AMERICAN MICROWAVE CORPORATION

TEST DATA

ON

2.0 GHz TO 18.0 GHz

LOW LOSS

LOW VIDEO TRANSIENTS (L/C)

BALANCED ON/OFF

5nS-ULTRA HIGH SPEED

ECL LOGIC

REFLECTIVE, SPST PIN DIODE SWITCH

AMC MODEL No:
SWN-AGRA-1DR-ECL-GAK0-LVT
(Serial Number: 1MS508261)

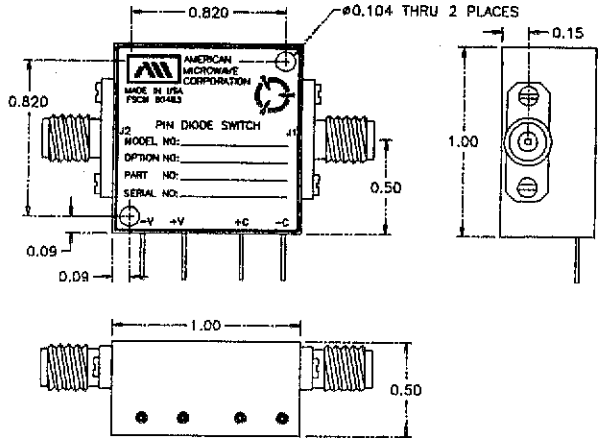
BY
ASH GORWARA
AMERICAN MICROWAVE CORPORATION
AND
PETER BORBAT
CORNELL UNIVERSITY

NOVEMBER 22, 1995

7311 G GROVE ROAD, FREDERICK, MARYLAND 21701 • Tel. (301) 662-4700 • Fax (301) 662-4938

AMERICAN MICROWAVE CORPORATION

LOW VIDEO TRANSIENT ULTRA HIGH SPEED, ECL LOGIC REFLECTIVE, SPST SWITCH



- **LOW VIDEO TRANSIENTS**
- **ULTRA HIGH SPEED**
- **HIGH ISOLATION**
- **ECL LOGIC**

AMC MODEL No: SWN-AGRA-1DR-ECL-GAK0-LVT

SPECIFICATIONS:

• FREQUENCY RANGE	: 2.0 GHz to 18.0 GHz
• INSERTION LOSS	: 2.0 dB MAX.
	: 0.56 dB TYP. @ 2.0 GHz
	: 0.56 dB TYP. @ 8.0 GHz
	: 1.26 dB TYP. @ 18.0 GHz
• ISOLATION	: ≥ 70 dB MIN.
	: ≥ 88 dB TYP. @ 2.0 GHz
	: ≥ 92 dB TYP. @ 8.0 GHz
	: ≥ 80 dB TYP. @ 18.0 GHz
• VSWR	: 2.0:1
• SWITCHING SPEED	: RISE : 2nS MAX., 1nS TYP.
	: FALL : 2nS MAX., 1nS TYP.
	: ON : 8nS MAX., 5nS TYP.
	: OFF : 8nS MAX., 5nS TYP.
• CONTROL	: ECL Compatible
• VIDEO TRANSIENTS	: ≤350 mV Peak to Peak, 300 MHz Bandwidth
	: ≤ 15 mV Peak to Peak, 20 MHz Bandwidth
• RF INPUT POWER	: + 20 dBm Operating, 1 Watt Survival
• DC POWER SUPPLY	: ± 5 vdc @ ±80mA MAX.
• SIZE	: 1.0" X 1.0" X 0.5"
• WEIGHT	: ≤2.0 oz.

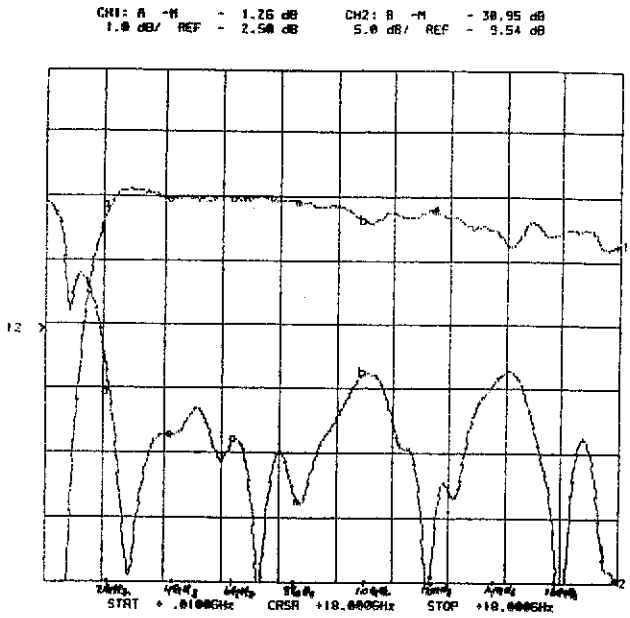
MULTI-THROW VERSIONS AVAILABLE

7311G GROVE ROAD, FREDERICK, MARYLAND 21701 • Tel. (301) 662-4700 • Fax (301) 662-4938

SUMMARY TEST DATA
SWN-AGRA-1DR-ECL-GAK0-LVT
PAGE 3

SERIAL NUMBER : 1MS508261
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : ±5 vdc On : +11mA, -65mA
: Off : +43mA, -60mA

INSERTION LOSS & RETURN LOSS



FREQUENCY	INSERTION LOSS	RETURN LOSS
2.0 GHz	0.56 dB	15.71 dB
4.0 GHz	0.51 dB	18.05 dB
6.0 GHz	0.53 dB	18.50 dB
8.0 GHz	0.56 dB	23.18 dB
10.0 GHz	0.88 dB	13.21 dB
12.0 GHz	0.69 dB	29.76 dB
14.0 GHz	0.99 dB	13.97 dB
16.0 GHz	1.03 dB	31.29 dB
18.0 GHz	1.26 dB	30.95 dB

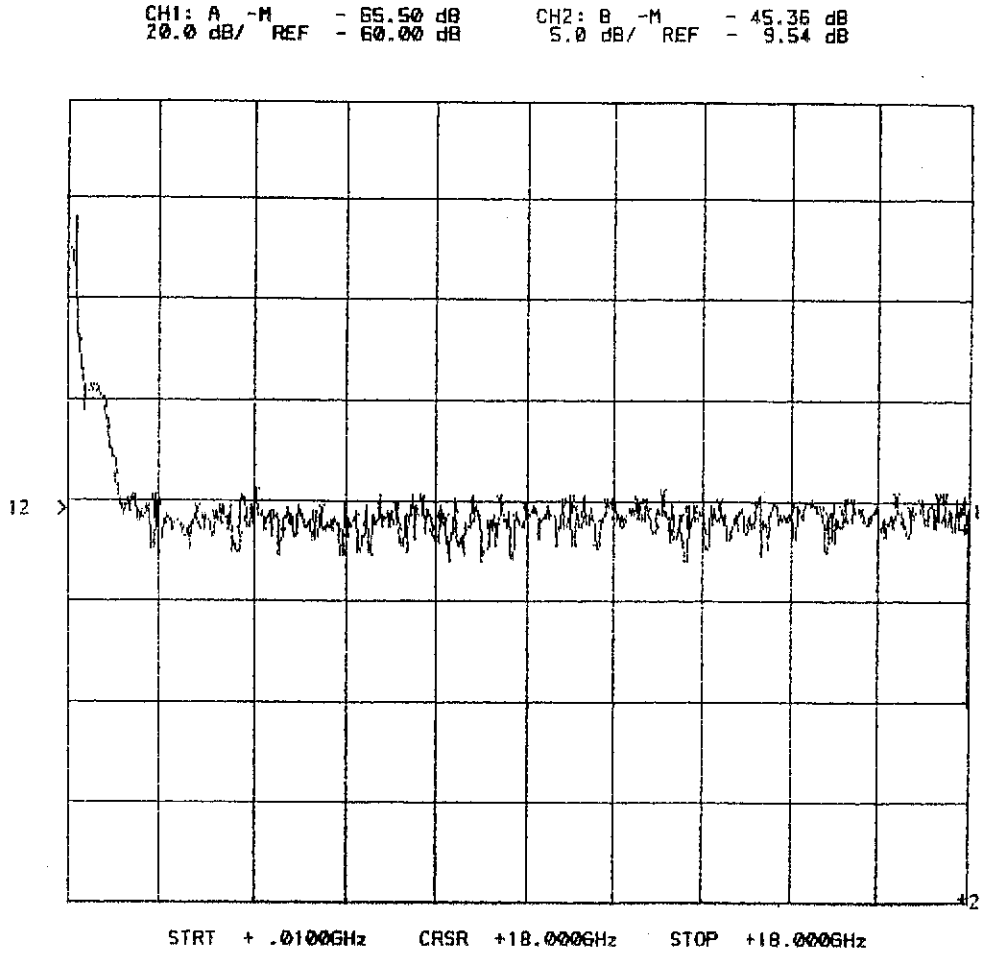
AUGUST 10, 1995

SUMMARY TEST DATA
SWN-AGRA-1DR-ECL-GAK0-LVT
PAGE 4

SERIAL NUMBER	: 1MS508261
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: ±5 vdc On : +11mA, -65mA
	: Off : +43mA, -60mA

ISOLATION

(AS MEASURED ON A NETWORK ANALYZER)



AUGUST 10, 1995

SUMMARY TEST DATA
SWN-AGRA-1DR-ECL-GAK0-LVT
PAGE 5

SERIAL NUMBER : 1MS508261
TECHNICIAN : RENE AFABLE
VOLTAGE & CURRENT DRAW : ±5 vdc On : +11mA, -65mA
: Off : +43mA, -60mA

ISOLATION

(AS MEASURED ON A SPECTRUM ANALYZER)

FREQUENCY	ISOLATION
500 MHz	50 dB
800 MHz	54 dB
1 GHz	63 dB
2 GHz	88 dB
4 GHz	95 dB
6 GHz	94 dB
8 GHz	92 dB
10 GHz	92 dB
12 GHz	90 dB
14 GHz	86 dB
16 GHz	84 dB
18 GHz	80 dB

AUGUST 10, 1995

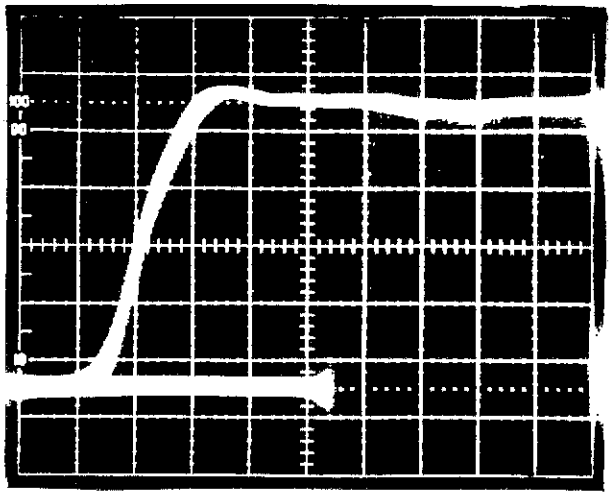
SUMMARY TEST DATA
SWN-AGRA-1DR-ECL-GAK0-LVT
PAGE 6

SERIAL NUMBER	: 1MS508261
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: ±5 vdc On : +11mA, -65mA
	: Off : +43mA, -60mA

SWITCHING SPEED

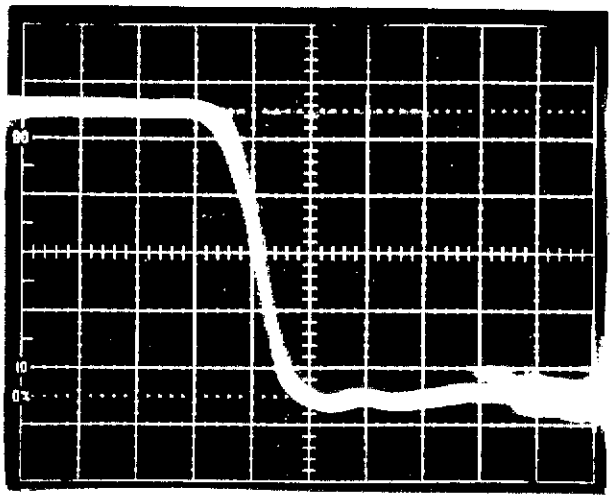
"Rise/Fall" Time: 10% RF to 90% RF & 90% RF to 10% RF
"On/Off" Time: 50% TTL to 90% RF or 10% RF
SUBTRACT THREE (3)nS FROM ALL SWITCHING SPEED PHOTOS FOR TTL to ECL CONVERTER DELAY.

VERTICAL SCALE:
10mV/DIVISION



RISE TIME: 1nS
ON TIME: ≤5nS

HORIZONTAL SCALE:
2nS/DIVISION



FALL TIME: 1nS
OFF TIME: ≤5nS

AUGUST 10, 1995

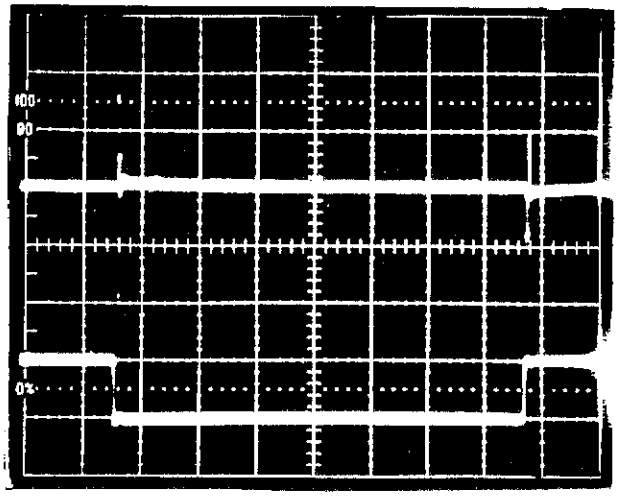
SUMMARY TEST DATA
SWN-AGRA-1DR-ECL-GAK0-LVT
PAGE 7

SERIAL NUMBER	: 1MS508261
TECHNICIAN	: RENE AFABLE
VOLTAGE & CURRENT DRAW	: ±5 vdc On : +11mA, -65mA
	: Off : +43mA, -60mA

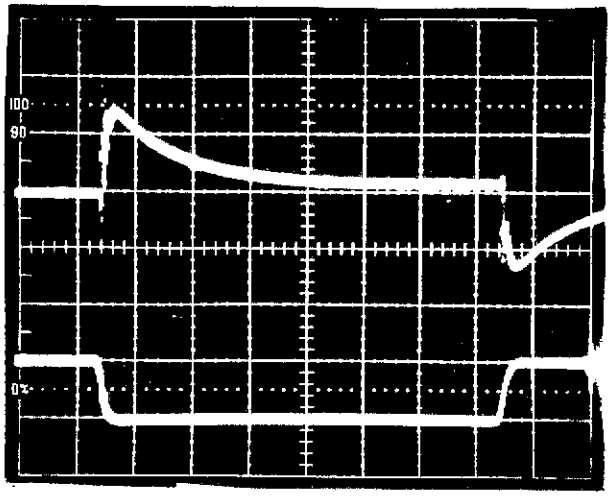
VIDEO TRANSIENTS

HORIZONTAL SCALE:
0.1μS/DIVISION

≤350 mV P-P
MEASURED IN A
300 MHz BANDWIDTH
VERTICAL SCALE:
100mV/DIVISION



≤15 mV P-P
MEASURED IN A
20 MHz BANDWIDTH
VERTICAL SCALE:
5mV/DIVISION



AUGUST 10, 1995

AMERICAN MICROWAVE CORPORATION

AMC

MODEL NO: SWN-AGRA-1DR-ECL-GAK0-LVT

TESTED

BY

MR. PETER BORBAT

AT

CORNELL UNIVERSITY

7311 G GROVE ROAD • FREDERICK, MARYLAND 21701 • Tel: (301) 662-4700 • Fax (301) 662-4938

November 1,1995

TO: Mr. Ash Gorwara
American Microwave Corp.
Ph# (301)662-4700, FAX# (301)662-4938

SUBJ: SWN-AGRA-1DR-ECL-GAK0-LVT

FROM: Peter Borbat
Cornell University, Baker Laboratory of Chemistry.
Ithaca, NY 14853
Ph# (607)255-6132, FAX# (607)255-4137

Dear Mr. Gorwara:

I tested the switch and sent it back today by UPS blue. Now I send test data on SWN-AGRA-1DR-ECL-GAK0-LVT for your review. I am satisfied by the test results. The data that I send to you clearly indicate stable switching with short rise and fall times.

The main conclusion is that tested switch could be successfully used in construction of Electron Spin Echo spectrometers. ***Therefore I would like to get price and delivery information for 4 each SWN-AGRA-1DR-ECL-GAK0-LVT.***

Fast SPST switches are not the only microwave components that we are interested in. Designing now the state-of-the-art research spectrometer we are looking for components with exceptional parameters. If some of the devices that conform with ones listed in ADDENDUM are manufactured by your company or if they were ever designed and could be reproduced ar your site we are interested in.

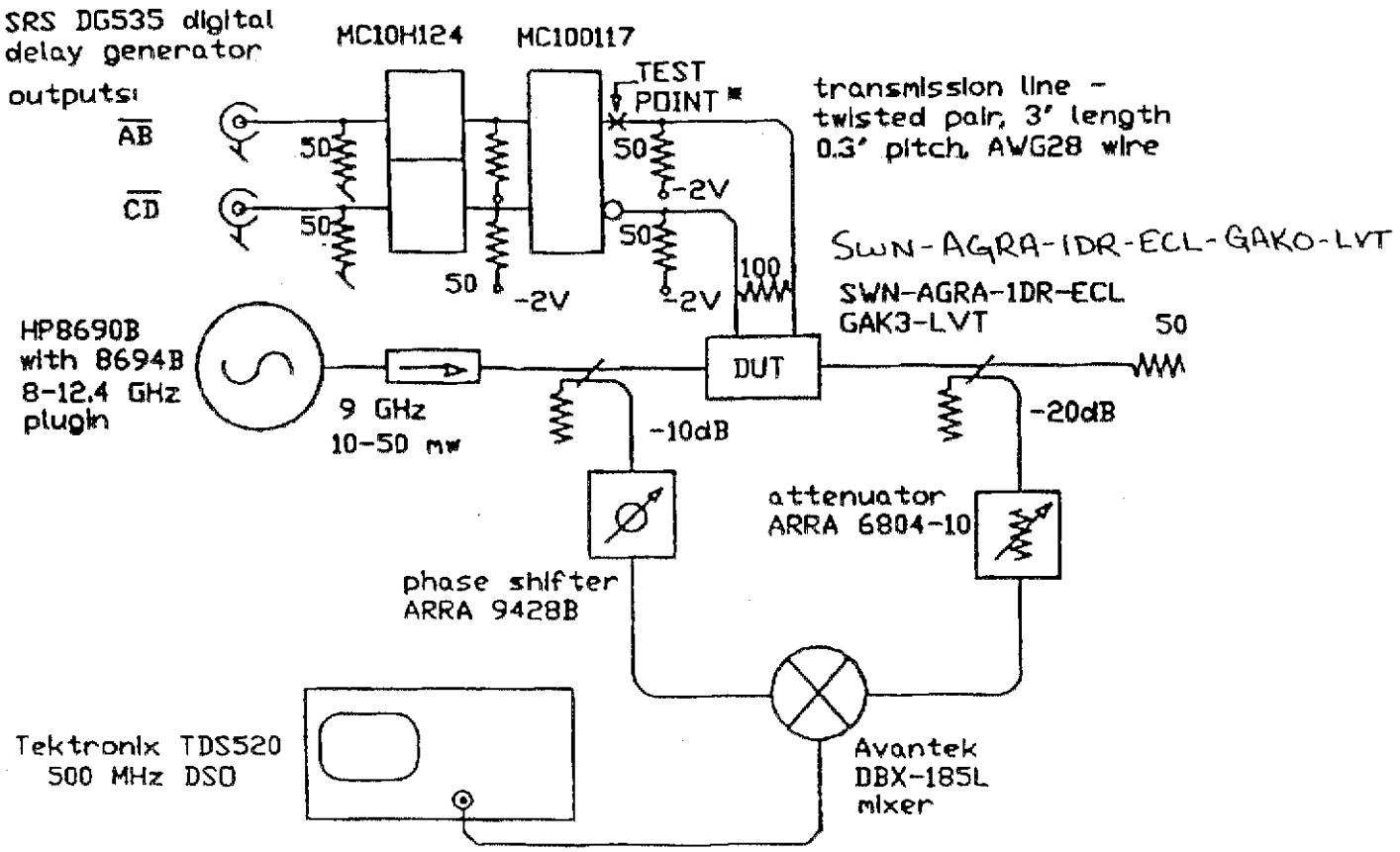
Best Regards,

Peter Borbat

Peter Borbat

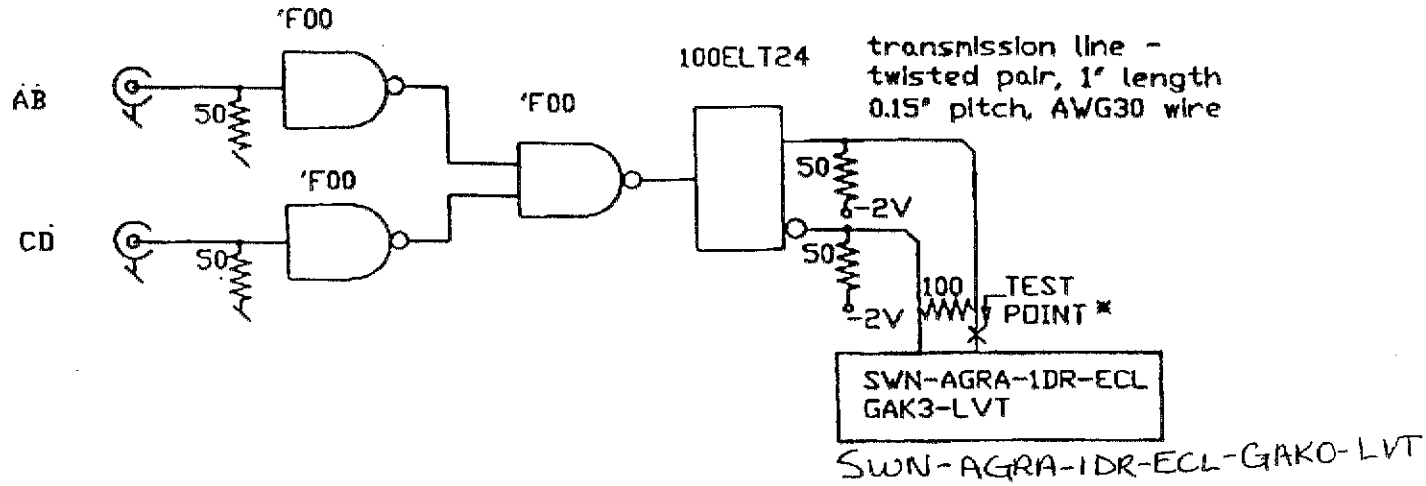
Enclosed:
Test Data on SWN-AGRA-1DR-ECL-GAK0-LVT

TEST CIRQUIT

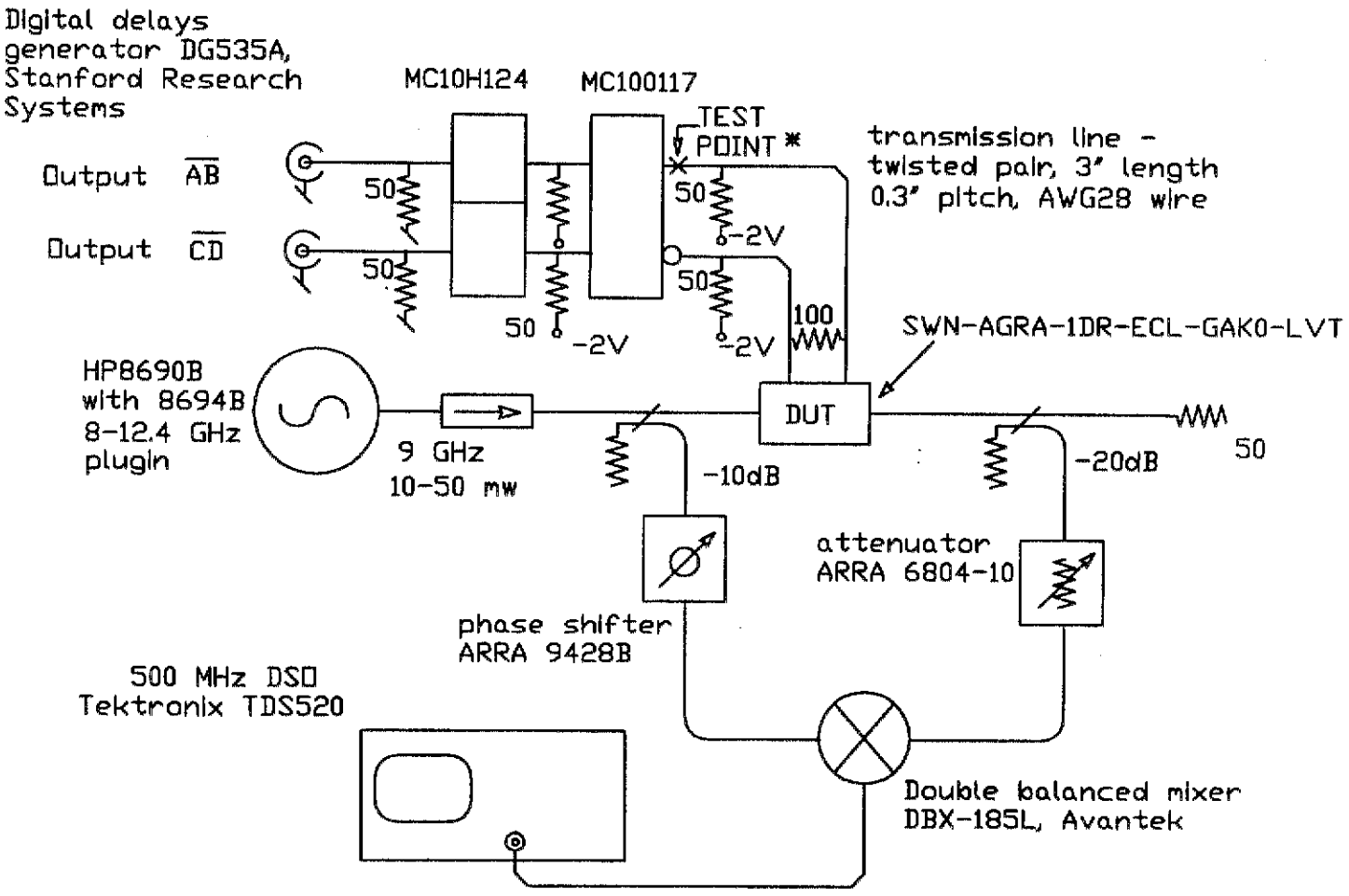


* I used standard Tektronix P6136 350MHz probe, inductunce of ground loop was minimized

I also used the following cirquit in accordance with suggestiones of Mr. Ash Gorwara, that cirquit modifies upper part of the above diagramm



CIRQUIT DIAGRAM OF THE SETUP
for tests of
2.0 GHz – 18.0 GHz PIN-diode switch, American Microwave Corp. model No.
SWN-AGRA-1DR-ECL-GAK0-LVT
SWN-AGRA-1DR-ECL-GAK3-LVT



* I used standard Tektronix P6136 350MHz probe, inductunce of ground loop was minimized to few nanogenry.

TEST DATA ON 2GHz TO 18 GHZ REFLECTIVE, SPST SWITCH AMC MODEL No: SWN-AGRA-1DR-ECL-GAK0-LVT (Serial Number: 1MS508261)

Parameters	Specified by AMC	Measured at CU	Comments
Delay on	8 nS MAX.	5.5nS	
Delay off	8 nS MAX.	7nS	
Rise time	<2nS MAX.	<1nS (0.9nS TYP.)	
Fall time	<2nS MAX.	<1nS (0.9 nS TYP)	

The following parameters were not tested because we are quite satisfied by the AMC specs that meet our requirements.

isolation	80 db MIN.
insertion loss	1.26 MAX.
frequency range	2-18GHz
VSWR	2:1
video transients	<350mV Peak to Peak (300 MHz BW)

Following application specific data were obtain at the Cornell University, Baker laboratory of chemistry.

RF pulse edges jitters	<50pS
Data Rate	100 MHz (MIN), 200 MHz (MAX).
Minimum RF Pulse duration	2.5-3 nS
Minimum RF pulse separation, criteria-no visible distortions of the second pulse occur	4nS
RF pulse width variation	-0.9nS (3-5nS interpulse separation) ±0.2nS MAX., ±0.1nS TYP (5-43nS interpulse separation)

Rise/fall times and Application specific data could be slightly improved after improving incident ECL waveform. Small jitters that is observed on RF pulses originates from Stanford Research Systems DG535A delay generator.

FIGURE CAPTIONS

FIG. 1

Upper trace: ECL waveform at '117 output recorded at the test point
Lower trace: RF pulses at 9 Ghz, detected by double-balanced mixer
Scope bandwidth here and below - 500 MHz
note: ECL pulses have additional delay approximately 2 nS due to difference in the cable lengths

FIG. 2

RF pulses at 9 Ghz, detected by double-balanced mixer, 25 averages.

FIG. 3

Averaged output of detected RF at mixer output. Mixer is well below saturation.

FIG. 4

Quality of the stand alone pulse. Pulse width is 3.28 nS, rising and trailing edges are shorter than 900 pS. Jitter does not exceed jitter of the control pulse derived from digital delay generator. Rising edge is stable and jitter is less then 50pS.

FIG. 5

This figure of detected RF (averaged) demonstrates that data rate is well in excess of 100 MHz.

FIG. 6-12

This sequence of figures shows recovery of the switch. Separations between the first and the second pulses decrease from FIG.6 to FIG.12. It is clearly seen that for interpulse separations less than 2 nS for the given switch ***in the current test setup*** it is observed droop of the second pulse amplitude and increased jitter. If one accepts that distance between the falling edges of pulses shown in FIG.7 - FIG.8 corresponds to the maximum possible data rate, then it is possible to establish an upper limit for data rate as high as 200-250 MHz, that exceeds my previous estimate.

When pulses composing incident ECL waveform have separation less than 4nS the second pulse is affected by the first pulse. To some extent it is due to quality of waveform at the input but mainly it is determined by internal driver recovery time, that seems to be of the order of 3nS. Therefore in my application (Electron Spin Echo Spectroscopy) minimum interpulse separation is 4 nS. For data communication it could be as low as 2.5 nS.

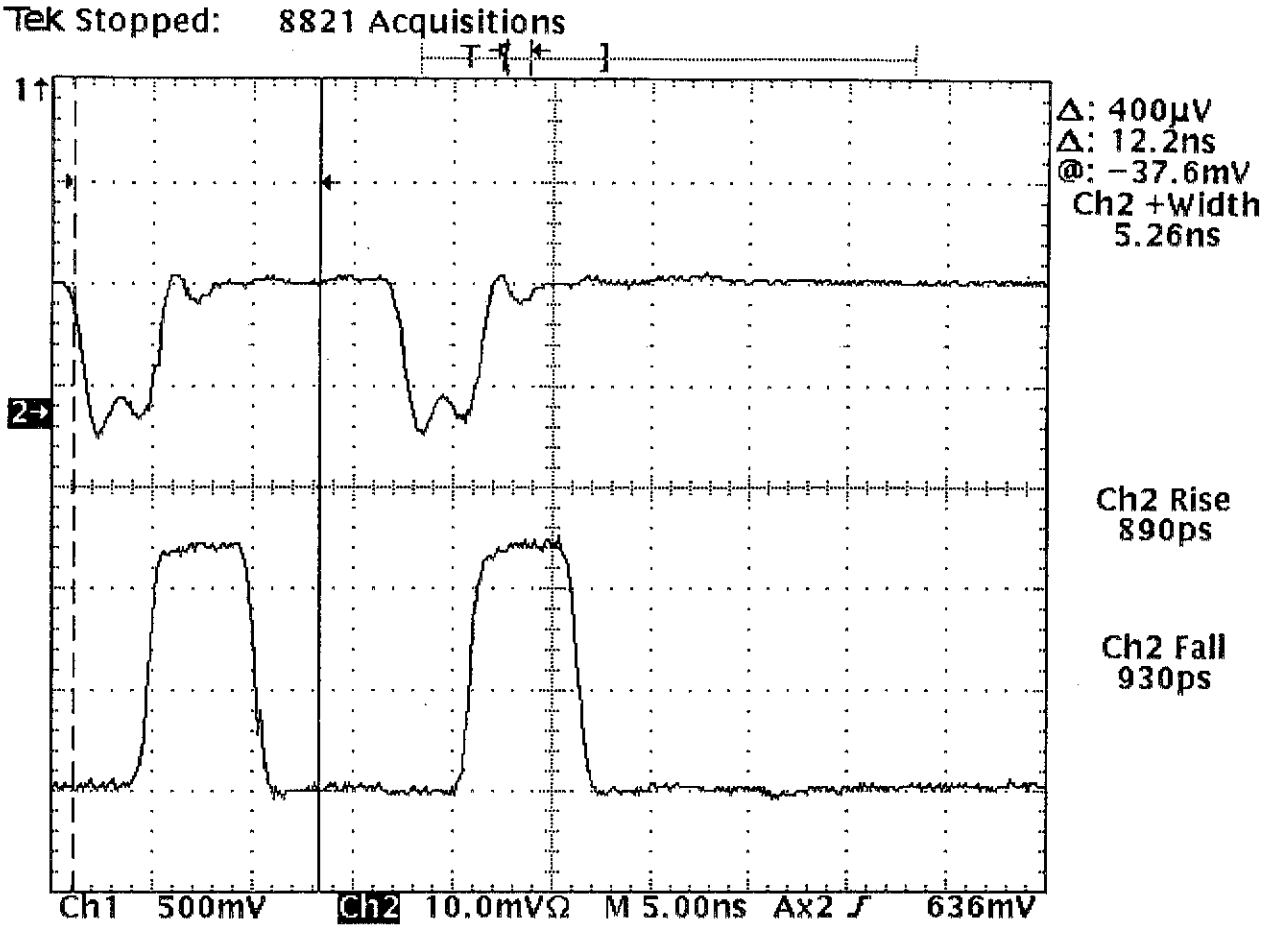

Tek Stopped: 8821 Acquisitions
Δ: 400µV
Δ: 12.2ns
@: −37.6mV
Ch2 +Width
5.26ns
Ch2 Rise
890ps
Ch2 Fall
930ps
Ch1 500mV
Ch2 10.0mVΩ
M 5.00ns Ax2
636mV

FIG. 1

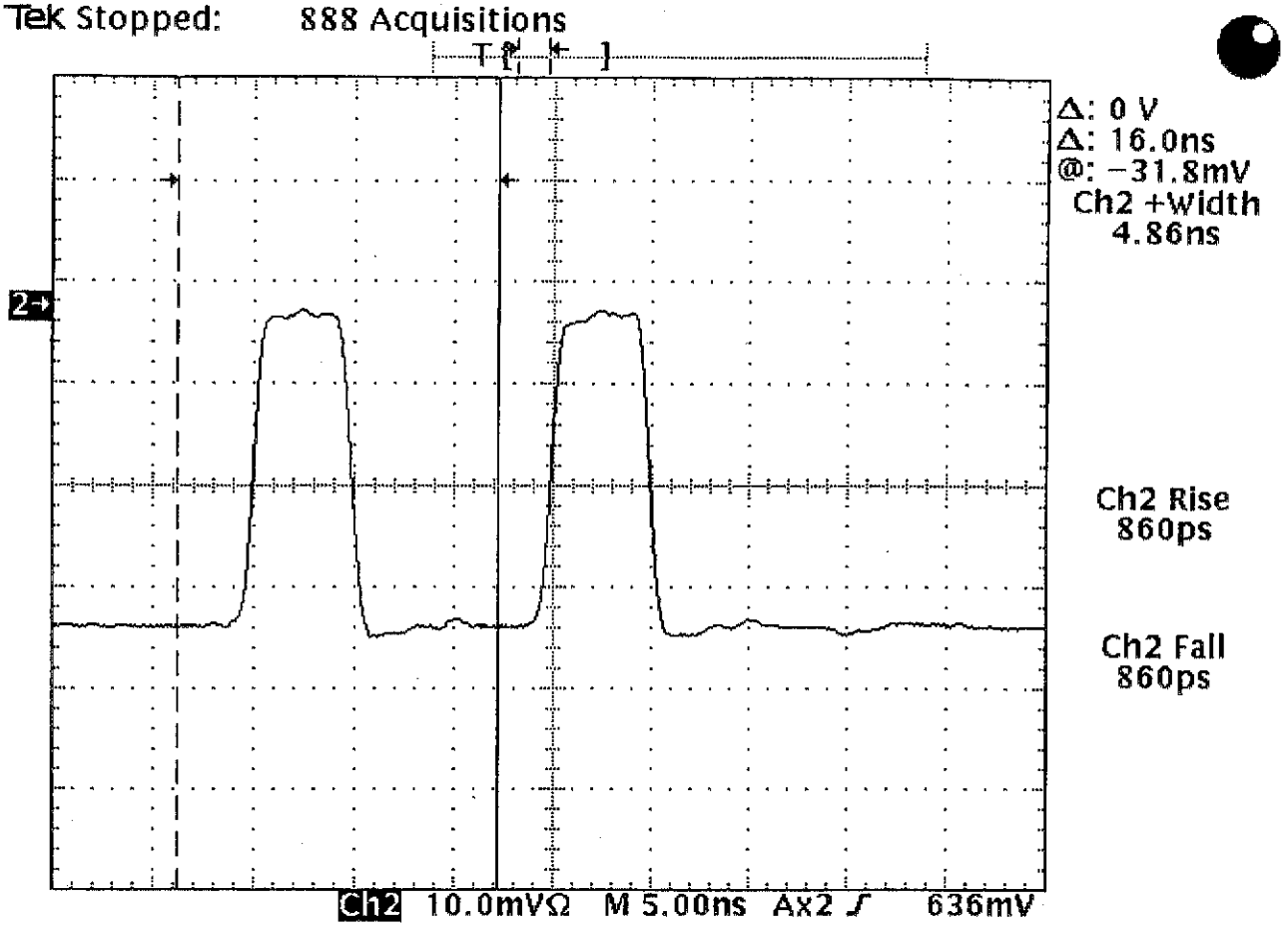

Tek Stopped: 888 Acquisitions
Δ: 0 V
Δ: 16.0ns
@: −31.8mV
Ch2 +Width
4.86ns
Ch2 Rise
860ps
Ch2 Fall
860ps
Ch2 10.0mVΩ M 5.00ns Ax2 ∫ 636mV

FIG. 2

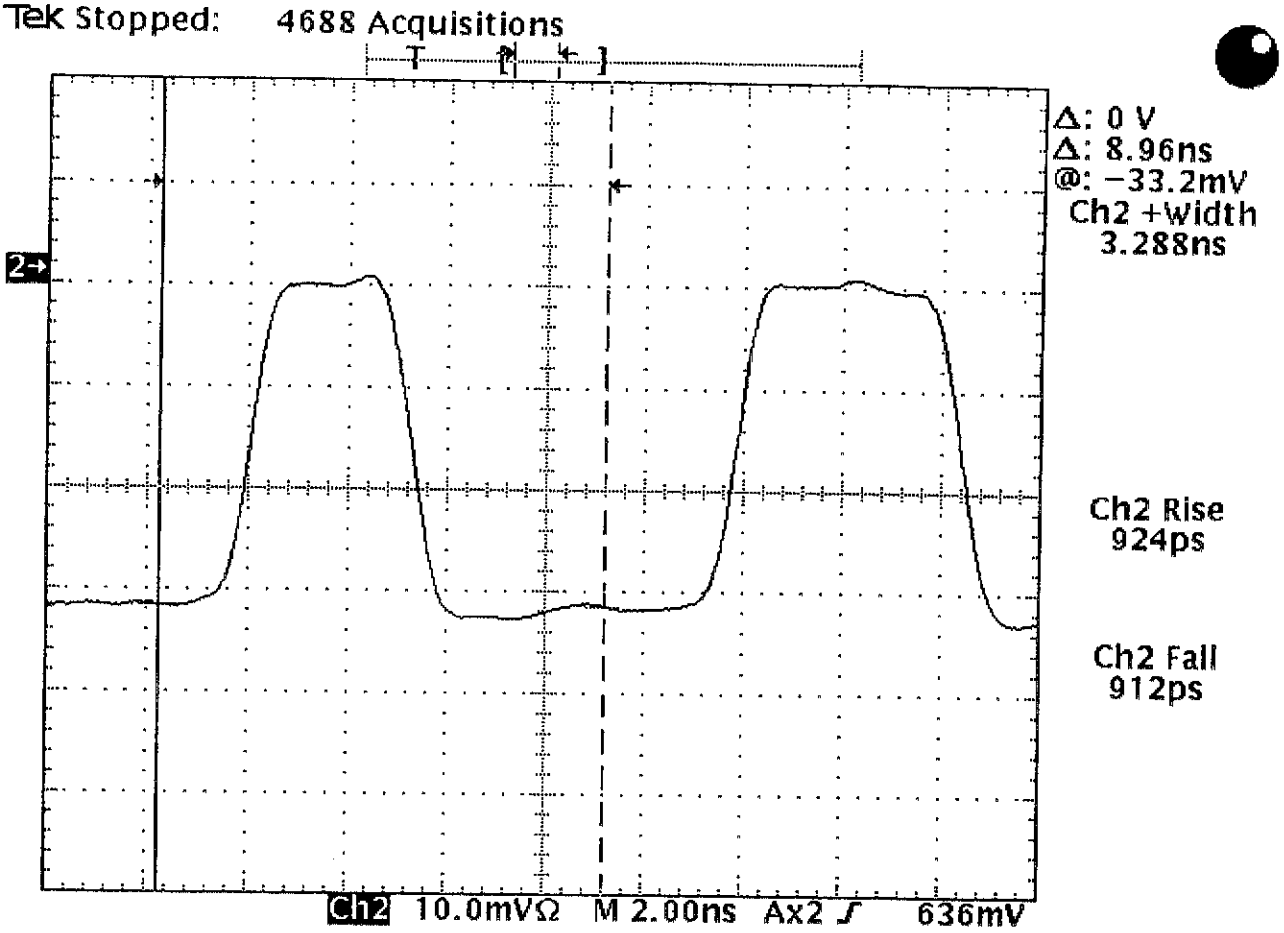

Tek Stopped: 4688 Acquisitions
Δ: 0 V
Δ: 8.96ns
@: −33.2mV
Ch2 +Width
3.288ns
Ch2 Rise
924ps
Ch2 Fall
912ps
Ch2 10.0mVΩ M 2.00ns Ax2 ∫ 636mV

FIG. 3

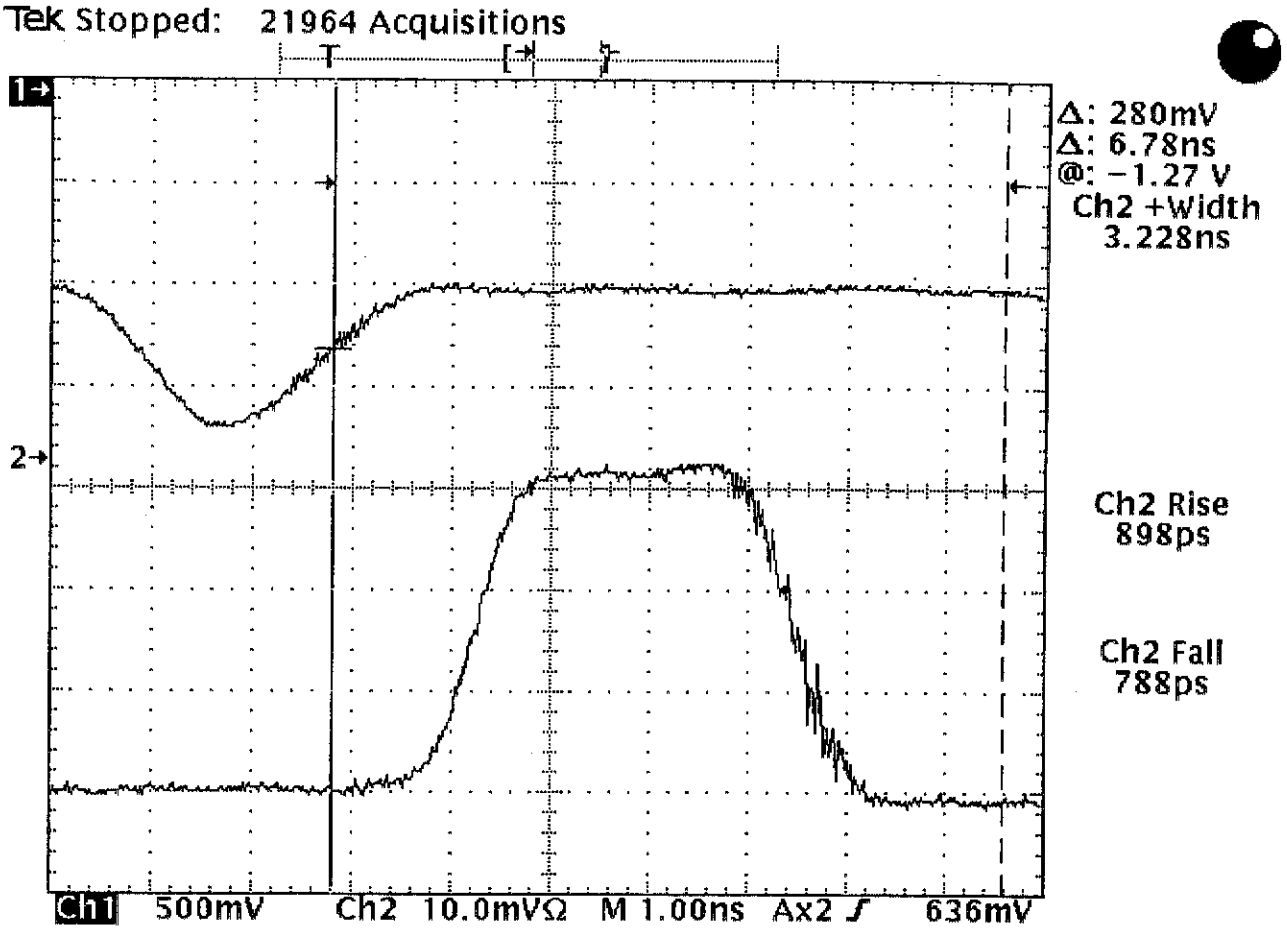

Tek Stopped: 21964 Acquisitions
Δ: 280mV
Δ: 6.78ns
@: −1.27 V
Ch2 +Width
3.228ns
Ch2 Rise
898ps
Ch2 Fall
788ps
Ch1 500mV Ch2 10.0mVΩ M 1.00ns Ax2 ∫ 636mV

FIG. 4

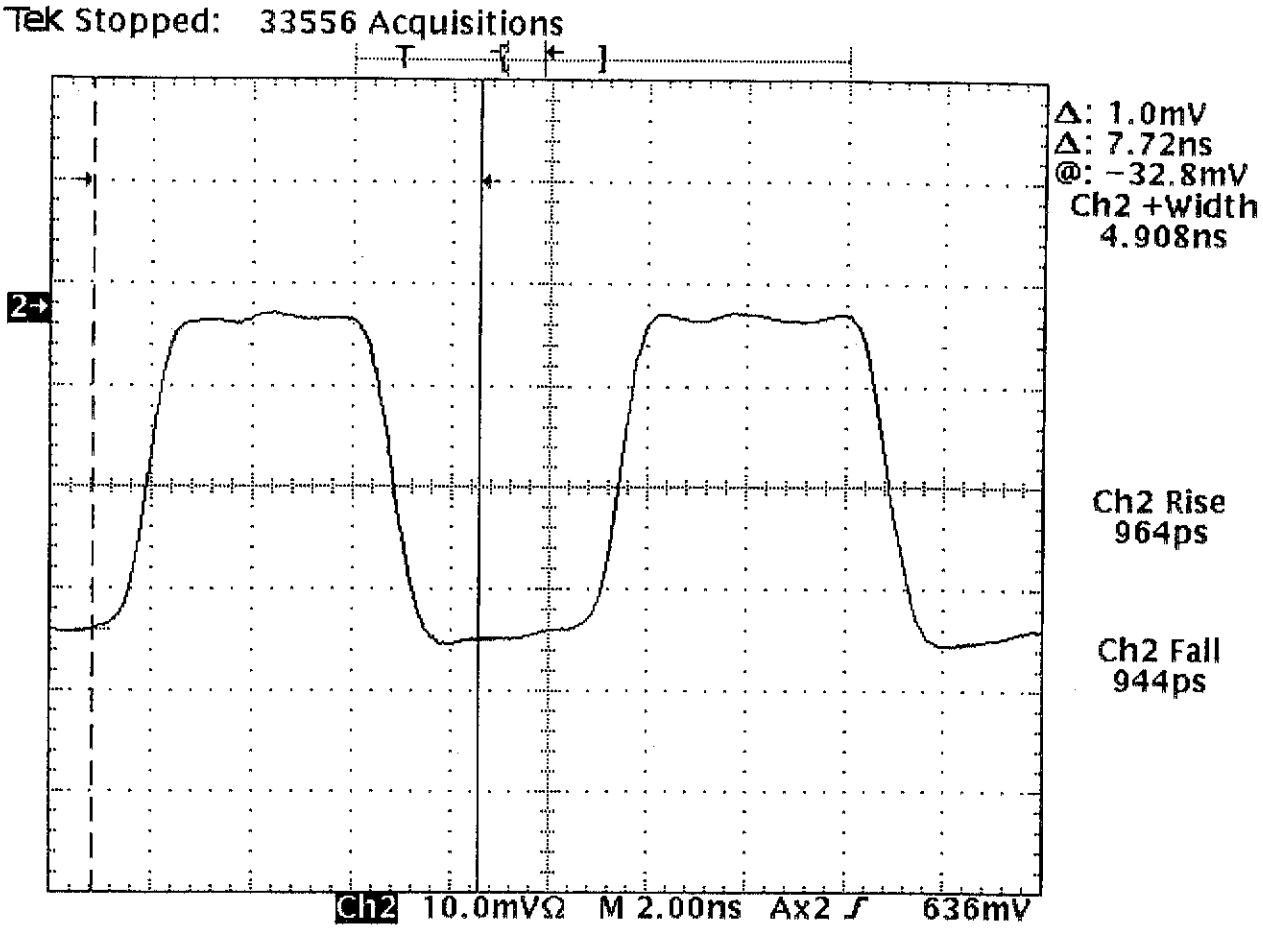

Tek Stopped: 33556 Acquisitions
Δ: 1.0mV
Δ: 7.72ns
@: −32.8mV
Ch2 +Width
4.908ns
2→
Ch2 Rise
964ps
Ch2 Fall
944ps
Ch2 10.0mVΩ M 2.00ns Ax2 ∫ 636mV

FIG. 5

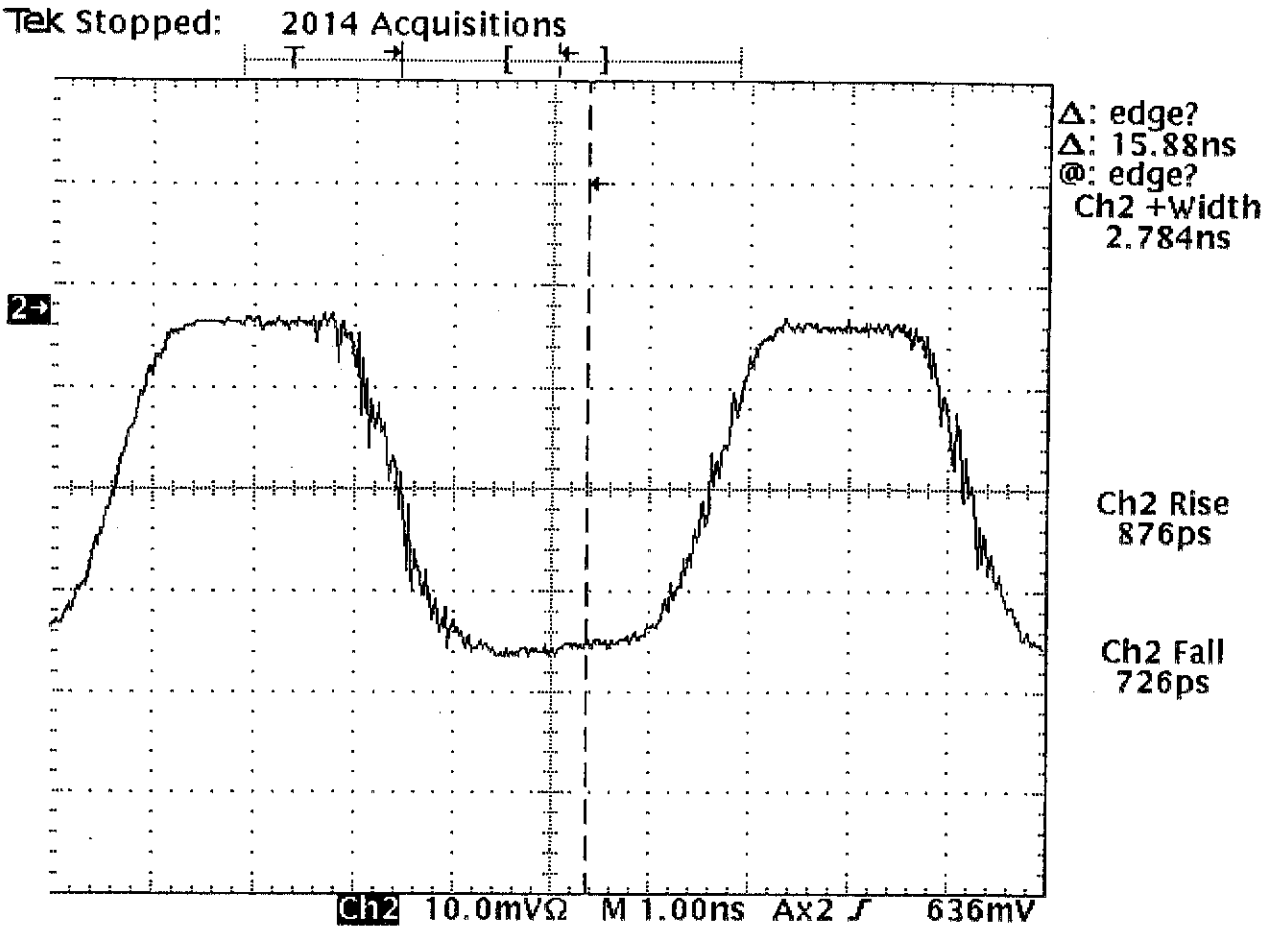

Tek Stopped: 2014 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
2.784ns
Ch2 Rise
876ps
Ch2 Fall
726ps
Ch2 10.0mVΩ M 1.00ns Ax2 ∫ 636mV

FIG. 6

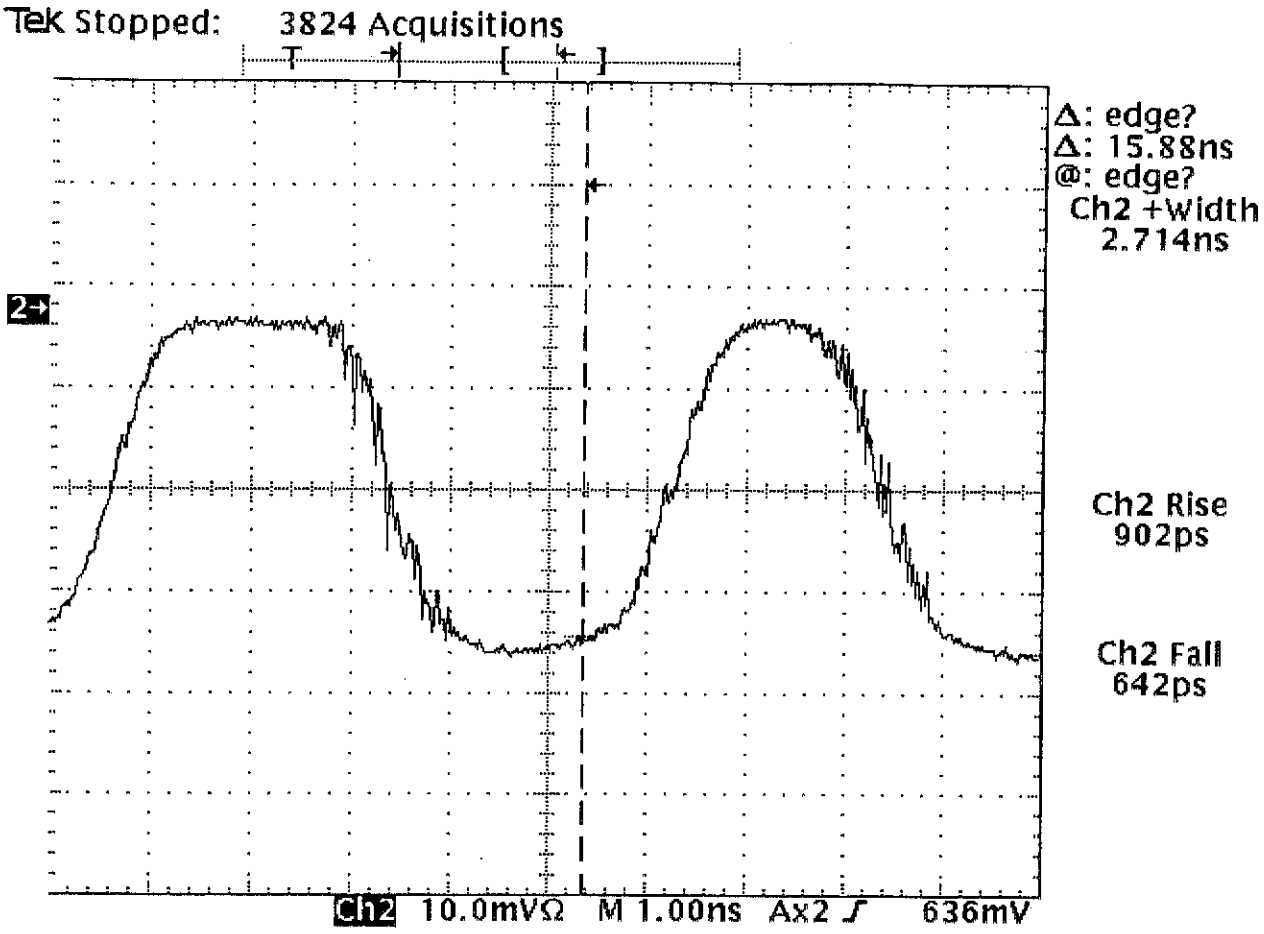

Tek Stopped: 3824 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
2.714ns
2→
Ch2 Rise
902ps
Ch2 Fall
642ps
Ch2 10.0mVΩ M 1.00ns Ax2 ∫ 636mV

FIG. 7

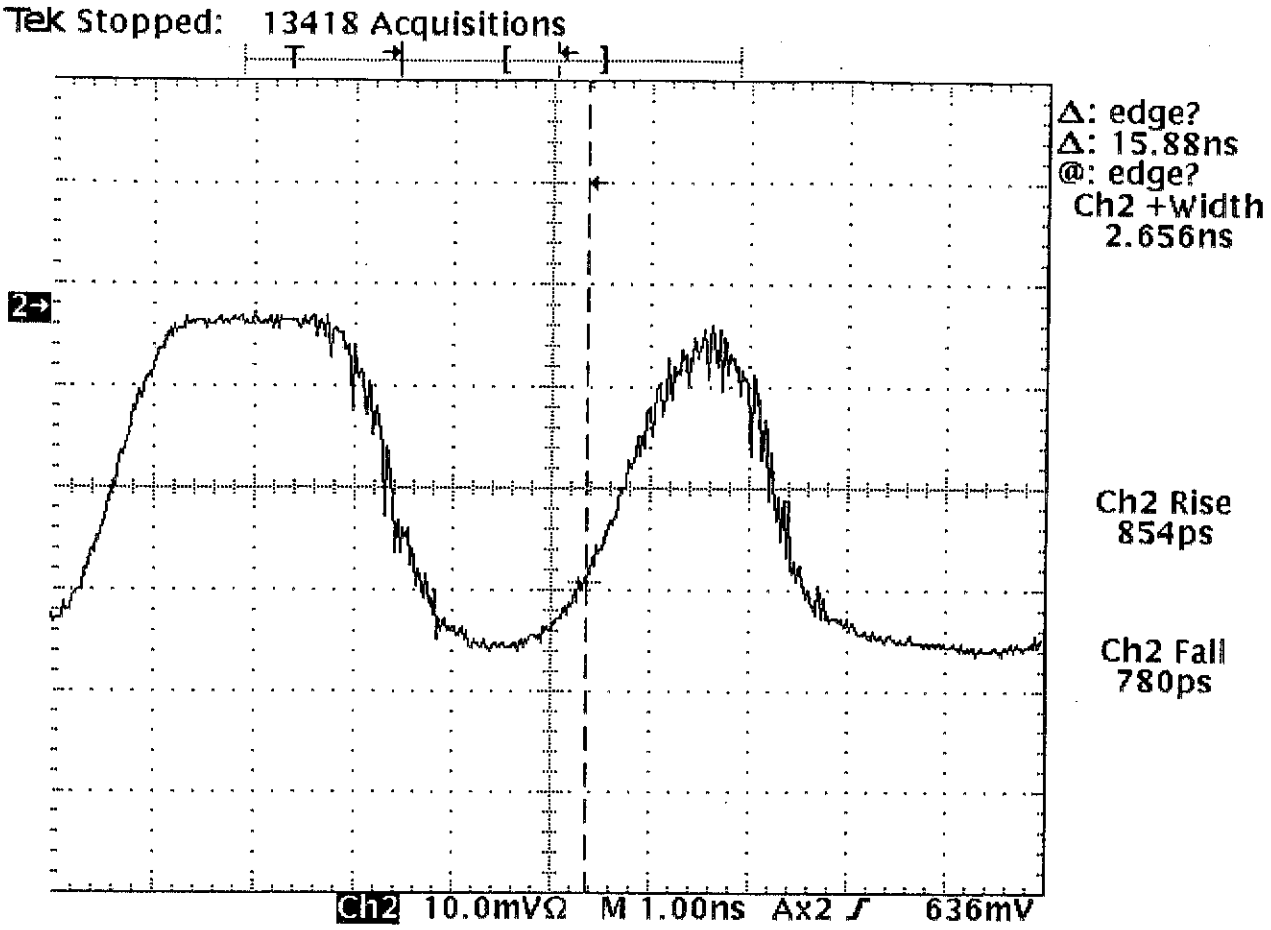

Tek Stopped: 13418 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
2.656ns
2→
Ch2 Rise
854ps
Ch2 Fall
780ps
Ch2 10.0mVΩ M 1.00ns Ax2 ∫ 636mV

FIG. 8

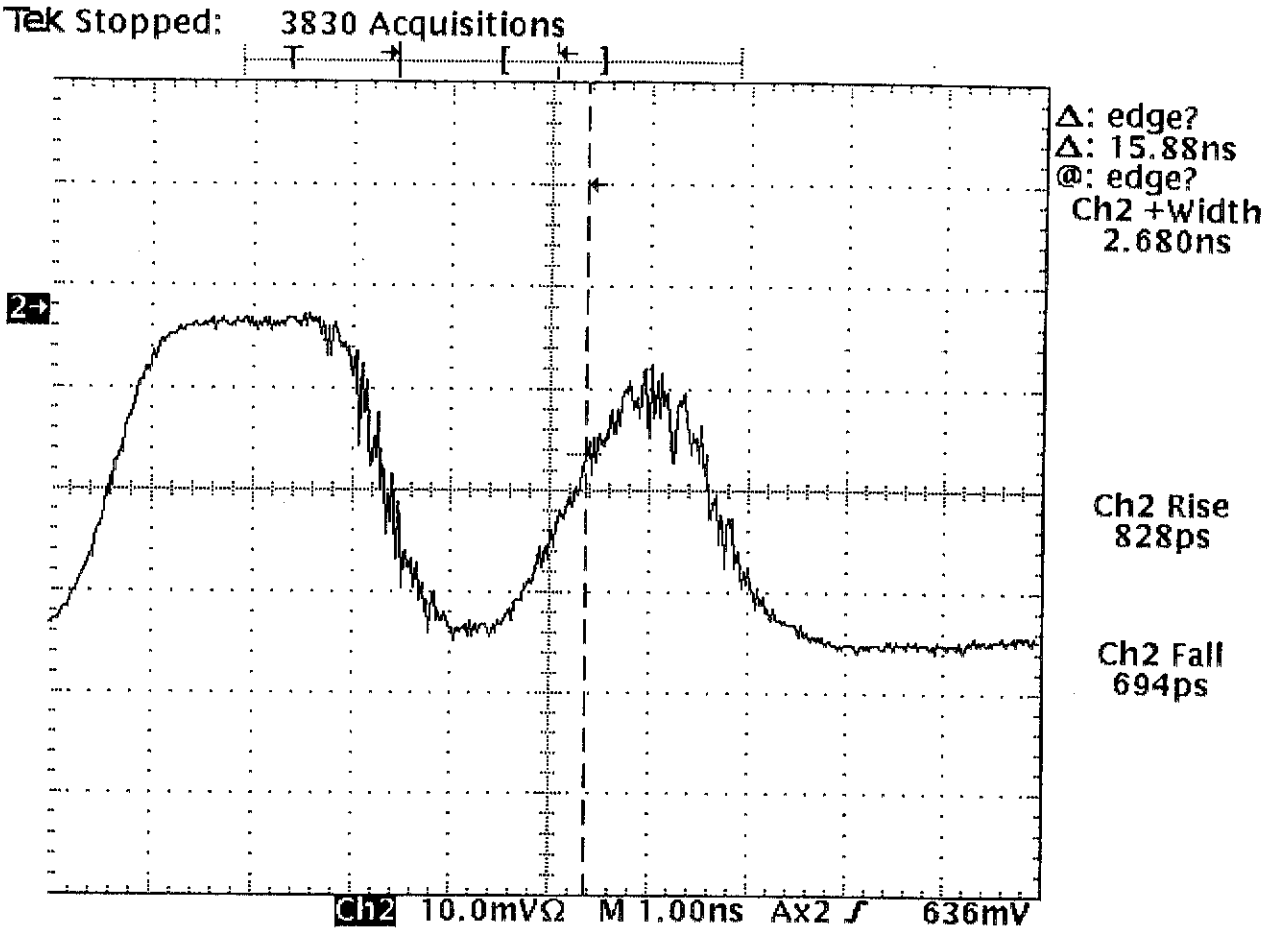

Tek Stopped: 3830 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
2.680ns
Ch2 Rise
828ps
Ch2 Fall
694ps
Ch2 10.0mVΩ M 1.00ns Ax2 ƒ 636mV

FIG. 9

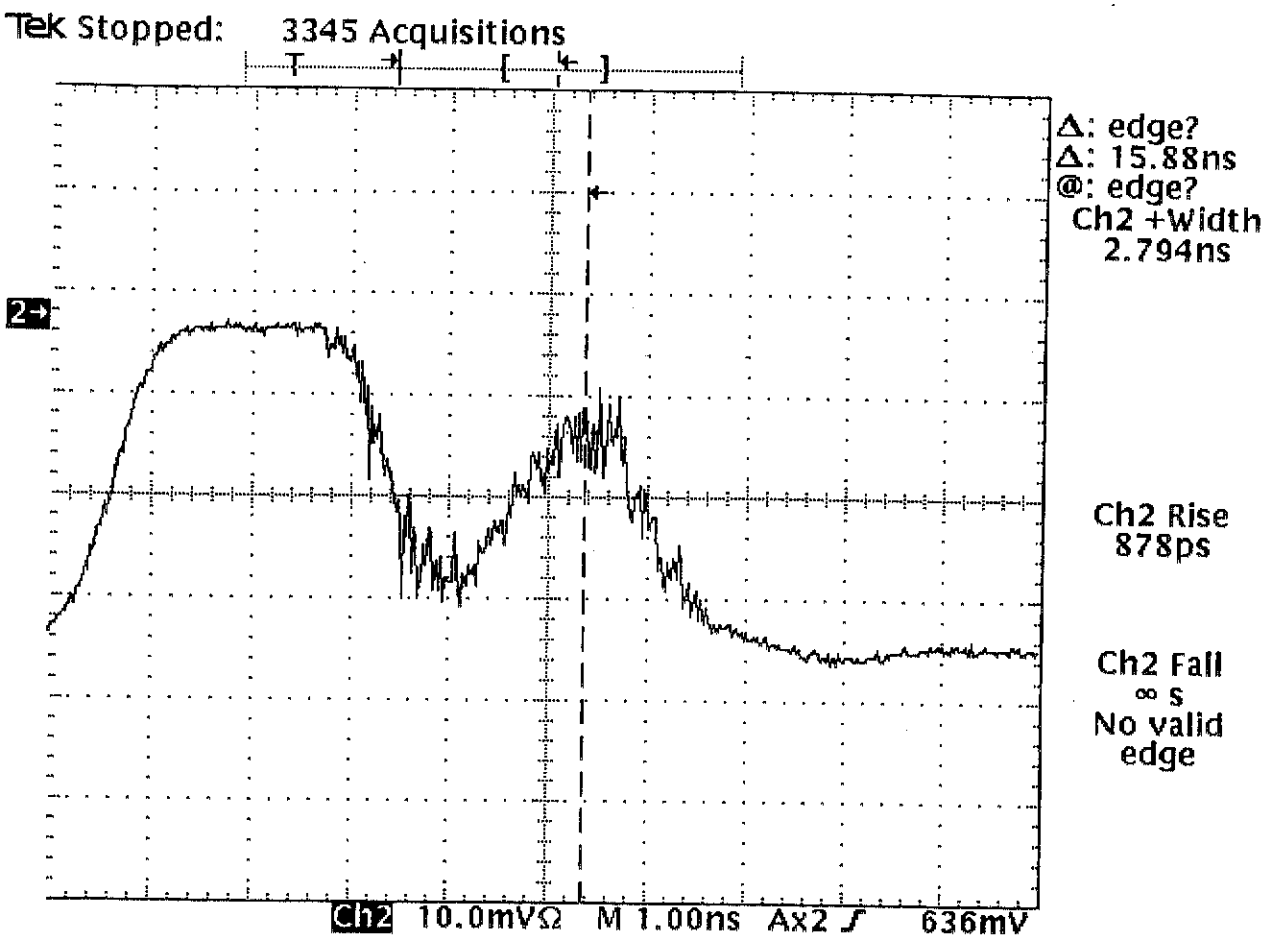

Tek Stopped: 3345 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
2.794ns
Ch2 Rise
878ps
Ch2 Fall
∞ s
No valid
edge
Ch2 10.0mVΩ M 1.00ns Ax2 ∫ 636mV

FIG. 10

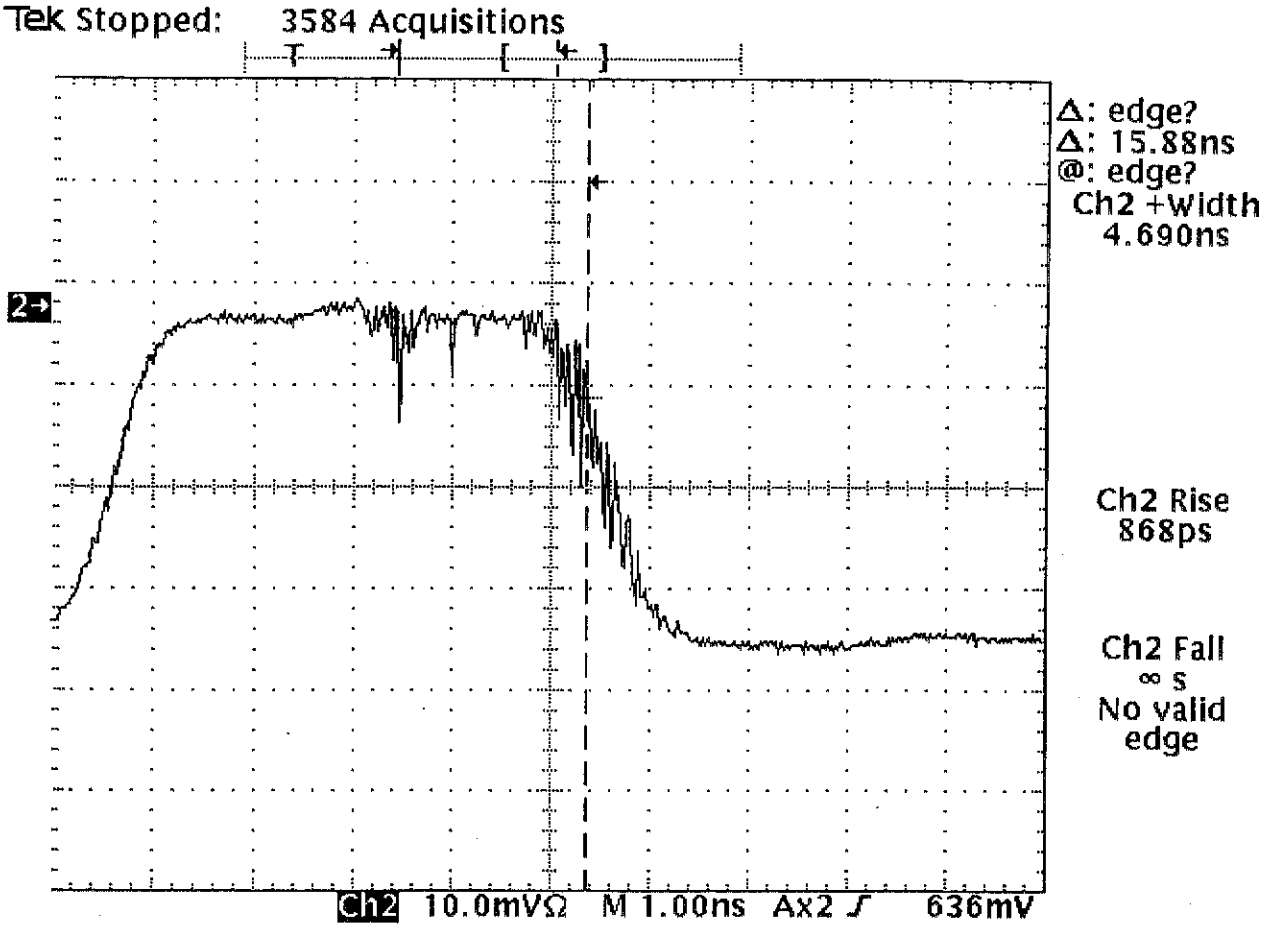

Tek Stopped: 3584 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
4.690ns
2→
Ch2 Rise
868ps
Ch2 Fall
∞ s
No valid
edge
Ch2 10.0mVΩ M 1.00ns Ax2 ∫ 636mV

FIG. 11

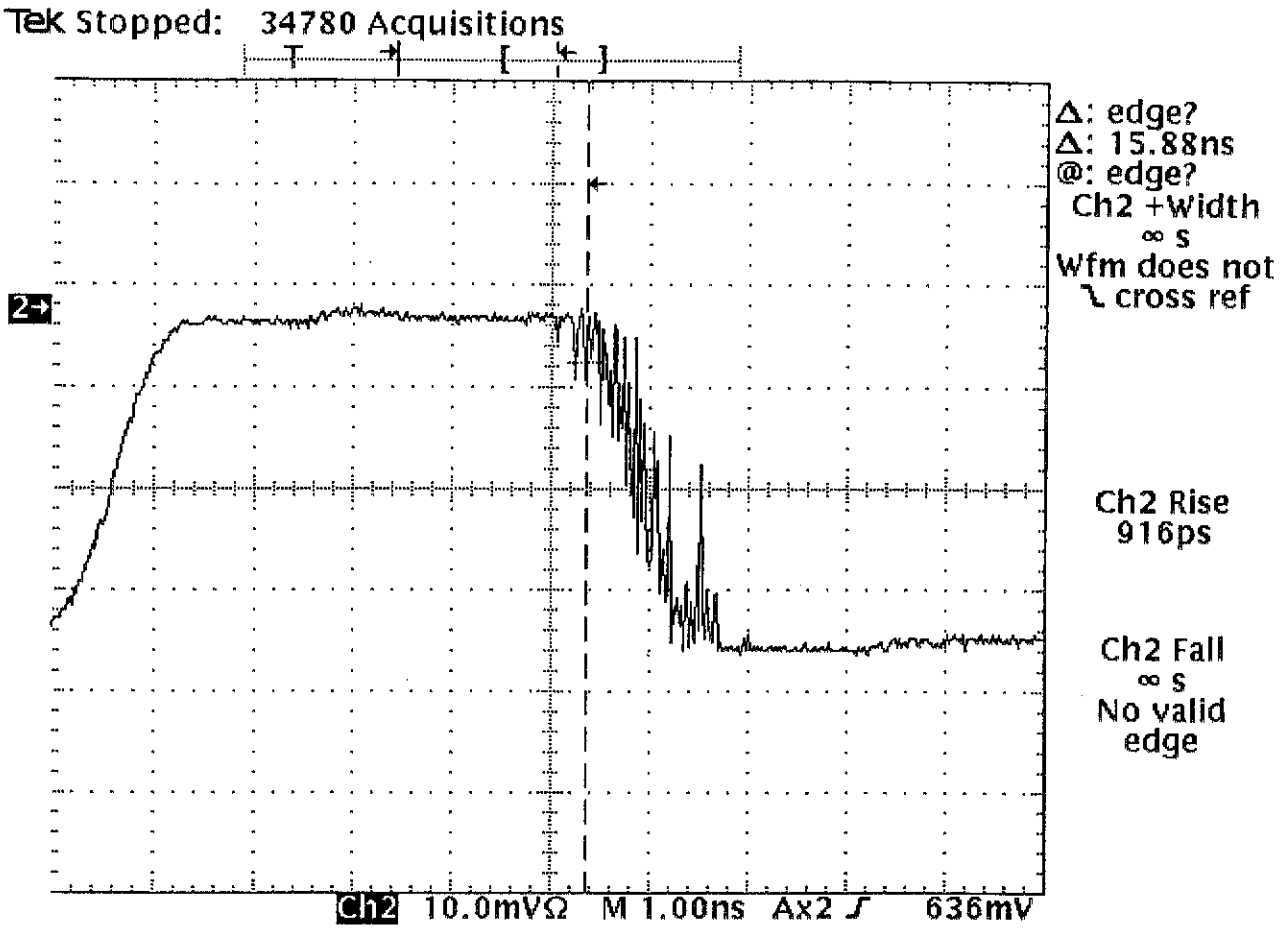

Tek Stopped: 34780 Acquisitions
Δ: edge?
Δ: 15.88ns
@: edge?
Ch2 +Width
∞ s
Wfm does not
cross ref
Ch2 Rise
916ps
Ch2 Fall
∞ s
No valid
edge
Ch2 10.0mVΩ M 1.00ns Ax2 636mV

FIG. 12