Kentech Instruments Ltd.

GOI-d GATED OPTICAL IMAGER

Single frame, 18 mm clear aperture,

S20 cathode with microprocessor control

Serial number J11*****

Version 1

Public version

Last modified 14-12-2011

PLEASE READ THIS MANUAL CAREFULLY BEFORE USING THE CAMERA.

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Figure 1 Image Intensifier electronics unit

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Figure Captions

1. DISCLAIMER

There are high voltage power supplies (6kV) present in this instrument when the unit is operating. Do not remove any covers from the GOI or expose any part of its circuitry. In the event of malfunction, the GOI 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 IEC power input connector. It is essential that the ground terminal of this connector is earthed 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.

Image intensifier tubes are very delicate and very expensive and must be handled with great care both in use and in storage. Read this manual before unpacking and using the instrument. Kentech Instruments Ltd. accepts no responsibility for any damage to the intensifier arising from misuse, we offer the manufacturer’s warranty only on this component.

If cleaning is necessary this should be performed with a soft dry cloth or tissue only.

2. 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, particularly in proximity to the cathode.

The emissions from this equipment should not exceed the limits specified in EN55011 “Emissions Specification for Industrial, Scientific and Medical equipment” with the cathode and phosphor windows covered with a conductive screen and with the two EMC clamps supplied fitted to the two ends of the umbilical.

In practice with the user’s equipment in place and the conductive screens removed from cathode and phosphor windows 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.

3. ABBREVIATIONS

ADC or adc	Analogue to Digital Convertor
CCD	Charge Coupled Device (camera)
cr	carriage return
EEPROM	Electrically programmable and erasable Read only memory, non-volatile
EHT or eht	Extra High Tension (high voltage)
MCP	Micro Channel Plate
ND	Neutral Density
PC	Photo Cathode
PRF	Pulse Repetition Frequency
PSU or psu	power supply unit
sw	software

4. INTRODUCTION

The GOI-d is a micro channel plate intensified, gated camera with a shortest gate time of 100 ps FWHM over an 18mm diameter cathode aperture.

The camera has four modes of operation: DC on, slow gate (10ns - 10μs), medium gate (300ps to 1ns) and fast gate (100ps to 250ps) and may thus be used as a fast camera or as an ungated image intensifier. The wafer type design gives a large number of pixels across the full 18mm diameter cathodes. The resolution is typically 10 1pmm^{-1}. The system has a PRF of 1kHz so sampling/ scanning operation is possible.

The cathode responds to 840nm light which allows easy setup with a laser diode (not supplied).

4.1 SPECIFICATIONS OF THE PACKAGE

Number of frames	1
Intensifier type	Photonis XX2050JD
	18mm micro channel plate intensified wafer genII
	S20 cathode on quartz input window
	P43 phosphor on fibre optic output.
MCP voltage	Minimum 260V
	Maximum as per manufacturers data sheet supplied
	Adjustable in 1V steps
Phosphor voltage	Approximately +6kV relative to MCP out.
Timing monitor	Fast rise monitor output, with fixed timing relative to the optical gate.
	Approximately 200mV into 50Ω rising in 1ns
Gating times	≤100, 100, 150, 200 and 250ps in FAST mode
	300ps to 9 ns in 100ps steps in MEDIUM mode
	10ns to 10μs in 5ns steps in SLOW mode
Spatial resolution	10 1pmm^{-1} typical
Power requirements	110/240 V AC <100W.
PRF	1 kHz.
Trigger delay	Approximately 46ns

	Measured from rising edge of trigger pulse at front panel to rising edge of gate pulse on cathode
Jitter	<20ps rms.
Trigger requirements	5V into 50Ω with <5ns rise.
Trigger threshold	Approximately 2.5V with 2ns rise time

4.2 PRINCIPALS OF OPERATION

The camera is very simple in operation. It consists of a micro channel plate intensifier tube configured for the fast application of high voltage gate pulses to the cathode with a high voltage supply for the tube bias voltages.

The tube is biased off by means of a small positive potential applied to the cathode with respect to the channel plate input. A short duration negative pulse is applied to the cathode in order to gate the camera on. There are two different mechanisms to apply this pulse, which is used depends on the selected gating mode.

4.2.1 FAST MODE

The gating pulse is applied to the relatively high capacitance load presented by the cathode via a ring electrode which is capacitively coupled to the cathode. The cathode forms the centre plate in a capacitive divider. The capacitive load seen by the pulser is reduced at the expense of pulse amplitude. The high voltage available from our fast pulse generators allows the voltage division ratio to be >10:1 with a 1/10 reduction in the load seen by the driver. This allows the very fast gating which is available with the GOI camera.

4.2.2 MEDIUM AND SLOW MODES

The gating pulse is conventionally driven by a suitable pulse applied directly to the cathode. The cathode to channel plate gap is very small (typically 200 microns) and the combination of small gap and high voltage gives a very small electron transit time, enabling fast gating.

The high resolution and large cathode area result in a very large number of pixels in the gated image. The input aperture to the intensifier tube is clear and coherent light may be imaged onto the cathode without the production of interference fringes.

5. POWER SUPPLY

The electronic package which drives the intensifier in the GOI-d is housed in one box. The box contains three sections.

These are:

i) Low voltage power supply with fast trigger buffer, fine delay and microprocessor control

ii) High voltage pulse generators

iii) High voltage tube bias supply

The system can be controlled locally using the front panel LCD and keypad, or remotely using RS232.

There is a trigger indicator light which shows when a trigger has been received. There is an adjustable delay circuit which provides a total of about 10ns timing adjustment in the trigger circuit.

There is a slow monitor logic output on the front panel which may be used to trigger an external CCD.

The high voltage tube bias supply provides the static potentials required for the intensifier tube.

The channel plate voltage is variable in 1V steps to adjust the intensifier gain

In the DC mode with the DC button depressed the cathode is biased at approximately -50 volts with respect to the channel plate input. The intensifier is DC on in this state. To turn the intensifier DC on DC mode must be selected and the DC button must be held in. The DC button is sprung so that the intensifier cannot be left for a long time with a bright and damaging image on the phosphor. In remote mode, where the GOI is controlled by RS232 from a remote computer, it is still necessary to press the DC button manually to get a DC image.

In the slow gate mode the cathode is normally biased at approximately +50Volts with respect to the channel plate input. The intensifier is off in this state. At the application of a trigger signal to the supply the cathode is pulsed to -50Volts, with respect to the channel plate input, for 10ns to 10μs, turning the intensifier on for this period. The rise time of the cathode gate signal and the trigger delay is identical for slow and medium gate modes of operation and no pretrigger is required for this mode. Note however that the fall time in slow gate mode is rather slower than in medium. The width of the slow gate is indicated by the width of the slow monitor logic signal.

In medium gate mode, operation is similar to slow gate mode, but the fall time of the cathode signal is much faster. Gate duration can be set in the range 300ps to 9ns in steps of 100ps.

In fast mode a variable positive bias is applied to the cathode with respect to the channel plate input. This bias is overcome when the fast gate signal from the pulser is applied to the imager. The bias is varied automatically by the microprocessor to give the correct gate time. Gate duration can be selected from 100, 100, 150, 200 and 250 ps. The trigger delay is set to be similar between fast mode and medium/slow mode, but note different pulse generator circuits are used for these modes and there can be some variation in the respective delays of the order of 10ps as the unit warms up.

The electrical delay in the GOI between the arrival of a trigger pulse at the front panel and the arrival of the gate pulse at the cathode is typically 46ns.

6. CONNECTIONS AND MECHANICS

Two EMC clamps are supplied to be assembled to each end of the umbilical. Their purpose is to make good contact between the stainless steel screen and the electronics box and head assembly to reduce EM emissions from the umbilical. In a sealed electromagnetic environment away they may be omitted if necessary as the GOI will operate without them.

Before the imager is powered up the photocathode input should be shielded from any ambient light. A large signal on the imager output phosphor will reduce the life of the imager and could even result in permanent damage .

Only turn on the imager with the gain control set to minimum. If a DC image is required for set up then it should be kept as dim as possible and the duration should be as short as possible. The image should only be sufficiently bright to see in a dimly lit room. When first obtaining a DC image press the DC button only momentarily in order to inspect the brightness of the output. Start at minimum gain and work up to a reasonable level. A safer alternative to using the DC button is to use the slow gate mode. The user may set a gate duration of 10μs and apply gate pulses to the trigger input at the rate of one or two Hz. Starting with the gain at minimum set the gate mode control to slow gate and look for a pulsed image on the phosphor. In this mode the imager is much safer in the presence of excessive illumination.

Ensure that no excessive force is applied to the phosphor fibreoptic as the tube may be damaged.

The individual head may be mounted using the four mounting holes.

The imager is most conveniently characterised by the use of a laser diode pulser. The cathode will respond to 840nm or shorter wavelength light. The user will require a pulse generator, a delay unit and a short pulse laser diode pulser in addition to the standard components supplied with the imager.

The imager may be triggered at up to 1 kHz. The image may be seen by eye on the phosphor if a sufficiently powerful laser diode is used. As a guide a diode producing 100mW with a pulse width of 80ps and a wavelength of <840nm is adequate to illuminate the whole of a cathode at a level which can be observed on the phosphor in a dimly lit room. In normal operation the camera will only be triggered once per image. The user will be able to see a single exposure in a darkened room and this exposure level will be captured easily by a well coupled scientific CCD camera.

7. OPERATIONAL NOTES

7.1 TIMING

Timing the imager is particularly critical when a single shot exposure is required such as in a laser produced plasma experiment. The first requirement is a trigger signal of stable timing (to within less than the gate window) and stable amplitude. Since the trigger circuits integrate the trigger signal for the first nanosecond or two a varying amplitude will cause a timing change.

A second requirement is a stable delay generator, ideally a passive switched cable network, to set the timing. A further highly desirable aid is an optical fiducial signal of suitable wavelength.

The camera has a relatively short trigger delay. The delay in the pulser is approximately 46ns. The camera could be triggered from the signal it is detecting if a suitable optical delay can be introduced after the trigger signal generator (which is probably a photodiode). This could be accomplished by means of fibre optics or by relaying the image via several lenses over a suitable distance. Ensure that the cables take the most direct path to the camera so that they do not contribute to the trigger delay.

This scheme would be most suitable if there is no reliable pretrigger available (for example in an electrical discharge machine).

The fast monitor is a proportional passive monitor taken directly off the cathode. The monitor output is delayed from the cathode signal by approximately 12ns due to the length of the connecting cable and it’s timing is absolutely fixed with respect to the optical gate. See the test result section for details of waveforms.

The slow monitor signal is driven from the input logic circuit. Note that in slow gate mode the timing of the rising edge can vary in position by put to 10ns depending on the gate width setting. In fast and medium modes the timing is fixed but the timing jitter may exceed 20ps.

7.2 DELAY ADJUSTMENT.

The delay adjustment gives approximately 10ns of adjustment in approximately 10ps steps. THIS IS NOT A PRECISION DELAY AND SHOULD NOT BE USED AS A CALIBRATED TIME REFERENCE.

8. TESTS

8.1 STATIC TESTS.

The imager should be set up with a target resolution grid imaged onto the cathode. A controlled and uniform light source should be used to backlight the target. This may be a variable output microscope lamp with a diffuser and ND filters over the front. All other light sources should be excluded from the input by using a black tube.

A microscope should be set up to view the output. This can be an objective lens mounted close to the output. Take care not to scratch the fibre optic window. Fibre optic face plates are made of soft glass and the surface is in the image plane.

In a dimly lit room (i.e. just enough light to manoeuvre after ones eyes have adjusted to the low light level) turn on the imager in DC mode with the gain set to 500V. Depress the DC button and gradually turn up the lamp until a dim image is seen. Then turn up the gain in 10V steps until a relatively bright image of the resolution mask should be present on the output.

Ensure that the imager is able to resolve lines separated by at most 100μm. Turn the imager off and remove the microscope. Set the imager to SLOW GATE mode with the slow gate duration set to 10μs. While triggering the power supply at a ~ 1kHz turn up the gain until a pulsed image is seen on the phosphor.

8.2 DYNAMIC TEST.

For this test a short pulse light source is required. A laser diode is most convenient although a single pulse mode locked glass laser can be used. The source should have a wavelength ≤ 840nm and should produce > 10^8 photons per pulse. A >100mW peak power laser diode with a ≤ 60ps pulse duration is suitable. In both cases a pretrigger signal is required with a lead time >25ns (>100ns if a sampling system is being used as a time reference). It should satisfy the trigger requirements in the specification. A switched cable delay generator and a "trombone" delay line will also be required.

Be sure to use the appropriate laser safety goggles.

Connect up the pulser, trigger source and delay lines as shown in Figure 2 on page 11. The camera should be removed from the imager. The light source ideally will run at a repetition rate from single shot to 1kHz. Set up the source to run at 1kHz (or the maximum possible) with the power level on the cathode at a minimum.

The laser should be set up to illuminate uniformly the input with a resolution mask in place as in the previous test. Take care that the power level is not so great as to burn the cathode. This is not a danger when using a laser diode. All other light sources should be excluded from the input.

In a dimly lit room turn on the imager in DC mode with the MCP set to about 500V. Depress the DC button and turn up the source brightness until a dim image is seen. Increase the MCP voltage in 10V steps until a relatively bright image of the resolution mask should be present on the output. This establishes a reasonable exposure level for the test.

Initially the longest gate pulse duration should be used. Set up the imager as shown. Check that the pulser is being triggered. In a dimly lit room turn on the imager and pulser and with the source intensity and gain setting as in the previous section and scan the delay until an image is present. Observe the effect of increasing and decreasing the delay and find a delay setting that positions the light pulse at the start of the cathode gate profile. Once this setting has been established, the gate width can be progressively reduced.

The gate window may now be measured either by monitoring the output intensity with a CCD or a photodiode. The most convenient way to obtain the gate time is with a photodiode monitoring

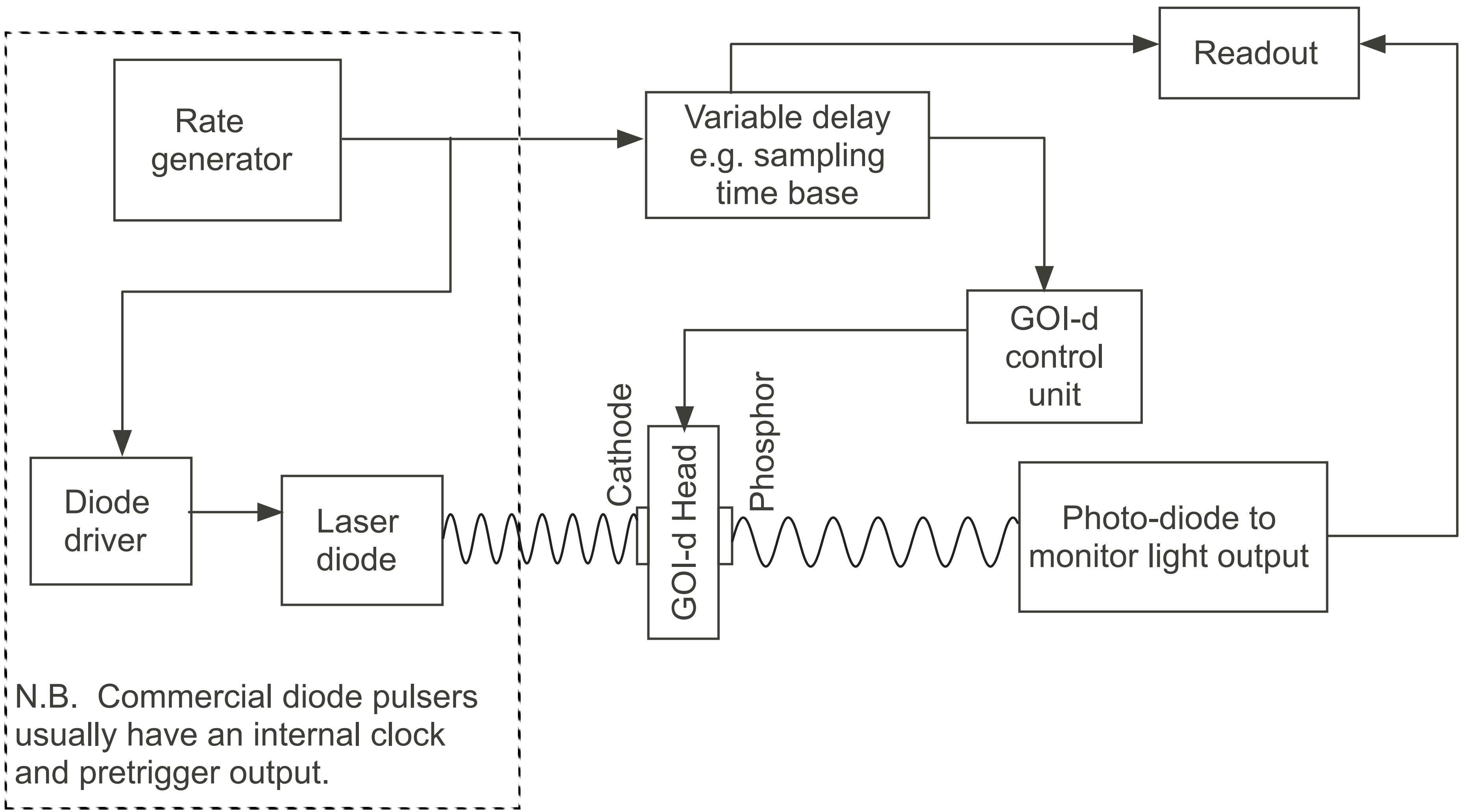


Figure 2 Configuration for characterising the GOI-d

the output signal and plotting the output intensity while stepping the delay. The source and camera must be triggered at a sufficient rate that a quasi DC signal can be obtained by integrating the diode output. This rate is typically 1kHz. A sampling time base may be used as a delay generator and the photodiode output displayed directly on the scope. By this means a rapid record of the gate profile can be obtained.

It should be established that the imager is being reliably triggered. This is most readily achieved by triggering the imager at a few hertz and looking to see if the image is stable. If there is jitter then the brightness of the image will vary from shot to shot. This test is most sensitive if the timing is set such that the image is approximately 50% of peak brightness, i.e. the source is changing most rapidly.

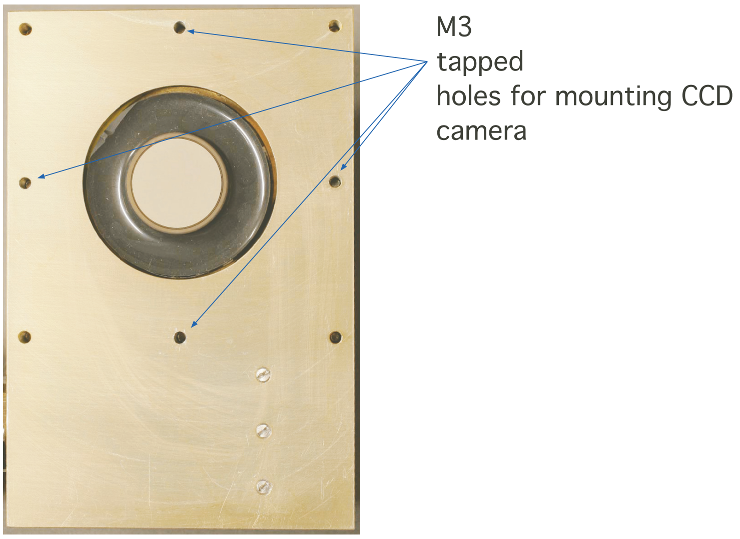


Figure 3 Mounting a CCD camera

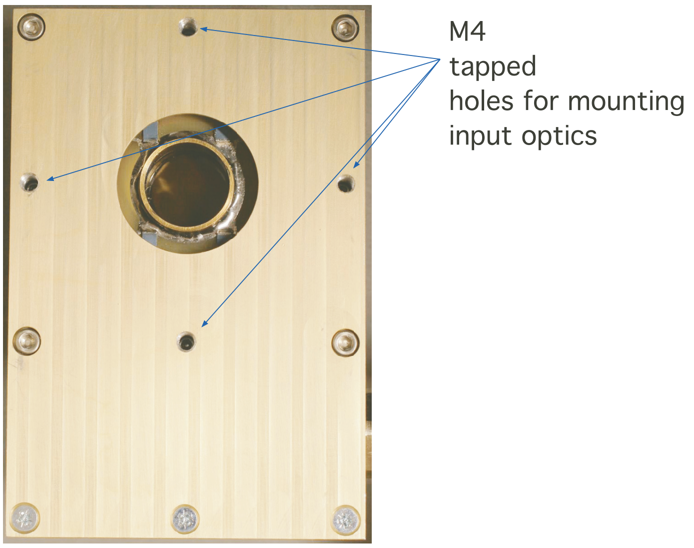


Figure 4 Mounting for input optics

9. CCD MOUNT

No CCD mount is included with this instrument. The CCD should be mounted using the four M3 tapped holes indicated.

10. INPUT OPTICS

No input optics are included with this instrument. The input optics can be mounted using the four M4 tapped holes indicated.

11. GOI-d SOFTWARE INSTRUCTIONS

11.1 INTRODUCTION

The GOI software allows complete control of the operation of the instrument from the front panel buttons. The GOI can also be fully controlled by the RS232 interface. User parameters can be saved in EEPROM.

11.2 POWER UP

On power up the "Kentech Instruments" banner will be displayed for approximately 1 second, then the display moves automatically to the menu page. The hardware adopts mode 0 (inhibit) safe user parameters, MCP voltage set to minimum and positive cathode bias.

11.3 MENU PAGE

In modes other than inhibit, menu page 1 appears as follows:-

Edit user...   >

Save = no

Restore = no

In inhibit mode, the page is simplified:-

Edit user...   >

Restore = no

The cursor will be under E on line 1. Any line can be selected by moving the cursor with up and down. Pressing right initiates the appropriate action for each line. Selection of unused blank lines is inhibited.

Right on line 1 moves to the Run Page

Right on line 2 moves the cursor under the n of no. To save user settings, press yes so that the line now reads

Save = yes

If you really wish to save user parameters, press left to commence saving, Otherwise press no to return the display to

Save = no

then the press left key. The cursor now moves back under the S of save.

Right key on line 3 invites you to restore user settings to the previously stored value in a similar manner.

Note: the < and > characters indicate access points to other pages.

Run Page

Run page is entered from the menu page. All the parameters that can be edited in user page are known as user parameters. The appearance of this page varies with the operating mode selected.

There are a maximum of 4 modes:-

Mode	Description
0	INHIBIT
1	FAST
2	MEDIUM
3	SLOW
4	DC

The mode editor is displayed on line 1 in all modes. In mode 0 (power up default) line 1 reads:-

<Mode=INHIBIT

lines 2 to 4 are blank.

Left returns to menu page 1. Right moves the cursor under the I of inhibit.

<Mode=INHIBIT

Up and down will step through all the available modes. For example

```
<Mode=FAST
 MCP   =   260 V
 Gate  =   250 ps
 Delay =    50 ps
```

Left here will exit the mode editor.

The MCP editor is displayed on line 2 in all modes except mode 0 (INHIBIT). To edit, move the cursor under the M of MCP using up/down, use right one or more times to select a digit then up/down to edit. Use left one or more times to exit the MCP editor.

Note that the cursor can only be moved up and down between the various parameters to be edited in the left hand position.

The gate editor is displayed on line 3 in fast, medium or slow modes. Use down to select line 4, right/left to select the item then up/down to toggle. Use left one or more times to exit the gate editor.

The delay editor is displayed on line 3 in fast, medium or slow modes. Use down to select line 4, right/left to select the item then up/down to toggle. Use left one or more times to exit the gate editor.

11.4 REMOTE CONTROL

The RS232 uses a very simple ascii protocol to drive the Forth interpreter, very similar to the delay generator. Use 9600 baud, 8 bit data, 1 stop bit, no parity. The GOI will enter remote control mode on receipt of one character from the serial port. All incoming characters are put into an 80 byte buffer under interrupt control, so all command lines should be less than 80 bytes long. Command words and numbers should be followed by either a carriage return or at least one space. The GOI uses 16 bit numbers only, use numeric characters only, do not use commas or decimal points. Commands are case sensitive.

The GOI will echo each character as it is received (so a simple terminal emulator can be used) and will output “ok” after each command line successfully executed.

The following list of commands may be used to inspect and alter the user parameters:-

LOCAL	puts the HRI back into local control
x !MD	set mode to x
xxx !MV	sets the MCP voltage to xxx volts
xxx !DL	set delay to xxx ps
xxx !FG	set fast gate width in ps
xxx !MG	set medium gate width in ps
xxx !SG	set slow gate width in ns

.MD	return current mode
.MV	return mcp voltage in volts
.DL	return delay in ps
.FG	return fast gate in ps
.MG	return medium gate in ps
.SG	return slow gate in ps
.OV	return overload flag
	-1 = overload
	0 = normal
0OV	reset overload condition

.TG (--)	return state of triggered latch
	-1 = triggered
	0 = not triggered
0TG	reset triggered latch
.REV	Lists the current software revision
.STATUS	Lists the current user parameters
	Mode no.
	MCP voltage
	Gate width for current mode
	Delay setting in ps

Mode Numbers

The mode numbers are:

0	Inhibit
1	FAST gate
2	MEDIUM gate
3	SLOW gate
4	DC

11.5 USER VARIABLES

These are the variables as displayed on the front panel LCD. User variables are volatile, i.e. any changes are lost if power is removed. The current state of the user variables can be saved and restored on the menu page.

The user variables are listed below, note that there are three independent variables which select the gate width, the variable used depends on the mode setting.

Mode	Selects gating mode
Fast gate width	Selects gate width in FAST mode
Medium gate width	Selects gate width in MEDIUM mode
Slow gate width	Selects gate width in SLOW mode
MCP voltage	MCP voltage
Fine delay	Delay setting in ps

12. OPTICAL GATE WAVEFORMS

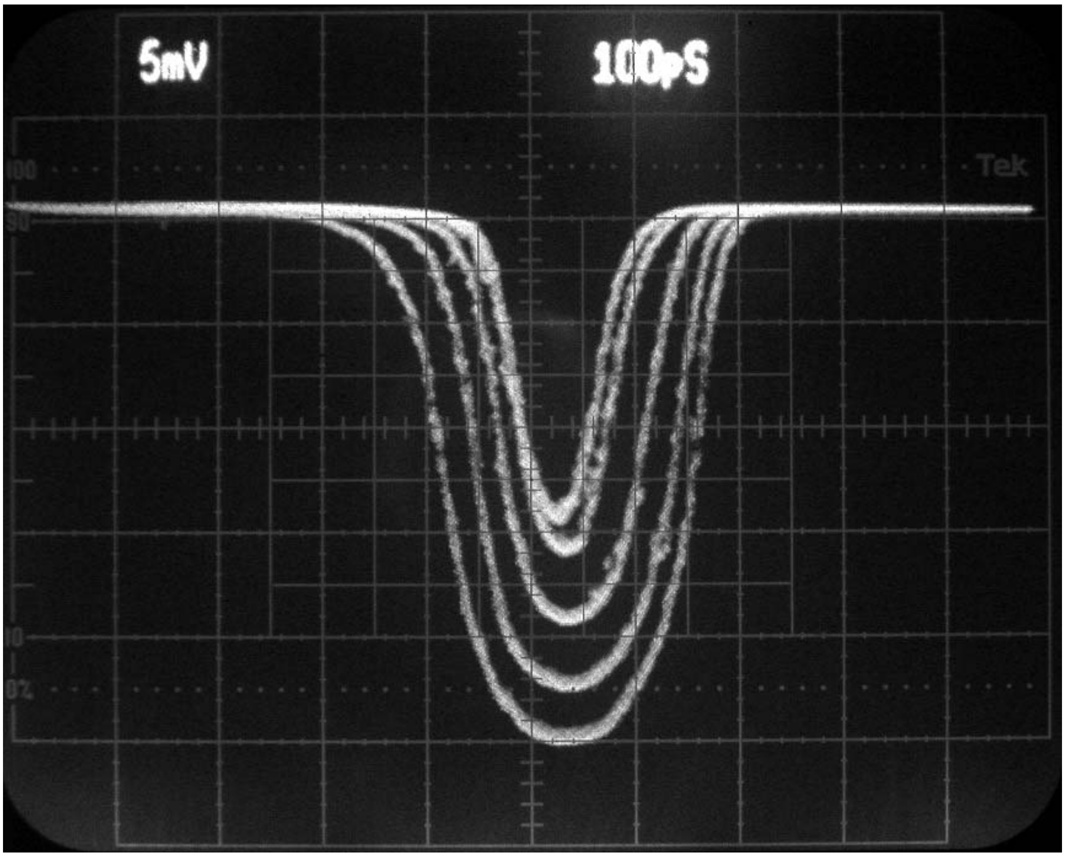


Figure 5 FAST gate mode 80-100-150-200-250ps

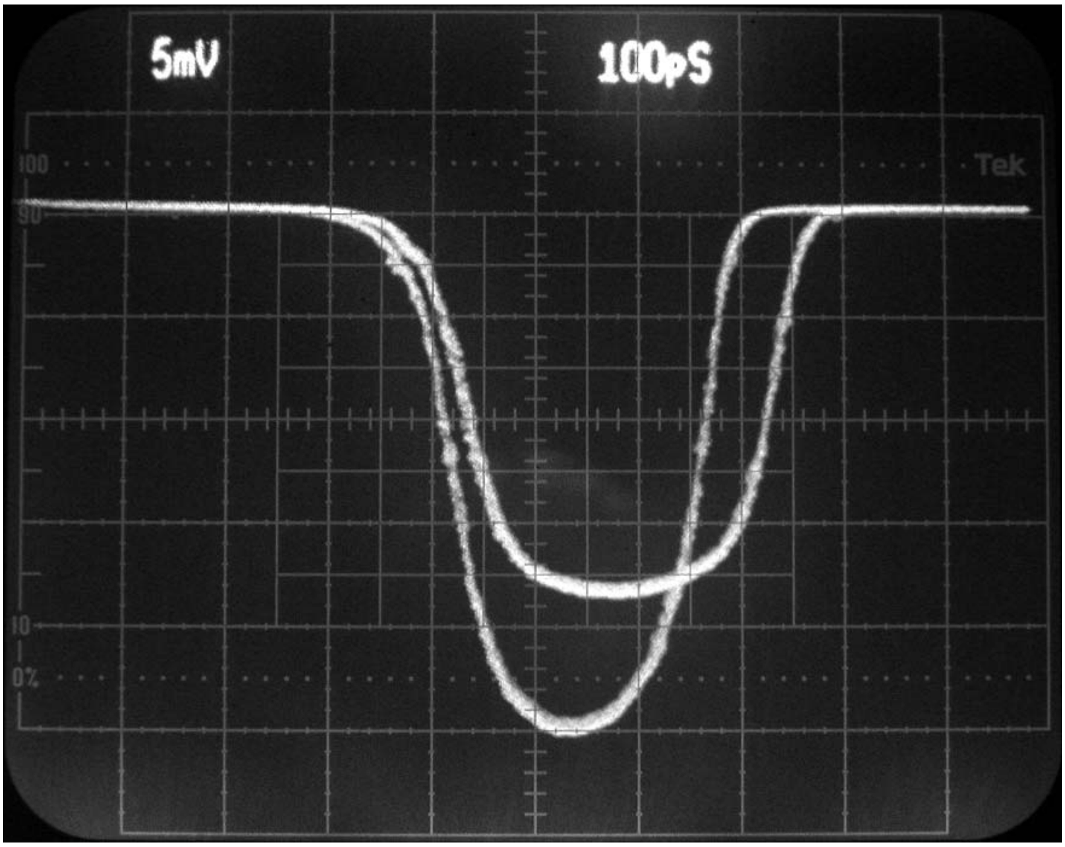


Figure 6 FAST gate mode 250ps and MEDIUM gate mode 300ps

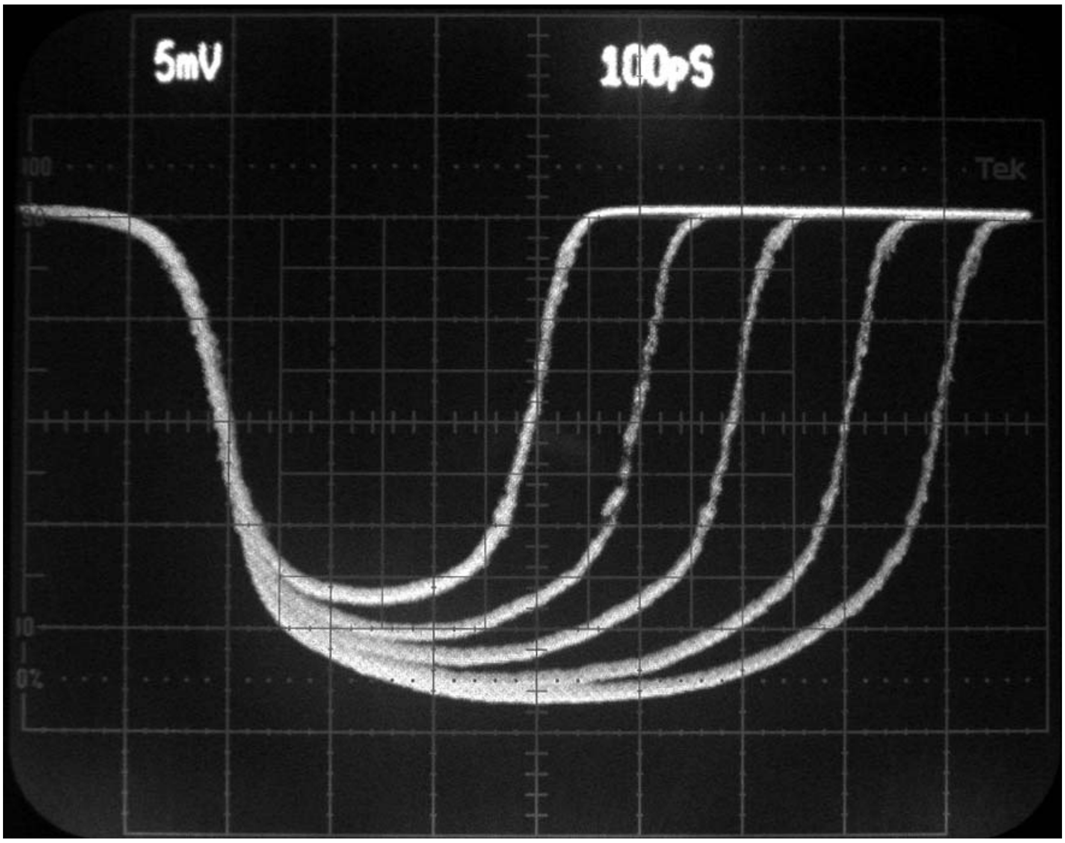


Figure 7 MEDIUM gate mode 300-400-500-600-700ps

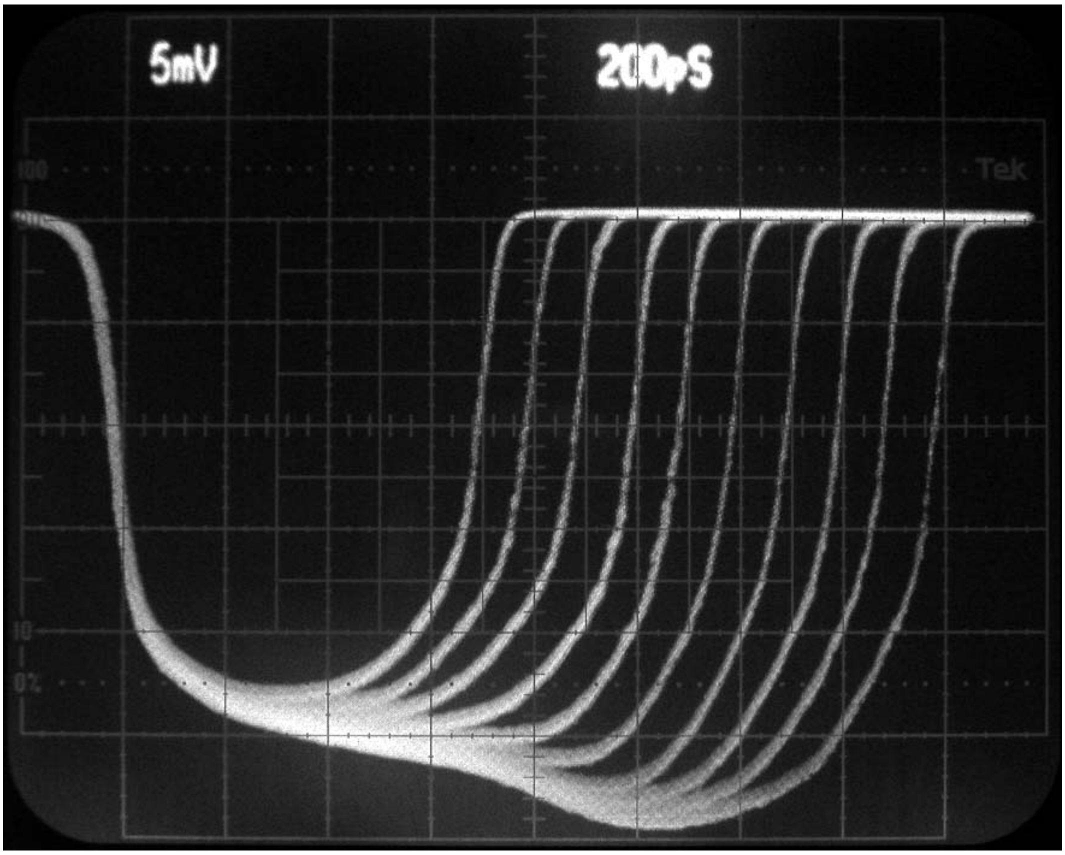


Figure 8 MEDIUM gate mode 700-800-900-1000-1100-1200-1300-1400-1500-1600ps

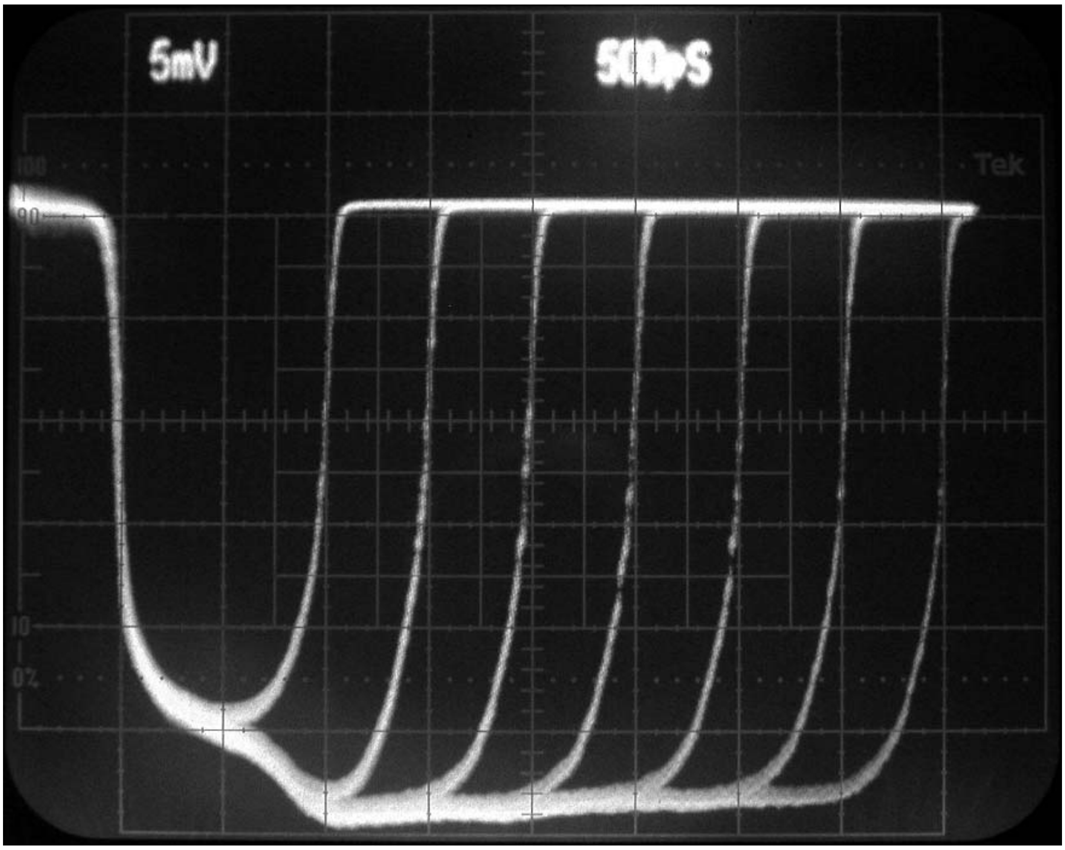


Figure 9 MEDIUM gate mode 1000-1500-2000-2500-3000-3500-4000 ps

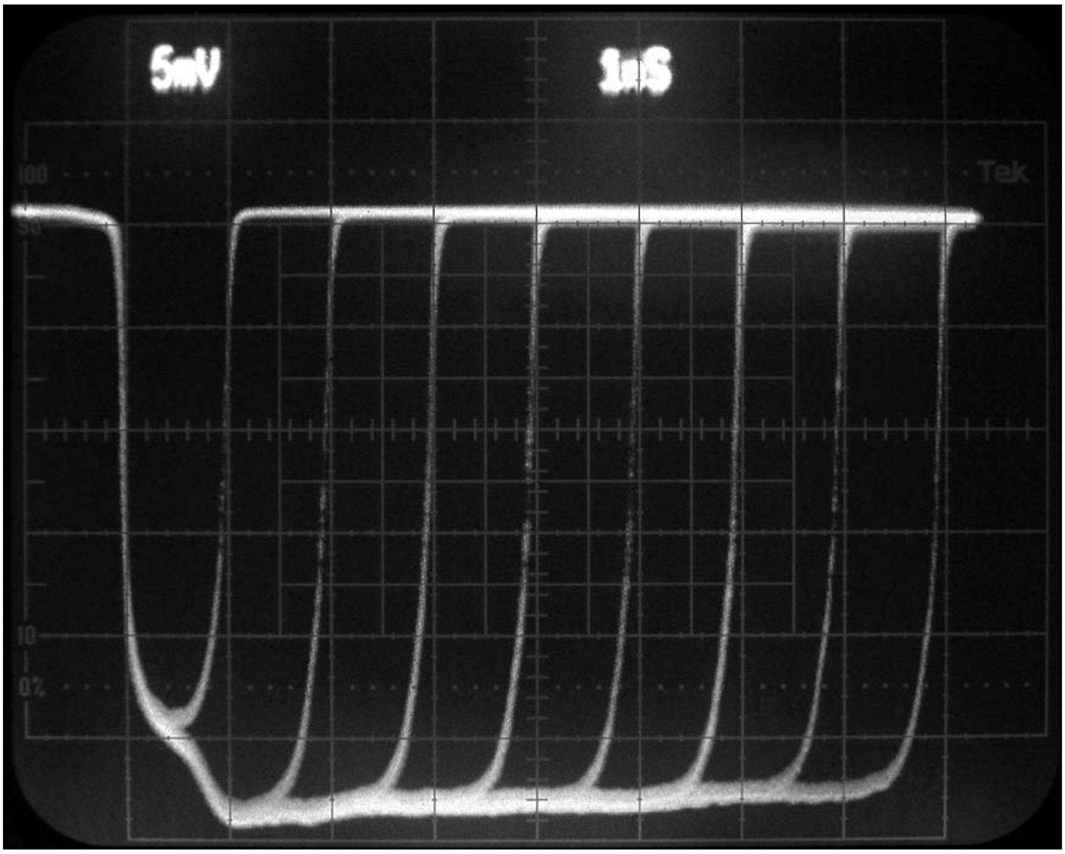


Figure 10 MEDIUM gate mode 1-2-3-4-5-6-7-8 ns

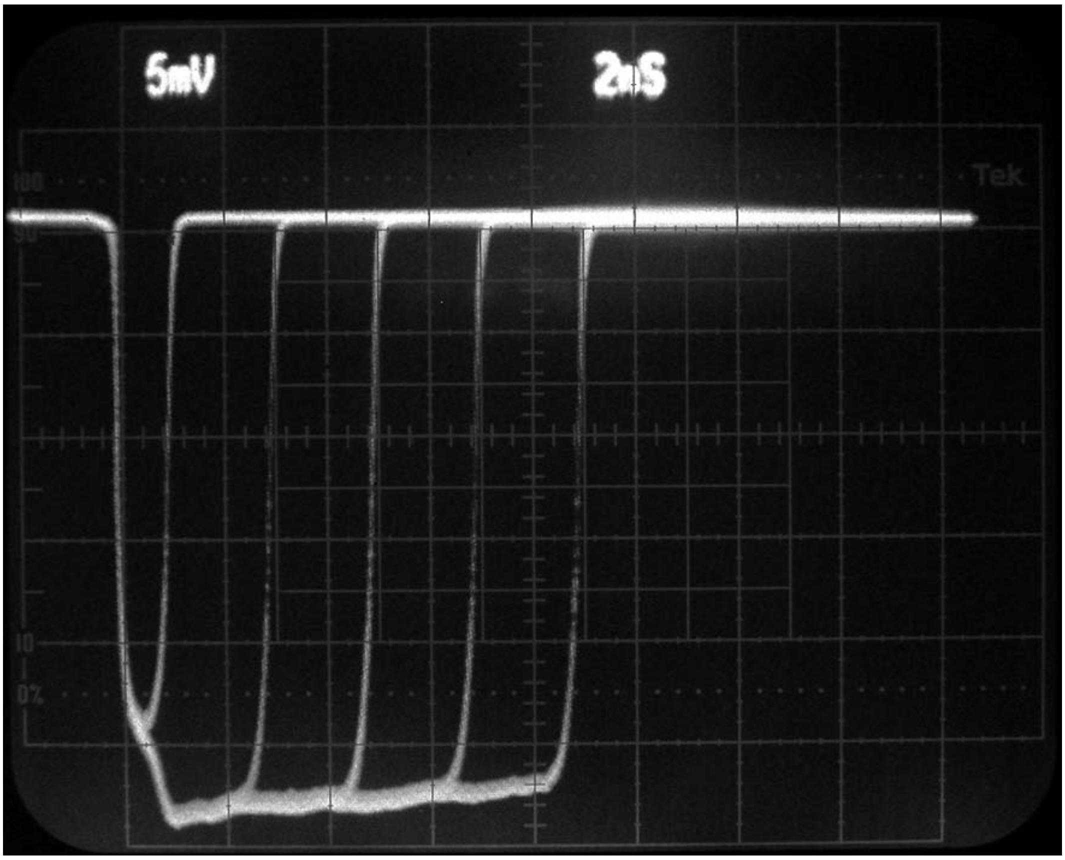


Figure 11   MEDIUM gate mode -3-5-7-9 ns

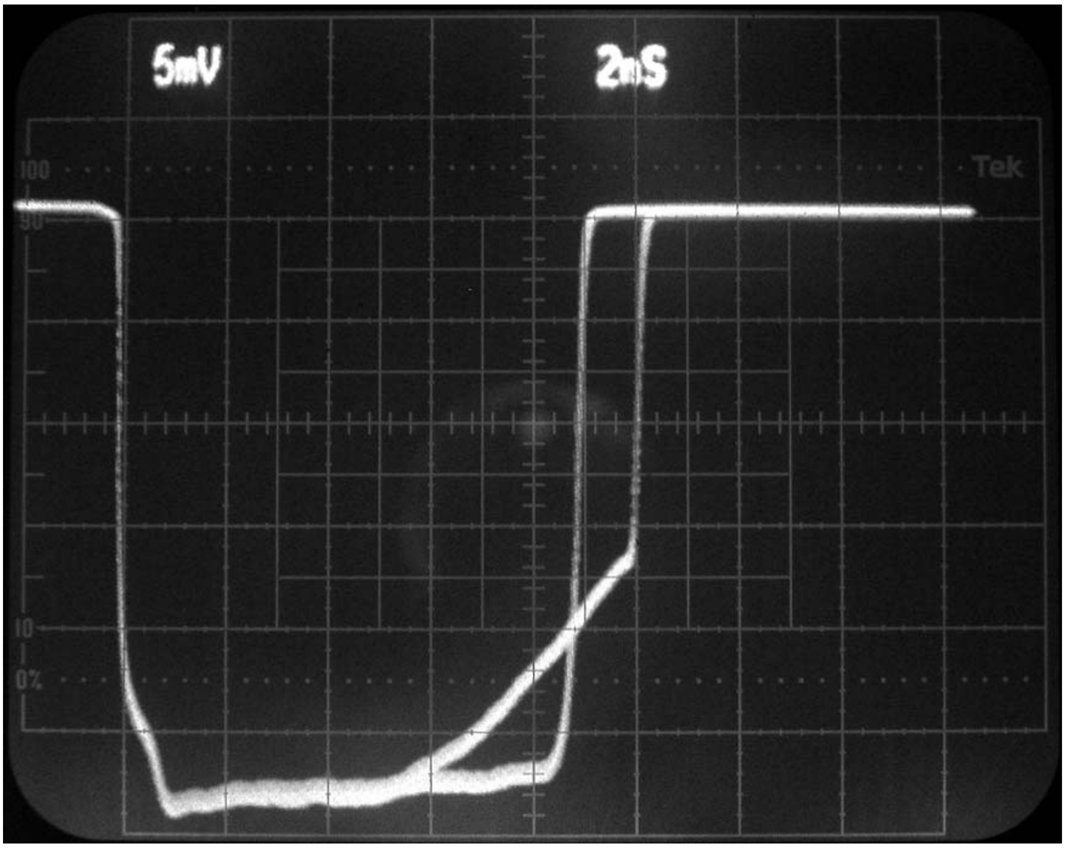


Figure 12   MEDIUM gate mode 9 ns SLOW gate mode 10 ns

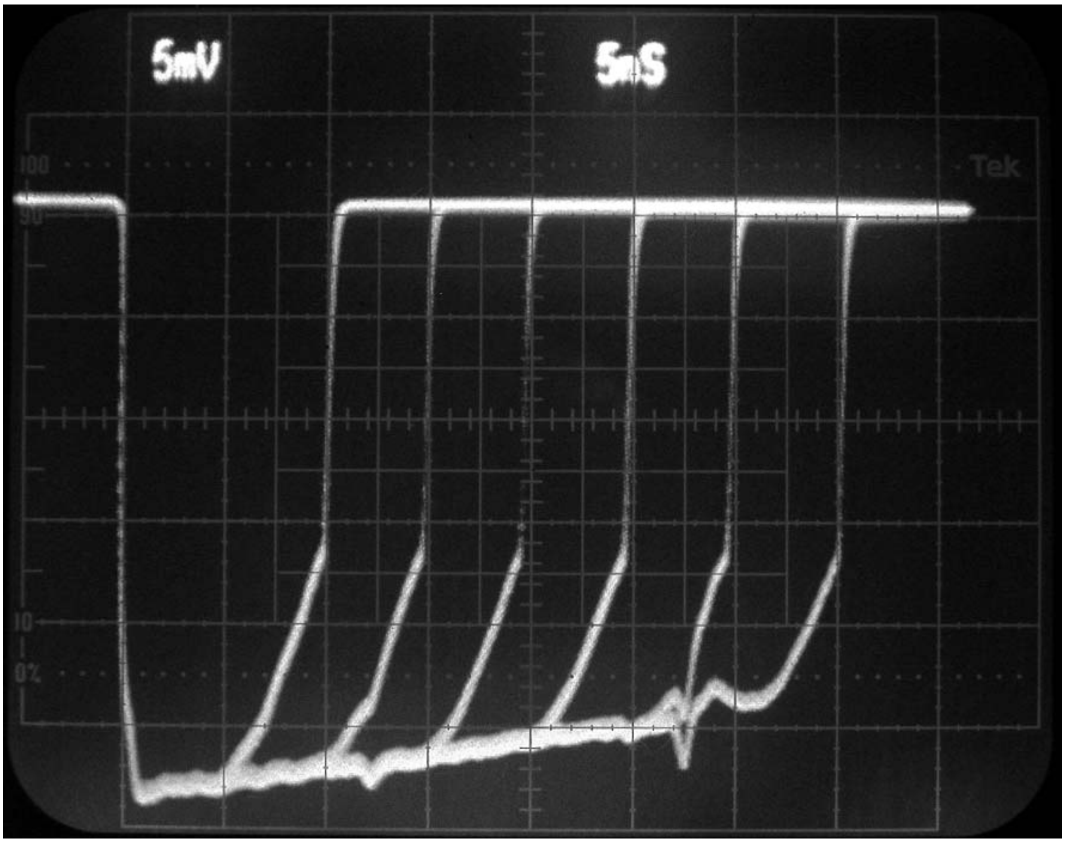


Figure 13   SLOW gate mode 10-15-20-25-30-35 ns

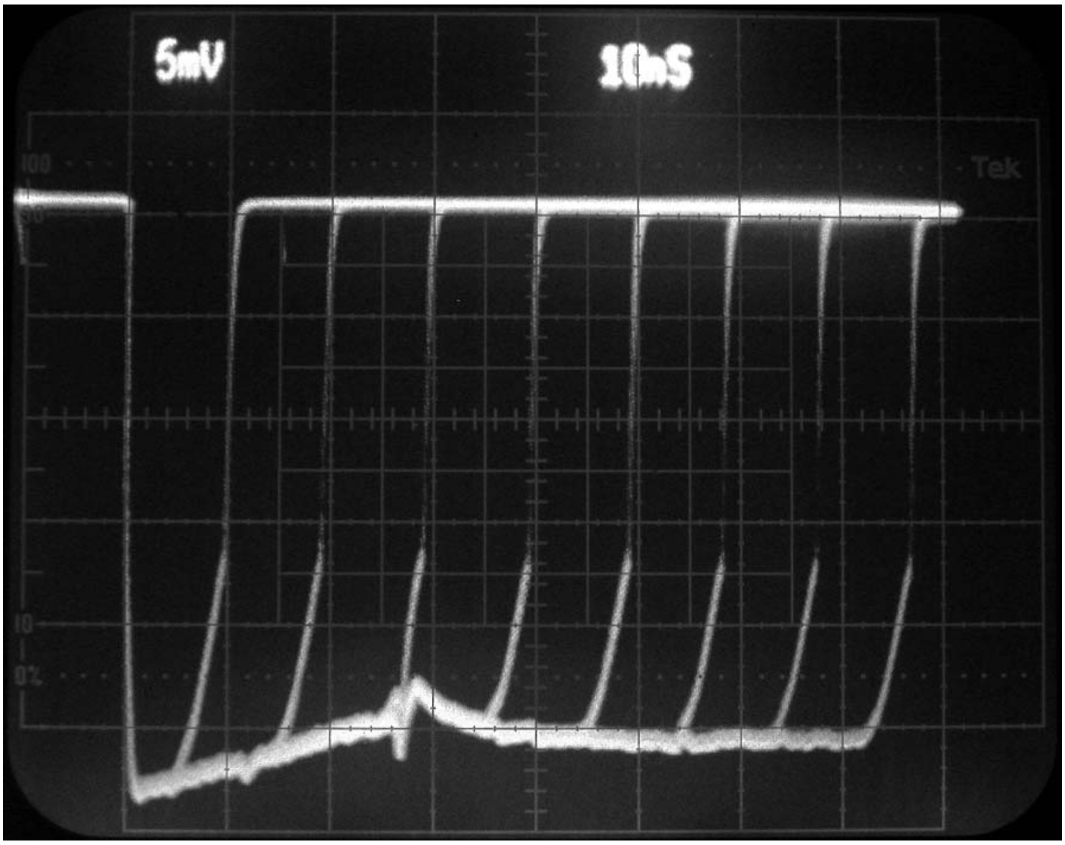


Figure 14   SLOW gate mode 10-20-30-40-50-60-70-80

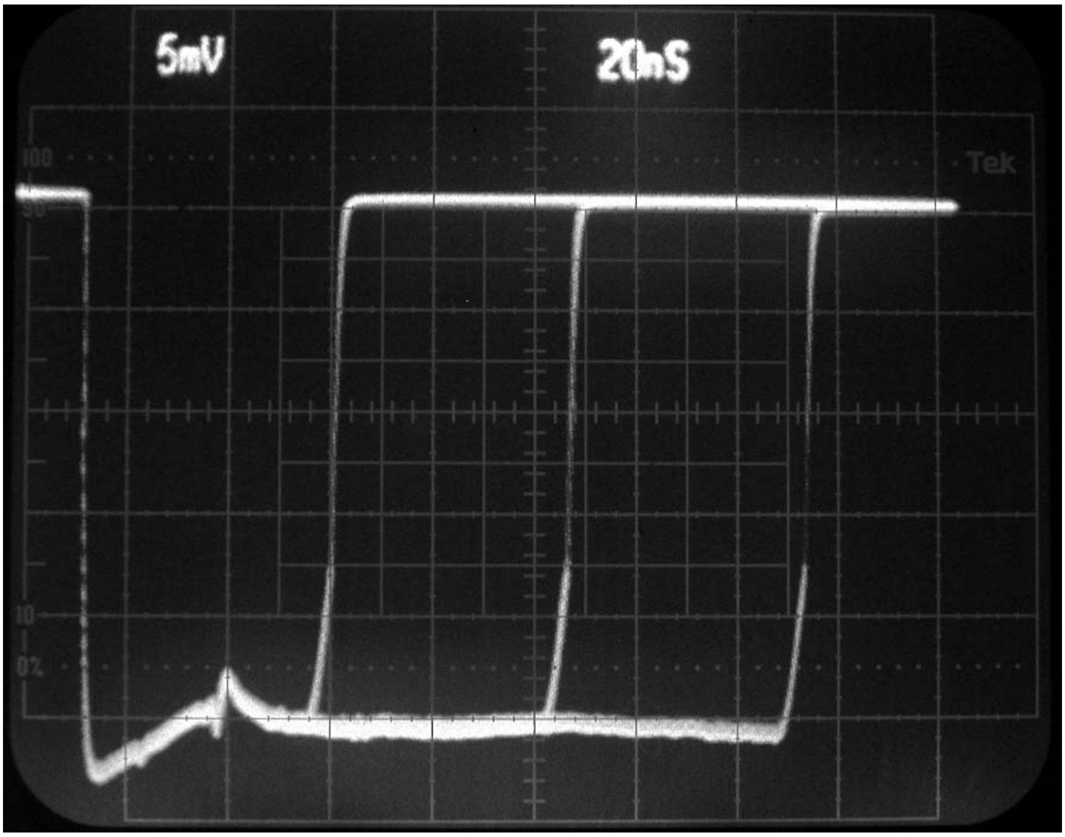


Figure 15 SLOW gate mode 50-100-150 ns

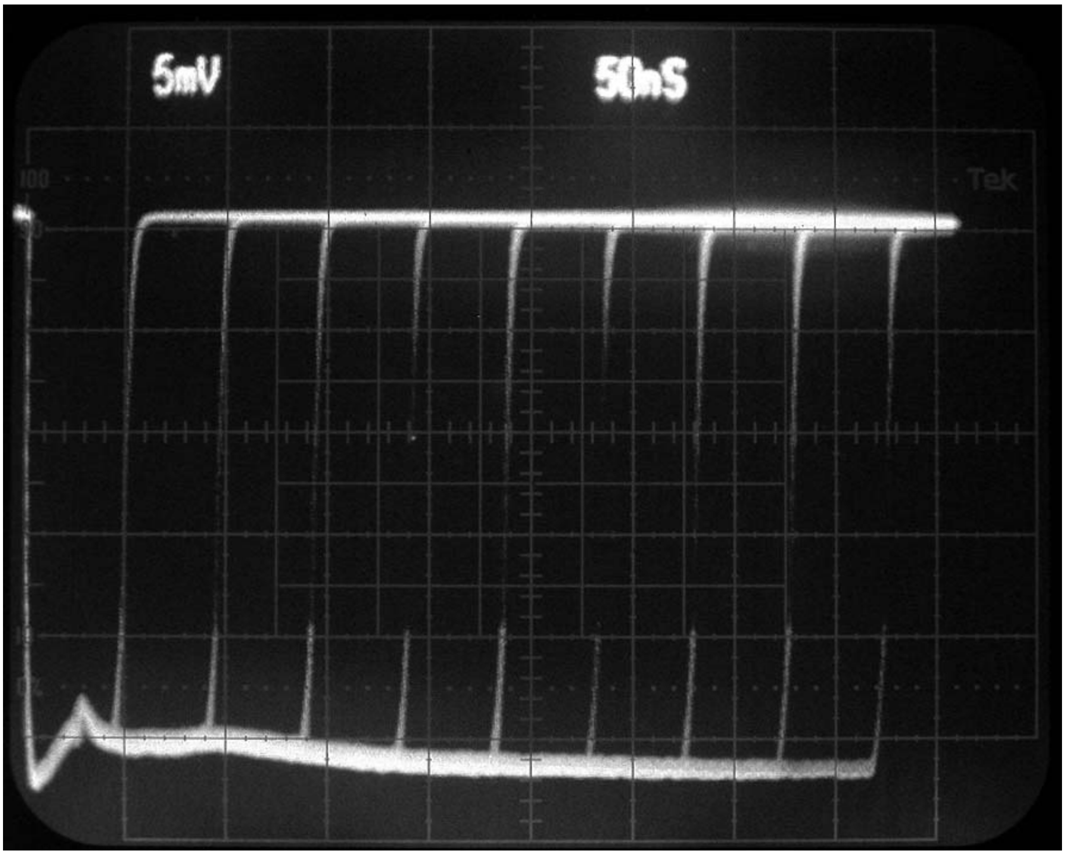


Figure 16 SLOW gate mode 50-100-150-200-250-300-350-400-450ns

13. ELECTRICAL WAVEFORMS

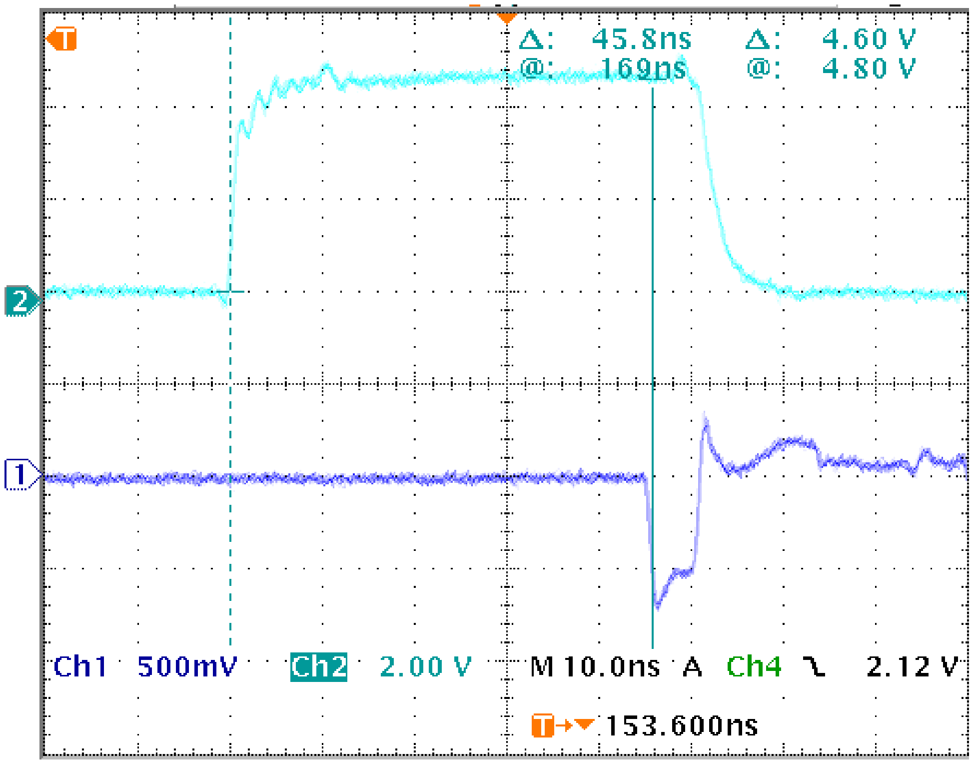


Figure 17 Trigger to PC delay.
Top trace = trigger signal measures with probe at T on trigger input at front panel
Bottom trace = cathode gating pulse picked up by holding scope probe near cathode
Taken in MEDIUM gate mode, gate width set to about 5 ns

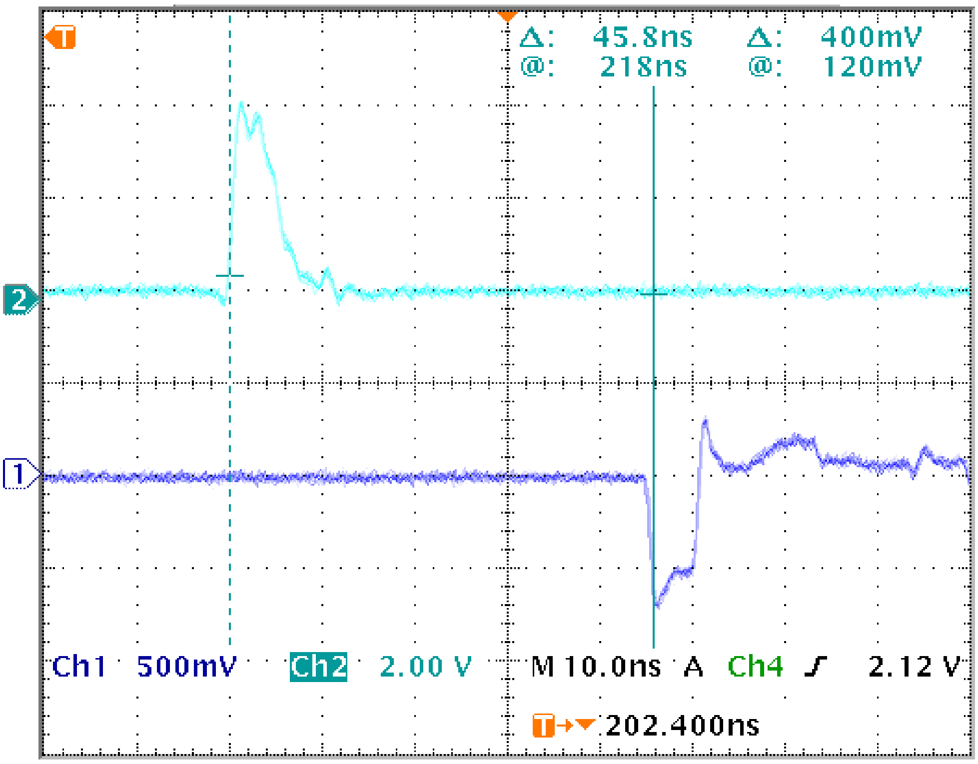


Figure 18 As Figure 17 but with 1ns pulse width

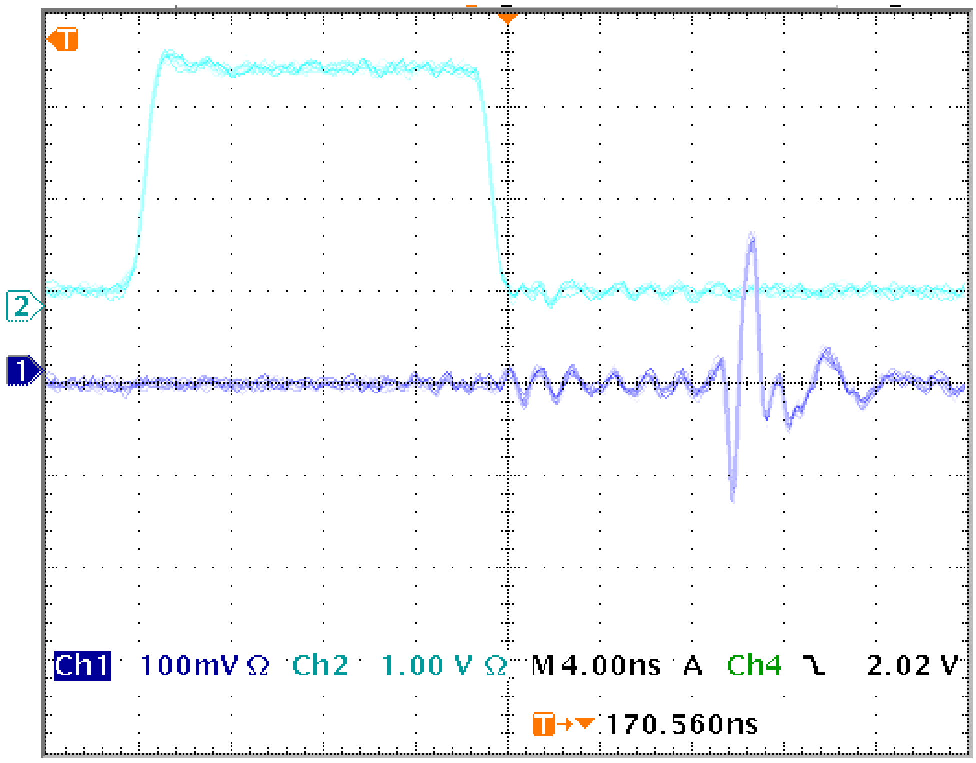


Figure 19 Monitors in Fast gate mode.
Top trace = slow monitor
Bottom trace = fast monitor

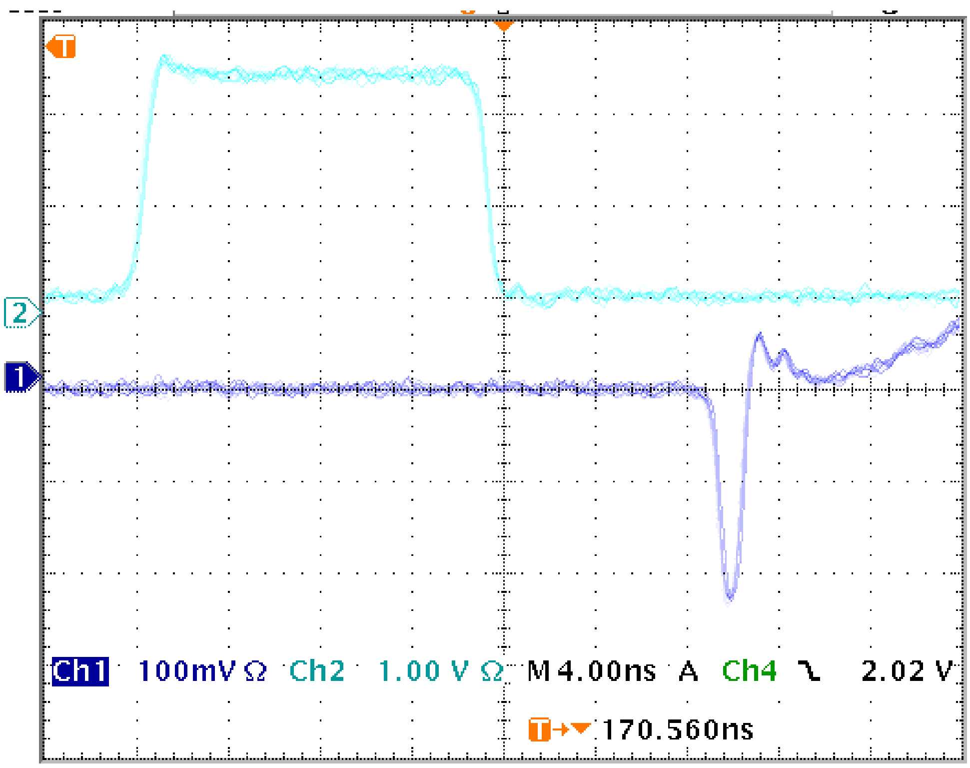


Figure 20 Monitors in Medium gate mode, 1 ns gate width.
Top trace = slow monitor
Bottom trace = fast monitor

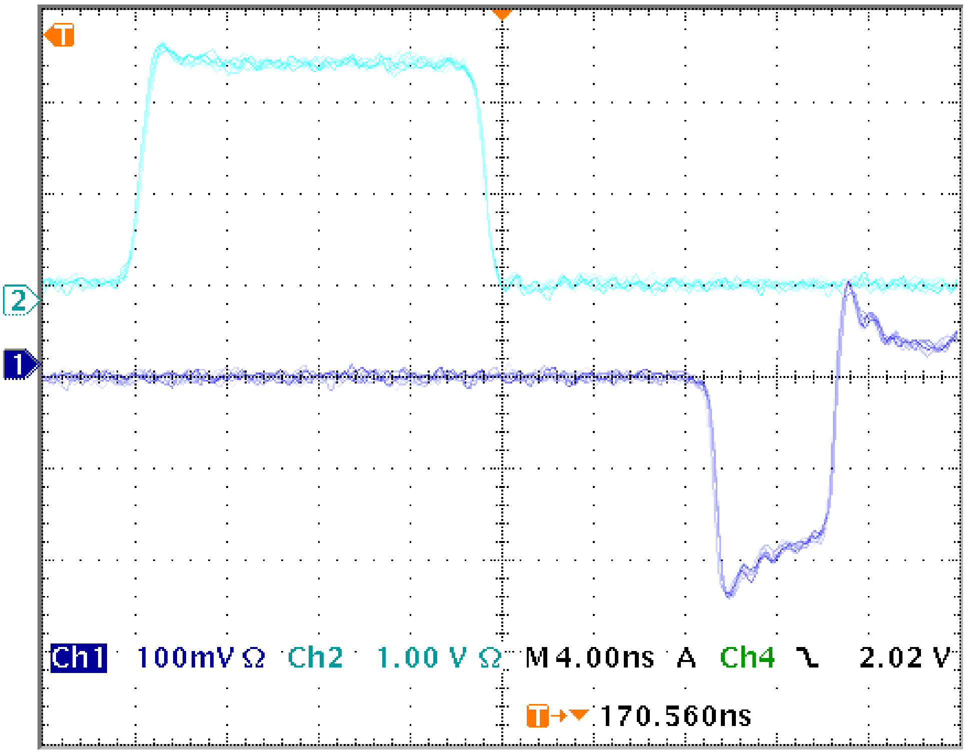


Figure 21 Monitors in medium gate mode with 5ns gate width.
Top trace = slow monitor
Bottom trace = fast monitor

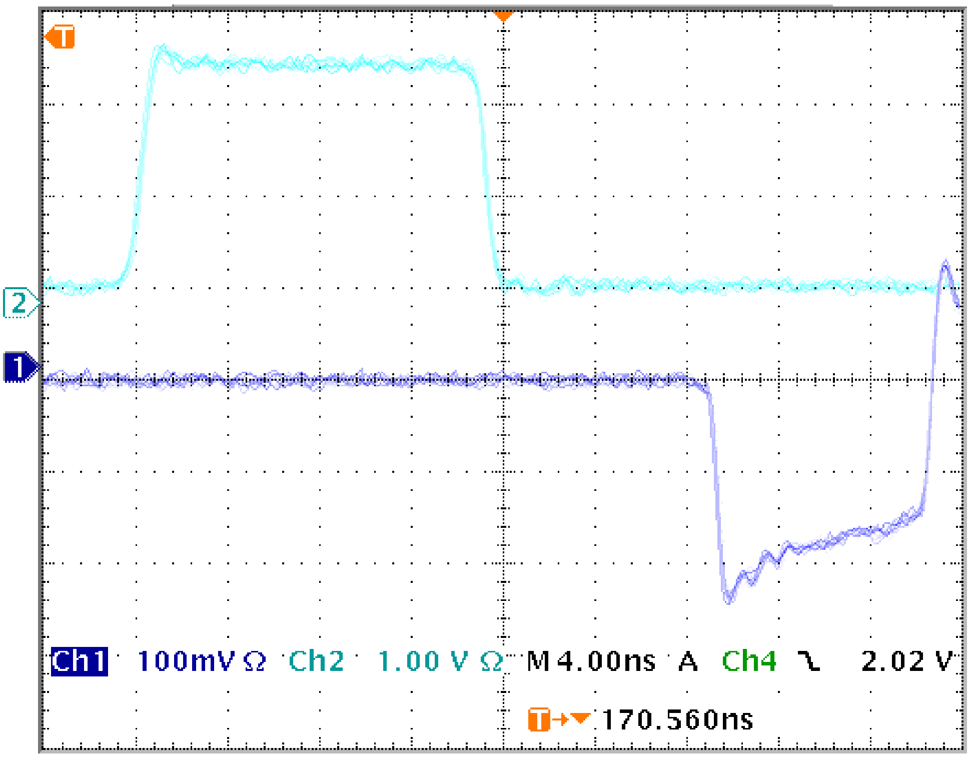


Figure 22 Monitors in medium gate mode, 9 ns gate width
Top trace = slow monitor
Bottom trace = fast monitor.

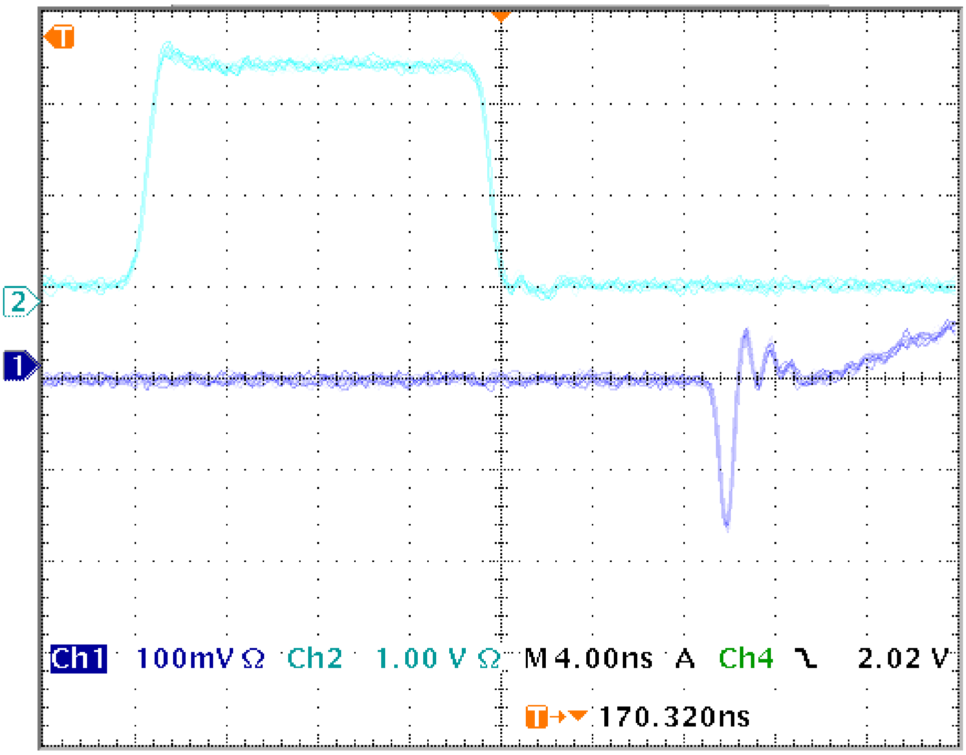


Figure 23 Monitors in medium gate mode, 300ps
Top trace = slow monitor
Bottom trace = fast monitor

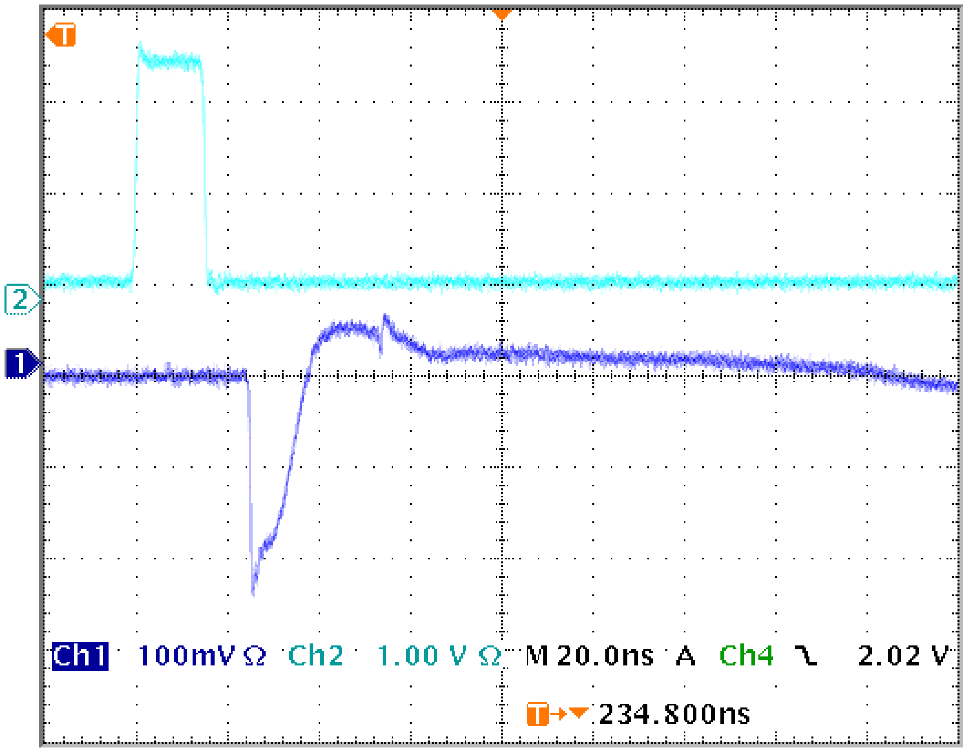


Figure 24 Monitors in slow gate mode, 10ns gate width
Top trace = slow monitor
Bottom trace = fast monitor

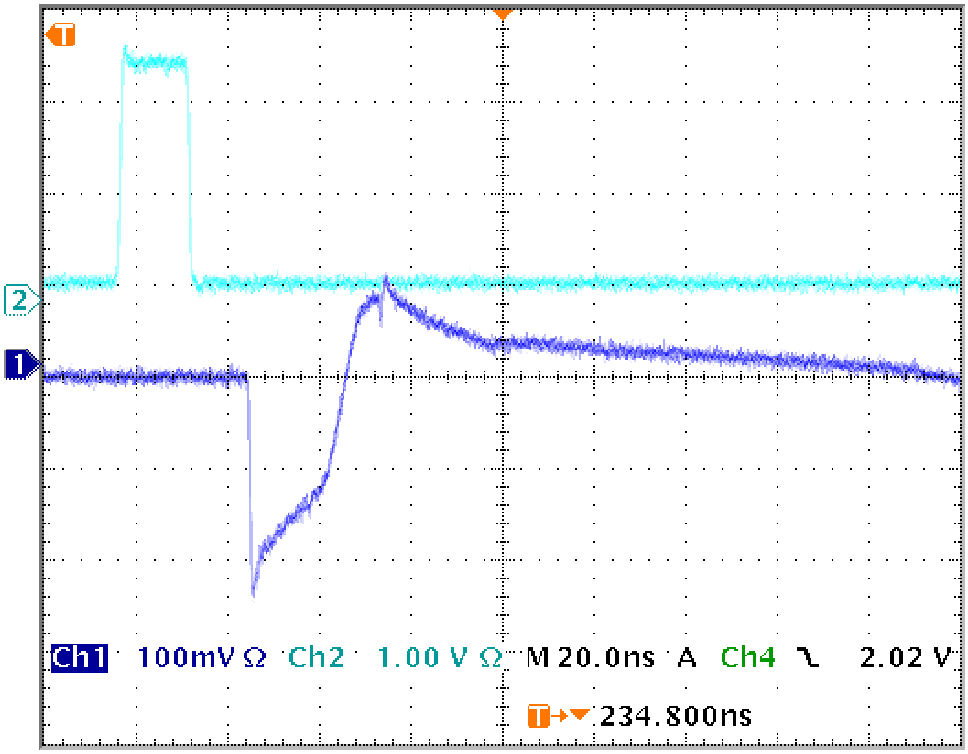


Figure 25 Monitors in slow gate mode, 20ns gate width
Top trace = slow monitor
Bottom trace = fast monitor

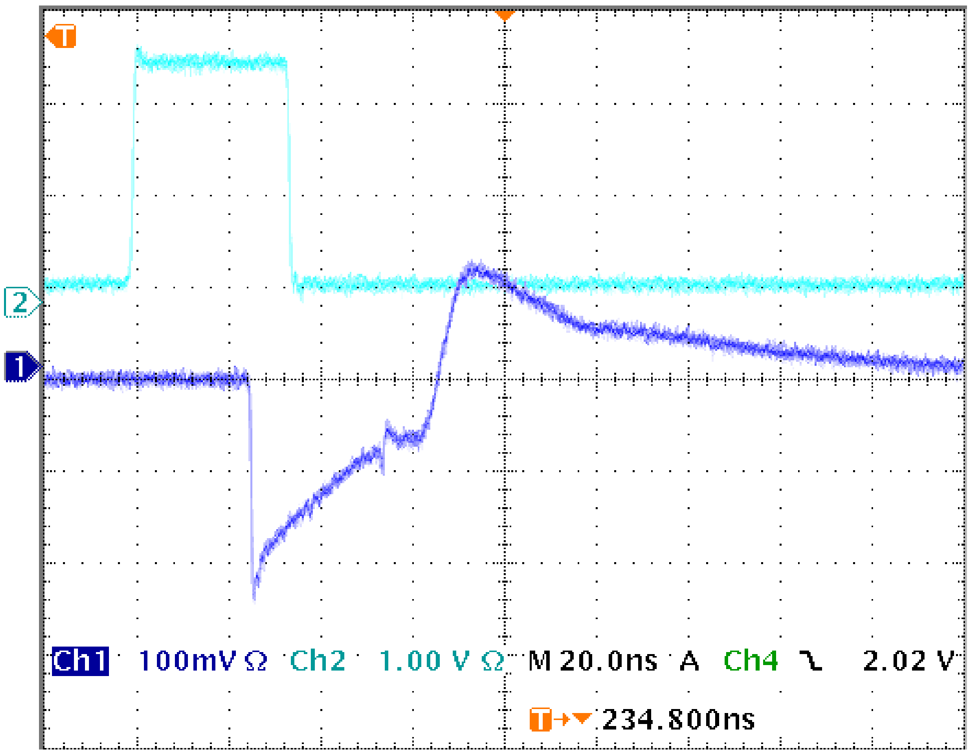


Figure 26 Monitors in slow gate mode, 40ns gate width
Top trace = slow monitor
Bottom trace = fast monitor

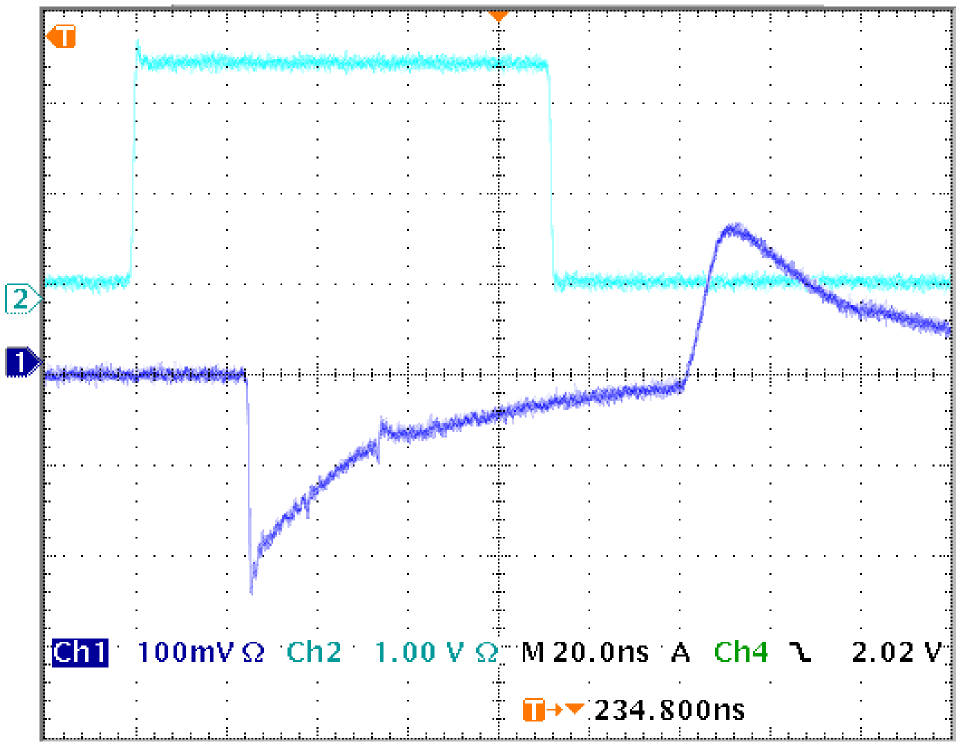


Figure 27 Monitors in slow gate mode, 100ns gate width
Top trace = slow monitor
Bottom trace = fast monitor

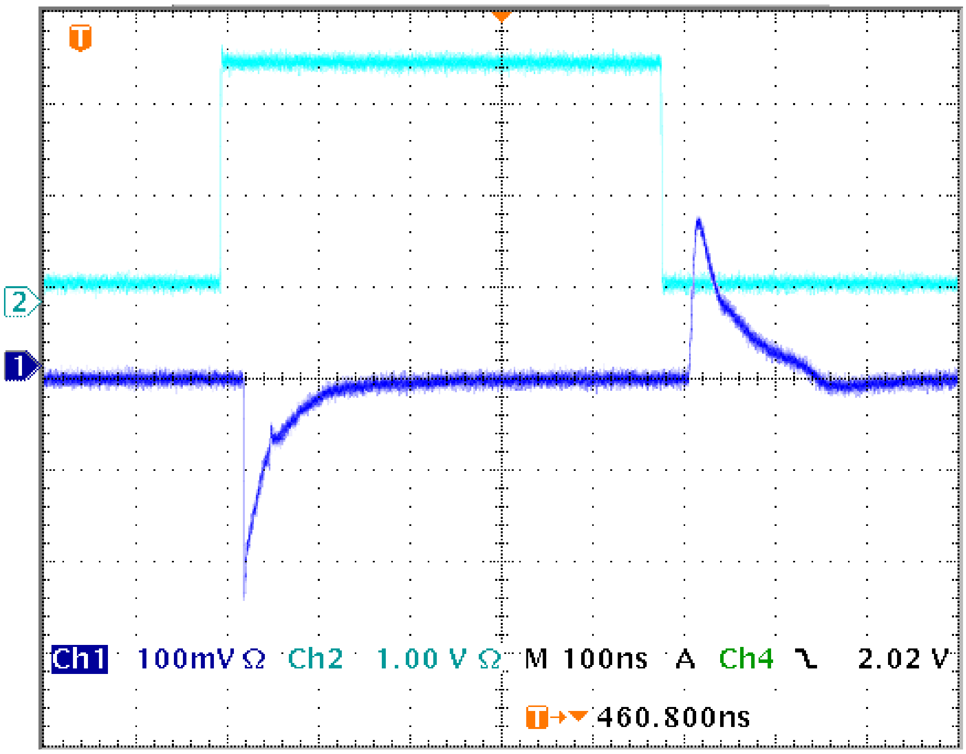


Figure 28 Monitors in slow gate mode, 500ns gate width
Top trace = slow monitor
Bottom trace = fast monitor

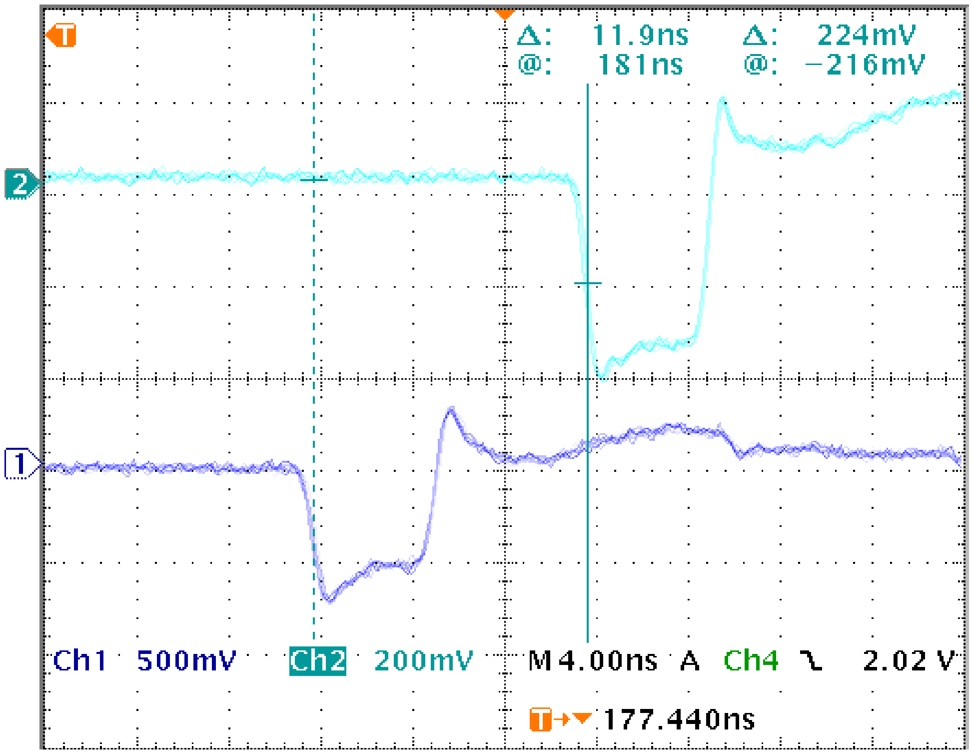
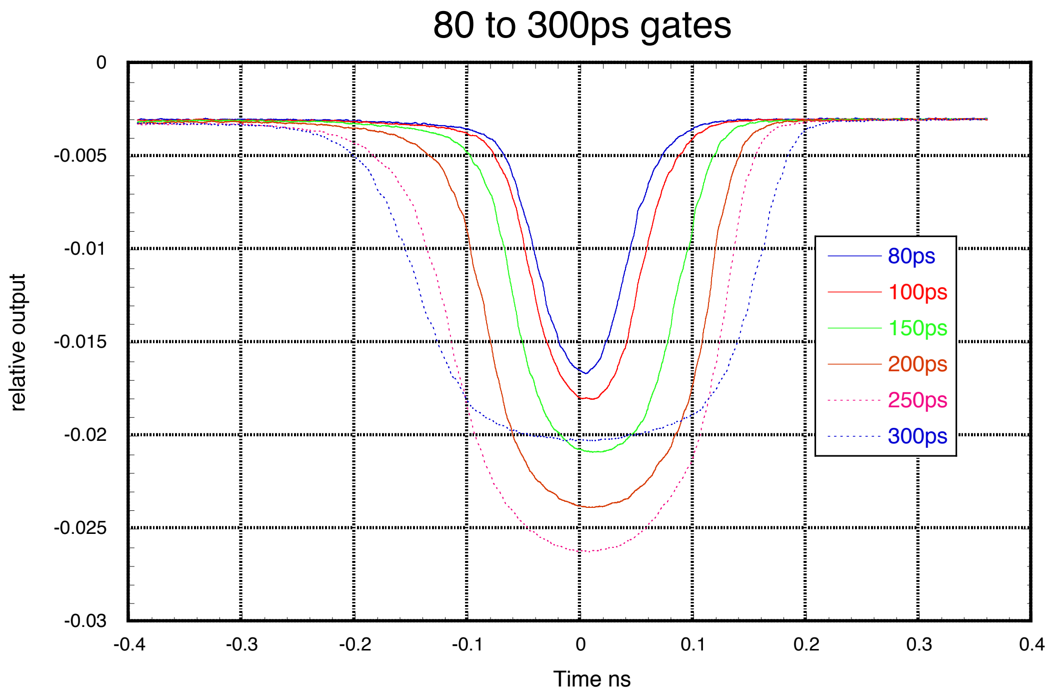
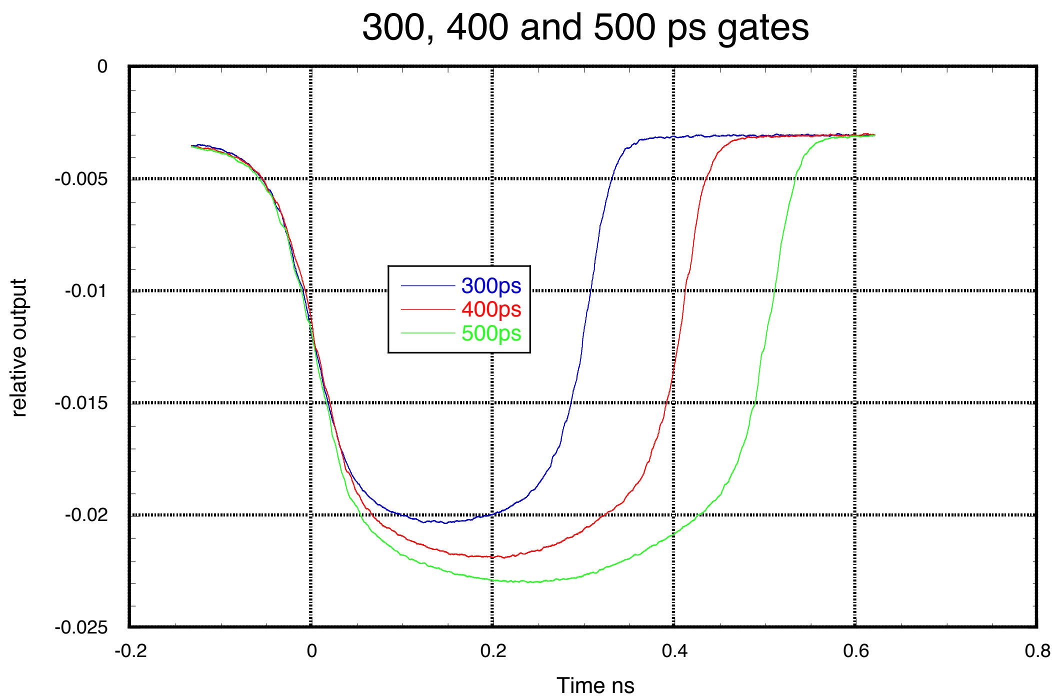
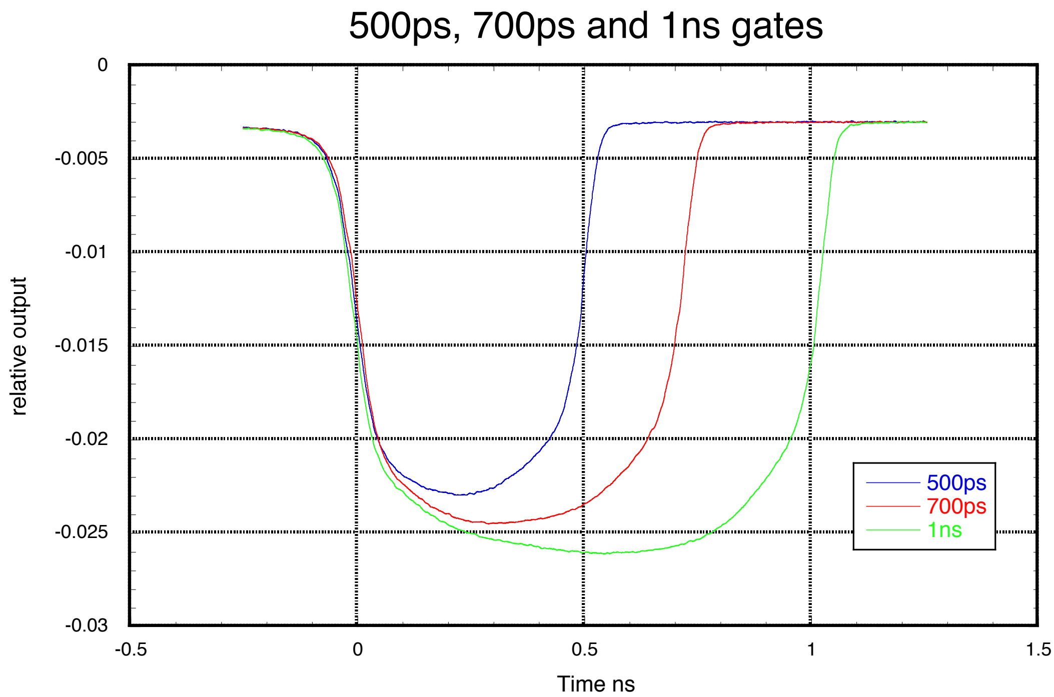


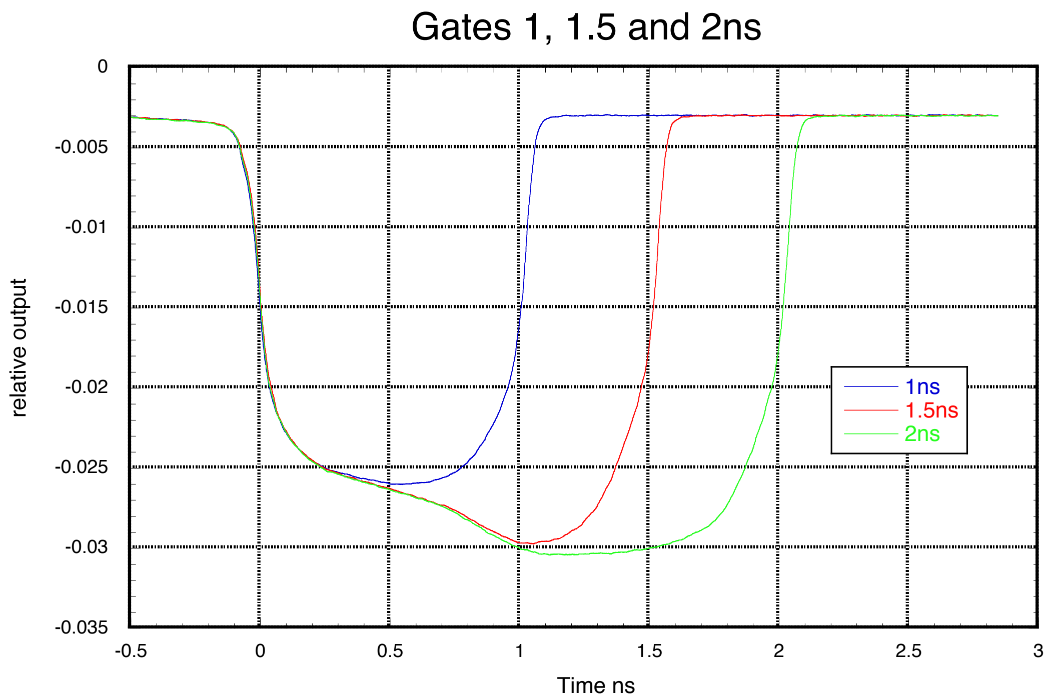
Figure 29 PC and fast monitor
Top trace = fast monitor
Bottom trace = cathode gating pulse picked up by holding scope probe near cathode
Medium gate mode with gate width 5ns

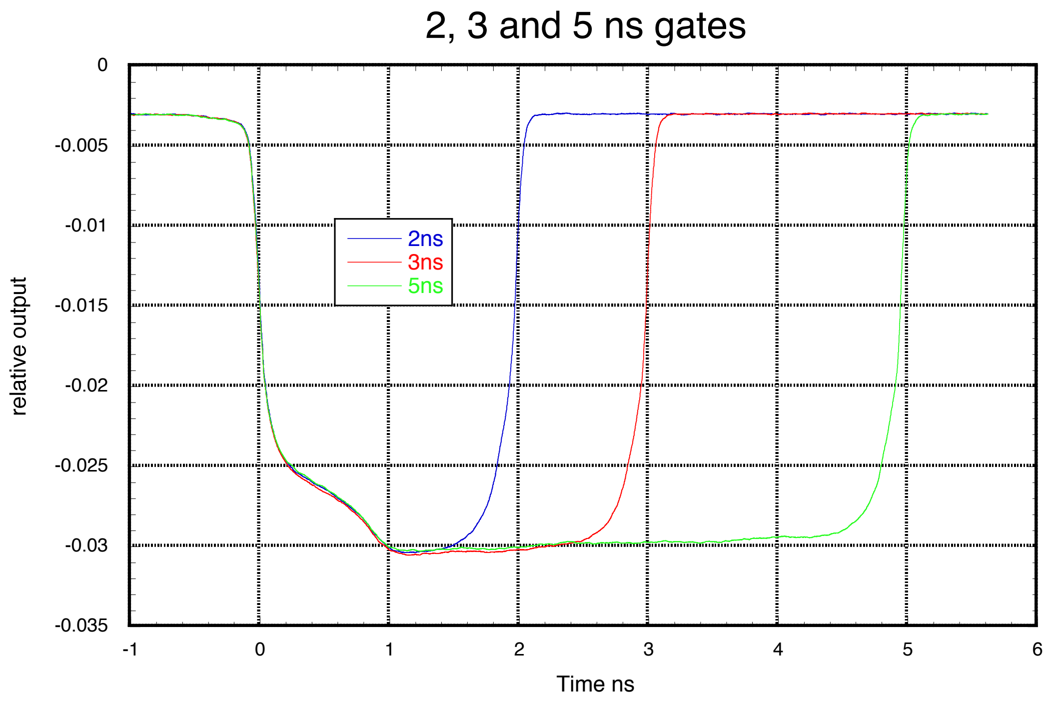
Figure 30   More optical gate waveforms

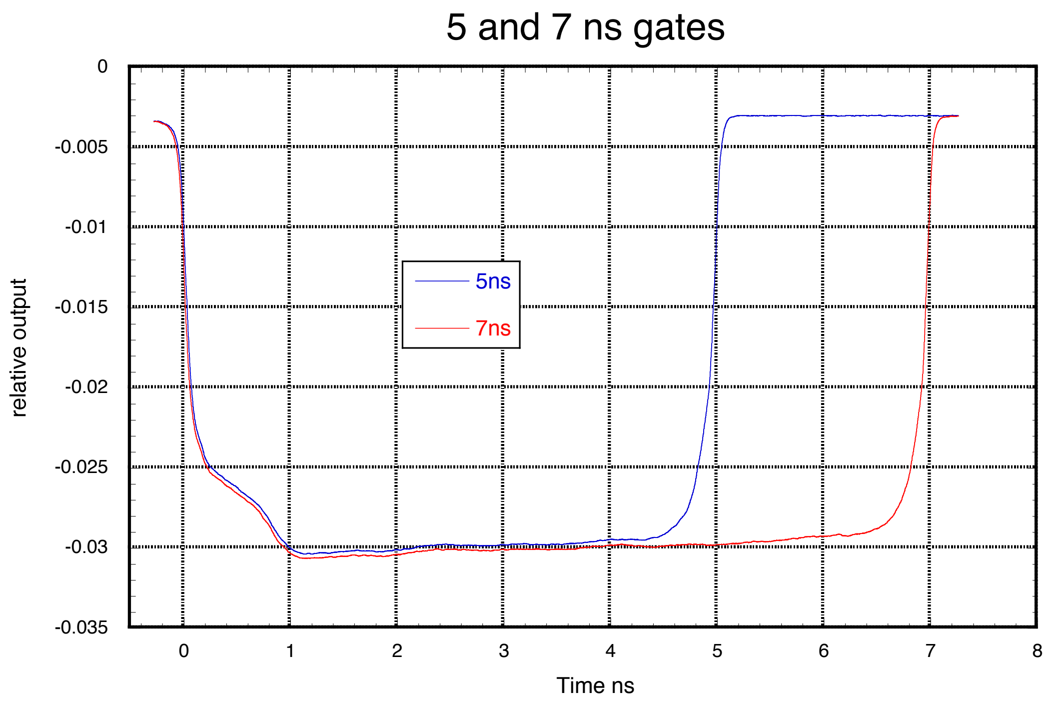


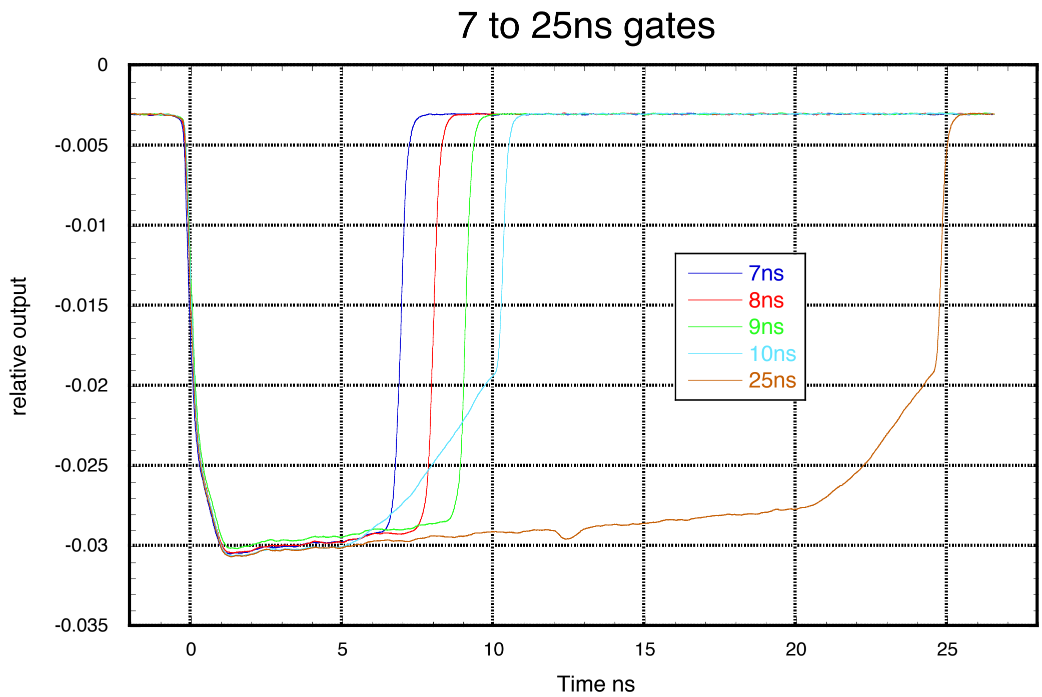


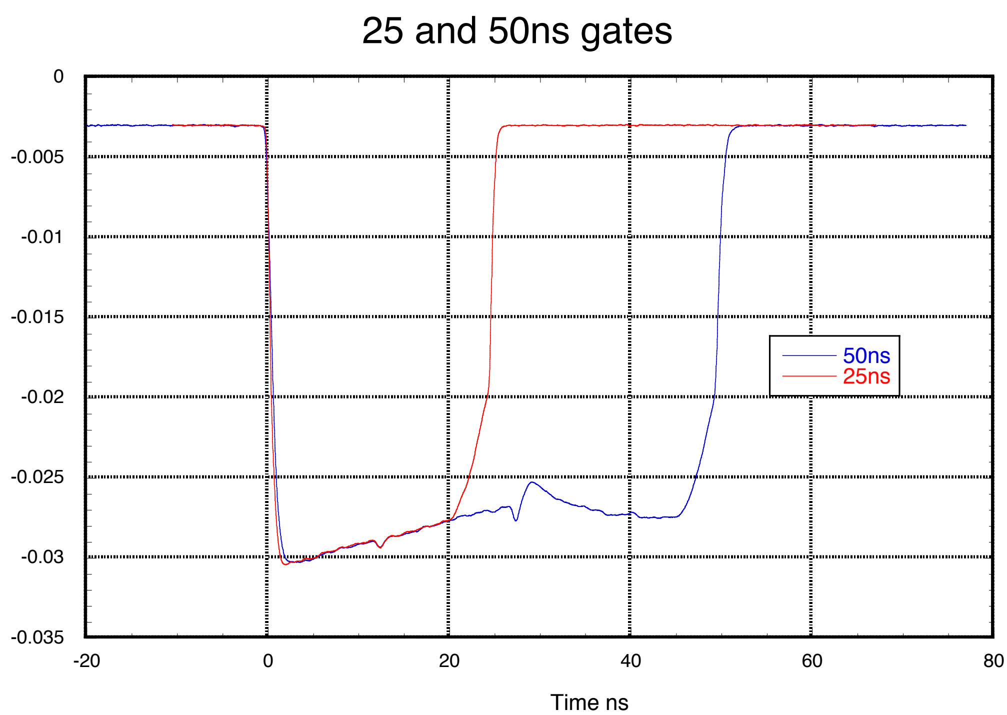

500ps, 700ps and 1ns gates
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
relative output
-0.5
0
0.5
1
1.5
Time ns
500ps
700ps
1ns

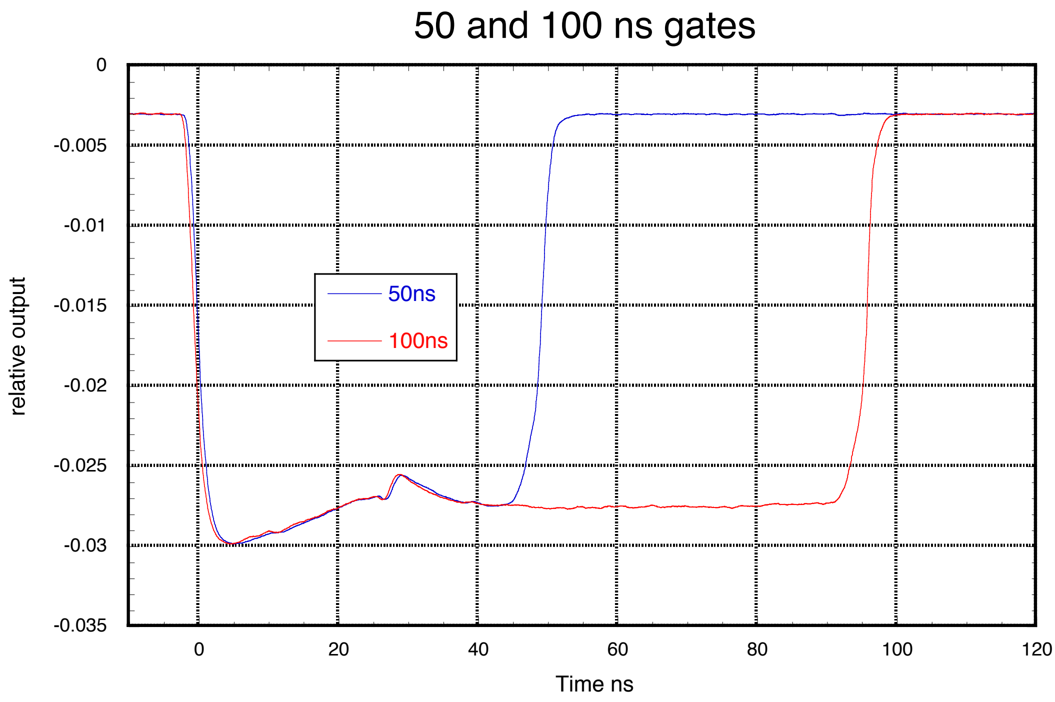

Gates 1, 1.5 and 2ns
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
relative output
-0.5
0
0.5
1
1.5
2
2.5
3
Time ns
1ns
1.5ns
2ns


2, 3 and 5 ns gates
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
relative output
-1
0
1
2
3
4
5
6
Time ns
2ns
3ns
5ns


5 and 7 ns gates
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
relative output
0
1
2
3
4
5
6
7
8
Time ns
5ns
7ns


7 to 25ns gates
relative output
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
0
5
10
15
20
25
Time ns
7ns
8ns
9ns
10ns
25ns


25 and 50ns gates
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
-20
0
20
40
60
80
Time ns
50ns
25ns



50 and 100 ns gates
0
-0.005
-0.01
-0.015
-0.02
-0.025
-0.03
-0.035
relative output
50ns
100ns
0
20
40
60
80
100
120
Time ns

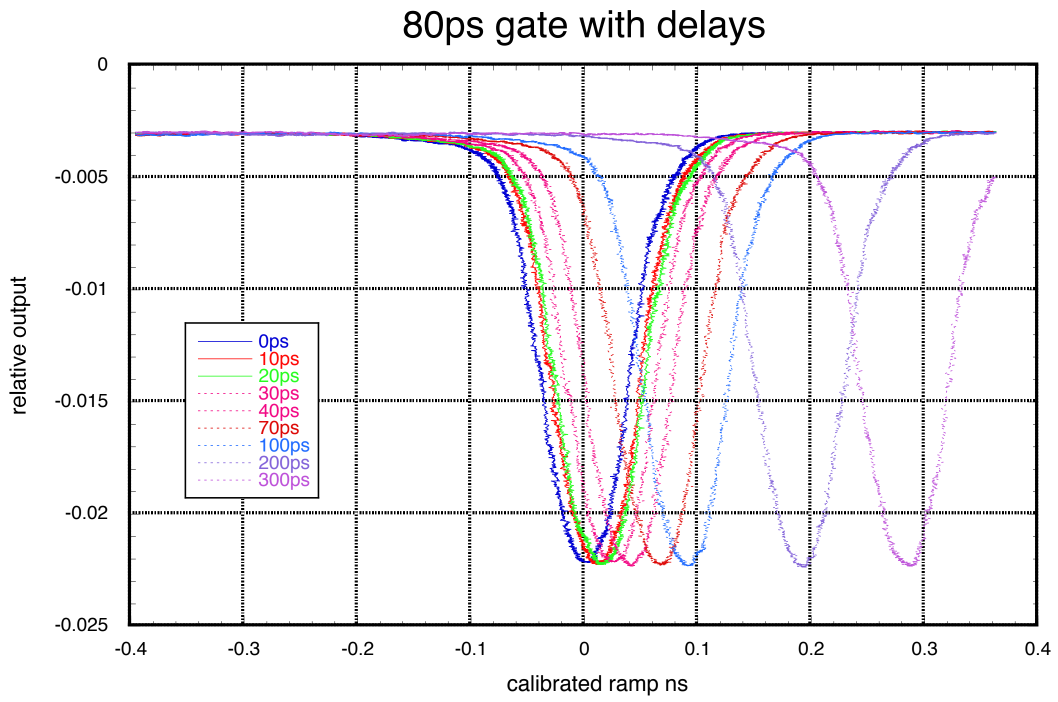


Figure 31 The internal delay system over short delays

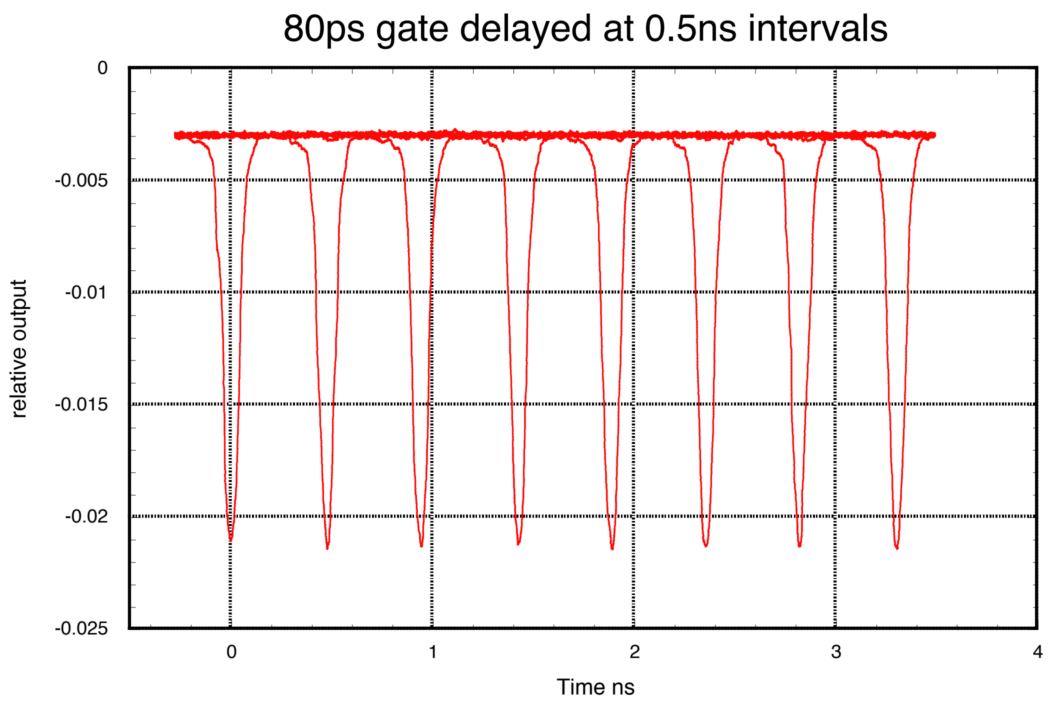


Figure 32 The internal delay system over medium delays

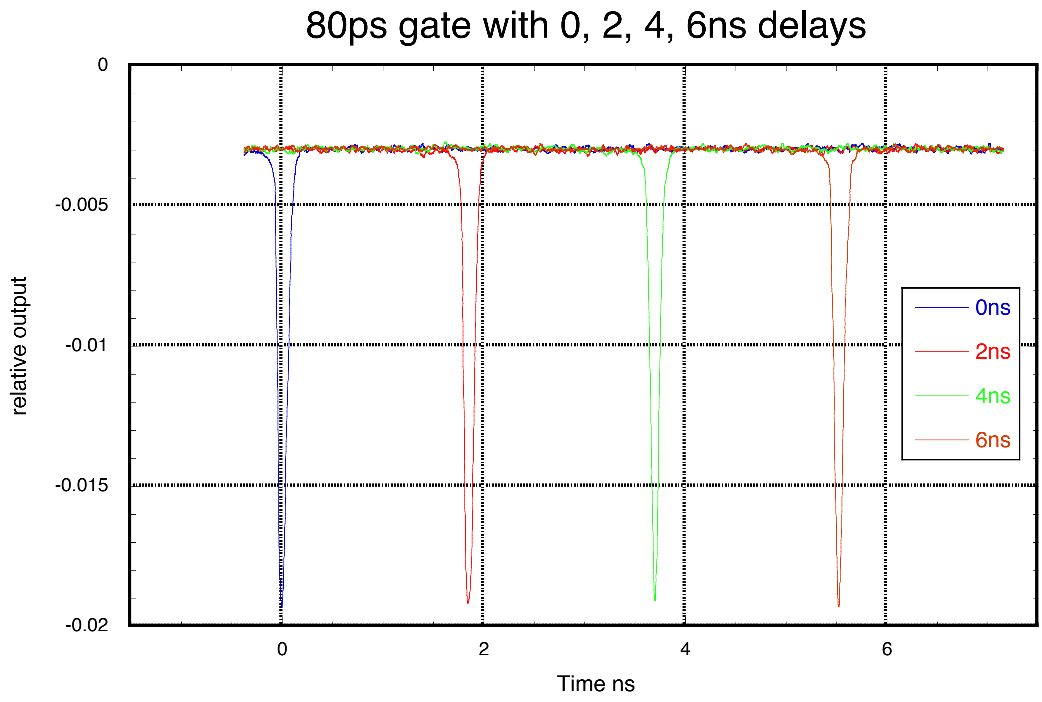


Figure 33 The internal delay system over long delays

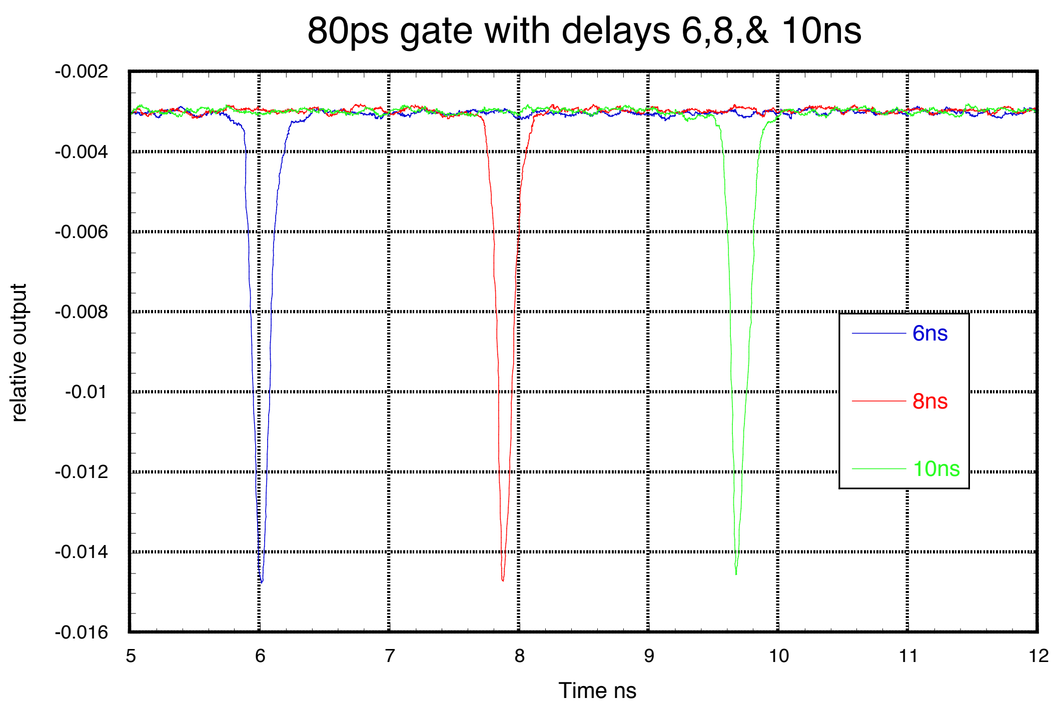


Figure 34 The internal delay system over longest delays

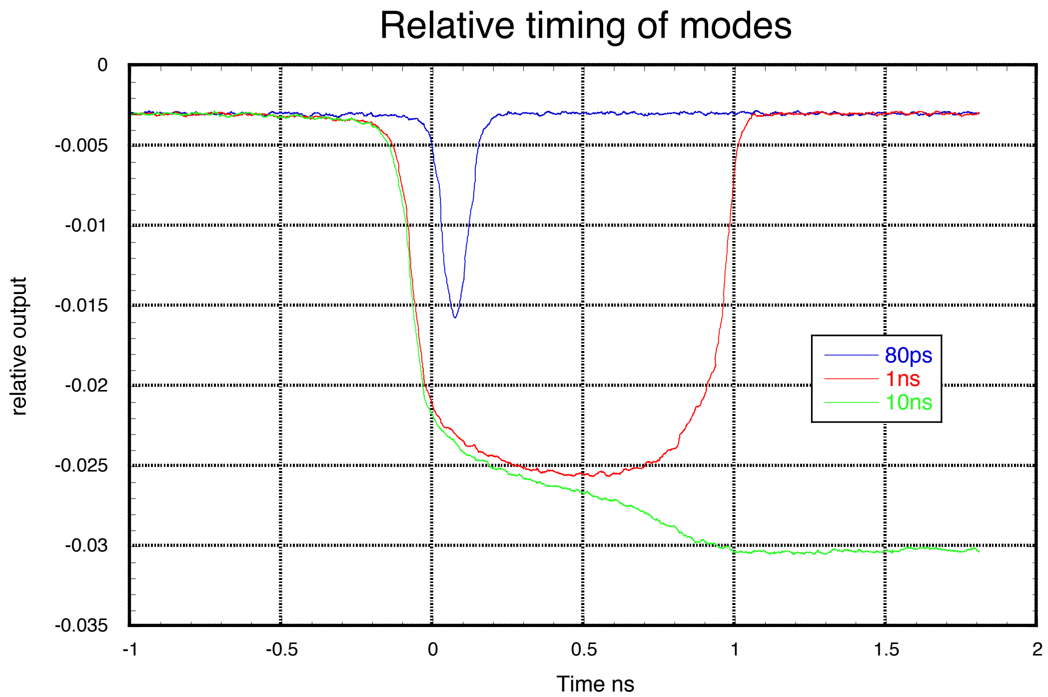


Figure 35 Relative timing of modes
This shows the relative timing of the shortest of each mode

14. TUBE DATA

PHOTONIS

TYPE : **XX2050JD**

SERIAL NO. : C399013
DATE : 2010/10/14

Parameter	Min	Measured	Max	Unit
Radiant sensitivity 270 nm 450 nm 520 nm	25 40 32	45.8 54 40.4		mA/W
Luminance gain 2500 cd/m²/lx at Vmcp		810		V
Luminance gain 5000 cd/m²/lx at Vmcp		879		V
Luminance gain max:6000 cd/m²/lx at Vmcp		895		V
Resolution center		44		lp/mm
Equiv. background illumin.		nm	0.25	µlx
MCP resistance		636		Mohm
Useful cathode diameter	17	OK		mm
Image quality		OK		
Remarks:				Verify by

PHOTONIS

SET-UP INSTRUCTIONS

A-Installation :

· Connect leads or contacts as follows:

Ring:	photocathode
8 bare leads:	MCP input
Black:	MCP output
Yellow:	screen

. Make sure there is a good isolation between the tube and the equipment in which it is mounted.

B-Start-up:

. Follow the instructions below in the order.
The tube being in darkness(less than 1 mlx) apply the voltages in the following order:

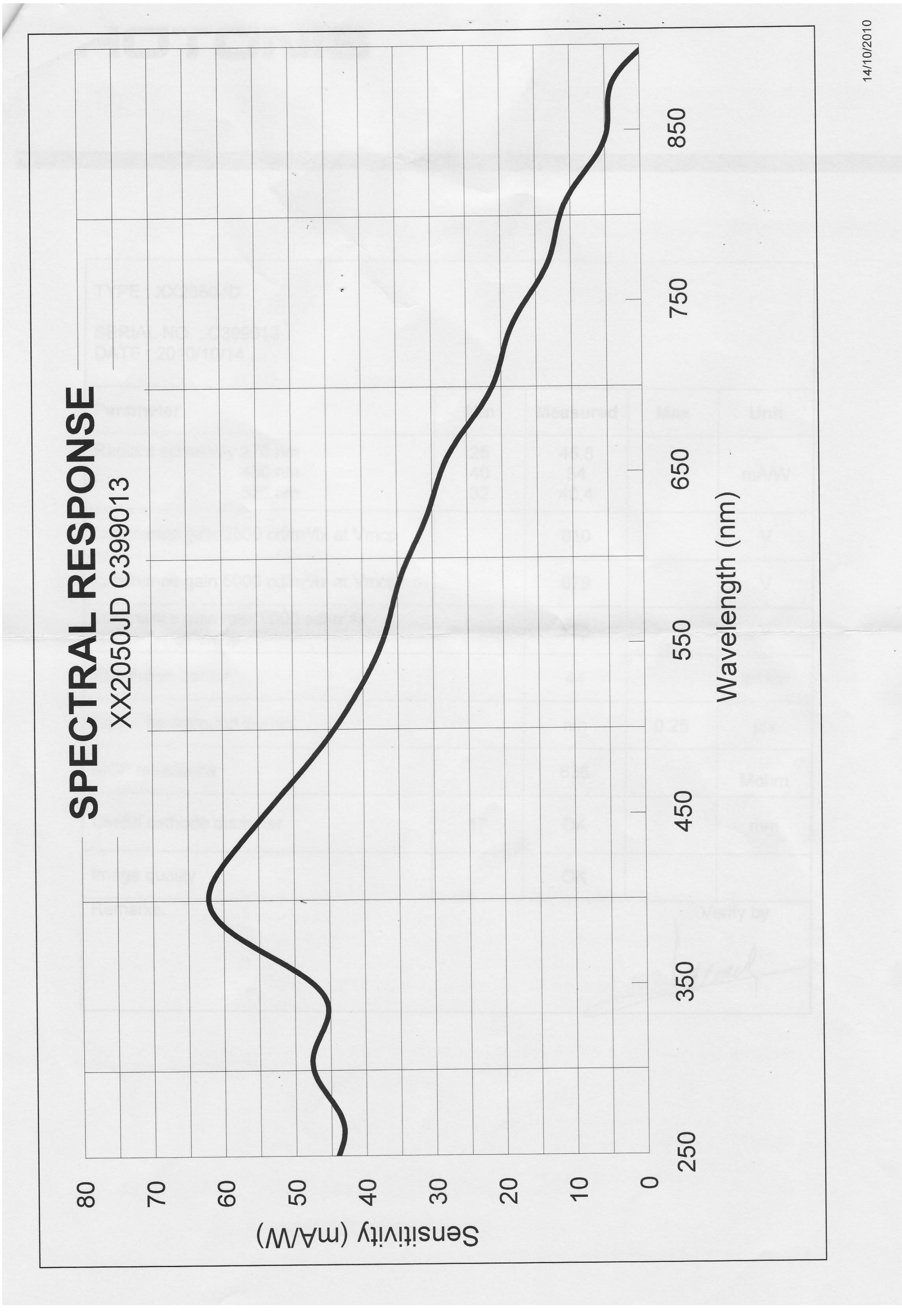
Screen – MCP output	3 000 V
MCP output – MCP input	300 V
MCP input – photocathode:	100 V

- Increase the voltages up to recommended values. Exceeding the maximum values will definitively damage the tube.
- Adjust the input illumination at the required level.

C – Operation precautions:

- Turn off or reduce both the input illumination and the voltages after use in order to avoid early degradation.
- Limit the input illumination in order to increase the life time of the tube. Preferably do not overpass 10 mlx in continuous operation.
- Limit the use of the gating capability (if relevant) to the necessary experiments.

To run the microchannel plate gain in linear mode, the MCP output current must not exceed 10% of the strip current.


SPECTRAL RESPONSE
XX2050JD C399013
Sensitivity (mA/W)
0
10
20
30
40
50
60
70
80
Wavelength (nm)
250
350
450
550
650
750
850
14/10/2010