Edge TCT and DAC scan on CHESS1

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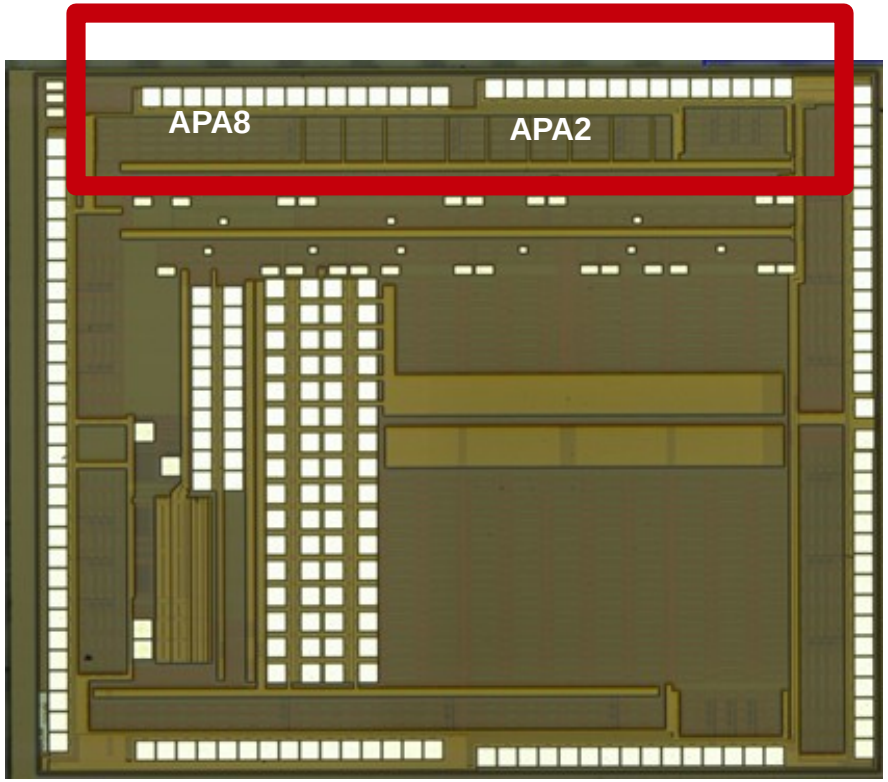
05.01.2016

Ljubljana Status

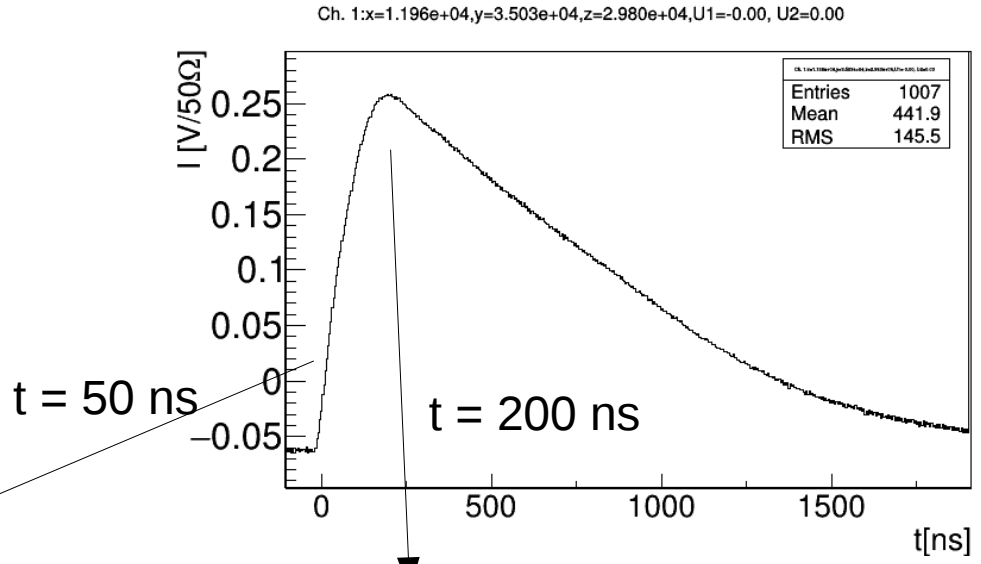
- First edge-TCT measurements done on APA02 and APA08
- A DAC scan was performed to compare the results to the simulation by Hervé G.
- Only 0 V bias voltage could be applied (diffusion contribution only)
- Our CHESS1 chip has been sent back to UCSC for “fixing” a HV short on the chip

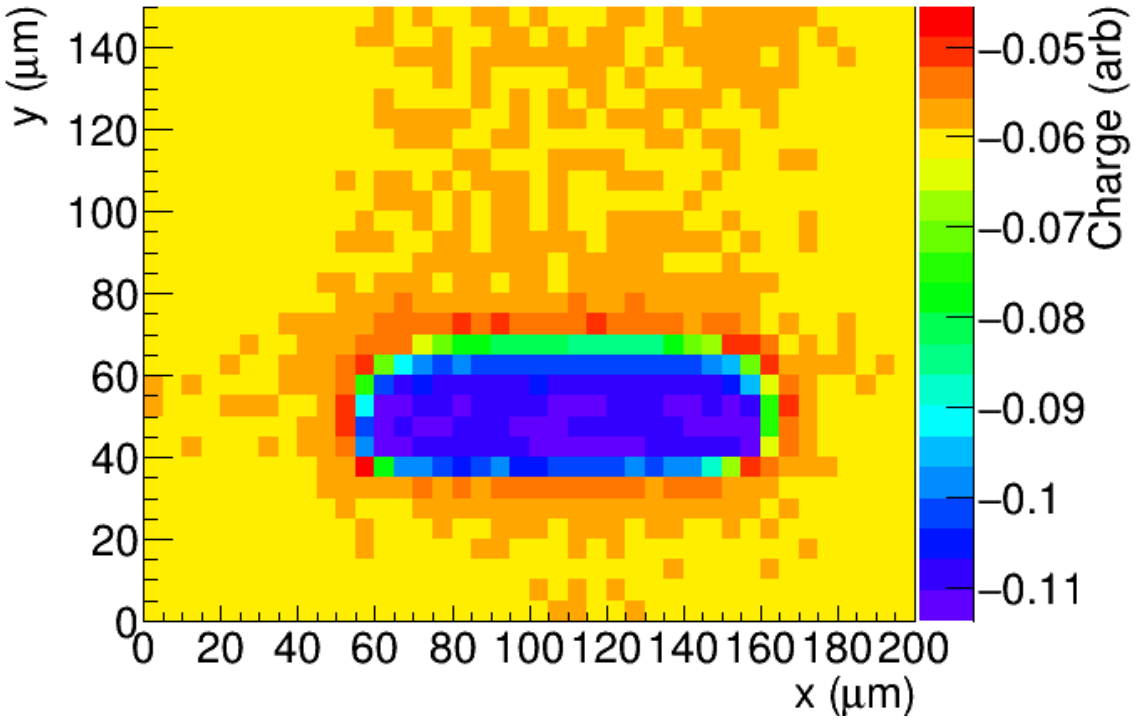


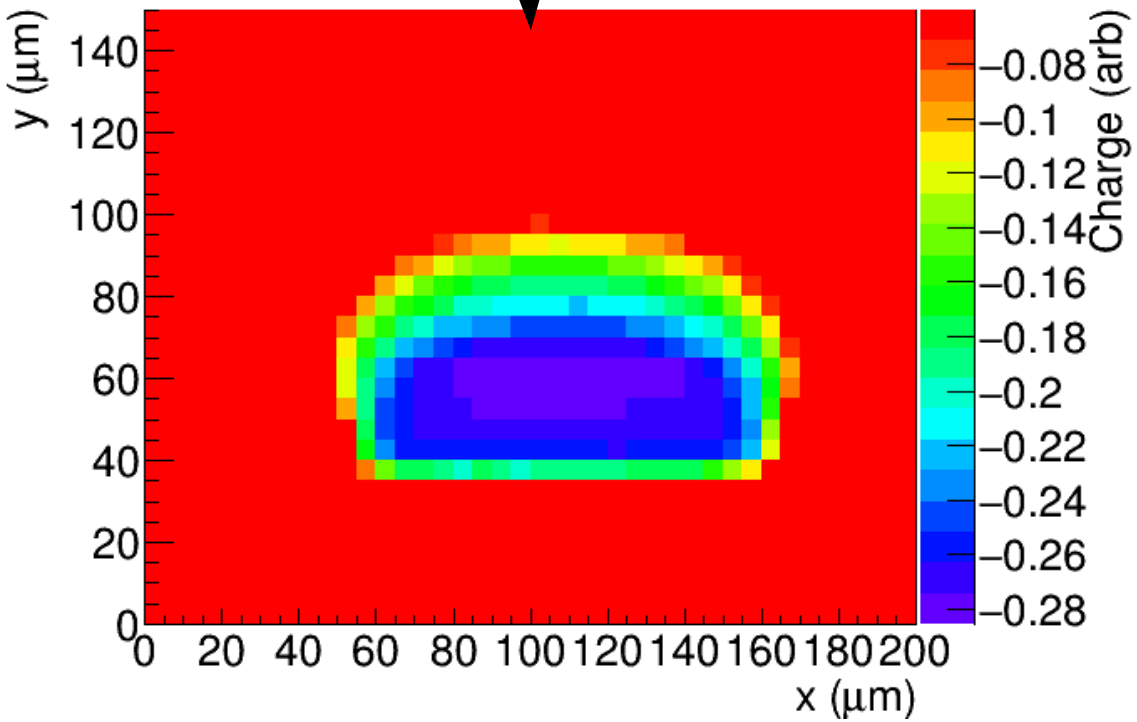
First edge TCT measurement on APA02

- Pixel APA02 output 4 (100 µm x 45 µm)
- Collected charge ~ pulse height
- Current pulse peaks 200 ns after injection

  → (diffusion)
- At shorter times only charge close to the surface collected

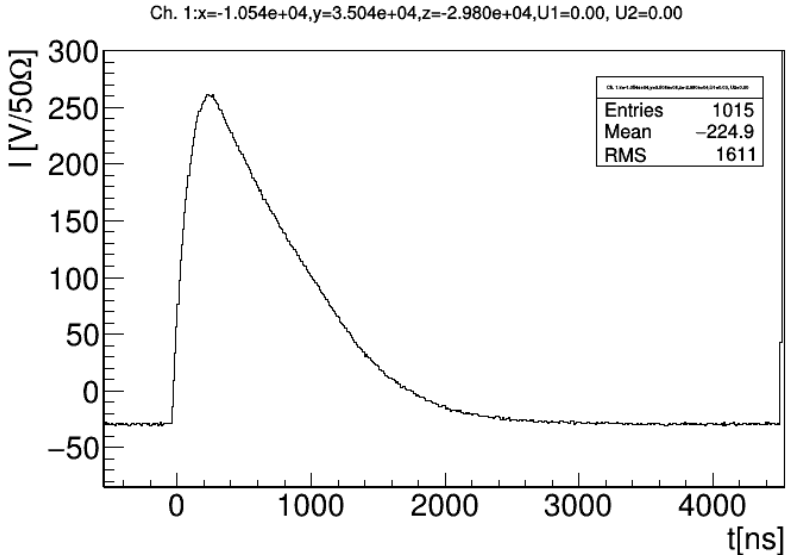


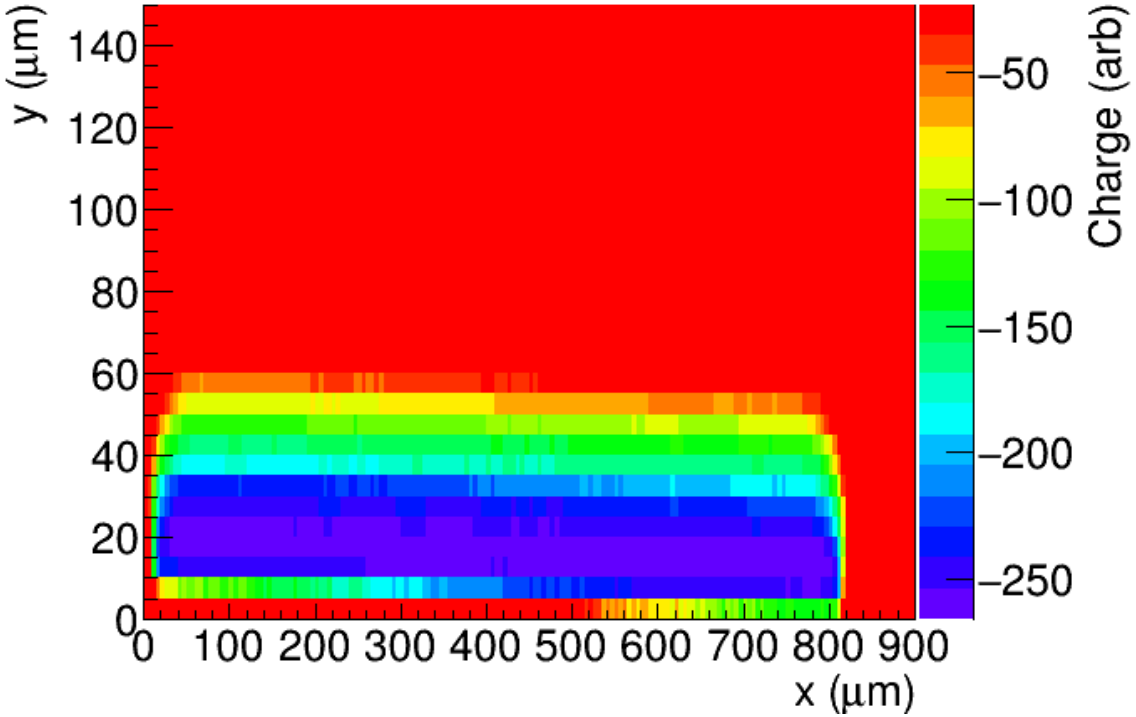


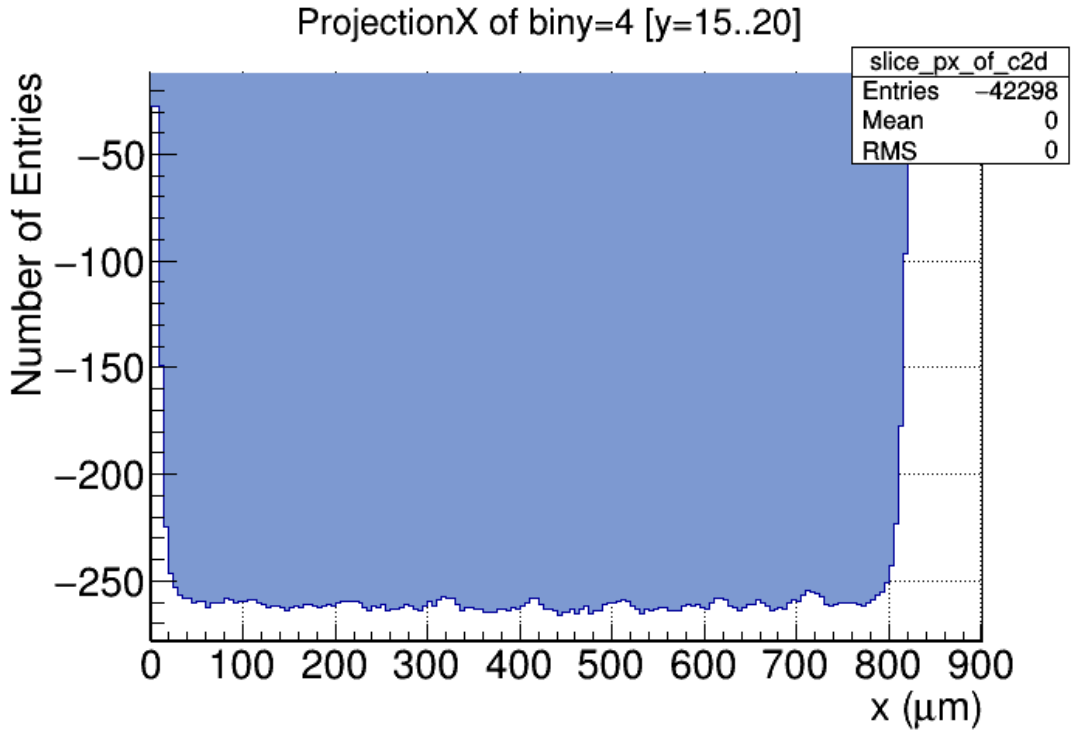


First edge TCT measurement on APA08

- Pixel APA08 output 6 (800 µm x 45 µm)
- Pixel substructure 8 x 100 µm sections visible



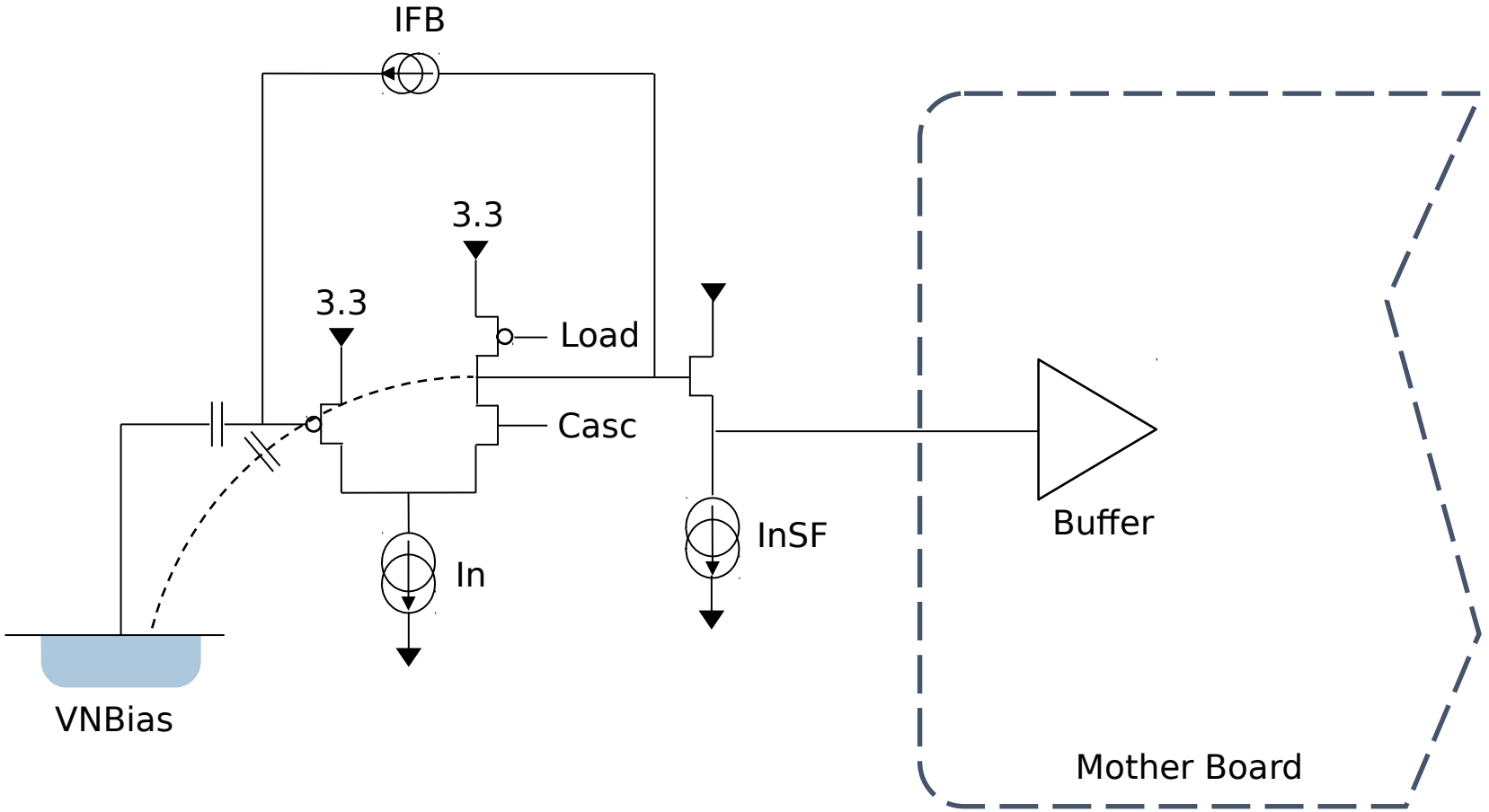




DAC scan

- Influence of DAC values on the signal shape described and simulated in a document from Hervé G. (distributed by email on 12.12.2015)
- Make measurements on a real device to verify the simulation
- Test pulses generated in APA02 (pixel 2) at a fixed position by edge TCT
- 0 V bias voltage
- No measurement of noise (next time could measure baseline fluctuations using RMS function on oscilloscope)
- Scan performed in the following way:
  - change values of DAC 1, while keeping other 5 DACs fixed at their default values
  - change values of DAC 2, while keeping other 5 DACs fixed at their default values
  - etc.

CHESS1 pixel and biases



[by Hervé G.]

Typical biases for CHESS1

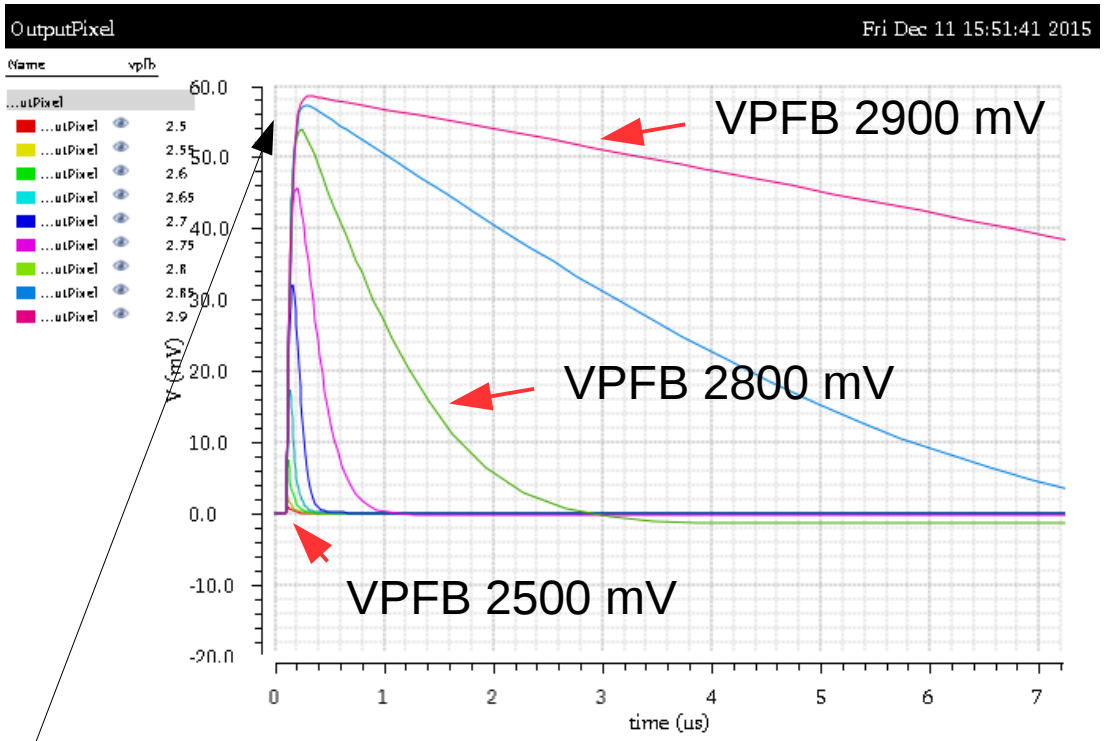
	Typical value	Can change?
VPFB	2.65V to 2.8V	Yes adjust gain
VNSF	0.5V to 0.8V	Yes adjust to your output load
VCasc	2.6V	Not needed
VPload	2.1V	Not needed
VN	1V	Not needed
VNBias	250mV	Not needed

[by Hervé G.]

Default values used in Ljubljana: 2700, 650, 2600, 2100, 1000, 250 (VPFB, VNSF, VCASC, VPLOAD, VN, VBIAS)

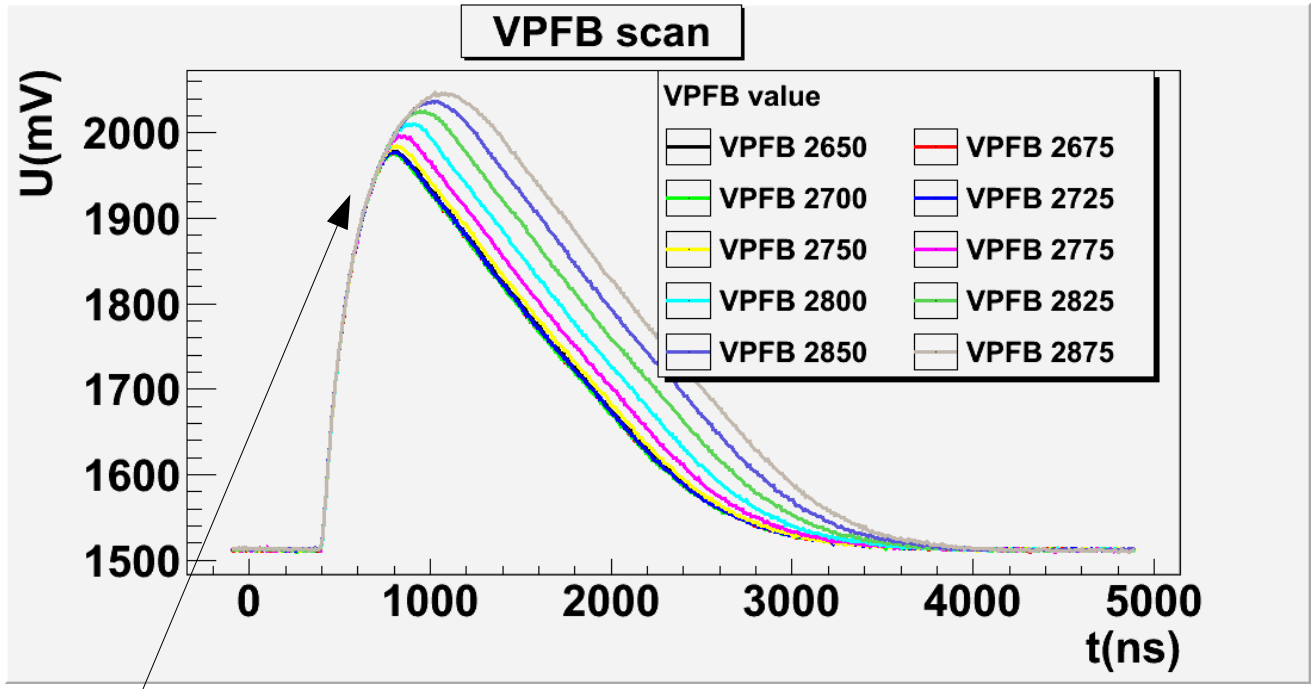
Simulation of results increasing VPFB

Simulation



Signal amplitude 60 mV

Measurement

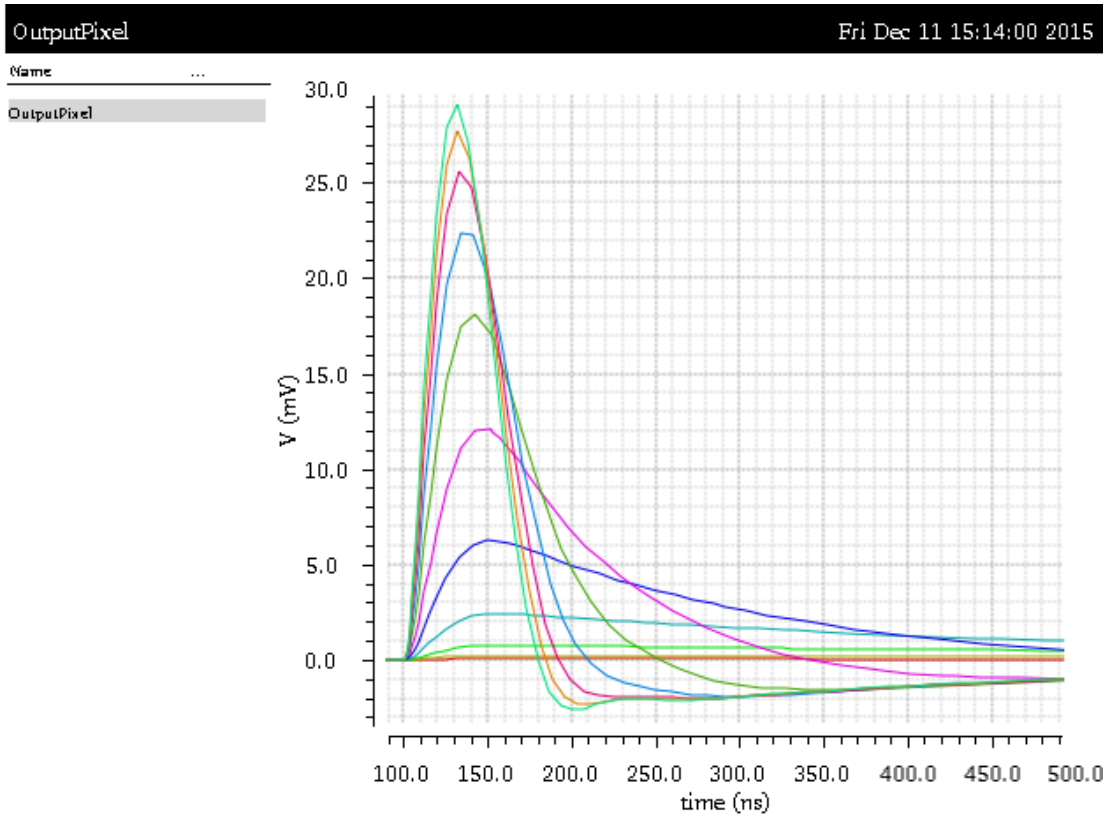


Signal amplitude 500 mV

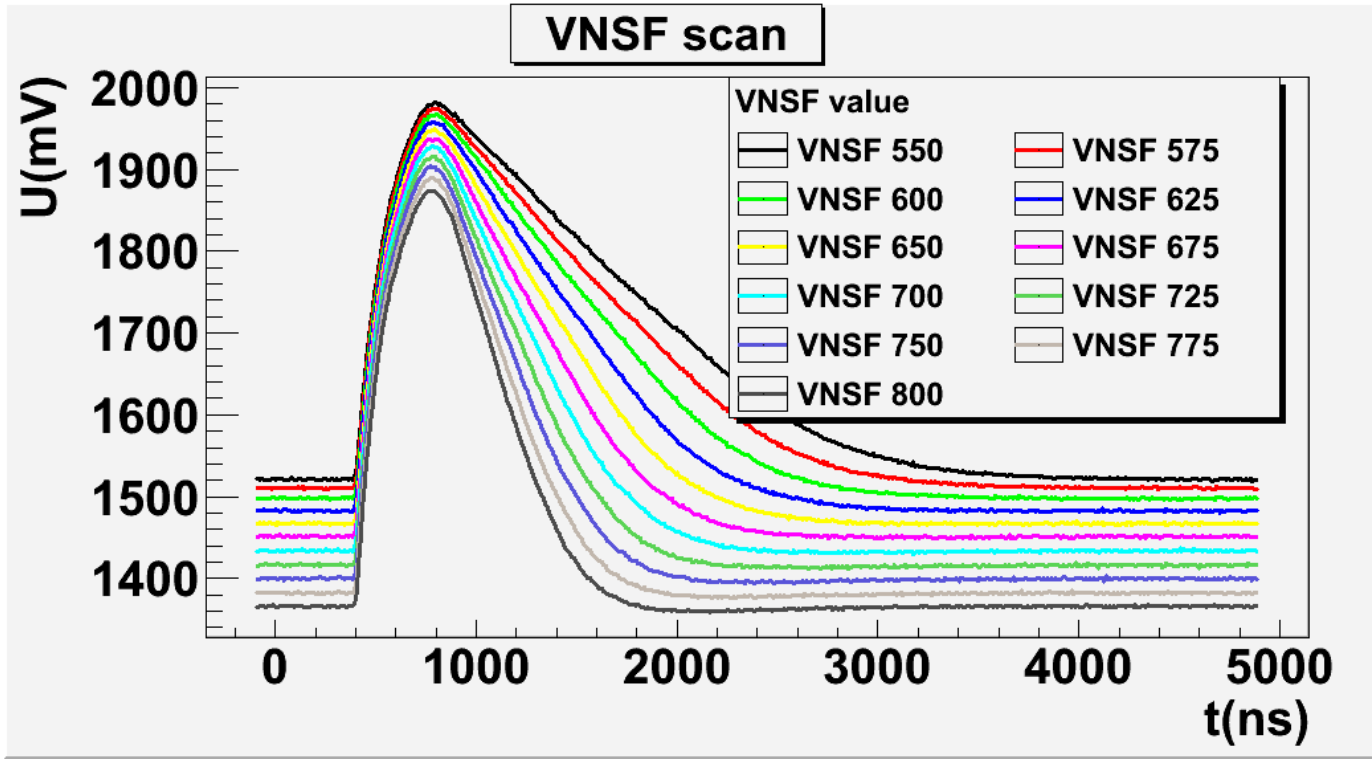
50 Ohm DC coupling on oscilloscope
→ baseline approx. 1.5 V

Simulation of results increasing VNSF

Simulation



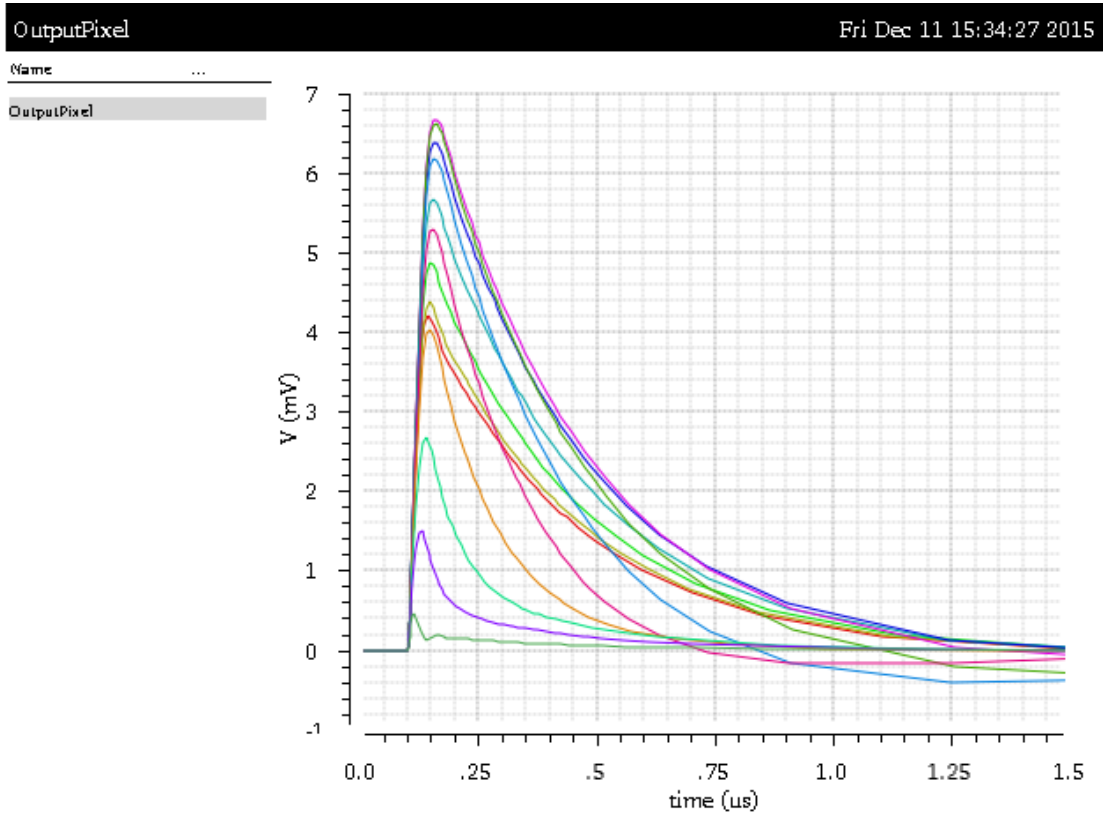
Measurement



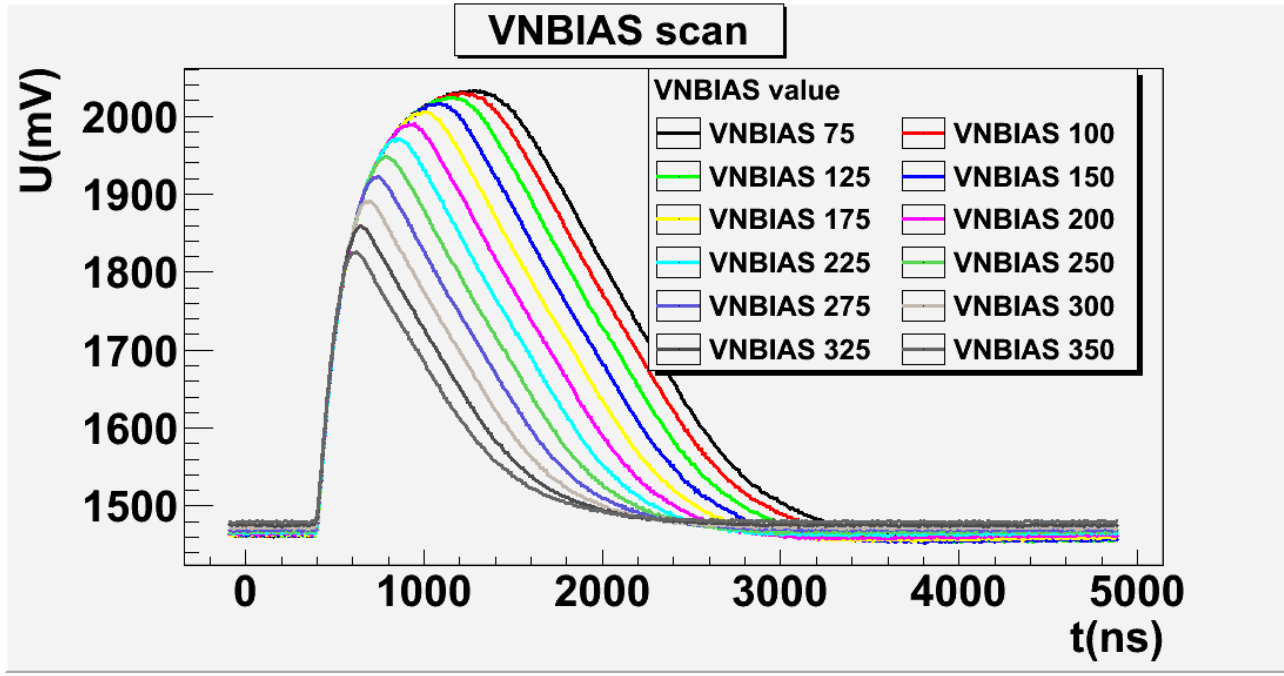
Signal amplitude:
simulation 30 mV
Measurement 500 mV

Increasing VNBias

Simulation



Measurement



Signal amplitude:
simulation 7 mV
Measurement 500 mV

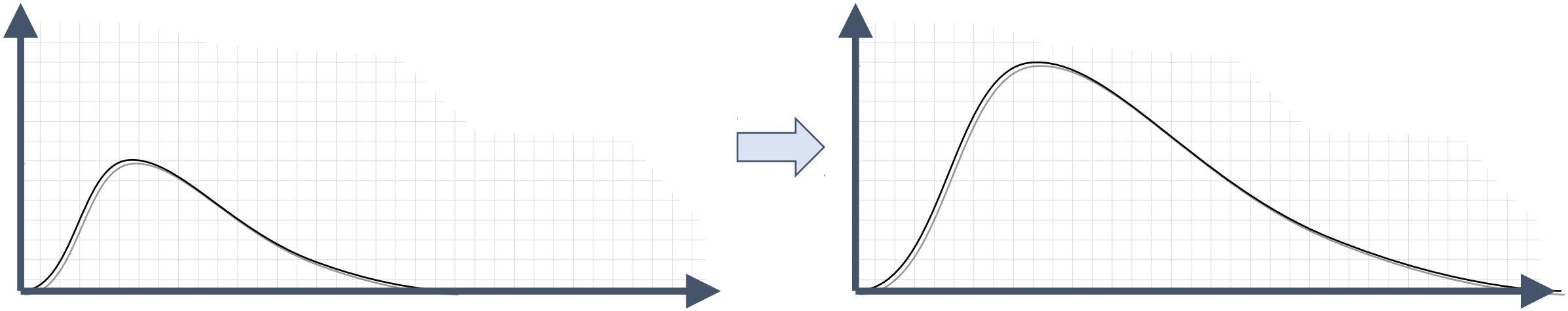
Summary

- First edge TCT measurements were done with CHESS1 (0 V bias)
- After “fixing” the chip, edge TCT measurements with BIAS VOLTAGE can be performed
- DAC scan: to achieve more comparable results between MEASUREMENT and SIMULATION the scan could be repeated using lower laser pulses or adding an absorber in front of the sample. Can also try measuring noise level.

BACKUP

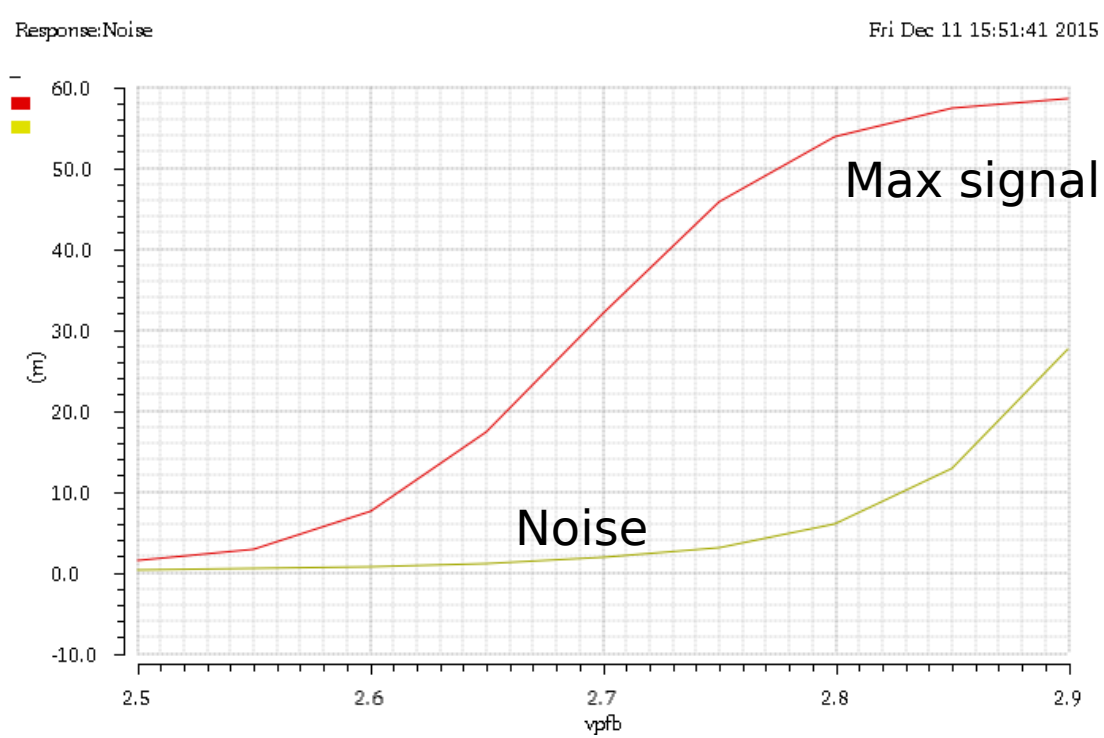
Increase of VPFB

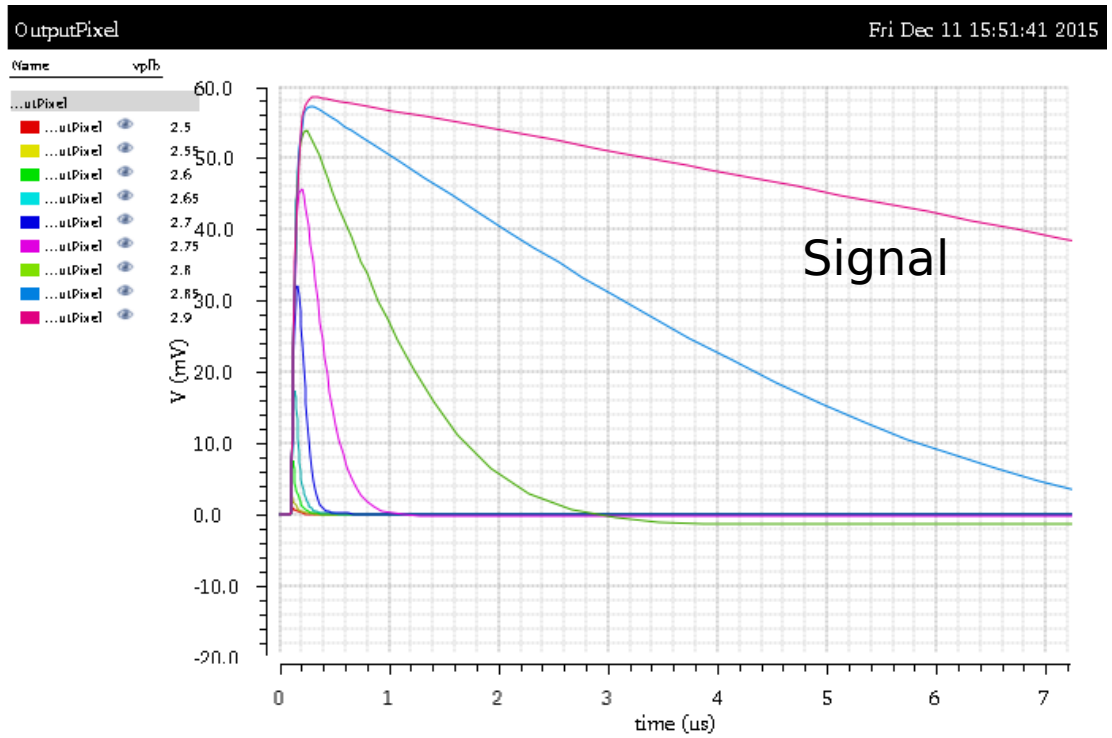
- VPFB controls the gain
  - Increasing VPFB increases the gain
  - However it also increases the pulse duration and the noise.
- Typ. Value = 2.65V to 2.8V



[by Hervé G.]

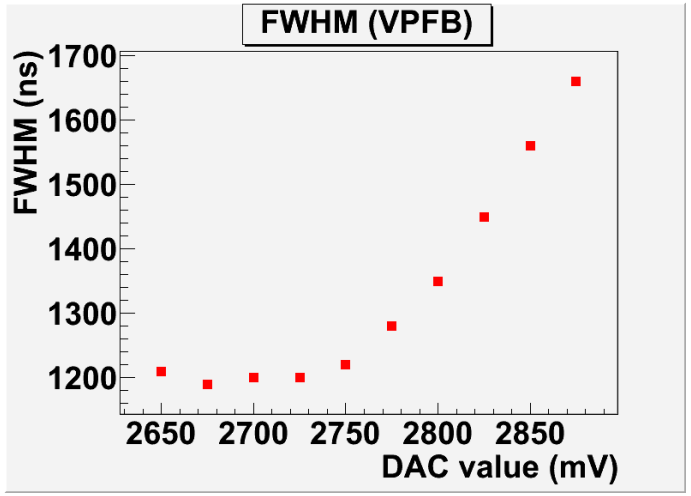
Simulation of results increasing VPFB

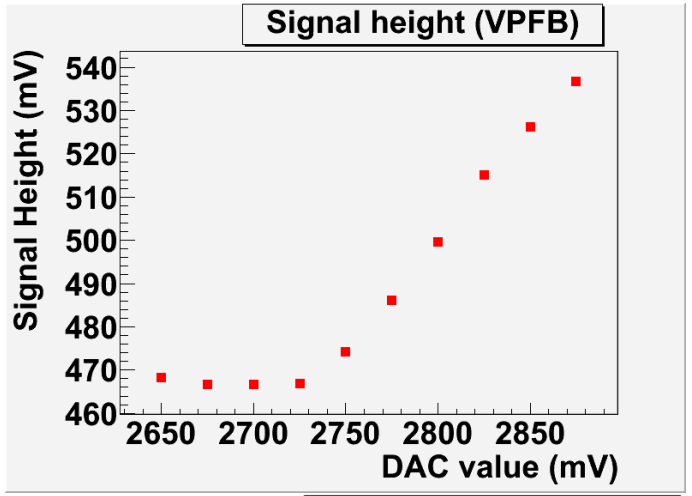


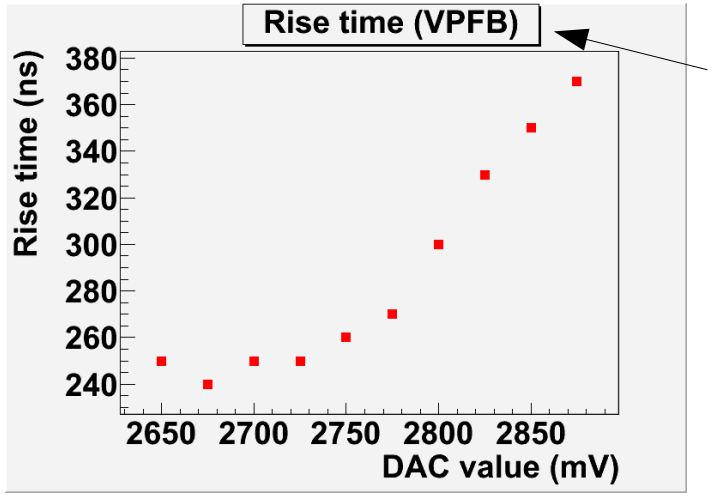


VPFB increase

[by Hervé G.]

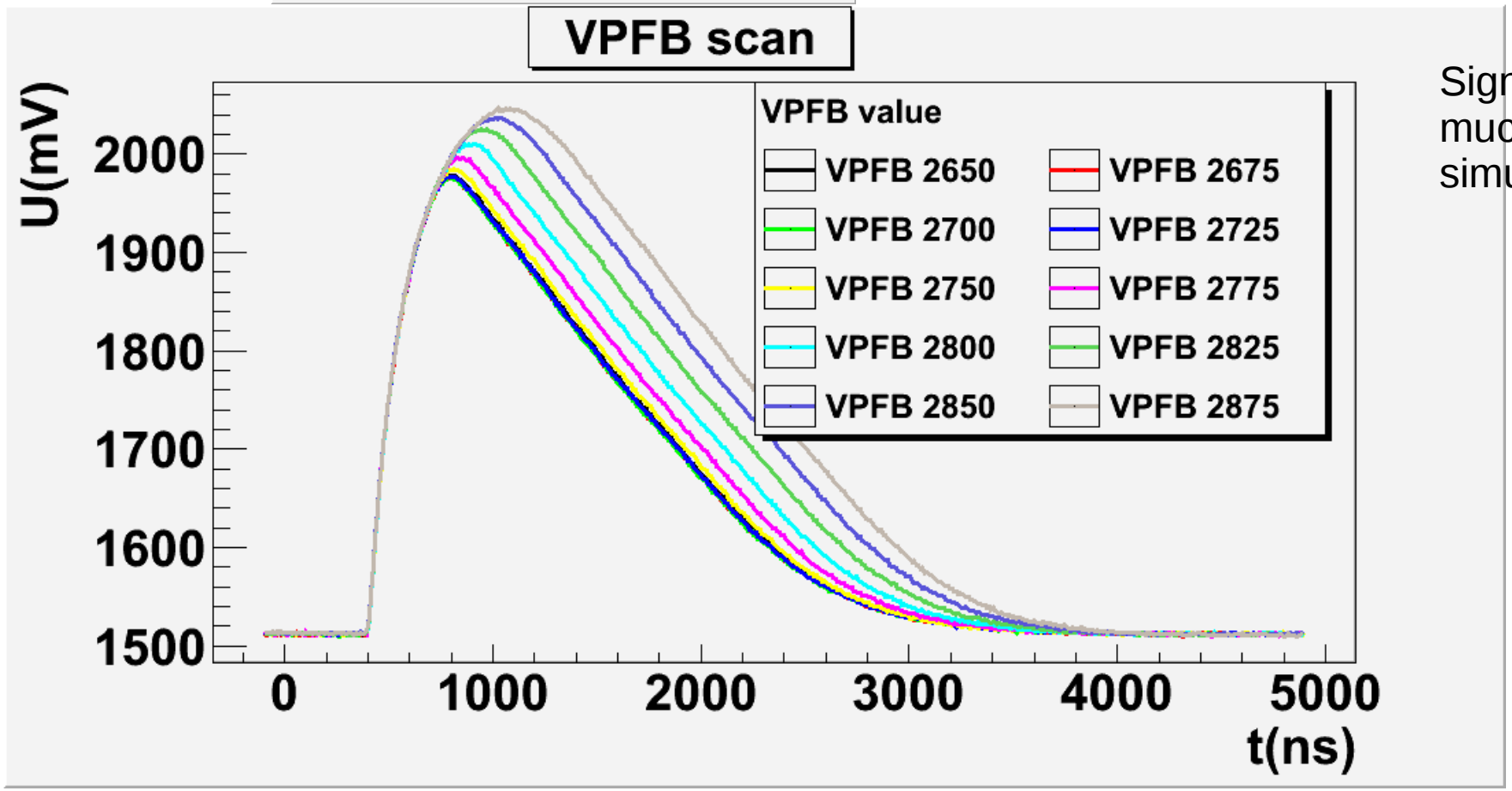






Between 0.1 and 0.9 signal height

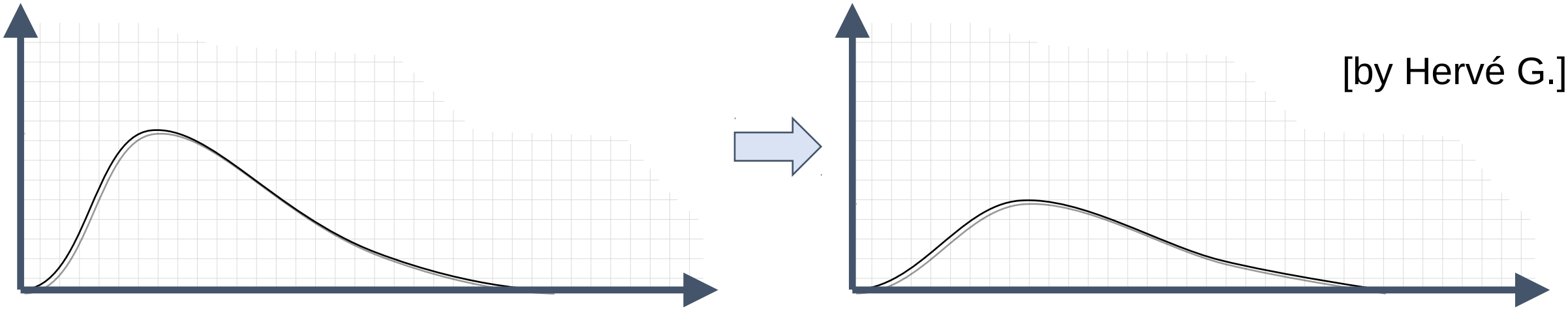
VNSF not at default value 650 mV, but at 570 mV (overlook)



Signal height 500 mV much greater than in simulation

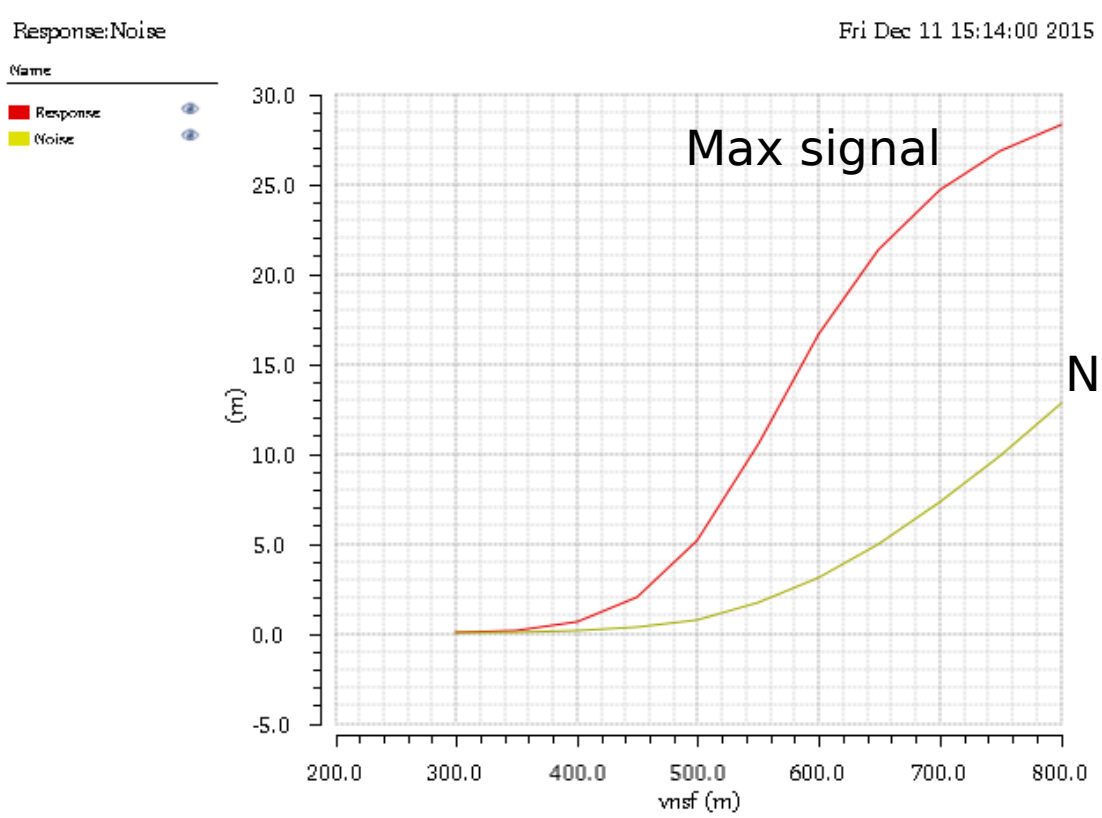
Decrease of VNSF

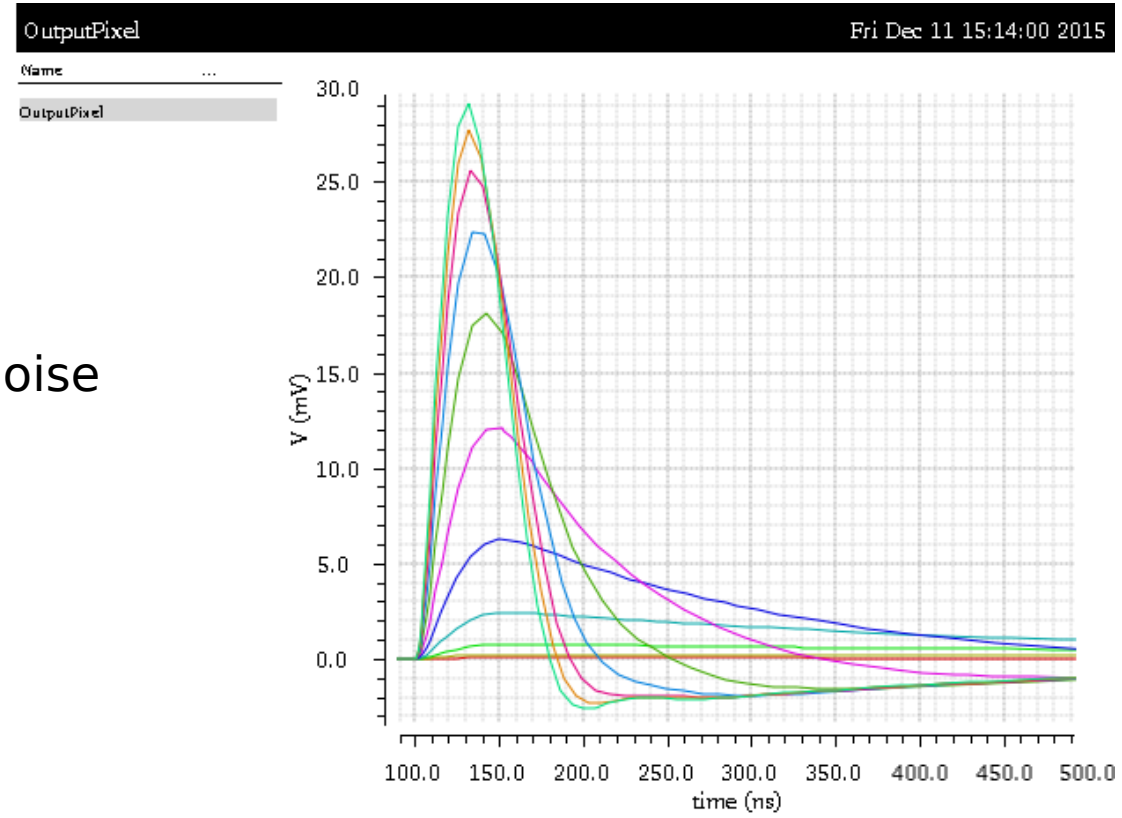
- VNSF controls the source follower after the amplifier.
- Decreasing VNSF decreases the current in the source follower
  - This Source follower can be considered as a low pass filter.
  - Reducing the current in the source follower increases the time constant of the low pass filter, slowing down the pulse and attenuating it
  - If the current is reduced too much the source follower is not able to drive the output capacitance and the gain will drop.
- Typ. value = 0.55V to 0.8V



[by Hervé G.]

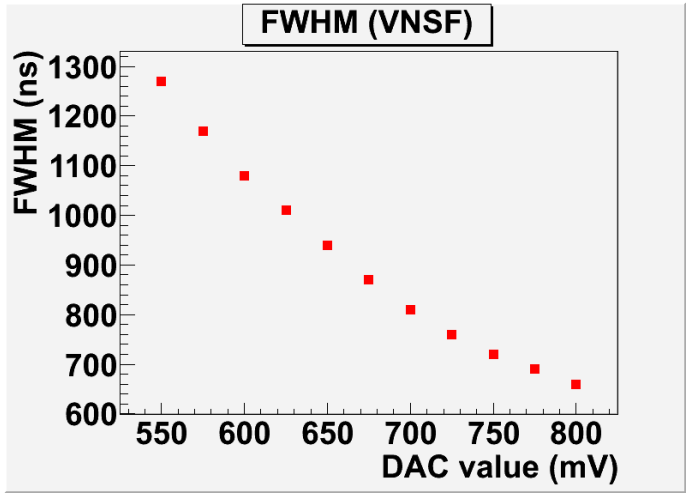
Increasing VNSF

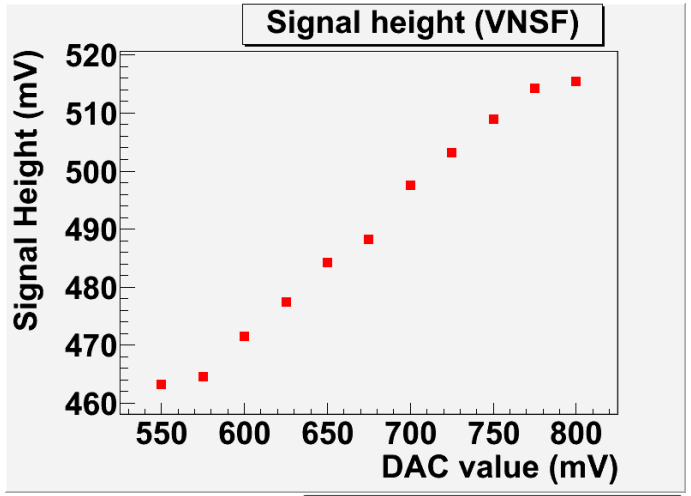


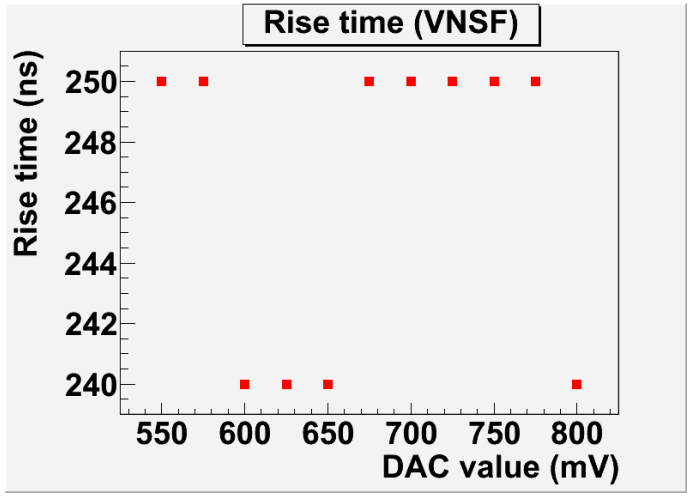


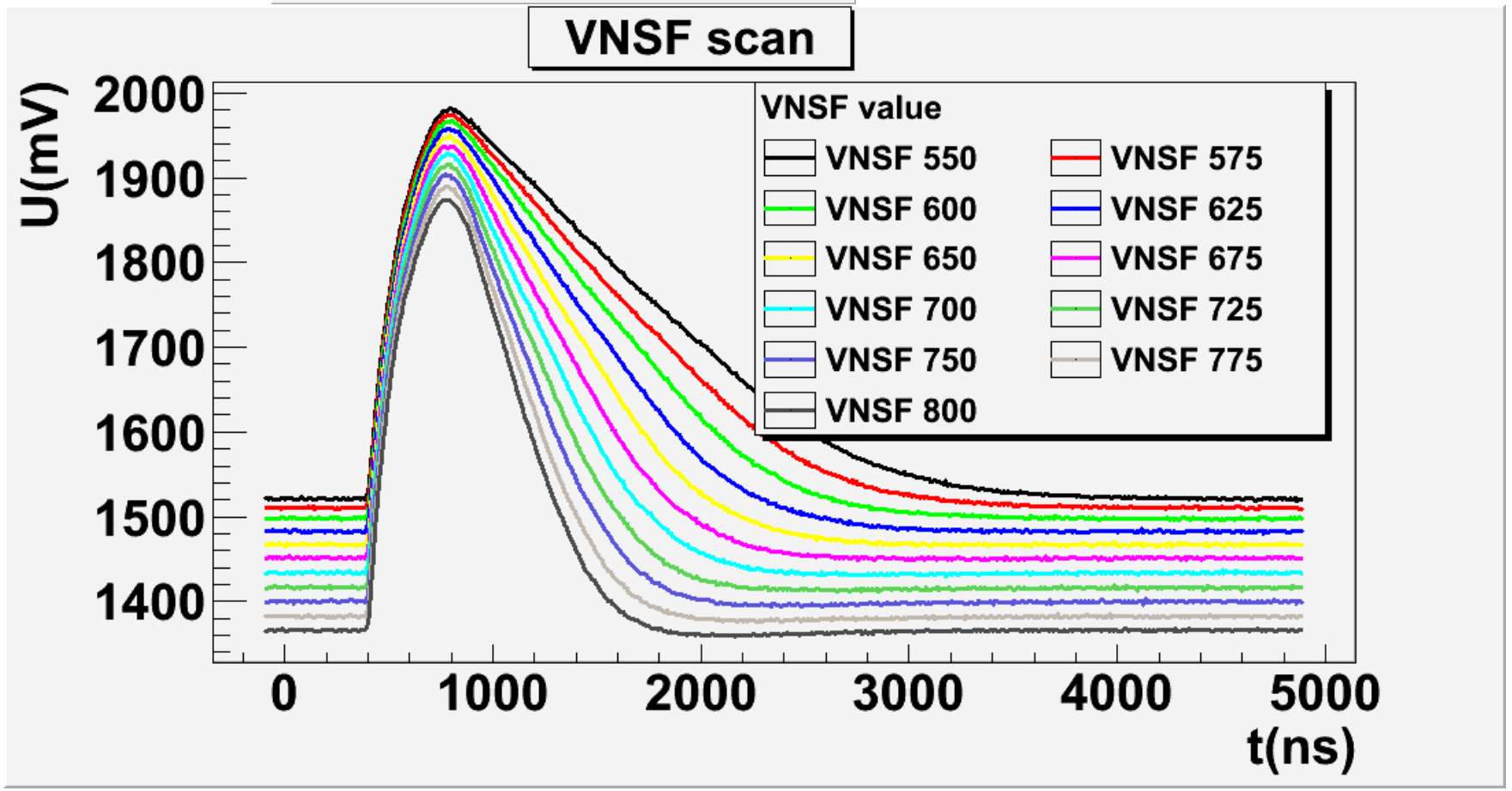
VNSF increase

[by Hervé G.]


FWHM (VNSF)
FWHM (ns)
1300
1200
1100
1000
900
800
700
600
550
600
650
700
750
800
DAC value (mV)

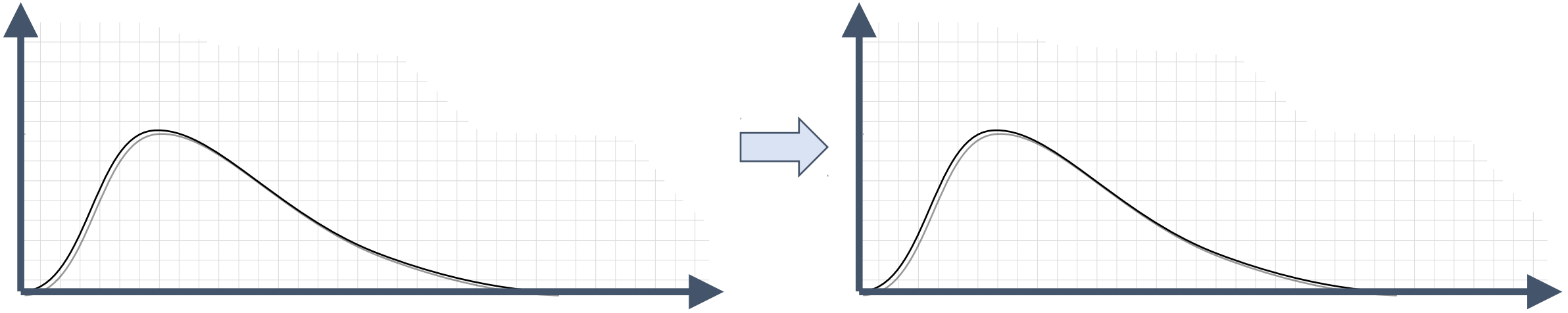

Signal height (VNSF)
Signal Height (mV)
520
510
500
490
480
470
460
550
600
650
700
750
800
DAC value (mV)


Rise time (VNSF)
Rise time (ns)
250
248
246
244
242
240
550
600
650
700
750
800
DAC value (mV)

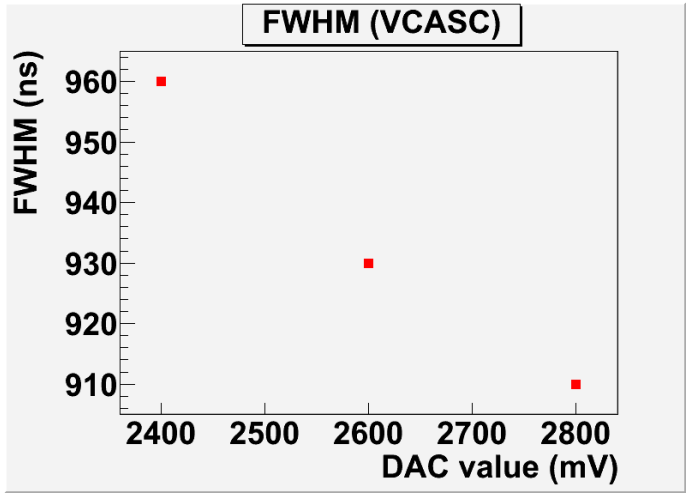

VNSF scan
U(mV)
2000
1900
1800
1700
1600
1500
1400
0
1000
2000
3000
4000
5000
t(ns)
VNSF value
VNSF 550
VNSF 575
VNSF 600
VNSF 625
VNSF 650
VNSF 675
VNSF 700
VNSF 725
VNSF 750
VNSF 775
VNSF 800

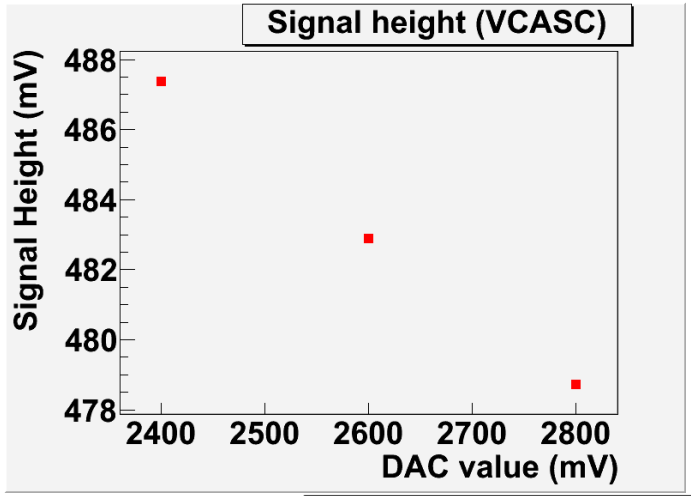
Modifying VCasc

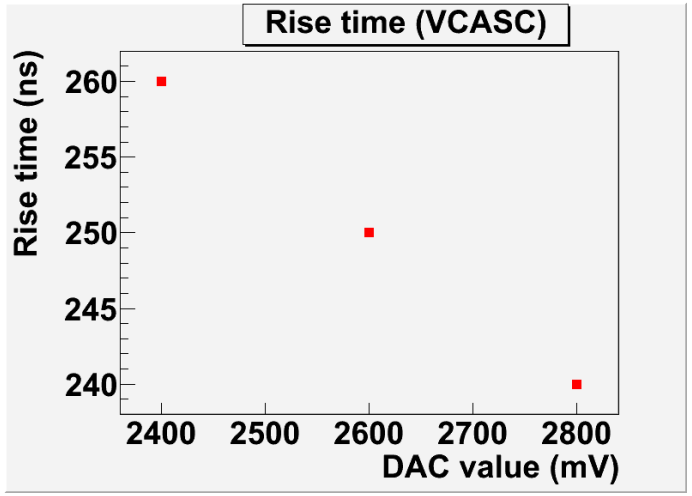
- Vcasc controls the cascoding of the amplifier.
- It shouldn’t be modified and modifying its value shouldn’t have an impact on the response.
- Typ. value = 2.6V

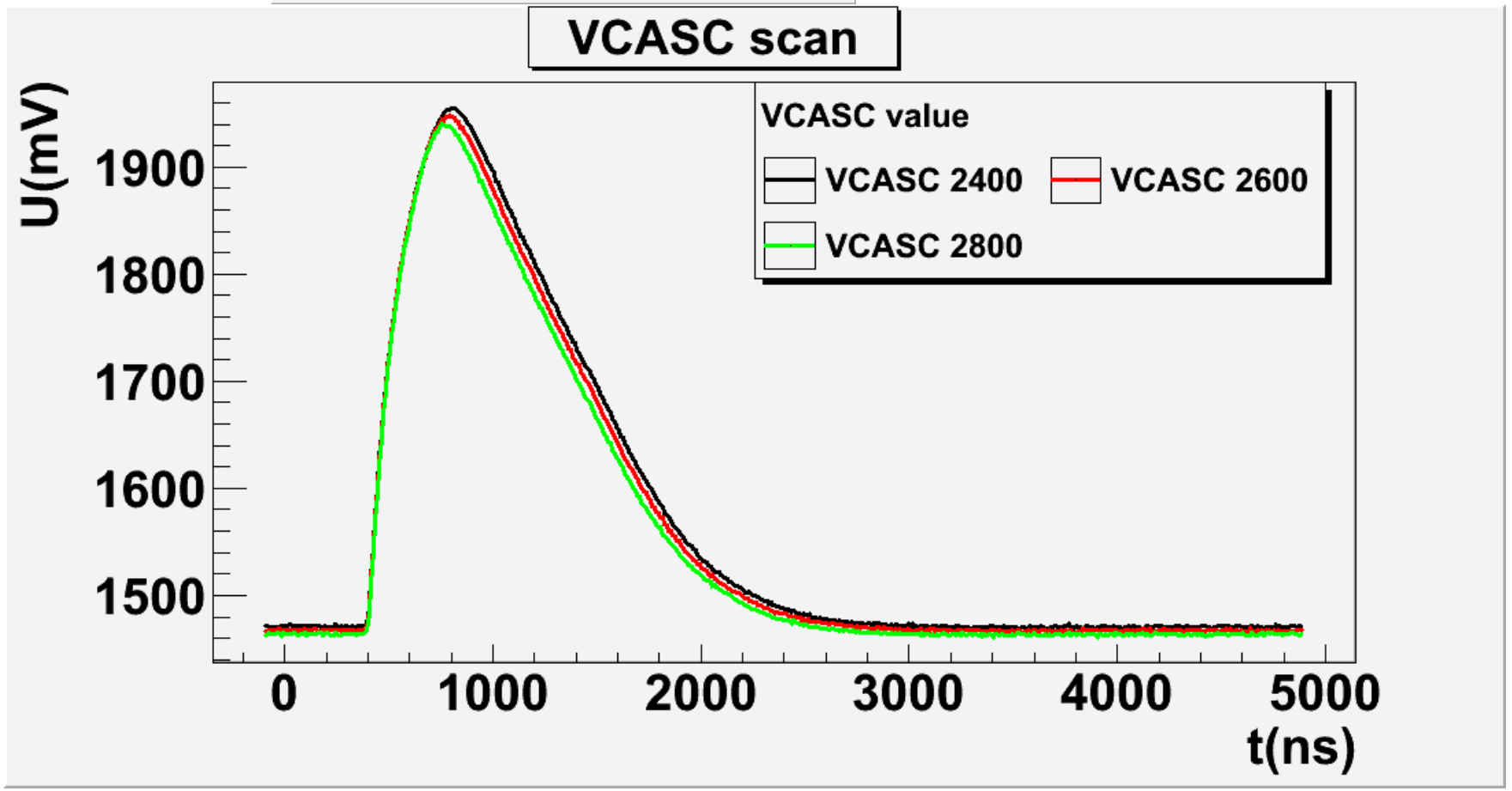


[by Hervé G.]


FWHM (VCASC)
FWHM (ns)
960
950
940
930
920
910
2400
2500
2600
2700
2800
DAC value (mV)

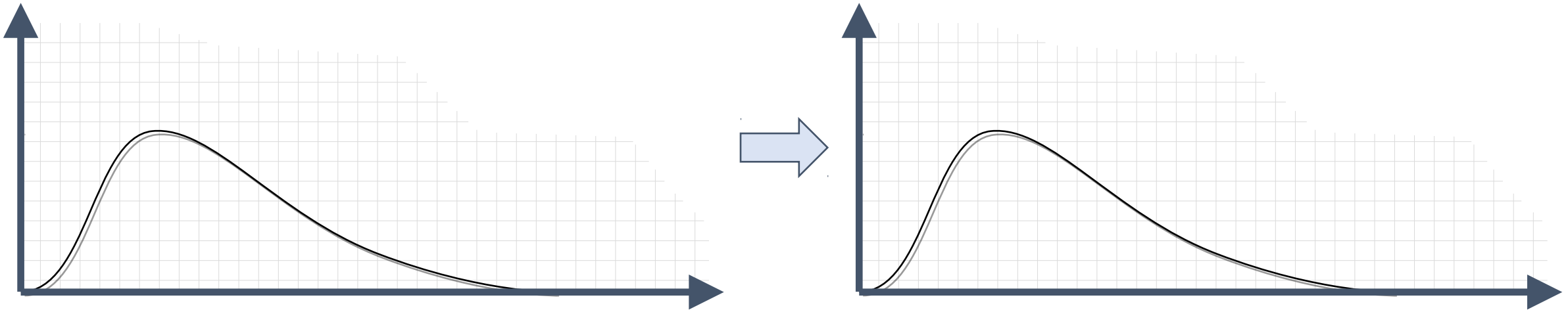

Signal height (VCASC)
Signal Height (mV)
488
486
484
482
480
478
2400
2500
2600
2700
2800
DAC value (mV)


Rise time (VCASC)
Rise time (ns)
260
255
250
245
240
2400
2500
2600
2700
2800
DAC value (mV)

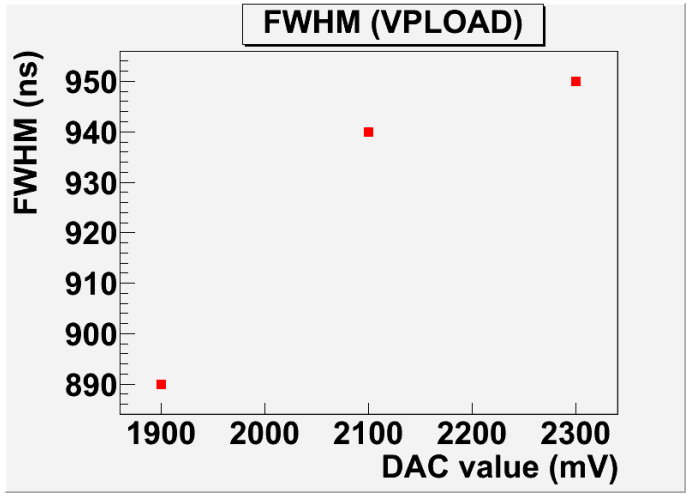

VCASC scan
U(mV)
1900
1800
1700
1600
1500
VCASC value
VCASC 2400
VCASC 2600
VCASC 2800
0
1000
2000
3000
4000
5000
t(ns)

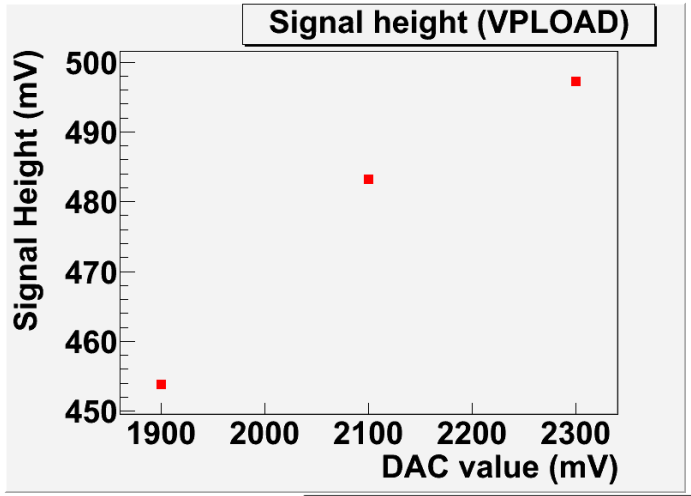
Modifying VPload

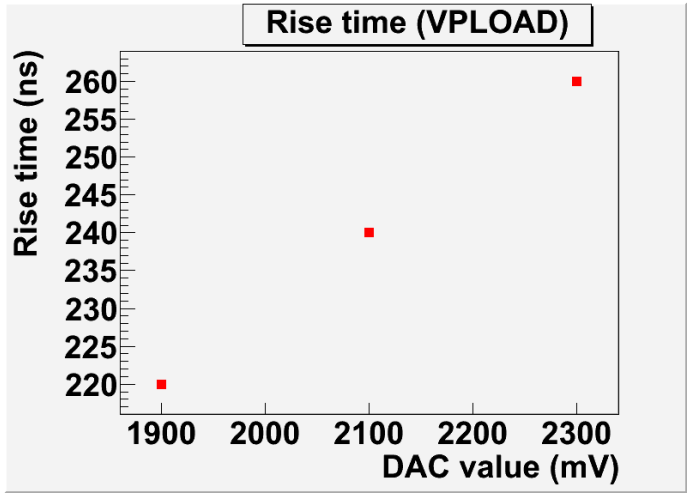
- VPLoad has been optimized. It shouldn’t be modified.
- It shouldn’t have an impact on the pulse response.
- Typ. value = 2.1V

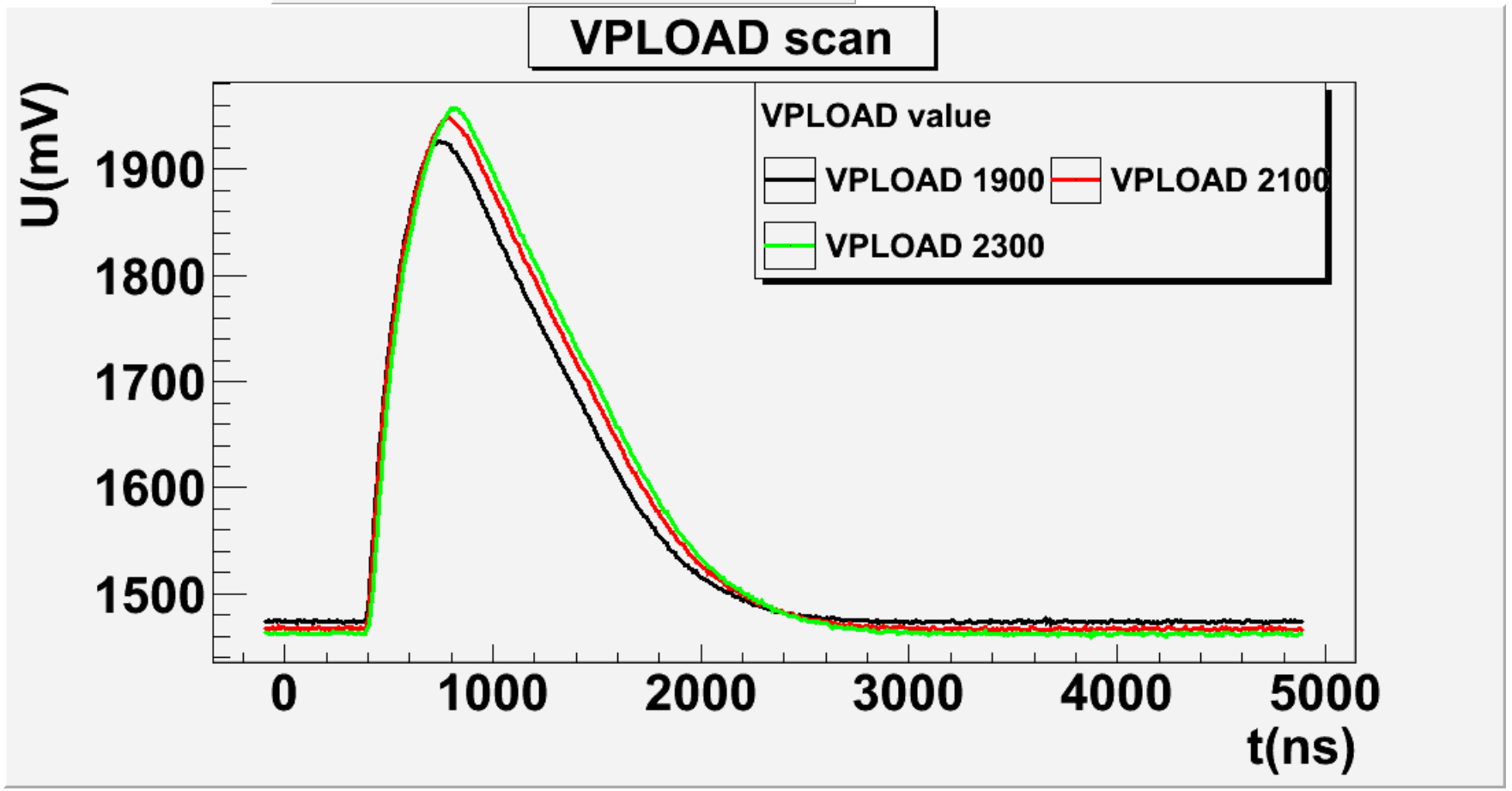


[by Hervé G.]


FWHM (VPLOAD)
FWHM (ns)
950
940
930
920
910
900
890
1900
2000
2100
2200
2300
DAC value (mV)

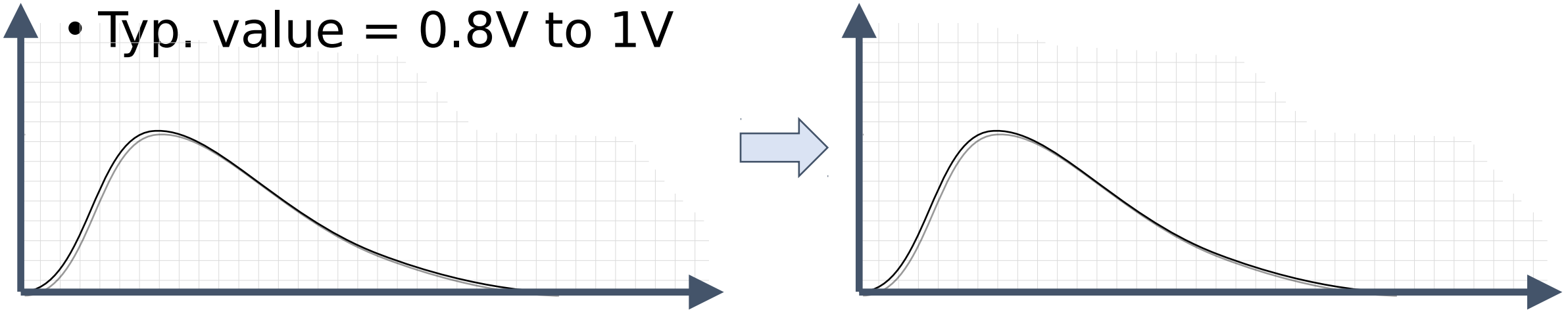

Signal height (VPLOAD)
Signal Height (mV)
500
490
480
470
460
450
1900
2000
2100
2200
2300
DAC value (mV)


Rise time (VPLOAD)
Rise time (ns)
260
255
250
245
240
235
230
225
220
1900
2000
2100
2200
2300
DAC value (mV)

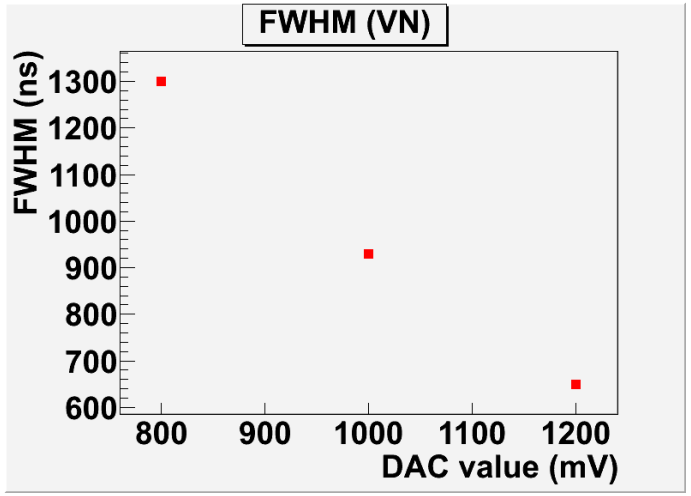

VPLOAD scan
U(mV)
1900
1800
1700
1600
1500
VPLOAD value
VPLOAD 1900
VPLOAD 2100
VPLOAD 2300
0
1000
2000
3000
4000
5000
t(ns)

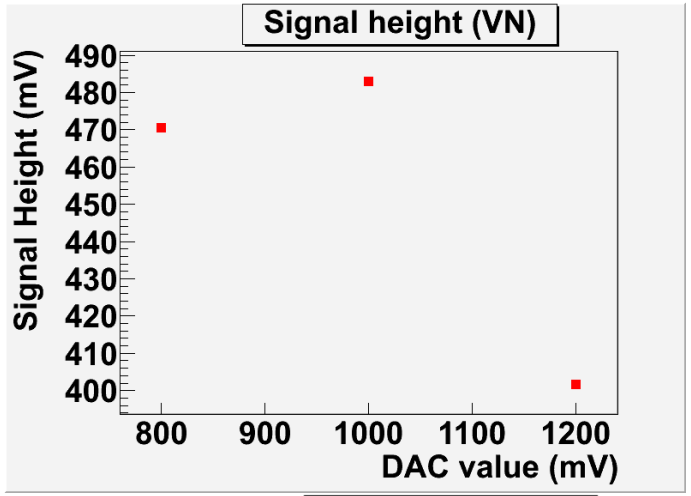
Modifying VN

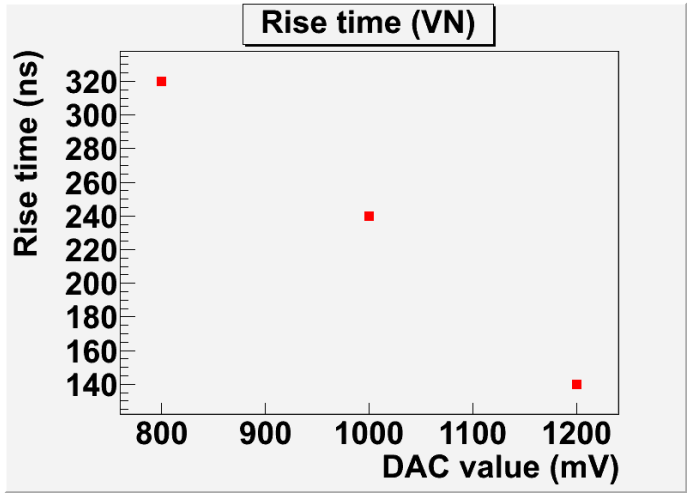
- VN controls the current source of the amplifier.
- The given VN value is optimized and shouldn’t be modified.
  - Decreasing the current too much would slow the amplifier and could make it unstable
- Typ. value = 0.8V to 1V

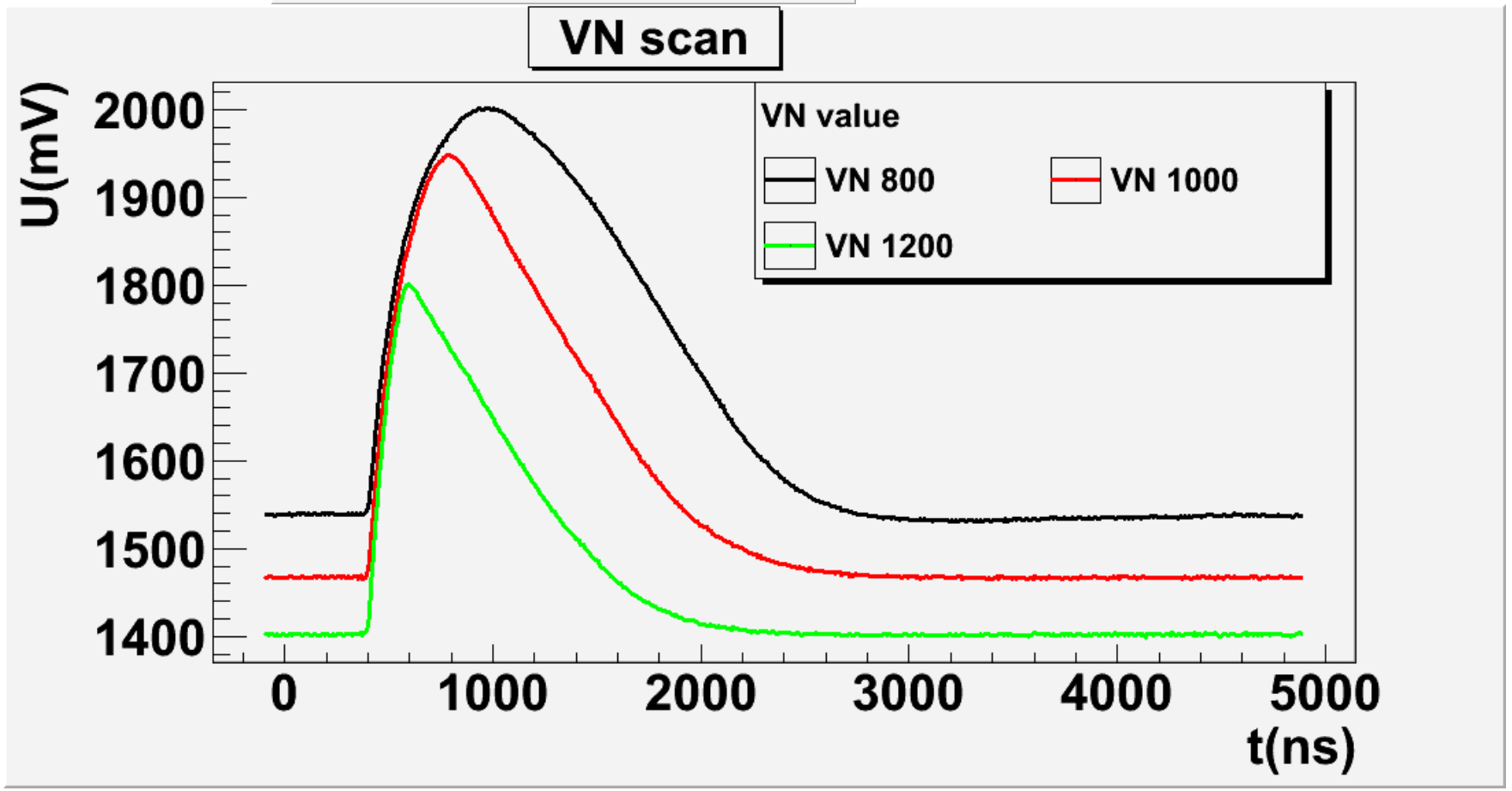


[by Hervé G.]


FWHM (VN)
FWHM (ns)
1300
1200
1100
1000
900
800
700
600
800
900
1000
1100
1200
DAC value (mV)

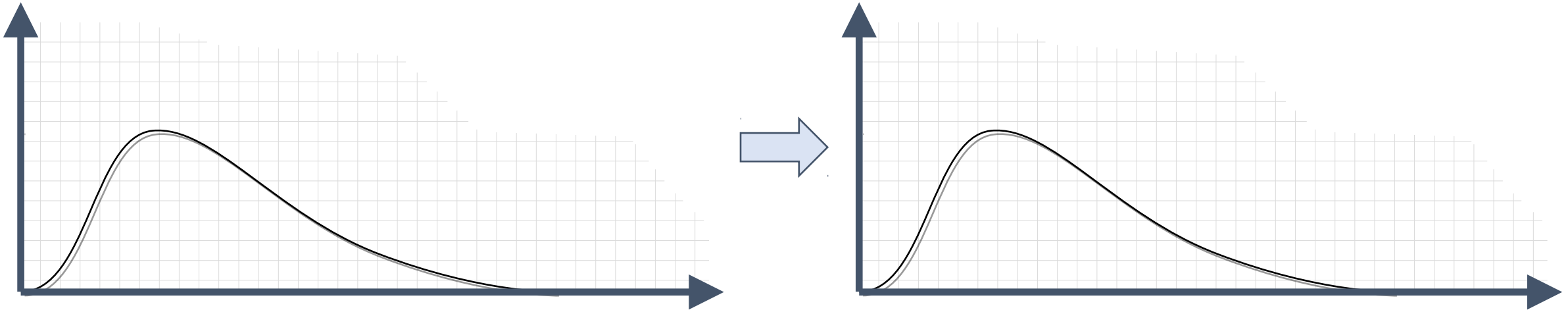

Signal height (VN)
Signal Height (mV)
490
480
470
460
450
440
430
420
410
400
800
900
1000
1100
1200
DAC value (mV)


Rise time (VN)
Rise time (ns)
320
300
280
260
240
220
200
180
160
140
800
900
1000
1100
1200
DAC value (mV)


VN scan
U(mV)
2000
1900
1800
1700
1600
1500
1400
VN value
VN 800
VN 1000
VN 1200
0
1000
2000
3000
4000
5000
t(ns)

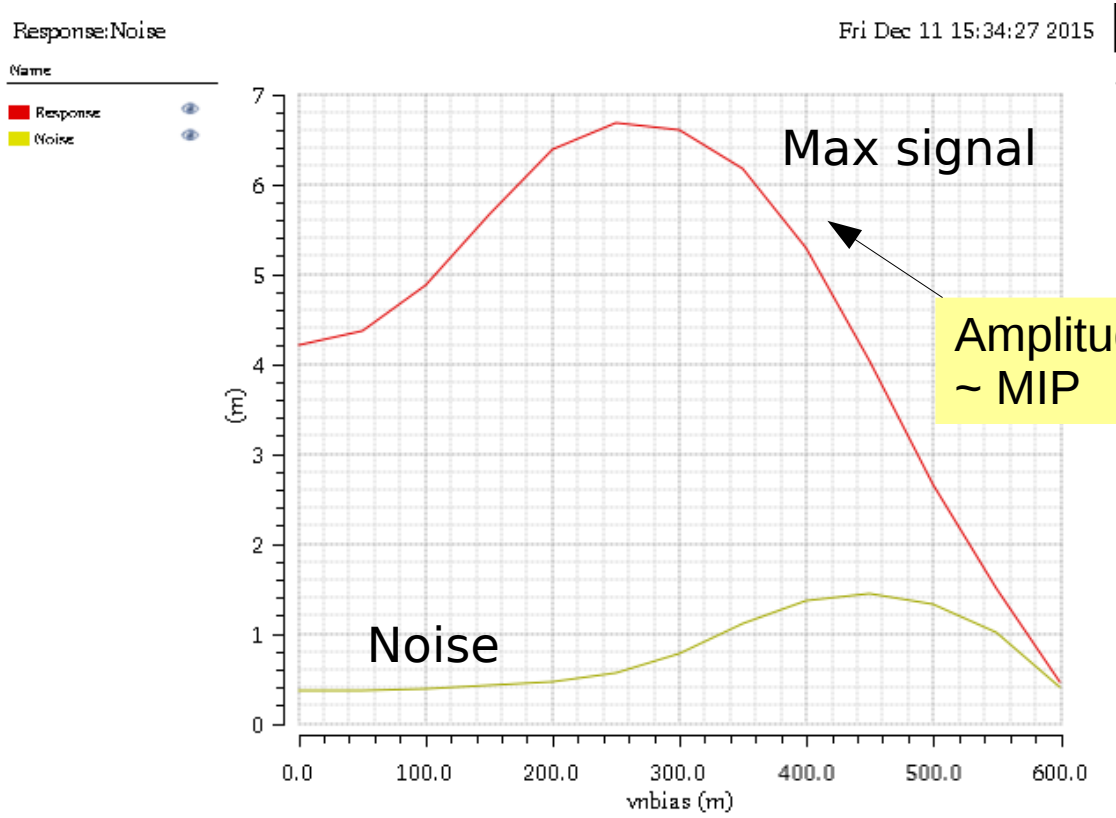
Modifying VNBias

- When using the isolated amplifier VNBias has no impact on the response.
- VNBias controls the bias of the Pixel diode. Value shouldn’t be changed .
- Typ. value = 250mV



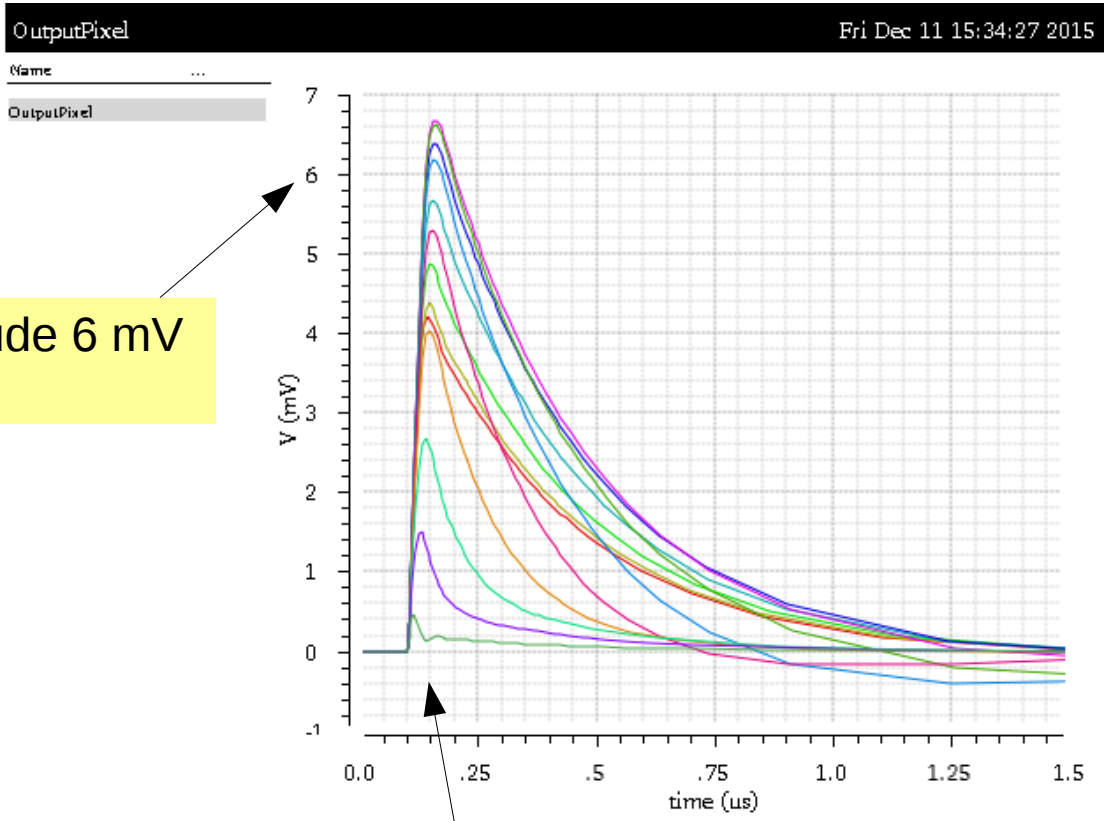
[by Hervé G.]

Increasing VNBias [valid for active pixel only]



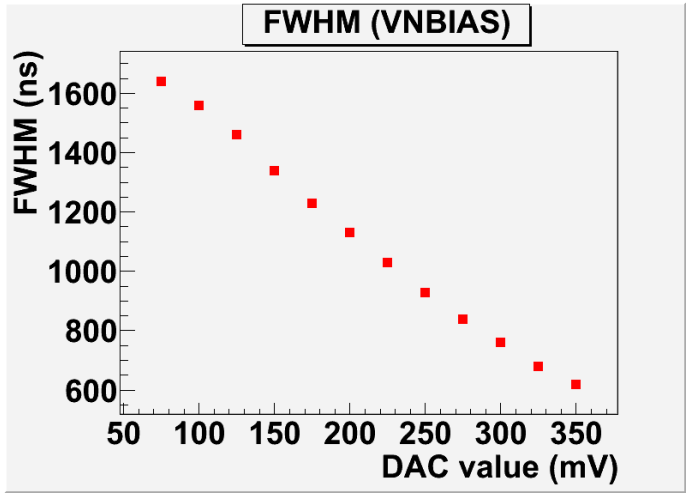
VNBias increase

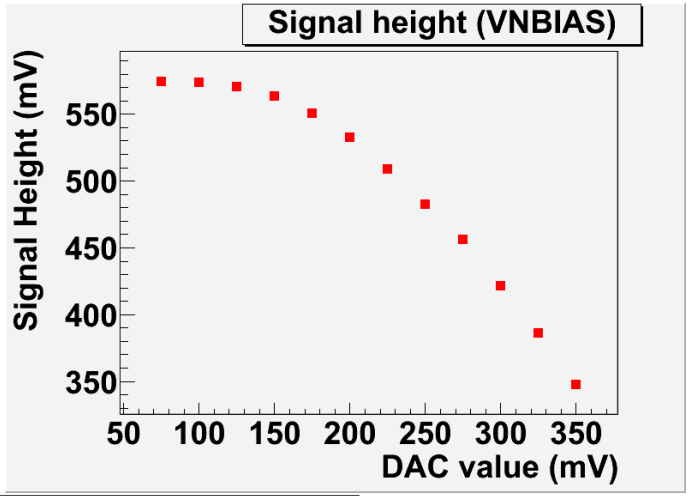
Amplitude 6 mV
~ MIP

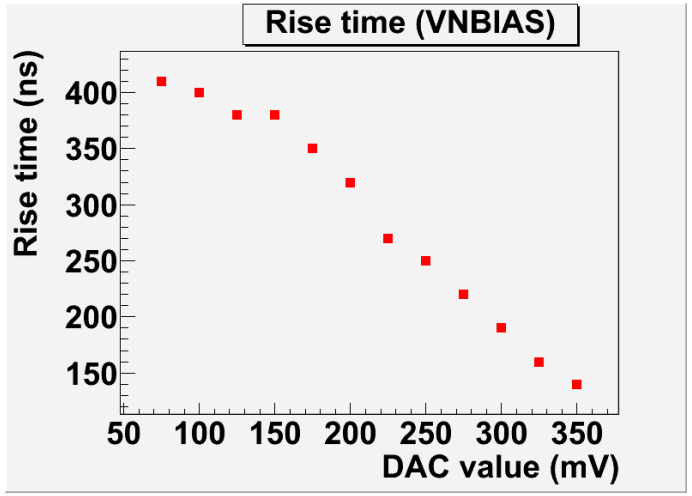


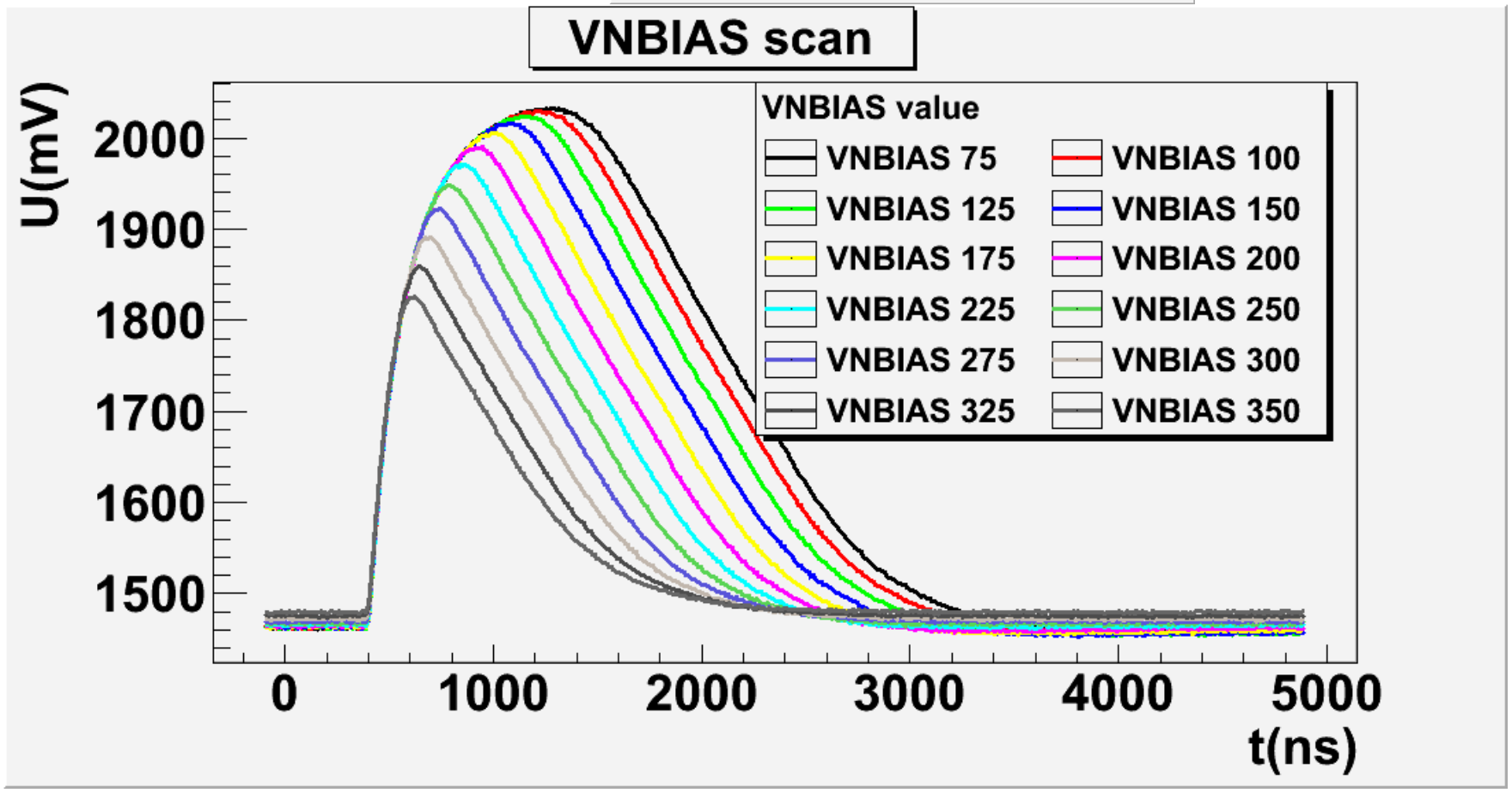
Rise time 50 ns

[by Hervé G.]









Amplitude much greater than in simulation, corresponding longer rise time