0.0 V	0.0 s
Std Dev	0.0 s	0.0 s	0.0 V	0.0 V	0.0 s
# of Meas	1	1	1	1	1
Edge Dir	Falling	Rising			

Channel 3

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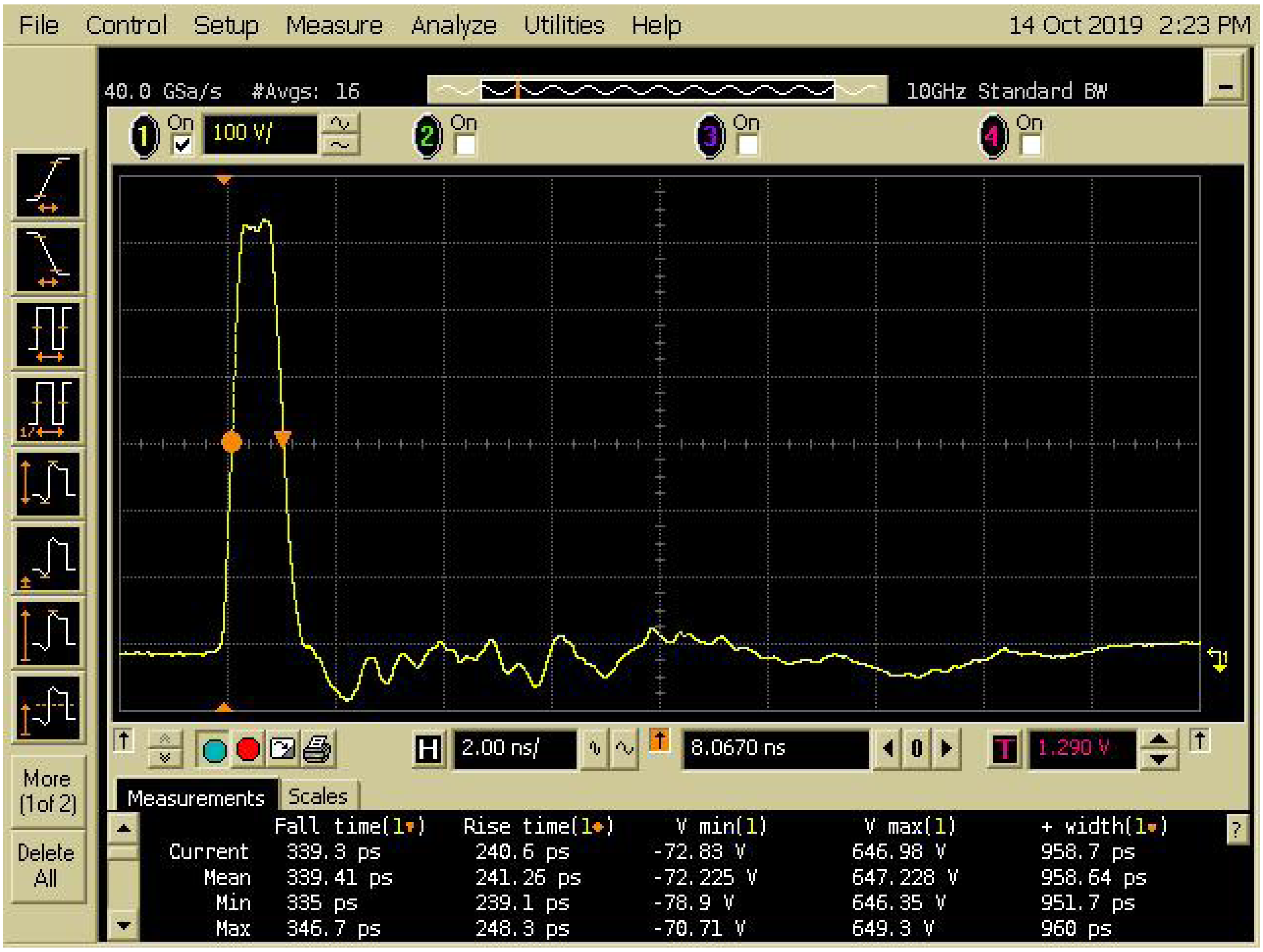

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1•)	V min(1)	V max(1)	+ width(1▾)
Current	339.5 ps	240.5 ps	-72.72 V	646.80 V	958.5 ps
Mean	339.41 ps	241.26 ps	-72.226 V	647.227 V	958.64 ps
Min	335 ps	239.1 ps	-78.9 V	646.35 V	951.7 ps
Max	346.7 ps	248.3 ps	-70.71 V	649.3 V	960 ps
Range	12.1 ps	9.2 ps	8.22 V	2.99 V	8.7 ps
Std Dev	1.74 ps	1.95 ps	732 mV	404 mV	1.83 ps
# of Meas	403	403	403	403	403
Edge Dir	Falling	Rising			

Channel 4

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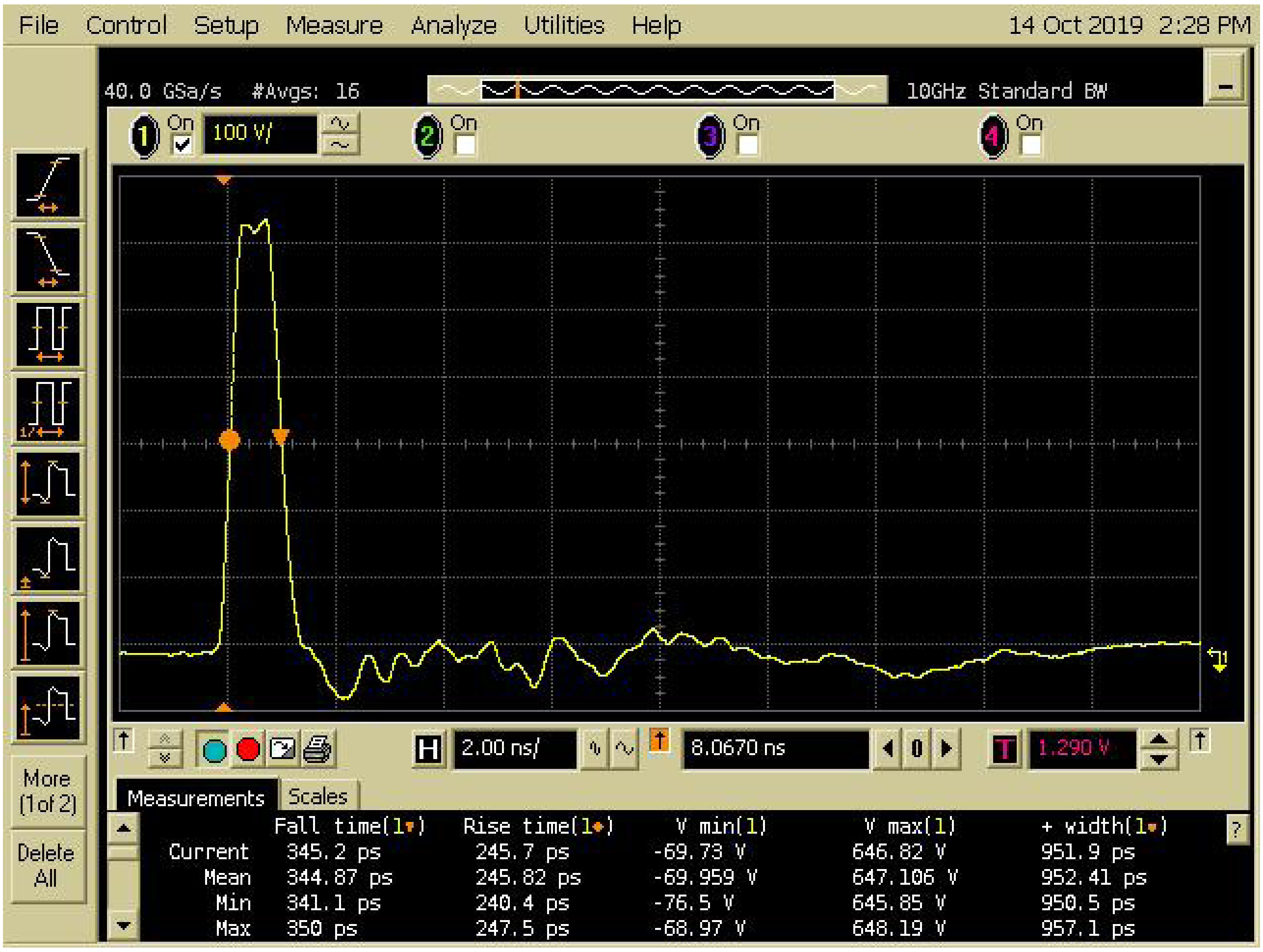

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure		Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
	Current	345.2 ps	245.7 ps	-69.73 V	646.82 V	951.9 ps
	Mean	344.87 ps	245.82 ps	-69.959 V	647.106 V	952.41 ps
	Min	341.1 ps	240.4 ps	-76.5 V	645.85 V	950.5 ps
	Max	350 ps	247.5 ps	-68.97 V	648.19 V	957.1 ps
	Range	8.7 ps	7.0 ps	7.55 V	2.34 V	6.6 ps
	Std Dev	830 fs	750 fs	623 mV	450 mV	620 fs
	# of Meas	418	418	418	418	418
	Edge Dir	Falling	Rising			

Channel 5

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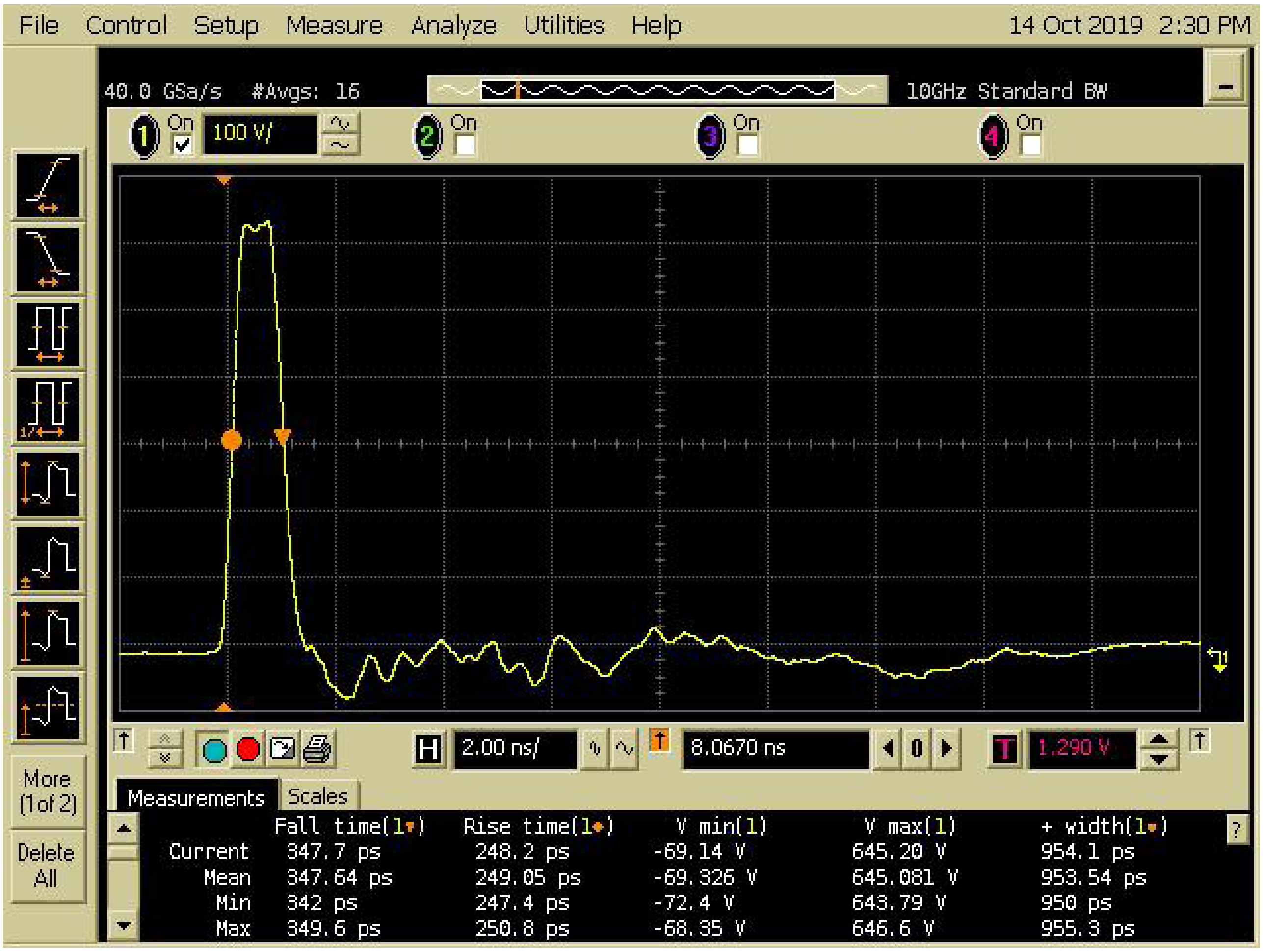

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	347.8 ps	248.3 ps	-68.90 V	645.18 V	954.2 ps
Mean	347.64 ps	249.05 ps	-69.326 V	645.081 V	953.54 ps
Min	342 ps	247.4 ps	-72.4 V	643.79 V	950 ps
Max	349.6 ps	250.8 ps	-68.35 V	646.6 V	955.3 ps
Range	7.8 ps	3.4 ps	4.02 V	2.78 V	5.1 ps
Std Dev	790 fs	620 fs	427 mV	492 mV	590 fs
# of Meas	436	436	436	436	436
Edge Dir	Falling	Rising			

Channel 6

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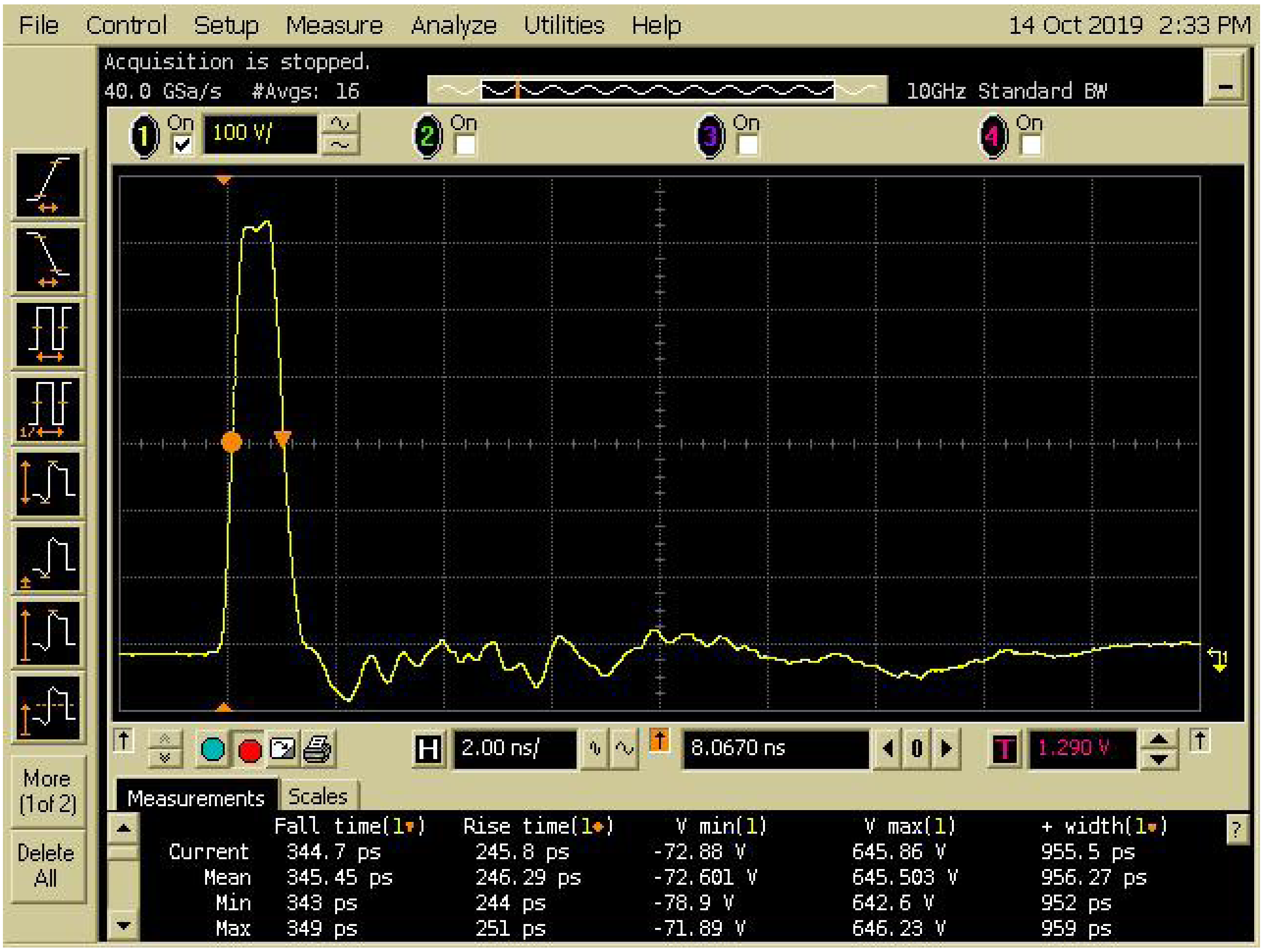

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1•)	V min(1)	V max(1)	+ width(1•)
Current	344.7 ps	245.8 ps	-72.88 V	645.86 V	955.5 ps
Mean	345.45 ps	246.29 ps	-72.601 V	645.503 V	956.27 ps
Min	343 ps	244 ps	-78.9 V	642.6 V	952 ps
Max	349 ps	251 ps	-71.89 V	646.23 V	959 ps
Range	7 ps	7 ps	6.99 V	3.61 V	7 ps
Std Dev	1.11 ps	1.01 ps	860 mV	544 mV	920 fs
# of Meas	70	70	70	70	70
Edge Dir	Falling	Rising			

Channel 7

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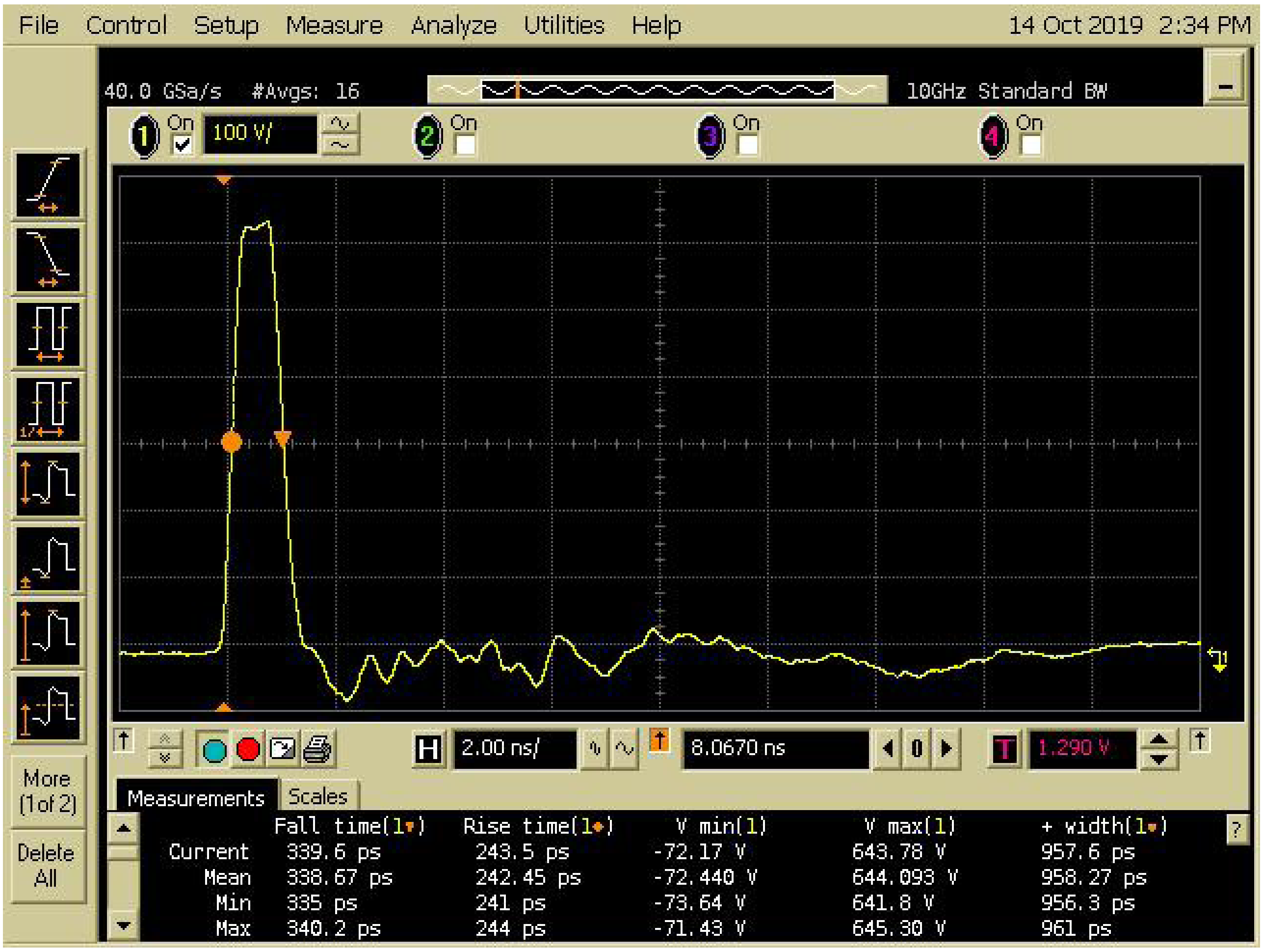

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	339.6 ps	243.5 ps	-72.17 V	643.97 V	957.9 ps
Mean	338.68 ps	242.46 ps	-72.440 V	644.093 V	958.27 ps
Min	335 ps	241 ps	-73.64 V	641.8 V	956.3 ps
Max	340.2 ps	244 ps	-71.43 V	645.30 V	961 ps
Range	5.0 ps	3 ps	2.21 V	3.53 V	4.8 ps
Std Dev	760 fs	710 fs	427 mV	480 mV	720 fs
# of Meas	387	387	387	387	387
Edge Dir	Falling	Rising			

Channel 8

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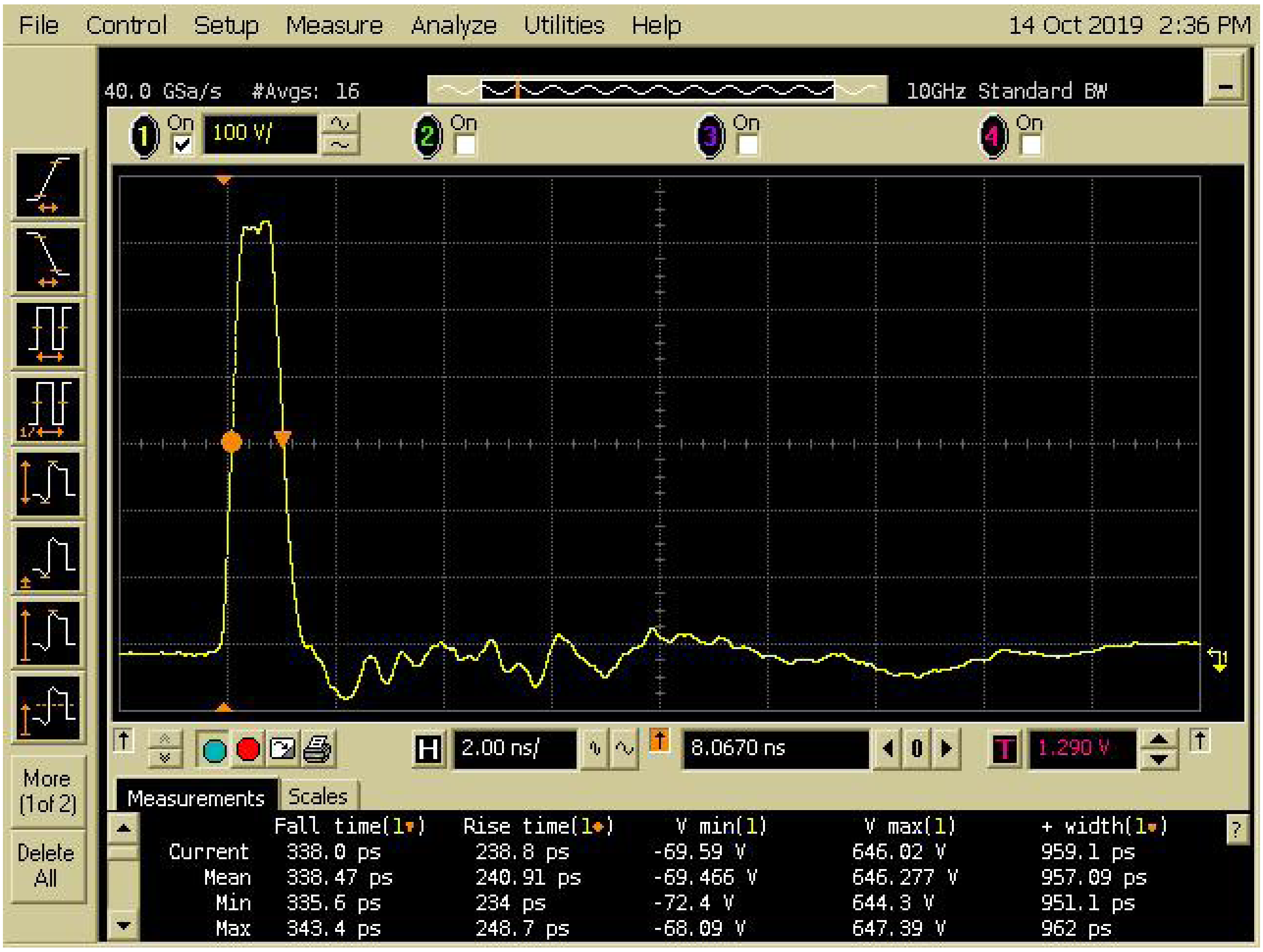

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	338.0 ps	238.8 ps	-69.59 V	646.02 V	959.1 ps
Mean	338.47 ps	240.91 ps	-69.466 V	646.277 V	957.09 ps
Min	335.6 ps	234 ps	-72.4 V	644.3 V	951.1 ps
Max	343.4 ps	248.7 ps	-68.09 V	647.39 V	962 ps
Range	7.8 ps	15.1 ps	4.35 V	3.10 V	10.5 ps
Std Dev	1.92 ps	2.73 ps	530 mV	579 mV	2.53 ps
# of Meas	274	274	274	274	274
Edge Dir	Falling	Rising			

Channel 9

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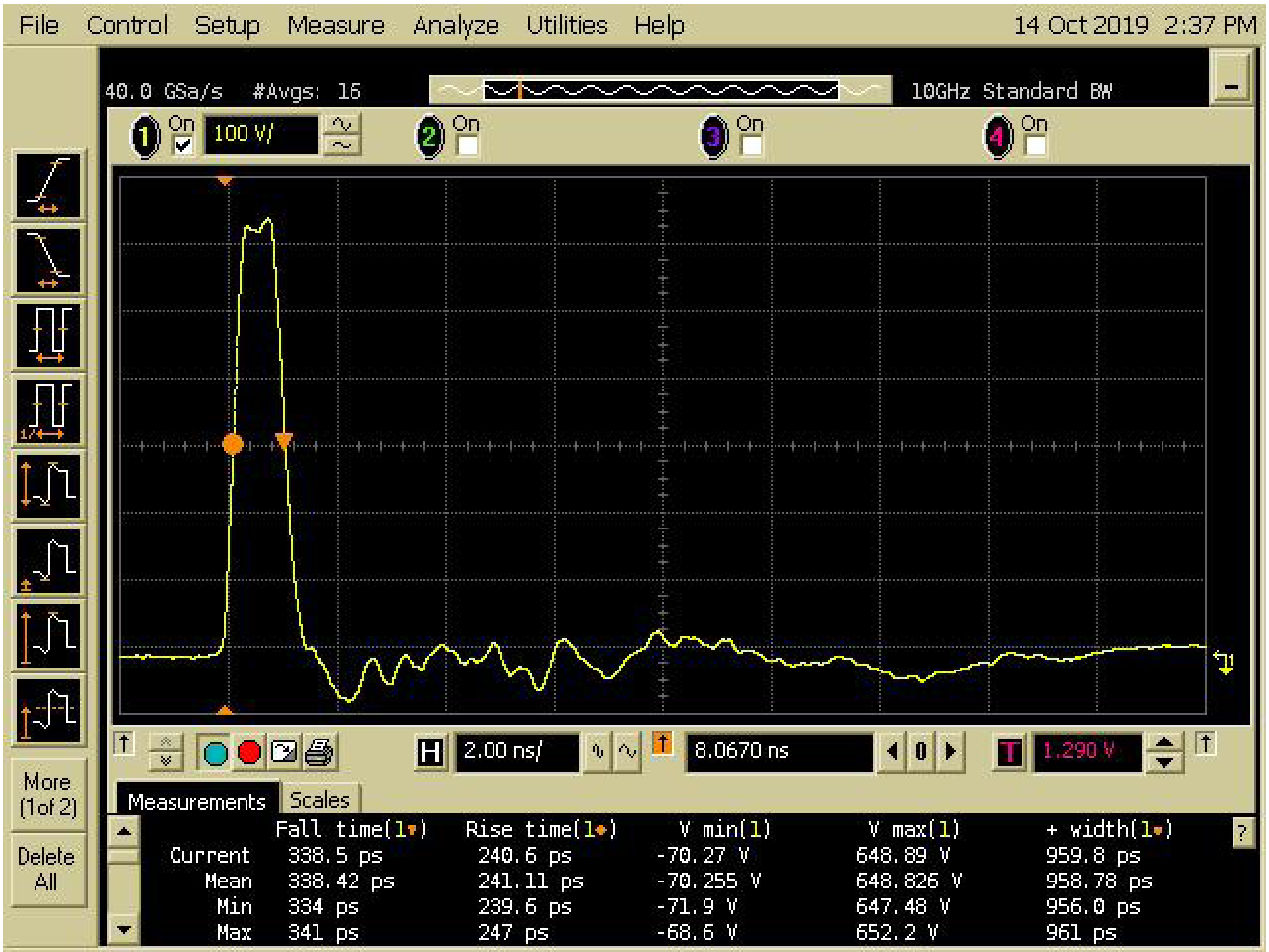

Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	339.1 ps	241.5 ps	-70.00 V	649.08 V	958.9 ps
Mean	338.43 ps	241.12 ps	-70.254 V	648.827 V	958.78 ps
Min	334 ps	239.6 ps	-71.9 V	647.48 V	956.0 ps
Max	341 ps	247 ps	-68.6 V	652.2 V	961 ps
Range	7 ps	6.9 ps	3.3 V	4.74 V	4.8 ps
Std Dev	900 fs	660 fs	514 mV	585 mV	760 fs
# of Meas	345	345	345	345	345
Edge Dir	Falling	Rising			

Channel 10

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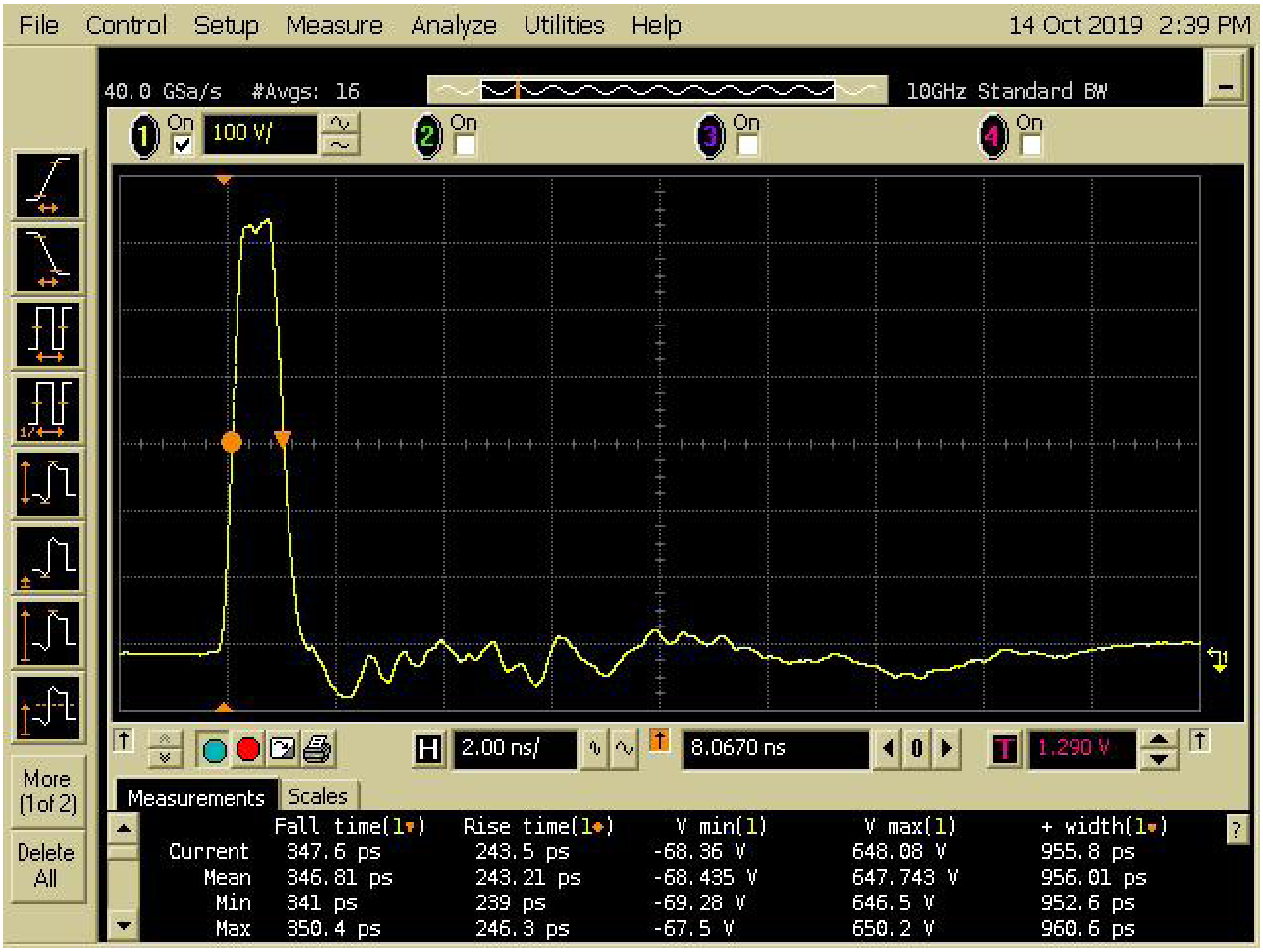


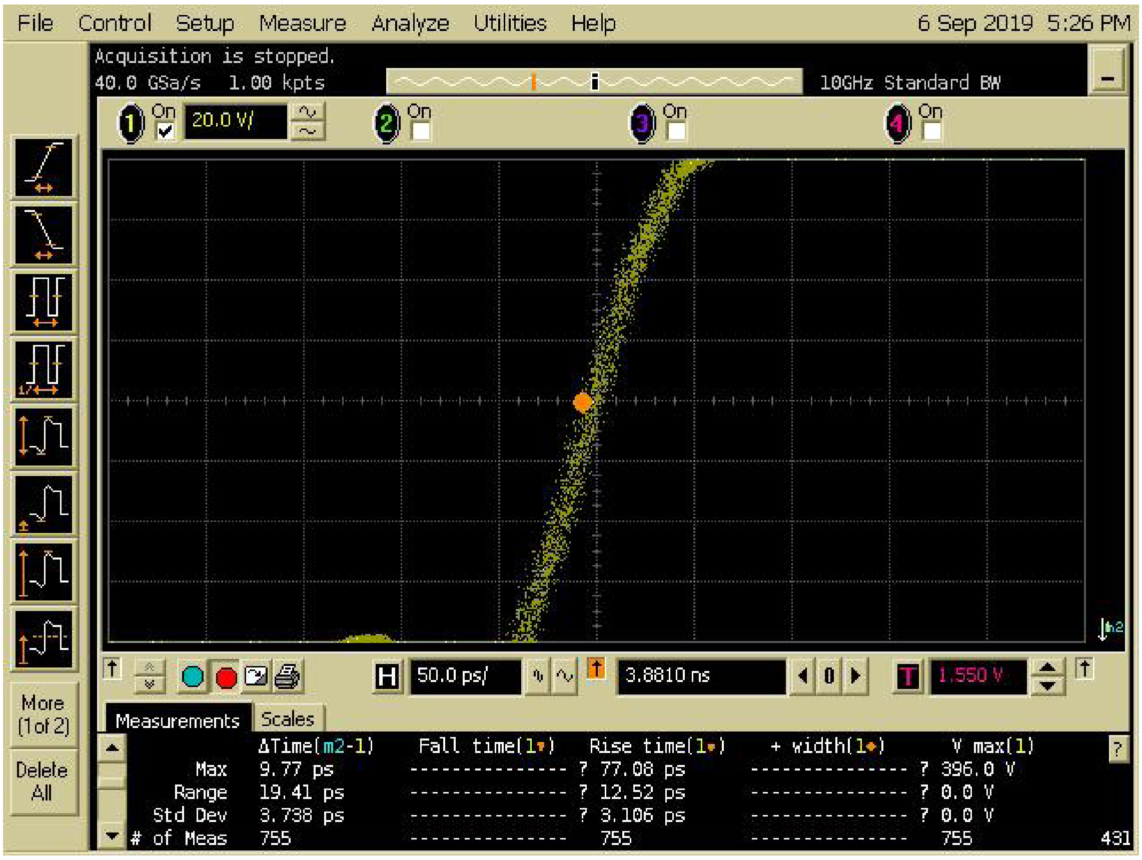
Acquisition	Sampling mode real time Hi resolution Memory depth automatic 1000 pts Sampling rate automatic Sampling rate 40.0 GSa/s Averaging on # of averages 16 Interpolation on
Channel 1	Scale 100 V/ Offset 312.0 V Coupling DC Impedance 50 Ohms
Channel 4	Scale 50 mV/ Offset 1.272 V Coupling DC Impedance 50 Ohms
Time base	Scale 2.00 ns/ Position 8.0670 ns Reference center
Trigger	Mode edge Sweep triggered Sensitivity high Holdoff time 100 ns Source channel 4 Trigger level 1.290 V Slope rising

Measure

	Fall time(1▾)	Rise time(1▴)	V min(1)	V max(1)	+ width(1▴)
Current	347.6 ps	243.5 ps	-68.36 V	648.08 V	955.8 ps
Mean	346.81 ps	243.21 ps	-68.435 V	647.743 V	956.01 ps
Min	341 ps	239 ps	-69.28 V	646.5 V	952.6 ps
Max	350.4 ps	246.3 ps	-67.5 V	650.2 V	960.6 ps
Range	9.6 ps	7.3 ps	1.77 V	3.6 V	8.0 ps
Std Dev	870 fs	680 fs	332 mV	447 mV	740 fs
# of Meas	329	329	329	329	329
Edge Dir	Falling	Rising			

14 JITTER

Standard deviation on trigger timing (jitter) = 3.738ps over 755 shots.



Acquisition — Sampling mode real time Normal
Memory depth automatic 1000 pts
Sampling rate automatic Sampling rate 40.0 GSa/s
Averaging off Interpolation off

Channel 1 — Scale 20.0 V/ Offset 316.0 V Coupling DC Impedance 50 Ohms

Channel 4 — Scale 20 mV/ Offset 1.500 V Coupling DC Impedance 50 Ohms

Time base — Scale 50.0 ps/ Position 3.8810 ns Reference center

Trigger — Mode edge Sweep auto
Sensitivity low Holdoff time 100 ns
Source channel 4 Trigger level 1.550 V Slope rising

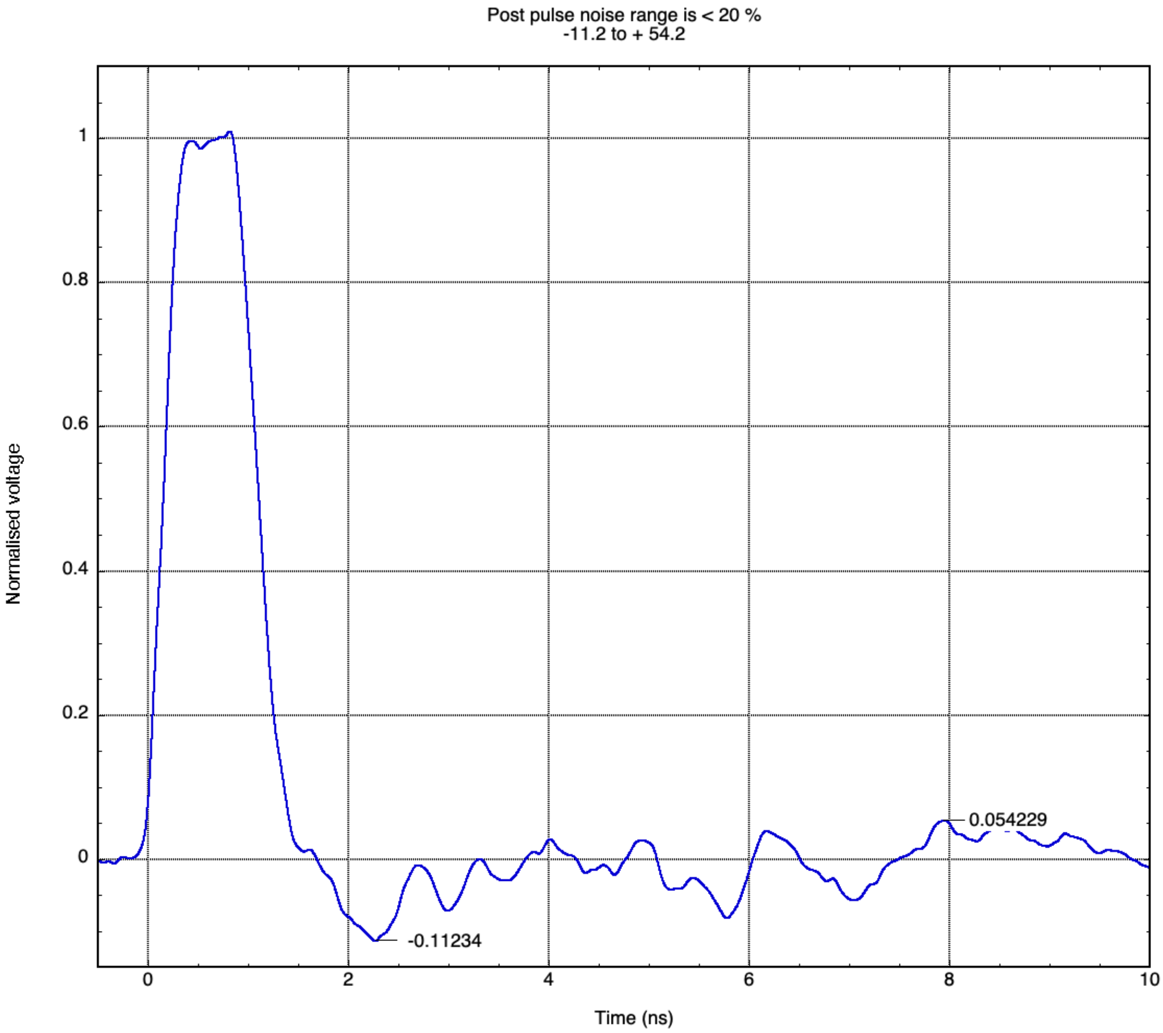
Memory 2 — Vertical scale 20.0 V/ Offset 316.000 V
Horizontal scale 50.0 ps/ Position 3.8810000000000 ns

Measure

	ΔTime(m2-1)	Fall time(1▾)	Rise time(1▴)	+ width(1▴)	V max(1)
Current	-4.93 ps	Edge?	≤ 68.99 ps	Edge?	≥ 396.0 V
Mean	660 fs	---------------	? 70.536 ps	---------------	? 396.00 V
Min	-9.64 ps	---------------	? 64.55 ps	---------------	? 396.0 V
Max	9.77 ps	---------------	? 77.08 ps	---------------	? 396.0 V
Range	19.41 ps	---------------	? 12.52 ps	---------------	? 0.0 V
Std Dev	3.738 ps	---------------	? 3.106 ps	---------------	? 0.0 V
# of Meas	755	---------------	755	---------------	755
Edge Dir		---------------	Rising		
From Num	1				
From Dir	Rising				
From Lvl	Middle				
To Num	1				
To Dir	Rising				
To Lvl	Middle				

15 POST PULSE SIGNAL

The post pulse signal is approximately ±10% of peak. Total range is ~16%.



16 TRIGGER DELAY

The trigger delay is about 26ns. The actual value will depend upon the trigger signal. An example is shown below.