Lab measurements with the Beetle 1.2

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and
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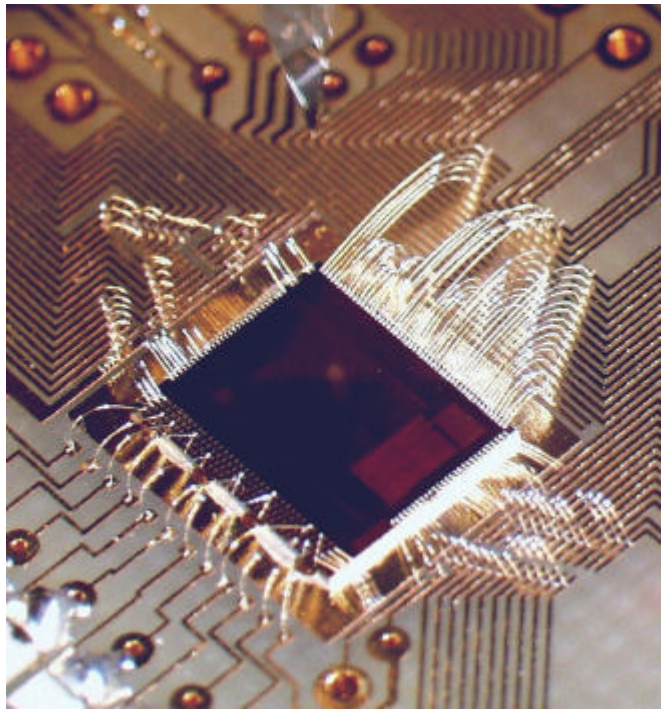
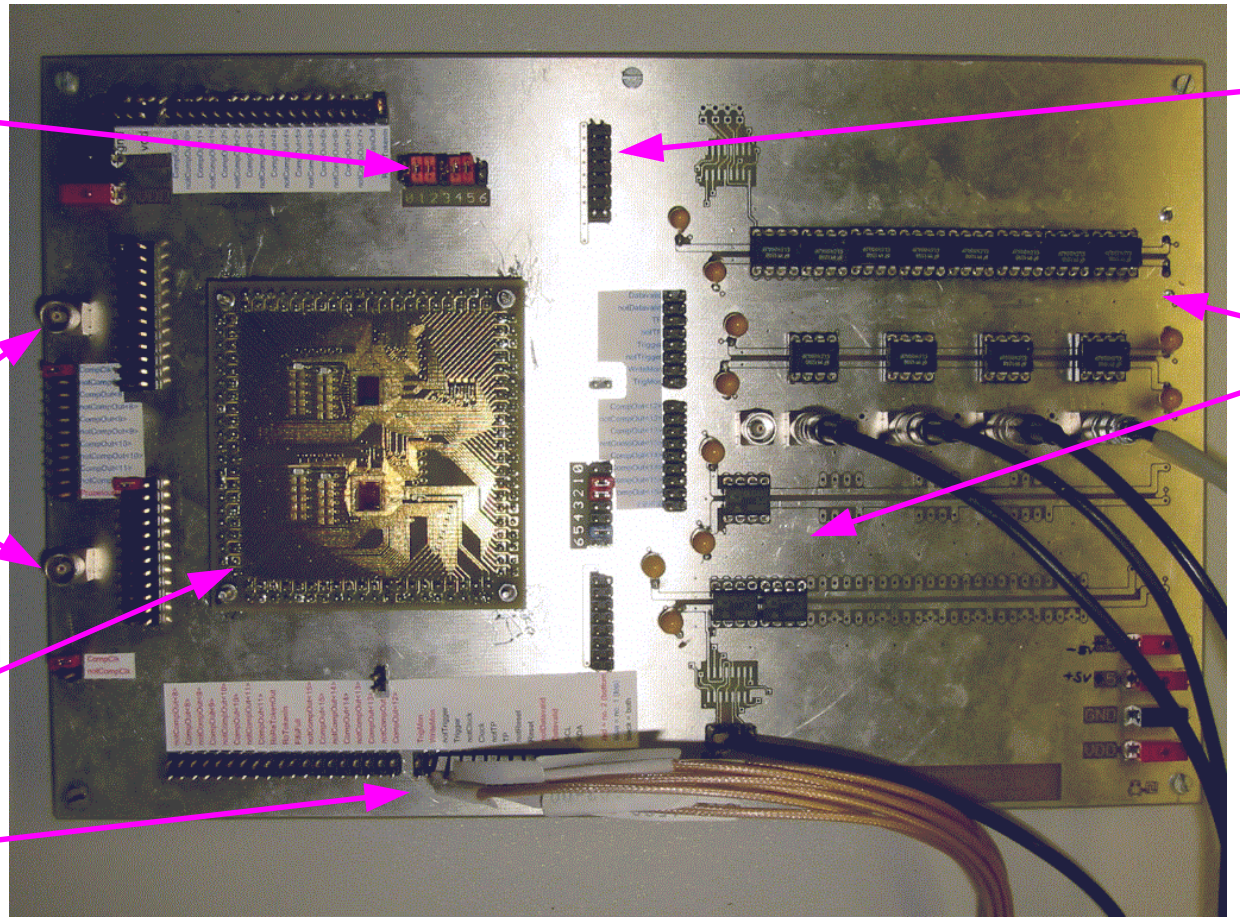
(Max-Planck-Institute for Nuclear Physics, Heidelberg)



Beetle 1.2 on a test PCB

Beetle 1.2 Lab Setup



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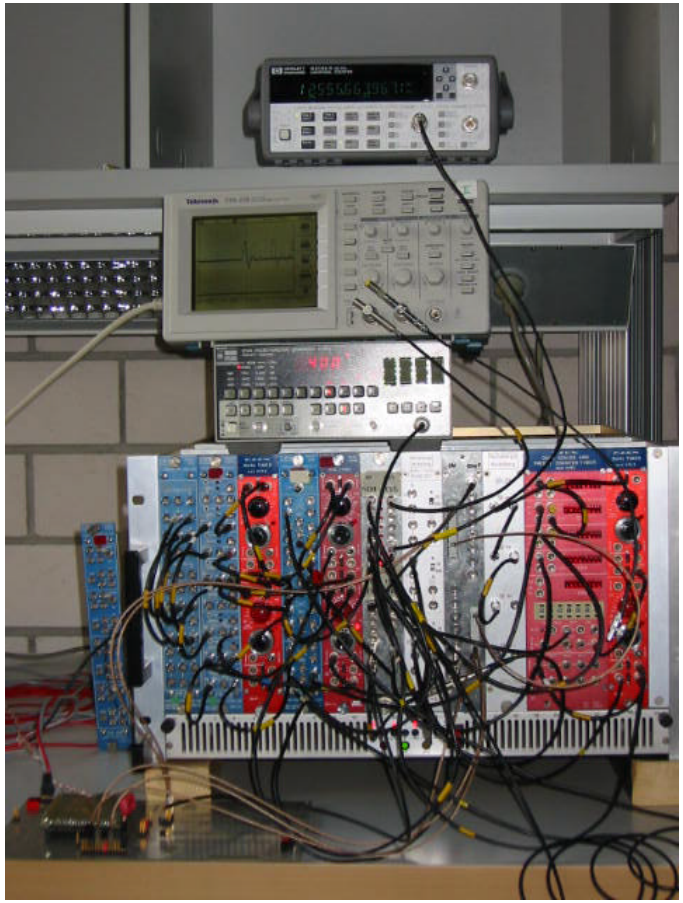
Random Trigger Test

- 2 Beetle 1.2 @ 40 MHz, both irrad. (10 Mrad)
- 2 x 2.5 · 10^{12} random triggers
  - 168h (1.814 · 10^{12}, Þ 2.99 MHz)
  - 72h (2.933 · 10^{11}, Þ 1.13 MHz)
  - 132h (3.911 · 10^{11}, Þ 0.82 MHz)
- no triggers lost



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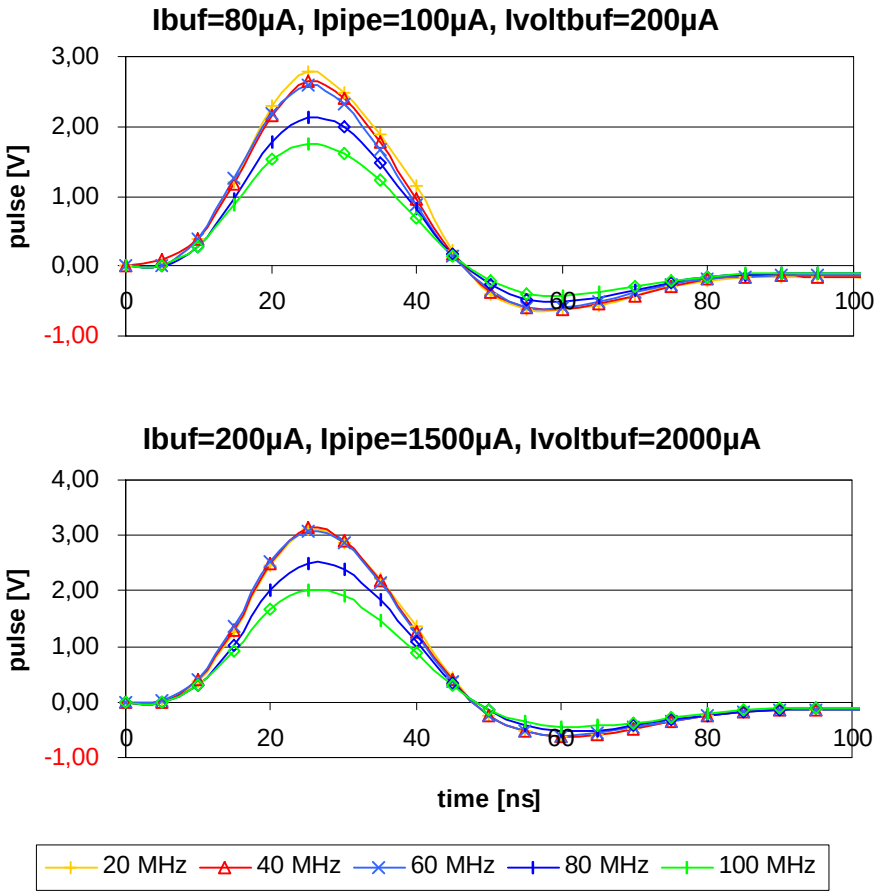
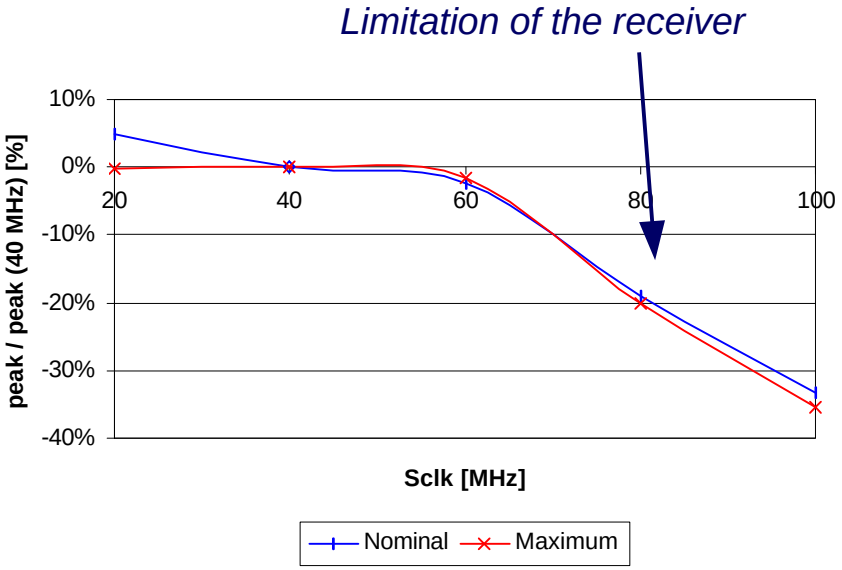
Overclocking Test





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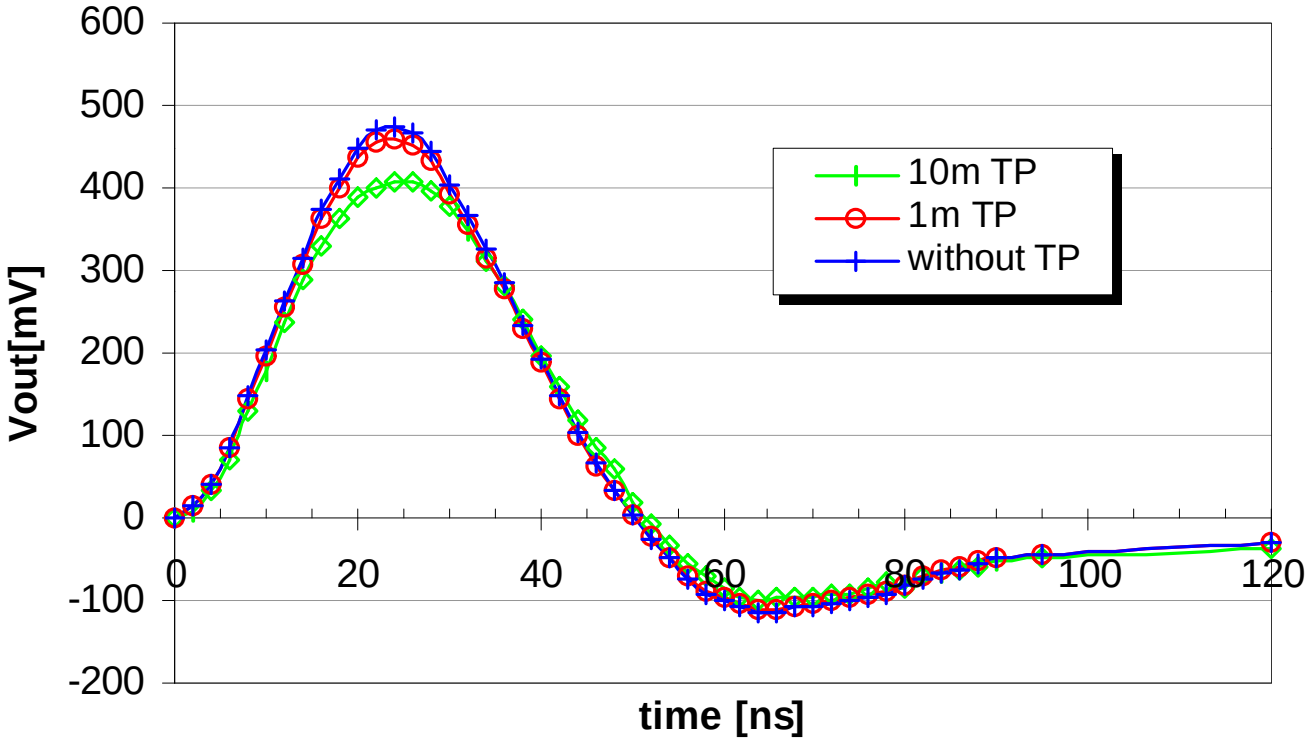
Driving Capabilities



Pulse shape characteristics

- **without Twisted Pair cable**
- **1m Twisted Pair cable**
- **10m Twisted Pair cable**

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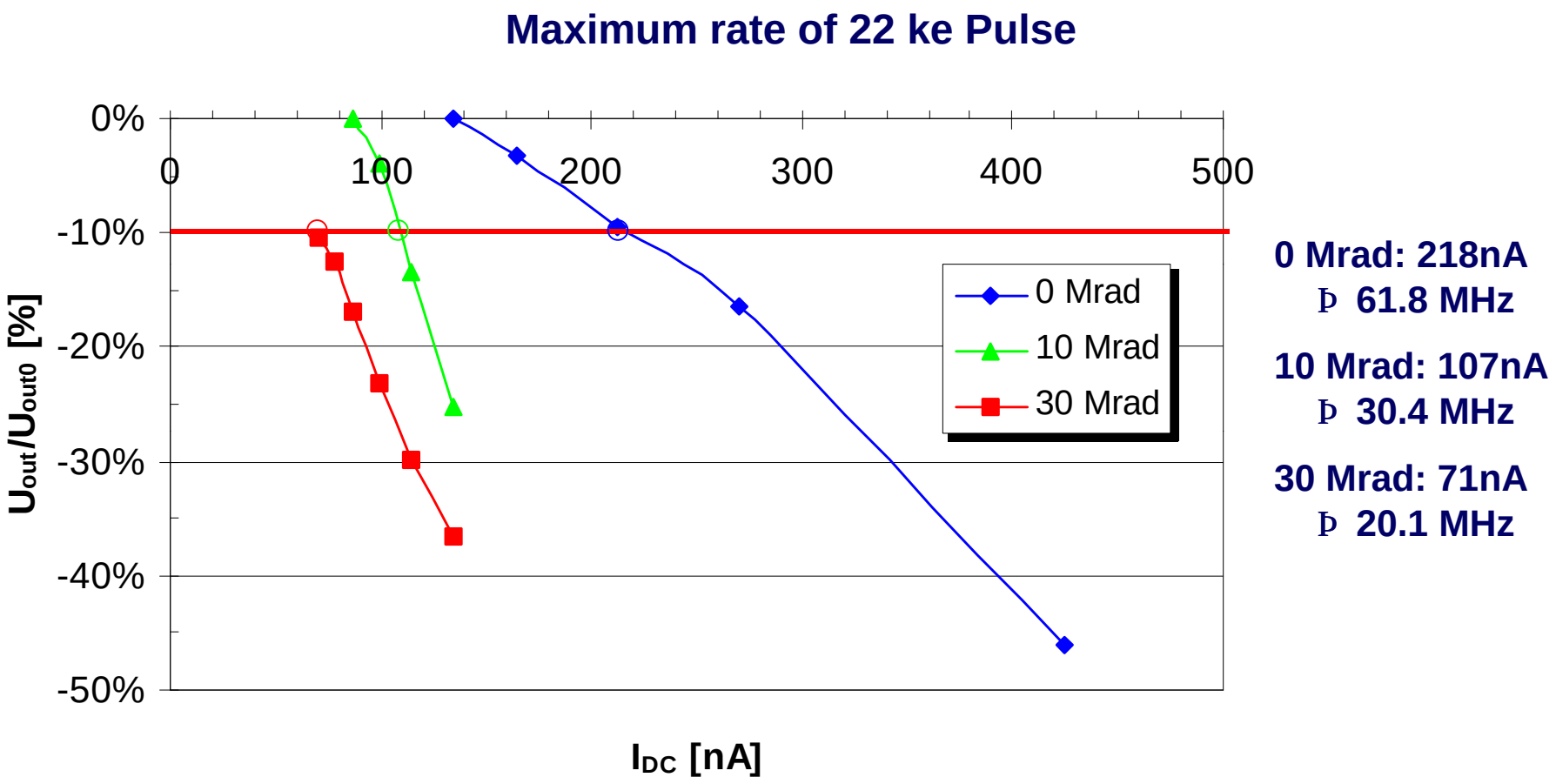
Saturation (1)



0 Mrad: 218nA
Þ 61.8 MHz

10 Mrad: 107nA
Þ 30.4 MHz

30 Mrad: 71nA
Þ 20.1 MHz

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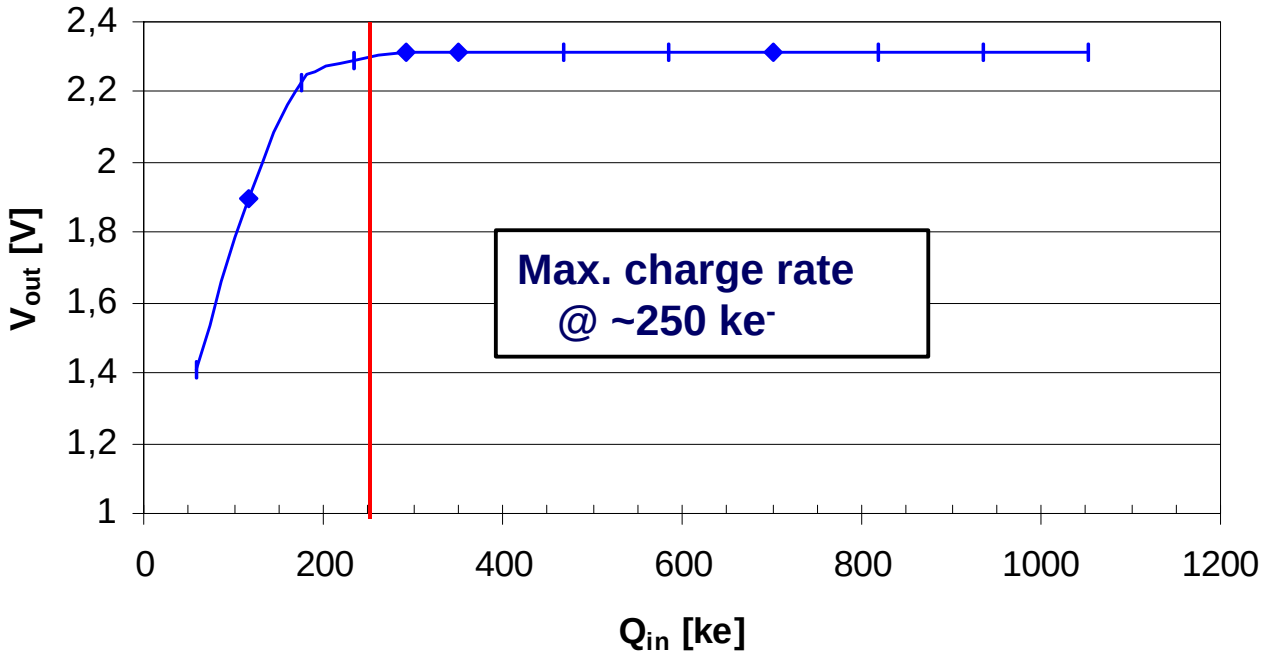
Saturation (2)

Maximum charge at low rates (1 Hz)



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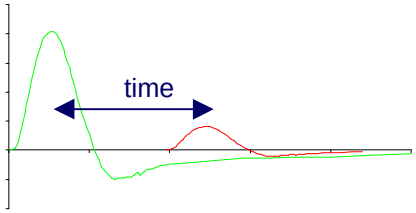
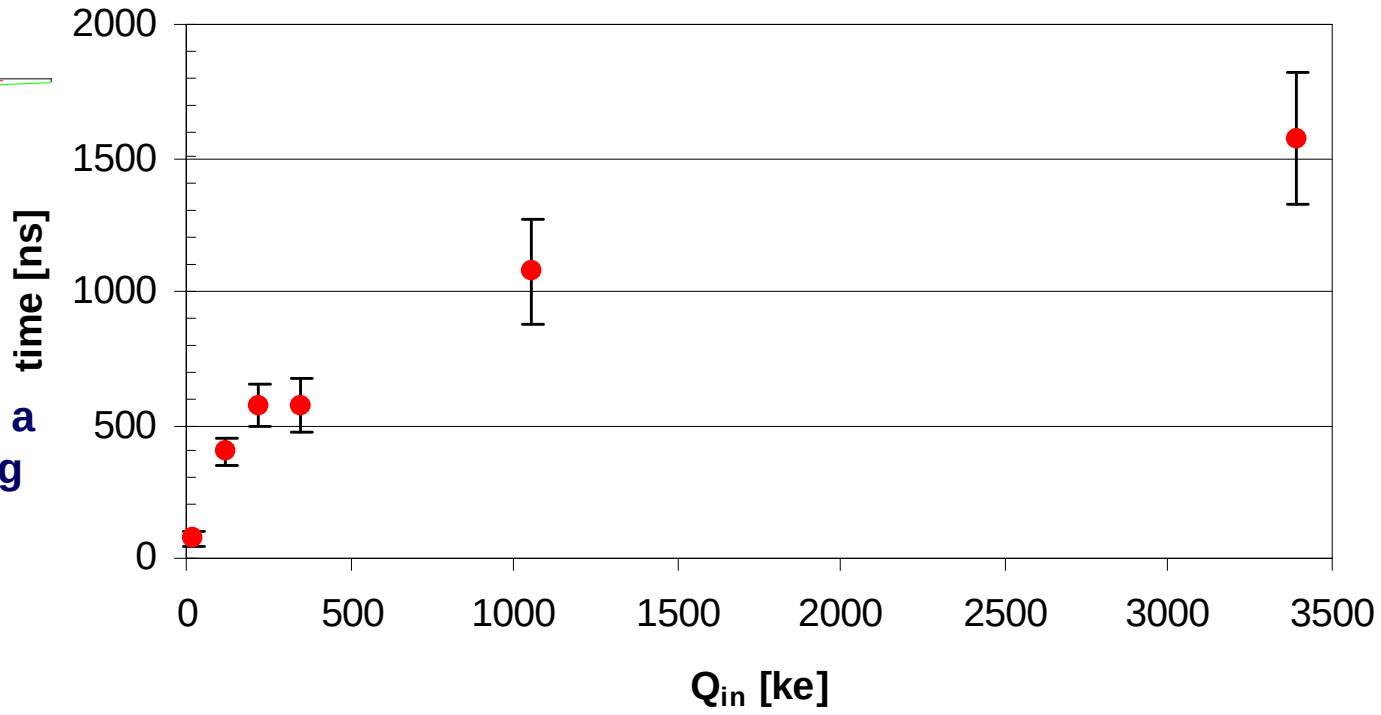
Saturation (3a)

Response to heavy ionizing particles





time between a heavy ionizing particle (Q_{in}) and a signal with 22 ke$^-$
(threshold: 90%)

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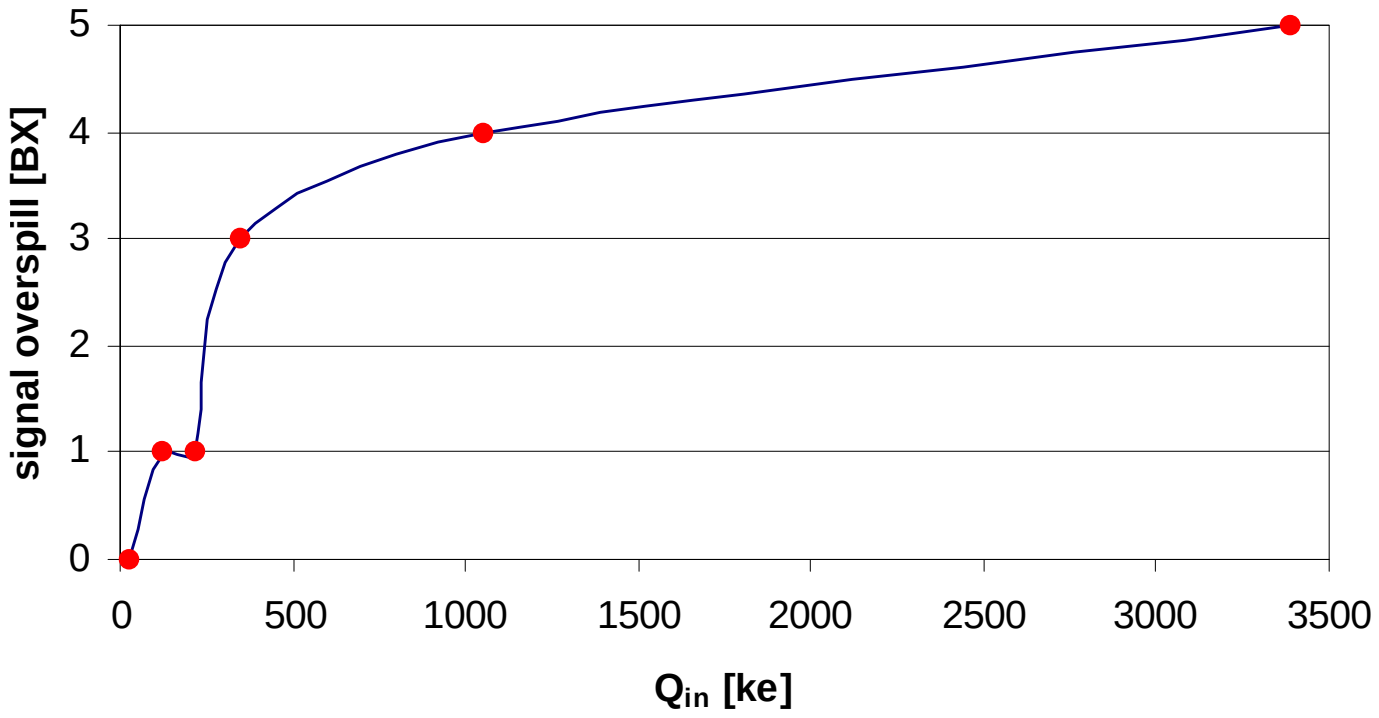
Saturation (3b)

Response to heavy ionizing particles

Signal overspill into next BX



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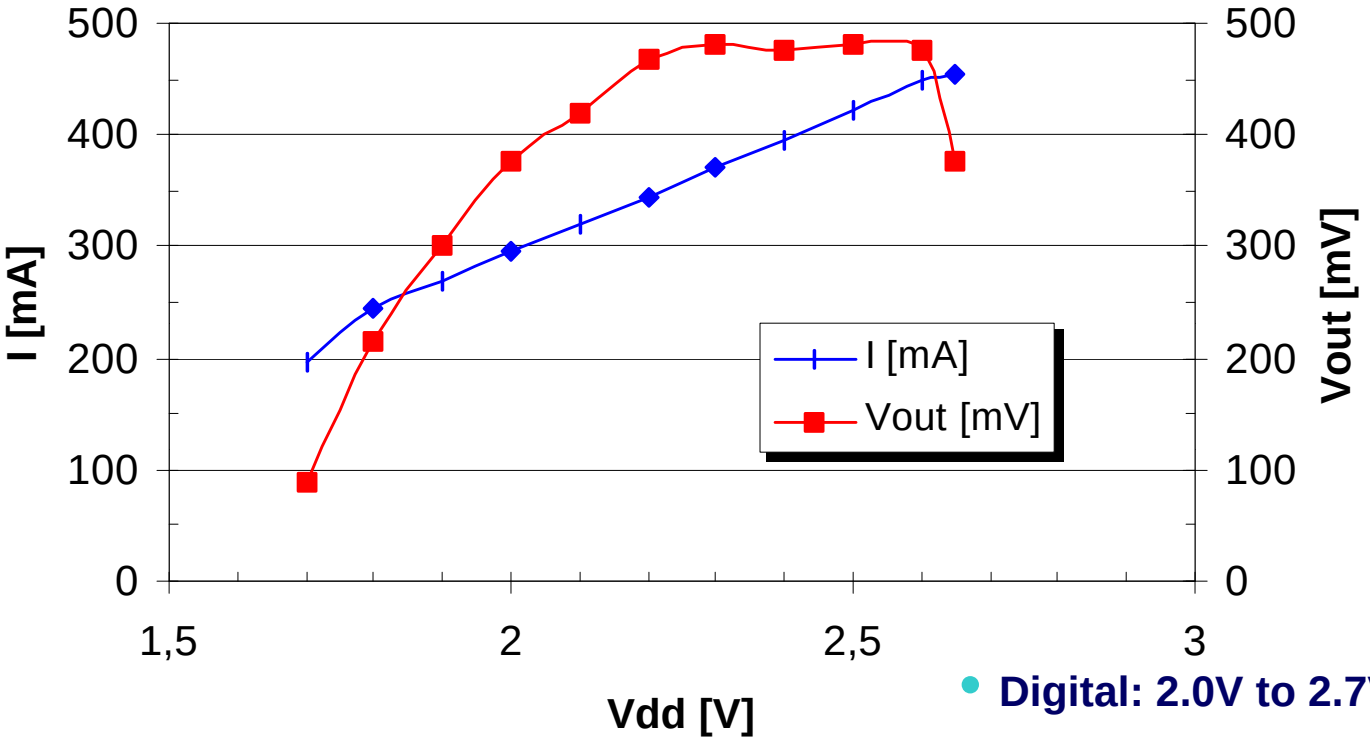
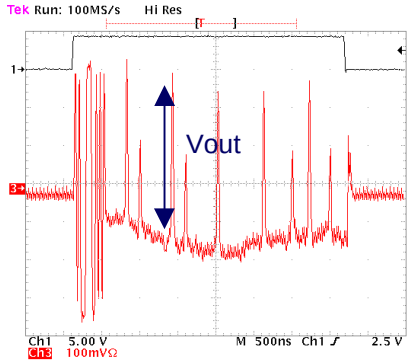
Power Supply Operation





- **Digital: 2.0V to 2.7V**
- **Analog: 2.2V to 2.6V**

Total Power Consumption

Power consumption [mW/ch.]	Minimal	Nominal	Max. operation	Max. DAC
without clock	2,03	4,14	5,57	16,12
only clock	3,04	5,17	6,55	16,88
clocked + 1.1 MHz trigger	3,09	5,32	6,71	17,03

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Temperature Test

- **Start-up tests (~ 10 times each chip):**
  - **3 Beetle 1.2 (non-irrad., 10 Mrad, 30 Mrad)**
  - **@ T=- 44°C, 60°C, 80°C** (facility temperature)
  - **Programming (I^2C)**
  - **1.1 MHz trigger + analog readout**
- **Longtime operating tests (~2 days):**
  - **non-irrad. Beetle 1.2** (because this is the only chip with a Pt100 on the surface)
  - **@ T=-44°C, 60°C, 80°C**
  - **1.1 MHz + analog readout**
- **Self-Heating test:**
  - **non-irrad. Beetle 1.2**
  - **@ room temperature**
  - **max. DAC settings**
  - **Þ $T_{surface}$=131,5°C, Operating over ~ 1 hour**

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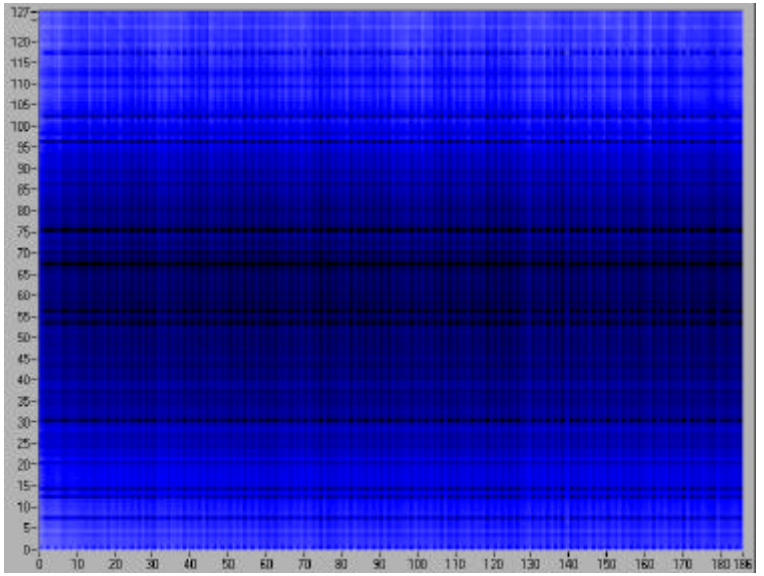
Pipeline and ch. homogeneity

- **Beetle 1.2:**
  - **Labview VI now adapted for 1.2**
  - **first data samples are written to disk**
  - **but not yet evaluated ☹**
- **Beetle 1.1:**
  - **3 chips**
  - **5000 samples per pipeline-cell**
  - **RMS-value £ 1.85mV (Þ 380e$^-$)**
  - **Pedestal variation per channel £ 2.36mV (Þ 485e$^-$)**



Beetle 1.2 Pipelinescan (raw data)

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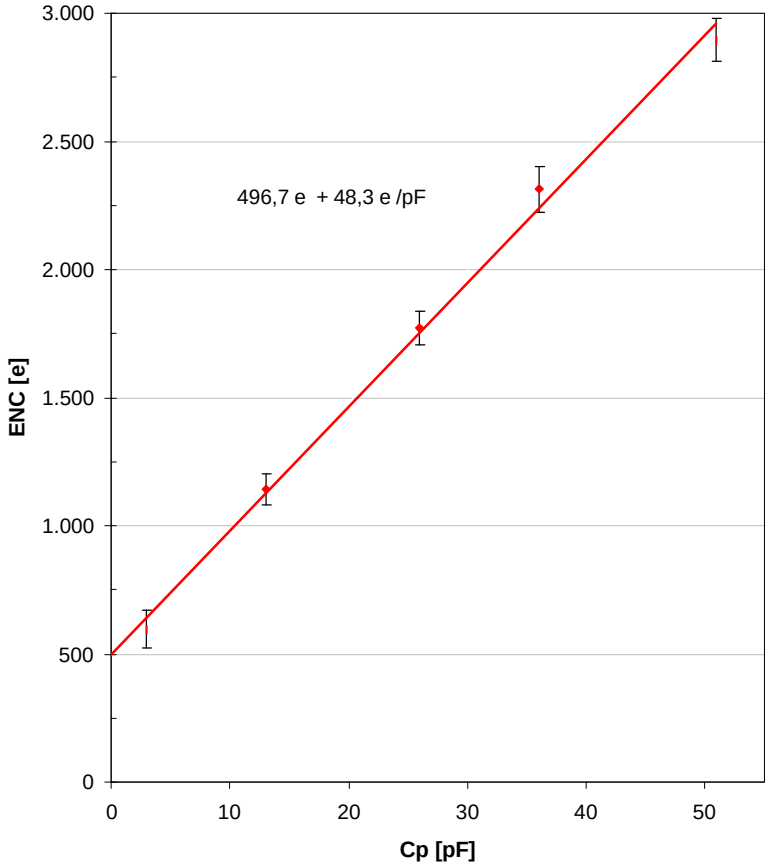
Front end: ENC



measured ENC of the new front end on a complete readout chip Beetle 1.2:

Heidelberg: 497 e^- + 48.3 e^-/pF

measured ENC of the new front end on a test chip BeetleFE 1.1:

NIKHEF:	429 e^- + 47.0 e^-/pF
Zurich:	436 e^- + 47.7 e^-/pF
Heidelberg:	483 e^- + 45.7 e^-/pF

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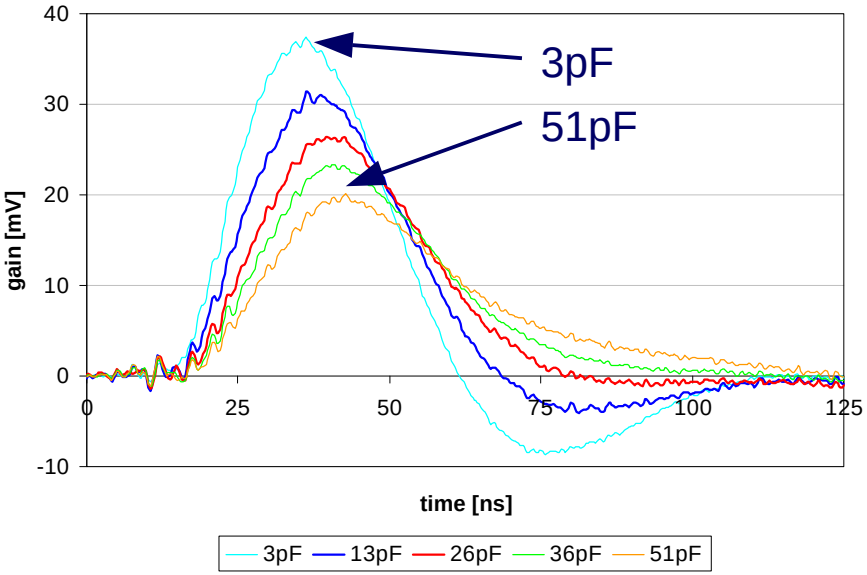
Front end: Pulseshape (1)

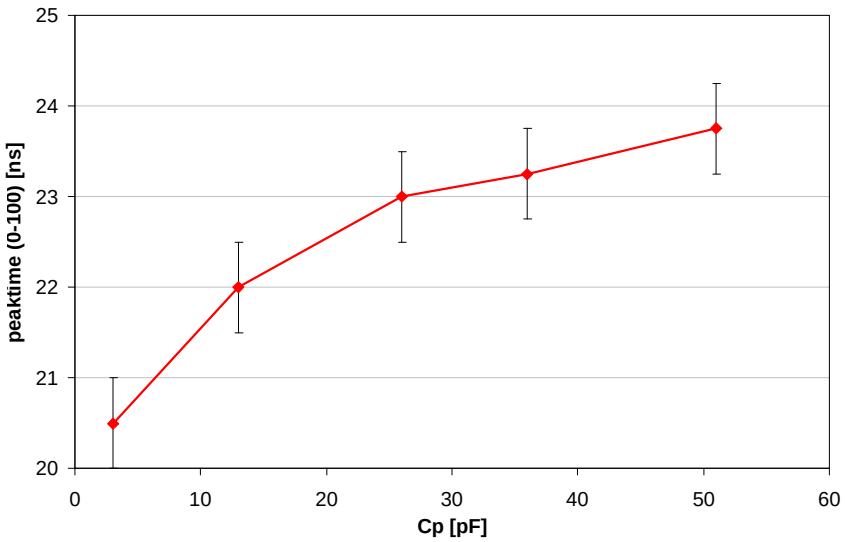
Front end behaviour of the Beetle 1.2

(measured with different Cp)

Ipre=600µA, Isha=80µA, Ibuf=200µA, Vfp=0V, Vfs=0V



peaktime (0-100)



- peaktime ≤ 25 ns for $C_p \leq 51pF$

1 measurement out of more than 100, all with different settings

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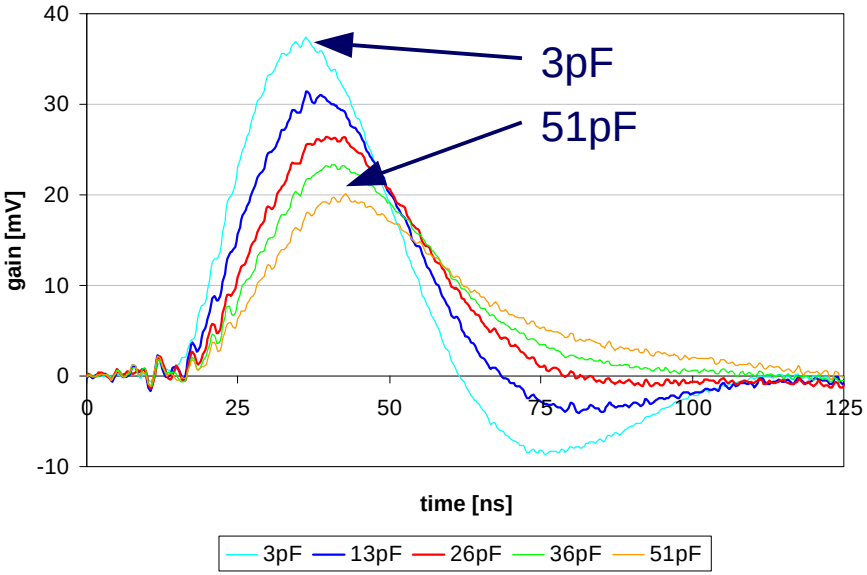
Front end: Pulseshape (2)

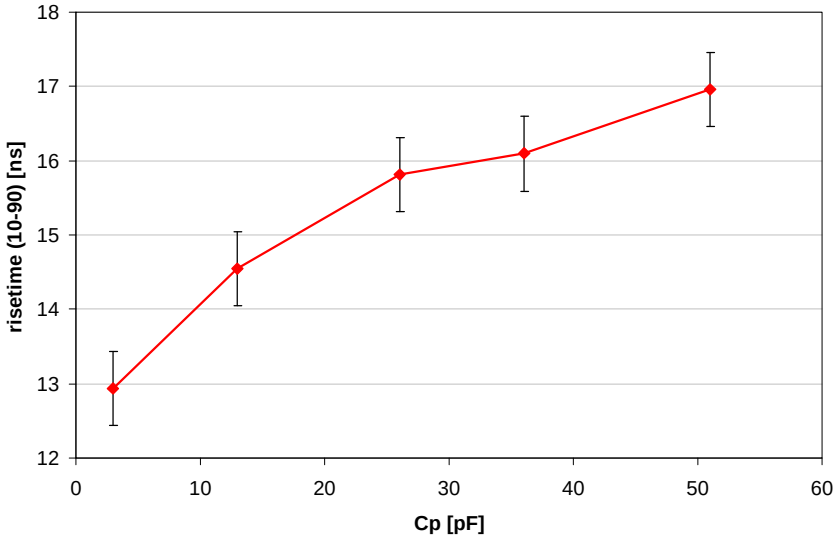
Front end behaviour of the Beetle 1.2

(measured with different Cp)

Ipre=600µA, Isha=80µA, Ibuf=200µA, Vfp=0V, Vfs=0V



risetime (10-90)



- risetime ≤ 17 ns for $C_p \leq 51pF$

Front end: Pulseshape (3)

Front end behaviour of the Beetle 1.2

(measured with different Cp)

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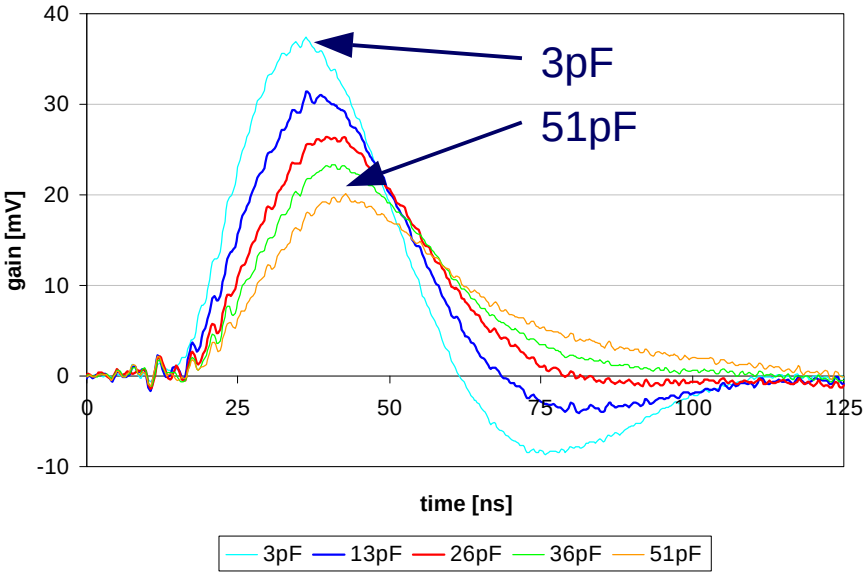
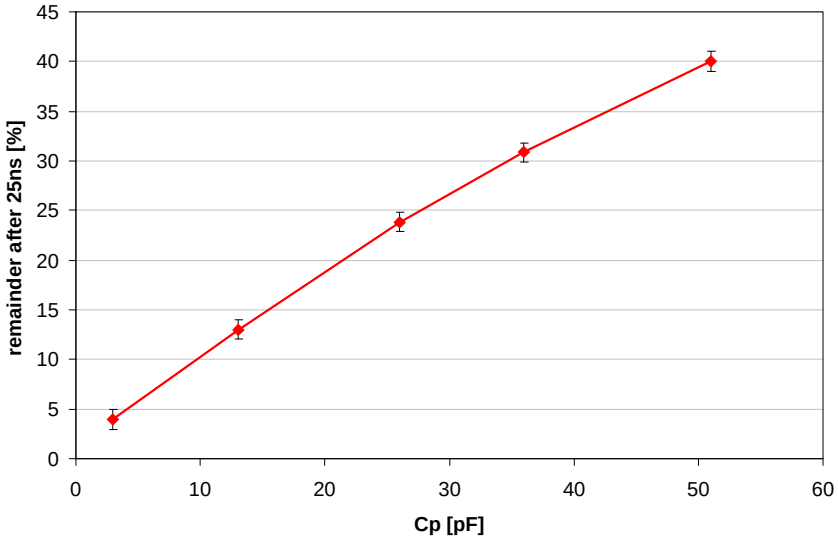


remainder after 25ns



- remainder 25 ns after peak is less than 30% for $C_p < 35pF$

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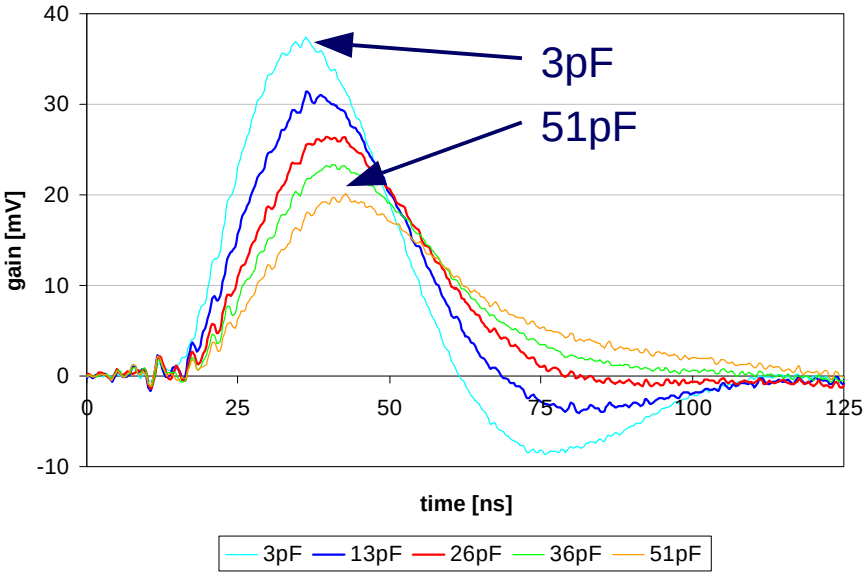
Front end: Pulseshape (4)

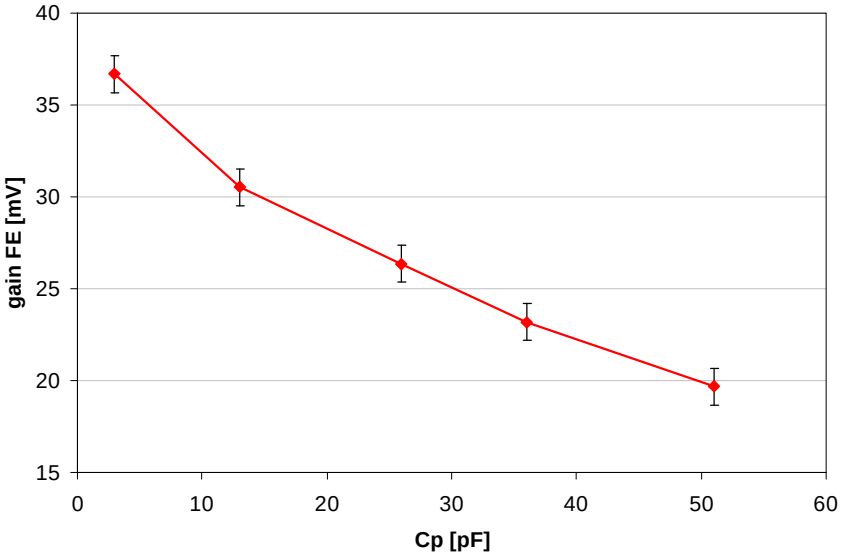
Front end behaviour of the Beetle 1.2

(measured with different Cp)

Ipre=600µA, Isha=80µA, Ibuf=200µA, Vfp=0V, Vfs=0V



gain front end



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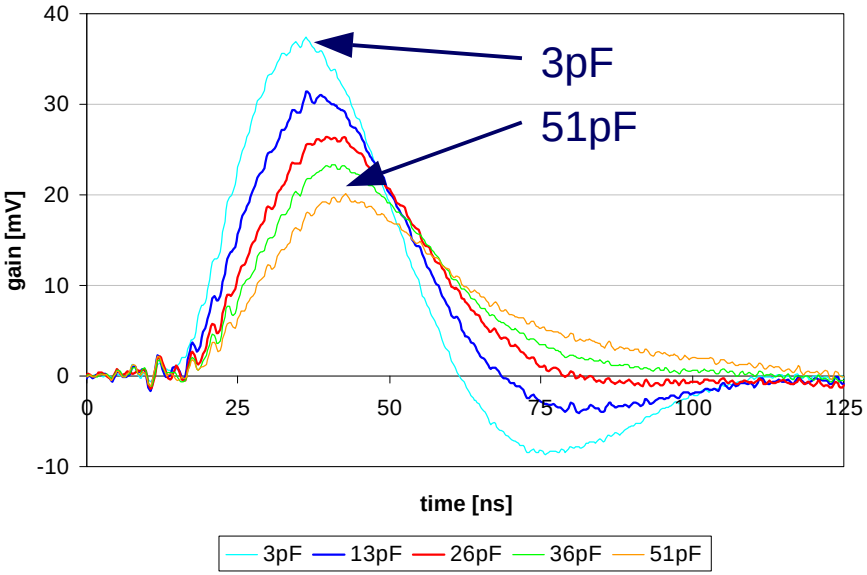
Front end: Pulseshape (5)

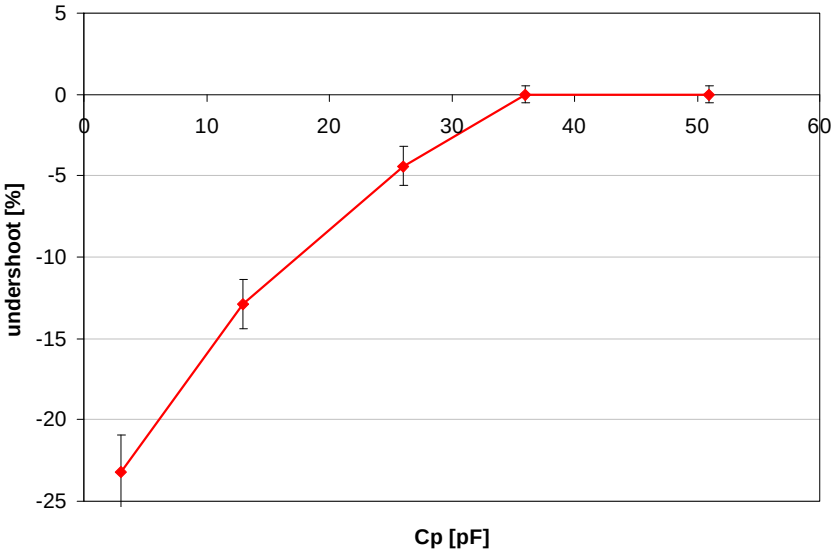
Front end behaviour of the Beetle 1.2

(measured with different Cp)

Ipre=600µA, Isha=80µA, Ibuf=200µA, Vfp=0V, Vfs=0V



max. undershoot



- max. undershoot less than 5% for $C_p > 25pF$

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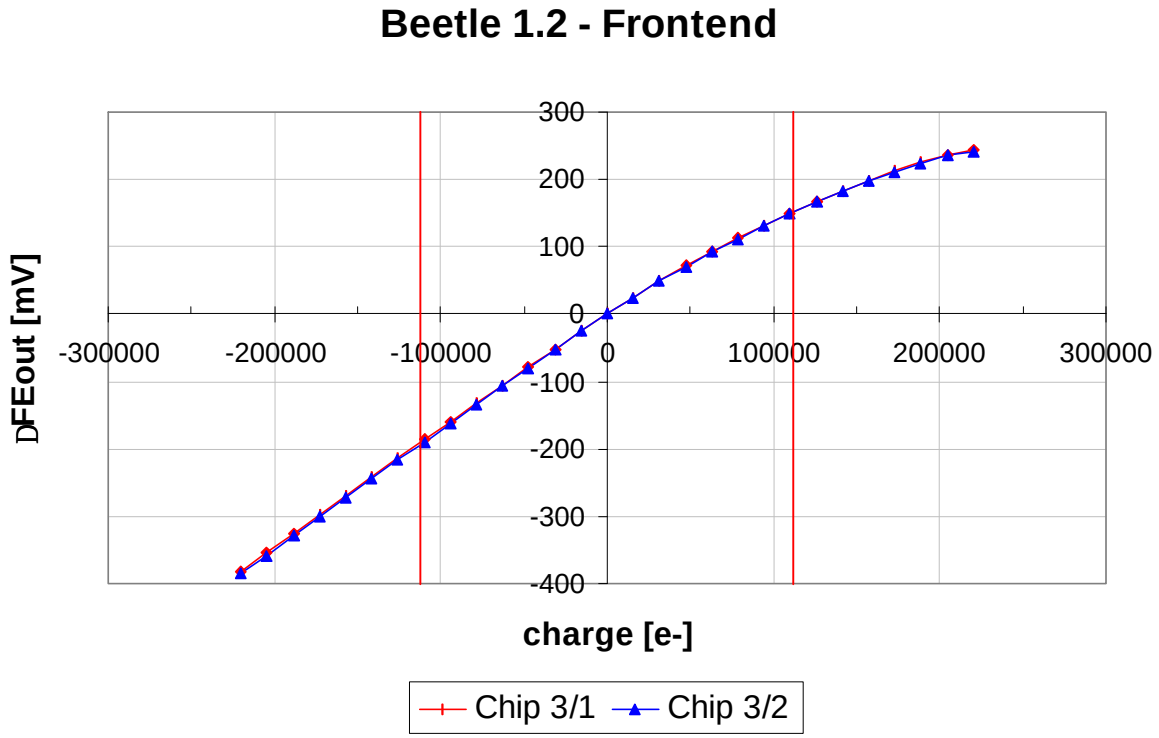
Front end: Dynamic range

Dynamic range for both polarities:

+/- 110.000 e^-: < 2% for negative pulses

< 5% for positive pulses



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