

Specific requirements for analog electronics of a high counting rate TRD

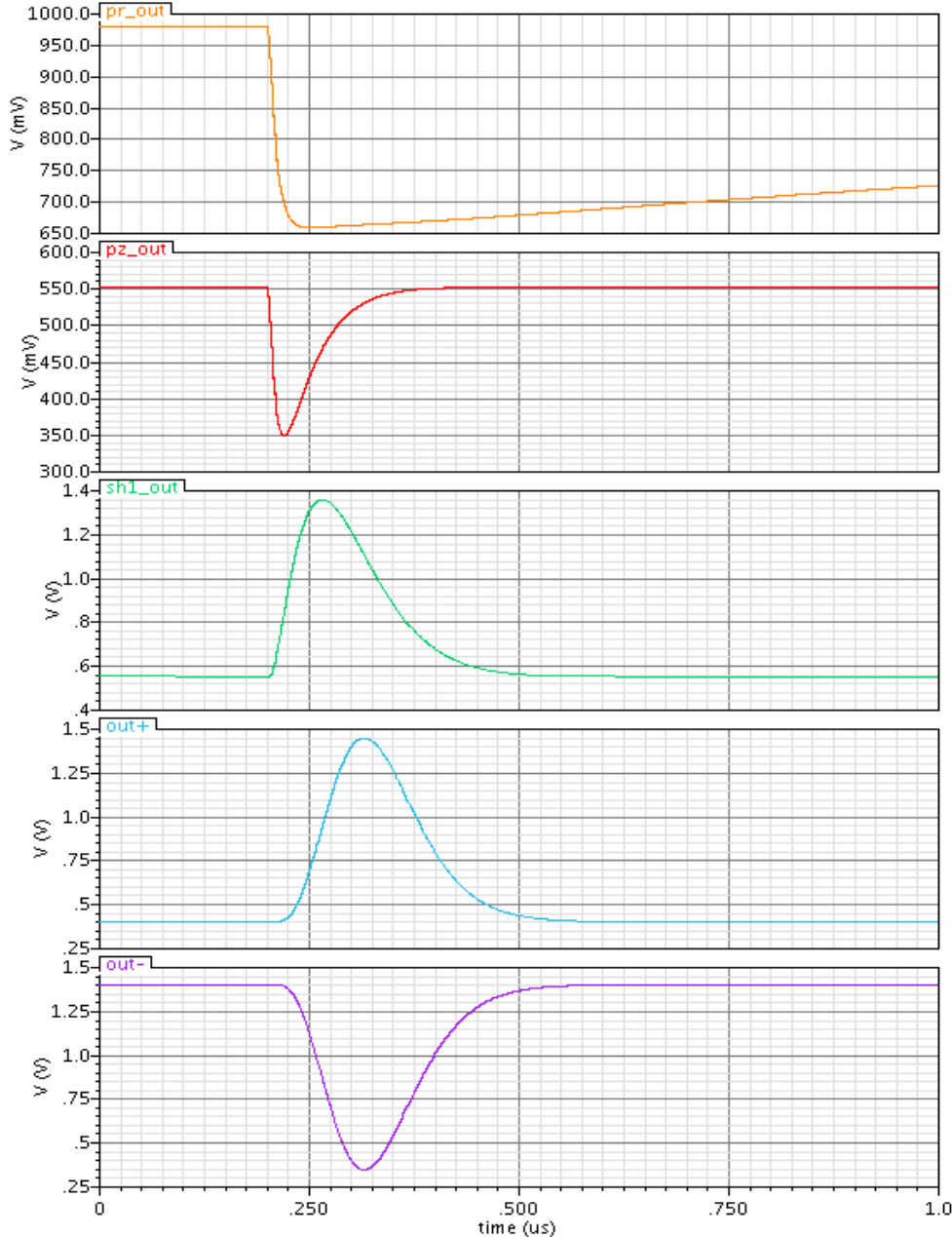
Vasile Catanescu
NIHAM - Bucharest

Summary

- 1. Introduction. A brief overview of the ALICE TRD analog channel**
- 2. Some particularities for a fast TRD analog channel**
- 3. Optional requirements for a fast TRD analog channel**
- 4. Towards a multifunctional analog channel cell**
- 5. Conclusions for a fast TRD analog channel**

1. Introduction. A brief overview of the ALICE TRD analog channel

Transient Response for ALICE-TRD analog channel



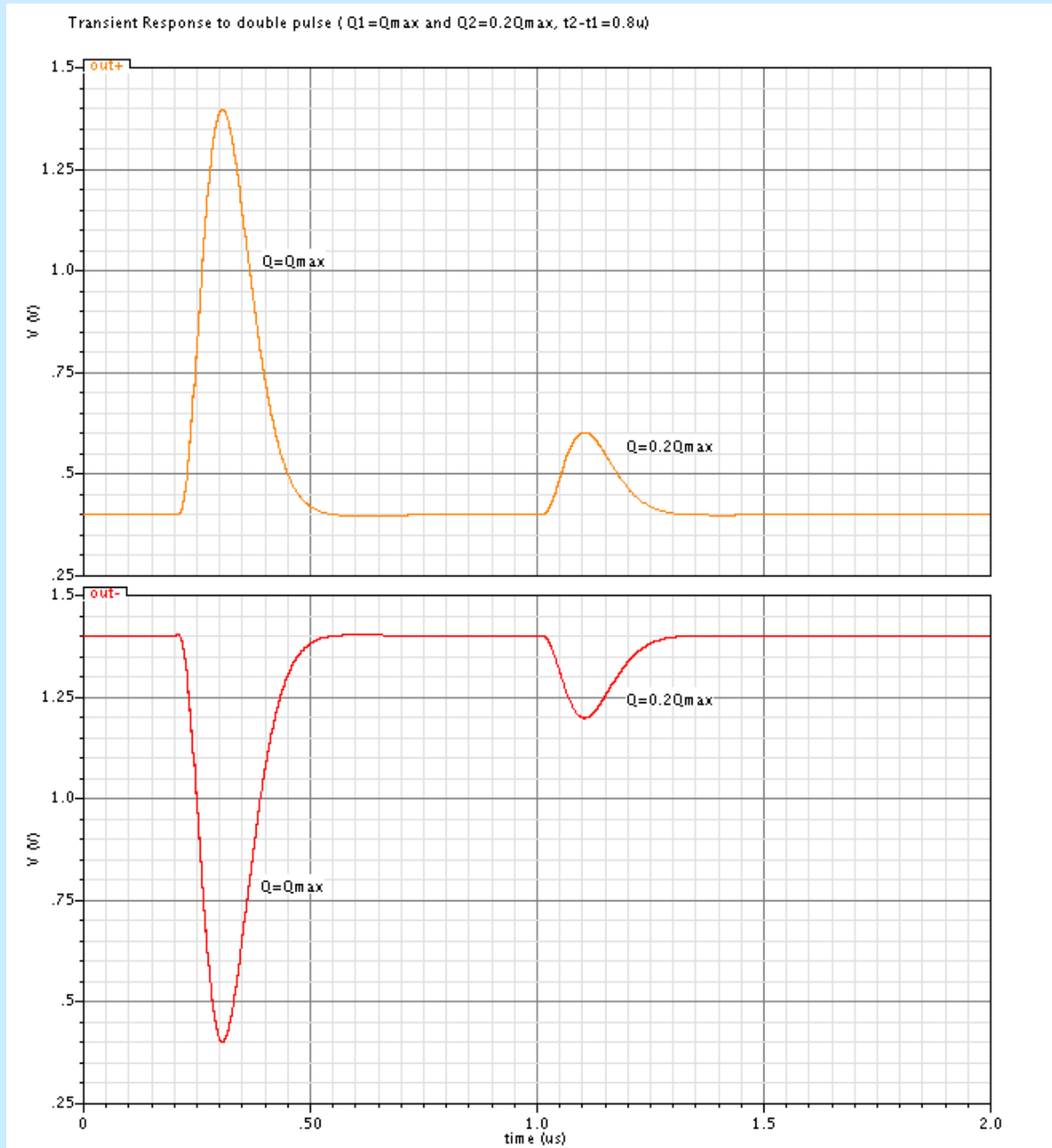
1.1 Analog channel main specification:

- average pulse rate: 10KHz
- detector capacitance: 25pF
- input charge rate: max 165fC
- input type: DC single ended
- channel gain (diff.): 12mV/fC
- output type: differential
- output voltage swing: 0...+/-1V
- channel ENC: <900e (Cd=25pF)
- output pulse FWHM: 125ns

1.2 Analog channel components:

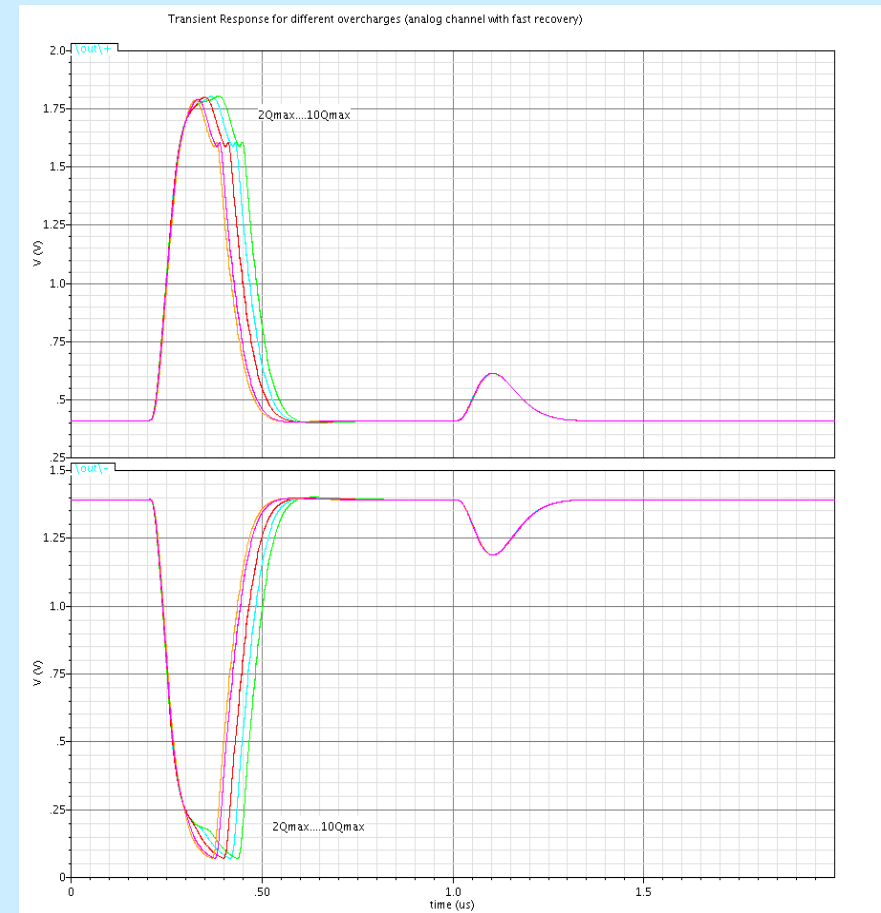
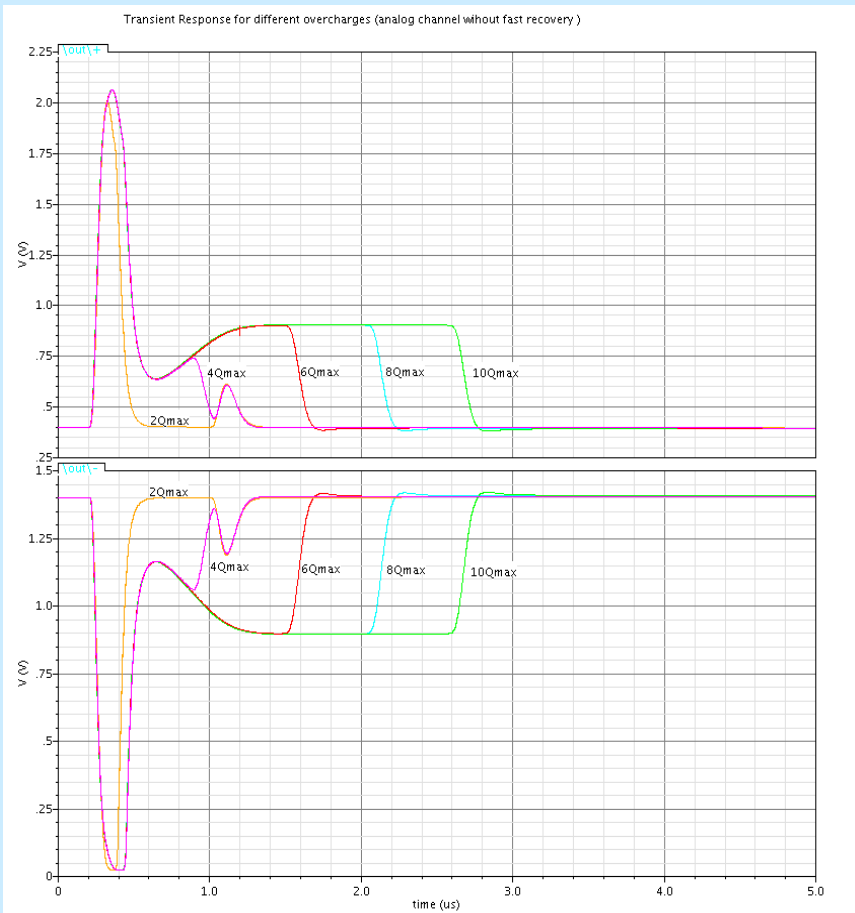
- Preamplifier: CSA, NMOST input, DC feedback
- Shapers: two stage 2-nd order filters
- Out amplifier: differential, 0...+/-1V swing
- Analog test pulse generator

2. Some particularities for a fast TRD analog channel



2.1 Good response to double pulses and to high rate pulses

2. Some particularities for a fast TRD analog channel (continued)

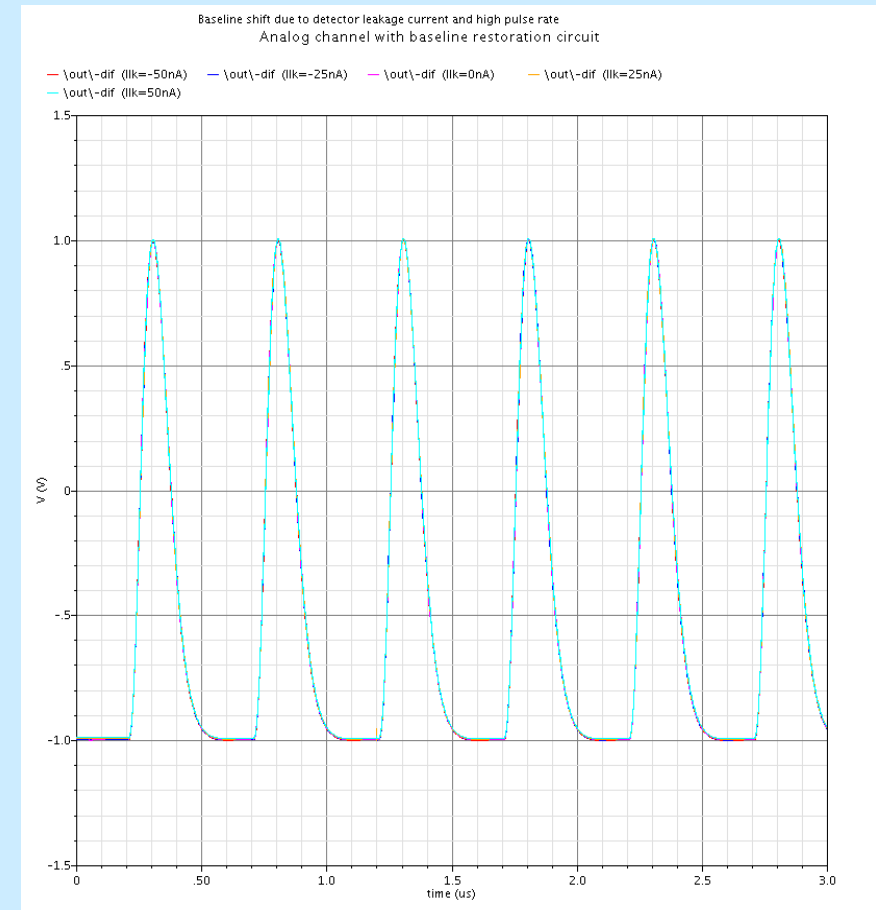
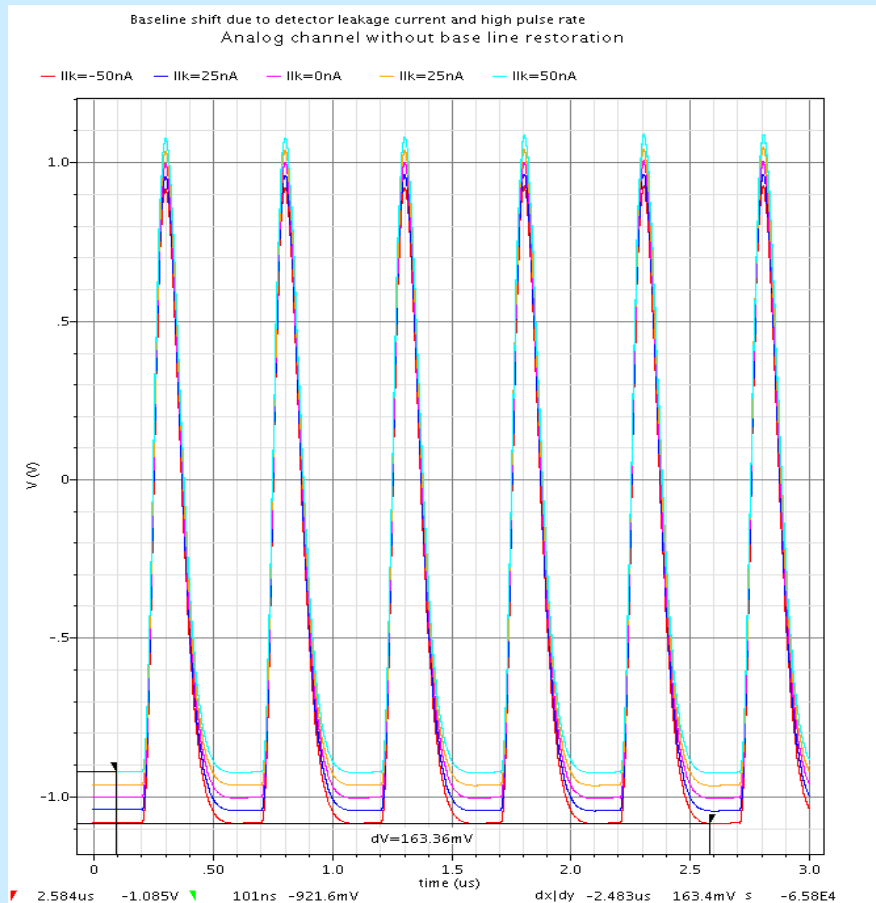


2.2 Fast recovery to charge overload

- Channel without fast recovery facilities:
 - channel is dead for long time
 - double pulses separation is not possible
 - base line perturbations

- Channel with fast recovery circuits:
 - short channel dead time even for large overload
 - very good double pulse separation
 - no baseline perturbations

2. Some particularities for a fast TRD analog channel (continued)



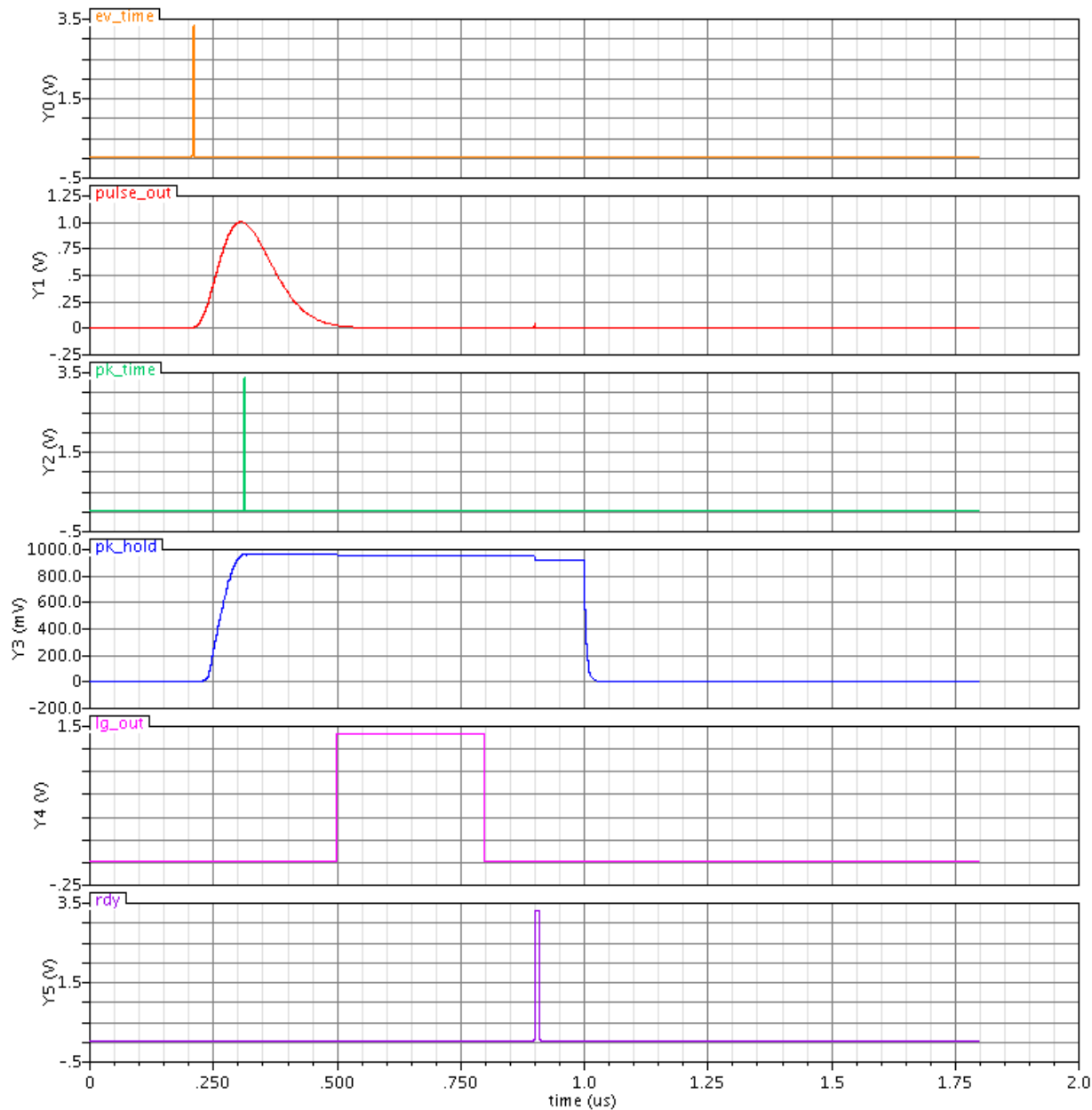
2.3 Baseline restoration to the detector leakage current and/or high counting rate

- Analog channel without baseline restoration:
 - large baseline shift, over 160 mV for 100nA leakage variation and an average pulse rate of 2 MHz

- Analog channel with baseline restoration:
 - baseline shift is 25 times less

2. Some particularities for a fast TRD analog channel (continued)

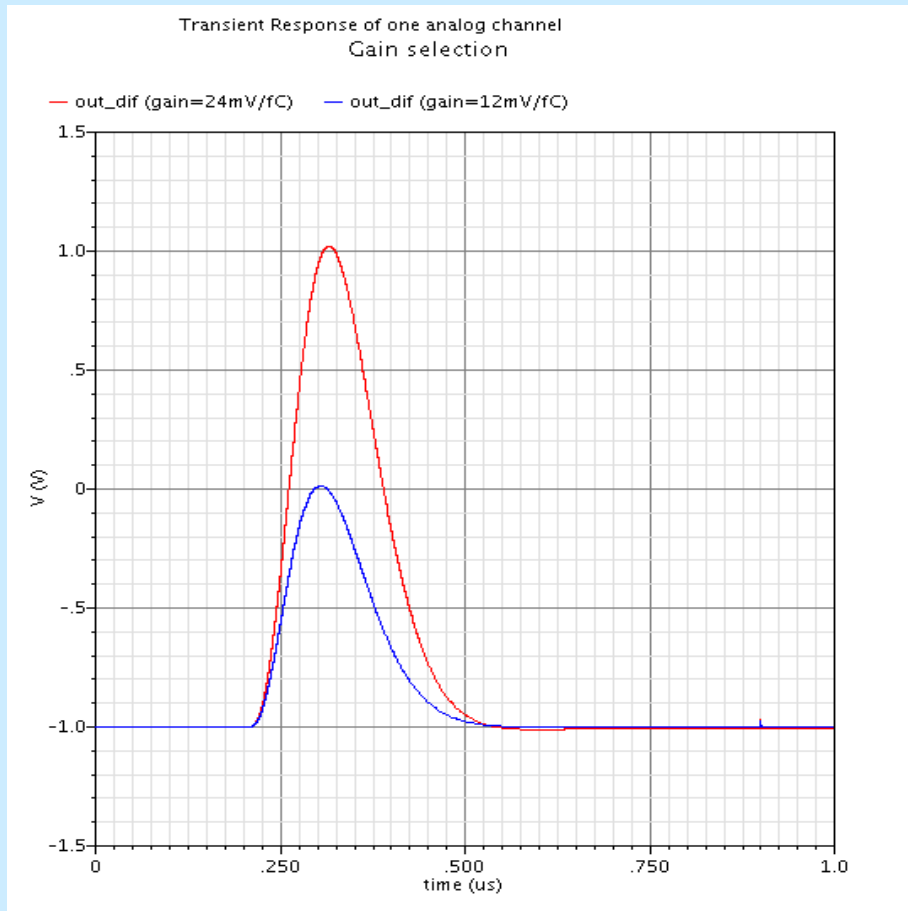
Transient Response. Analog and timing signals
Peak sense and hold circuit



2.4 More analog signal processing and timing signals

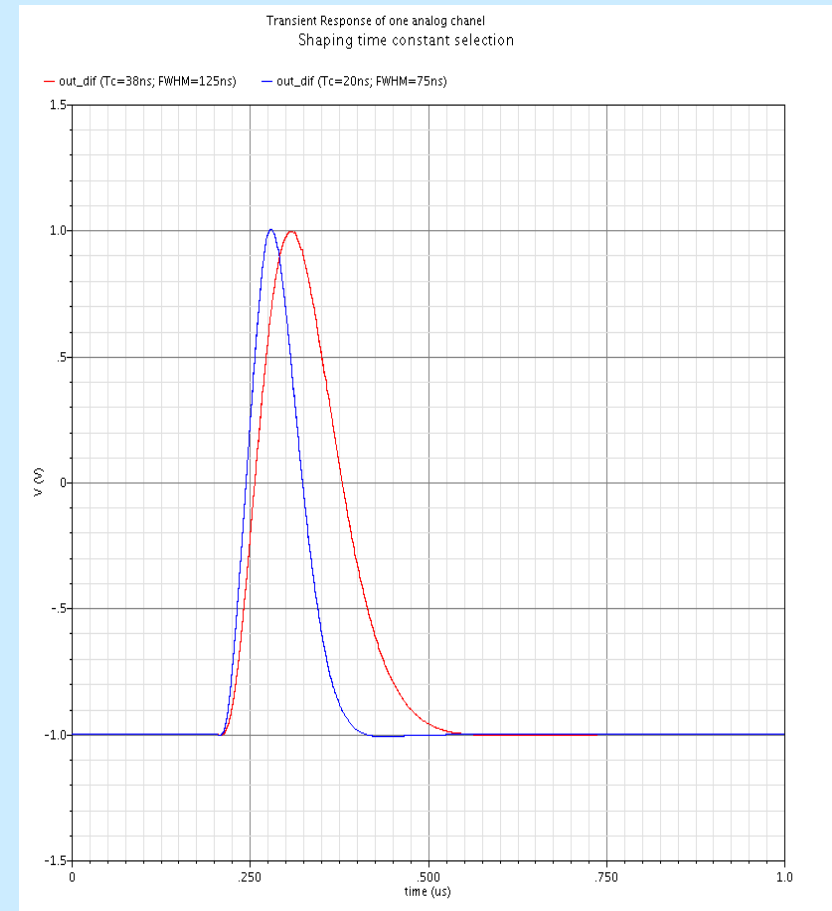
- Additional analog signal processing:
 - peak sense and hold circuit
 - linear gate circuit
 - pulse derandomizer
 - analog memory
- More timing generated signals:
 - hit occurrence signal (pretrigger) with programmable threshold and enable/disable option
 - peak time signal
 - trigger signal with rejection of false pretrigger signals
 - handshake signals on request/grant basis for adc interface

3. Optional requirements for a fast TRD analog channel



3.1 Gain selection:

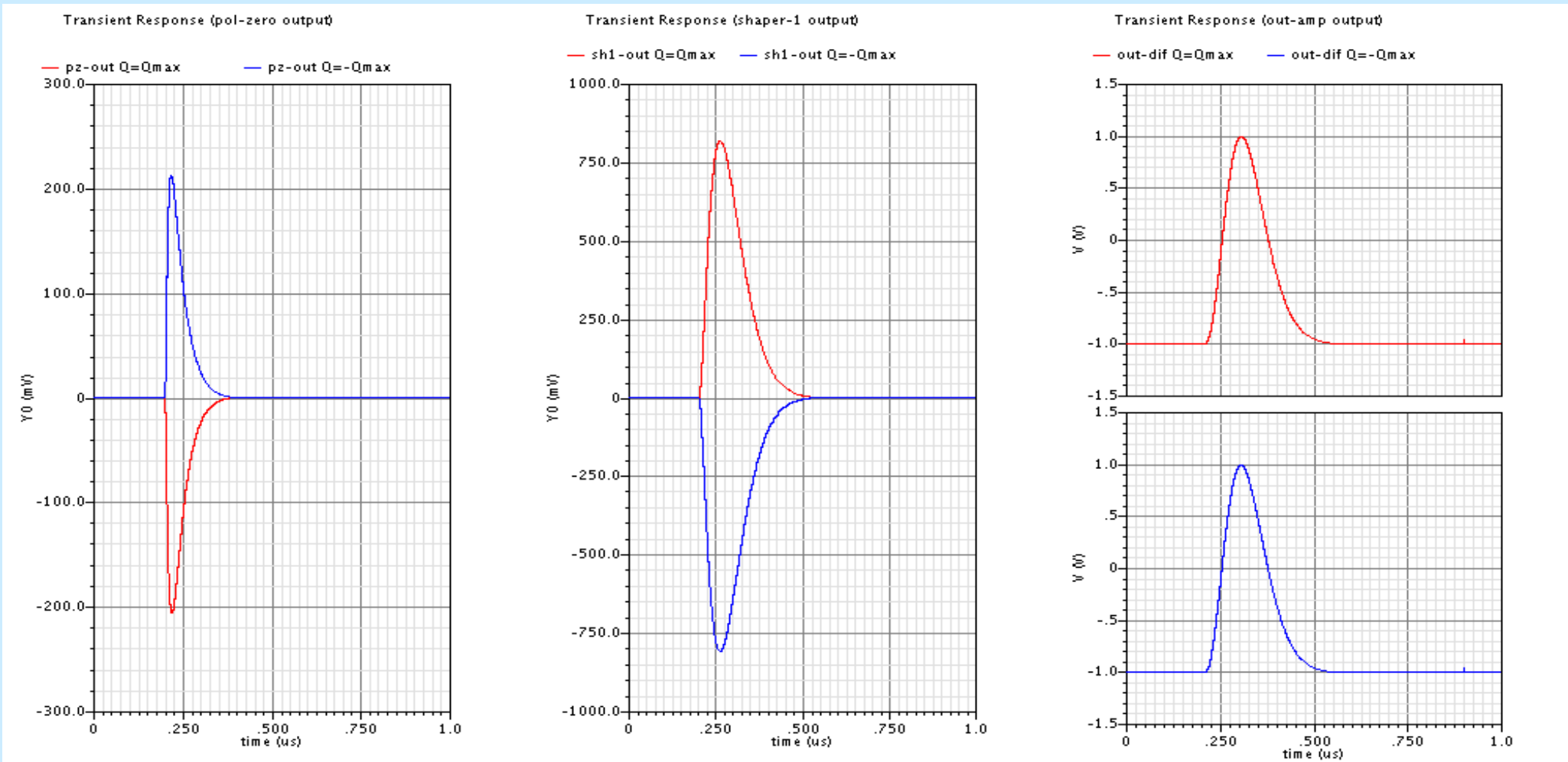
- two gain option: 24mV/fC and 12mV/fC
- voltage level selection (one line)



3.2 Shaping time constant selection:

- two shaping time option: 38ns and 20ns
- voltage level selection (one line)

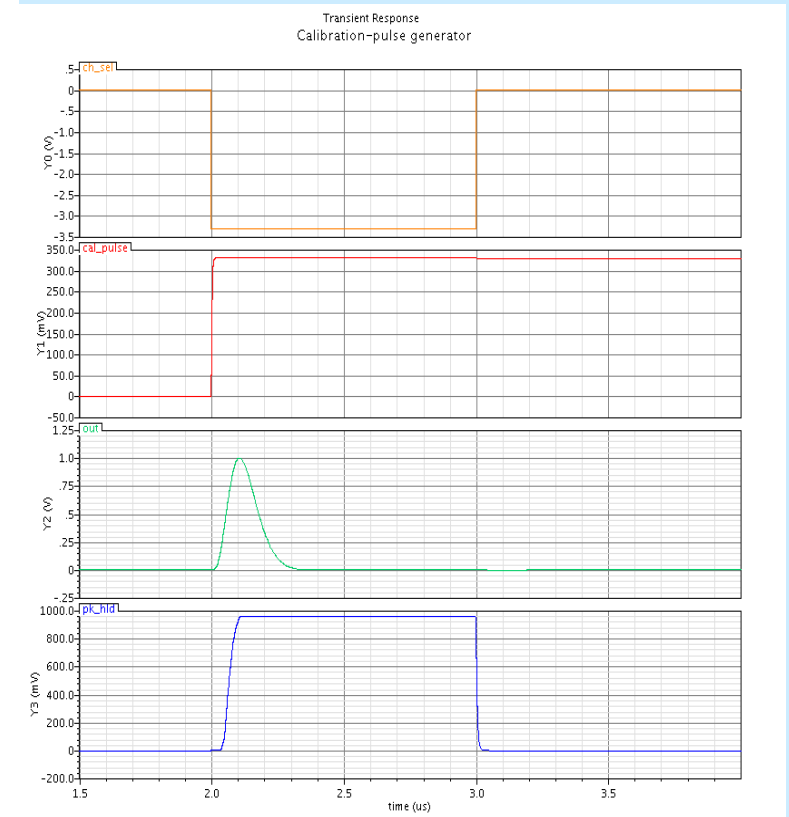
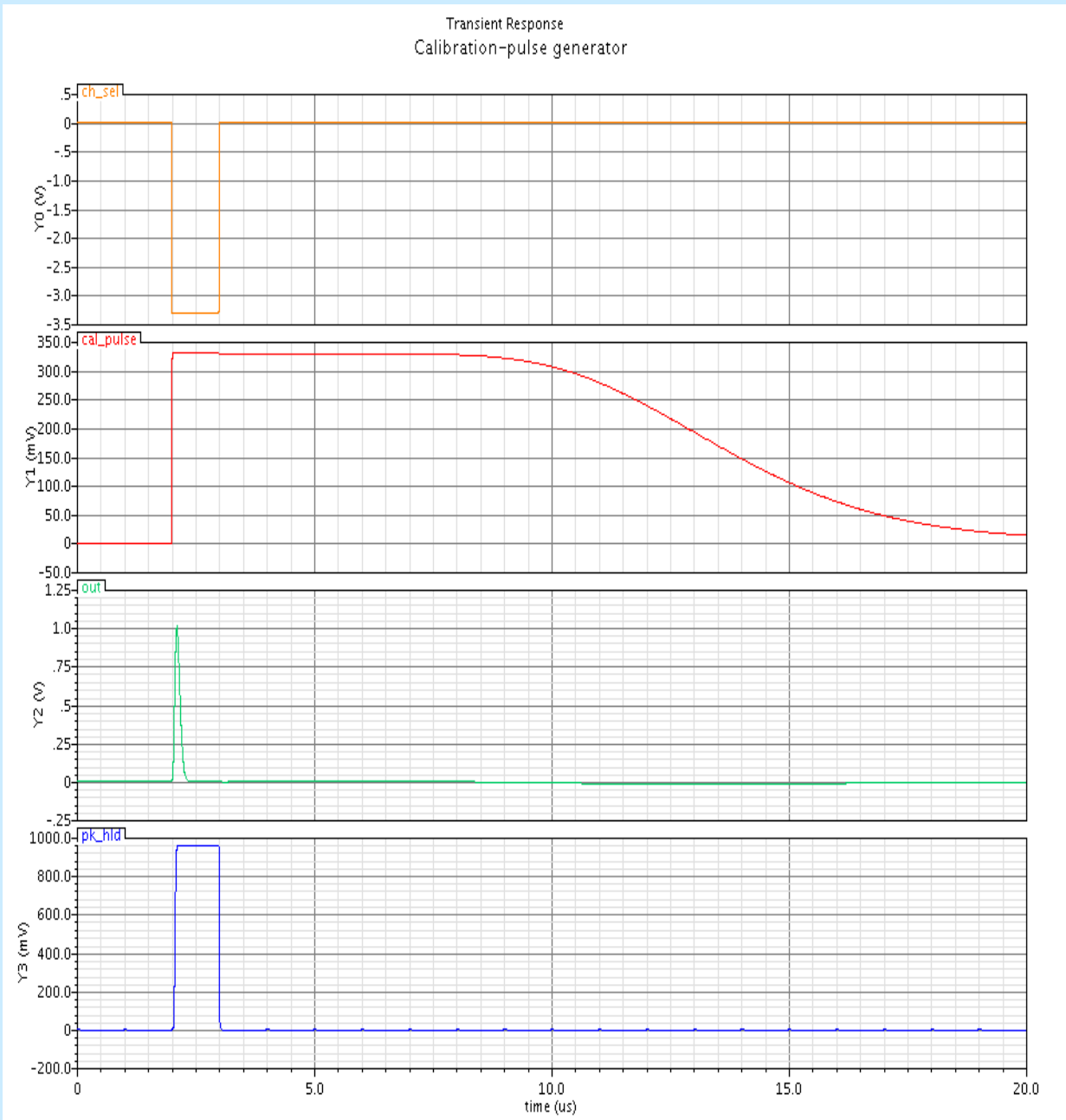
3. Optional requirements for a fast TRD analog channel (continued)



3.3 Polarity selection:

- select positive or negative input charge
- output stage automatically adapts its inputs to the right polarity
- polarity selection: voltage level (one line)

3. Optional requirements for a fast TRD analog channel (continued)



3.4 Calibration pulse generator:

- Useful in finding the channel gain
- Working mode: channel scanning
- No additional software for gain finding

4. Towards a multifunctional analog channel cell

4.1 Already implemented features:

- Function select on enable/disable basis
- Option select for many functions

4.2 Some possible configurations:

Gain(mV/fC) / Input Polarity / FWHM(ns)	Noise(e ⁻) (C _{DET} = 25 pF)
12 + 125	750
12 + 80	945
24 + 125	695
24 + 80	865
12 - 125	742
12 - 80	921
24 - 125	687
24 - 80	836

4.3 Next developments:

- New additional functions
- Programmable cell

5. Conclusions for a fast TRD analog channel

5.1 Desirable features to be implemented:

- Good response to double pulses
- Good response to high pulse rate
- Fast recovery from overload
- Immunity to detector leakage current
- Stable baseline

5.2 Useful additional features:

- More analog signal processing
- More generated timing signals

5.3 Outlook:

- First version of the NIHAM analog chip for high counting rate TRD