MICROMEGAS Read-Out Chip

Réunion technique
LAPP, France
apr 7^{th}, 2011

R. Gaglione

Laboratoire d'Annecy-le-Vieux de Physique des Particules,
Université de Savoie, CNRS/IN2P3
FRANCE

April 7^{th}, 2011

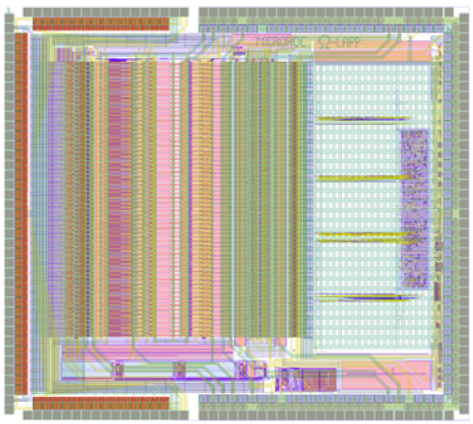
Outline

Outline

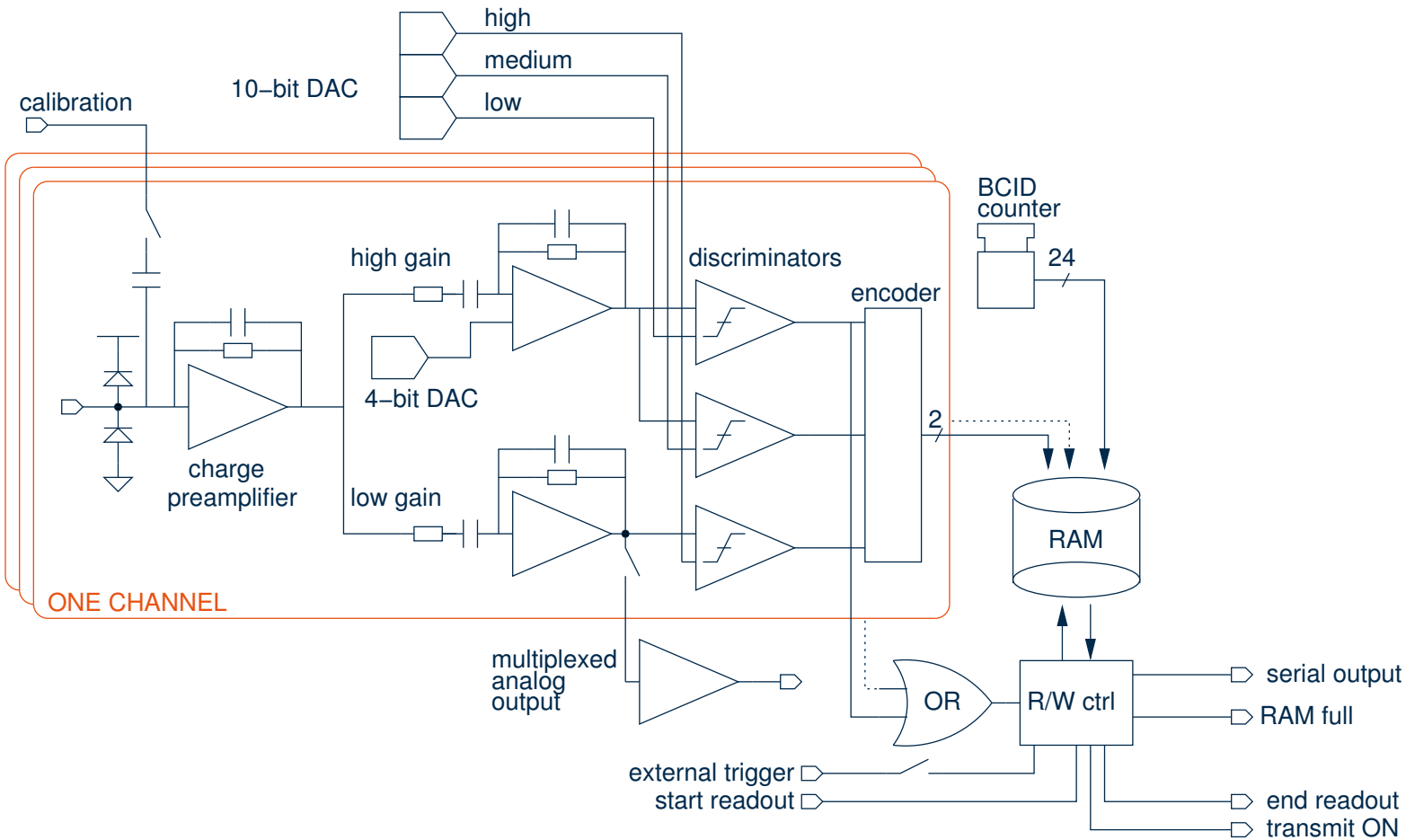
Introduction

MICROROC is a 64 channels integrated circuit packaged in TQFP160 intended to be used with MPGD-based DHCAL (MICROMEGAS or GEM).

- MICROROC is a fruit of the collaboration between LAPP and LAL/OMEGA based on the experience of previous ASICs (DIRAC and HARDROC) and on multiple test beam results
- Same Digital part as HARDROC2b, but charge preamplifier input stage + sparks protection [R. Gaglione] and slower shaping + 4-bit DAC offset correction per channel [N. Seguin]
- MICROROC is pin a pin compatible with the HARDROC2b to minimize boards modifications (see Cyril's talk).



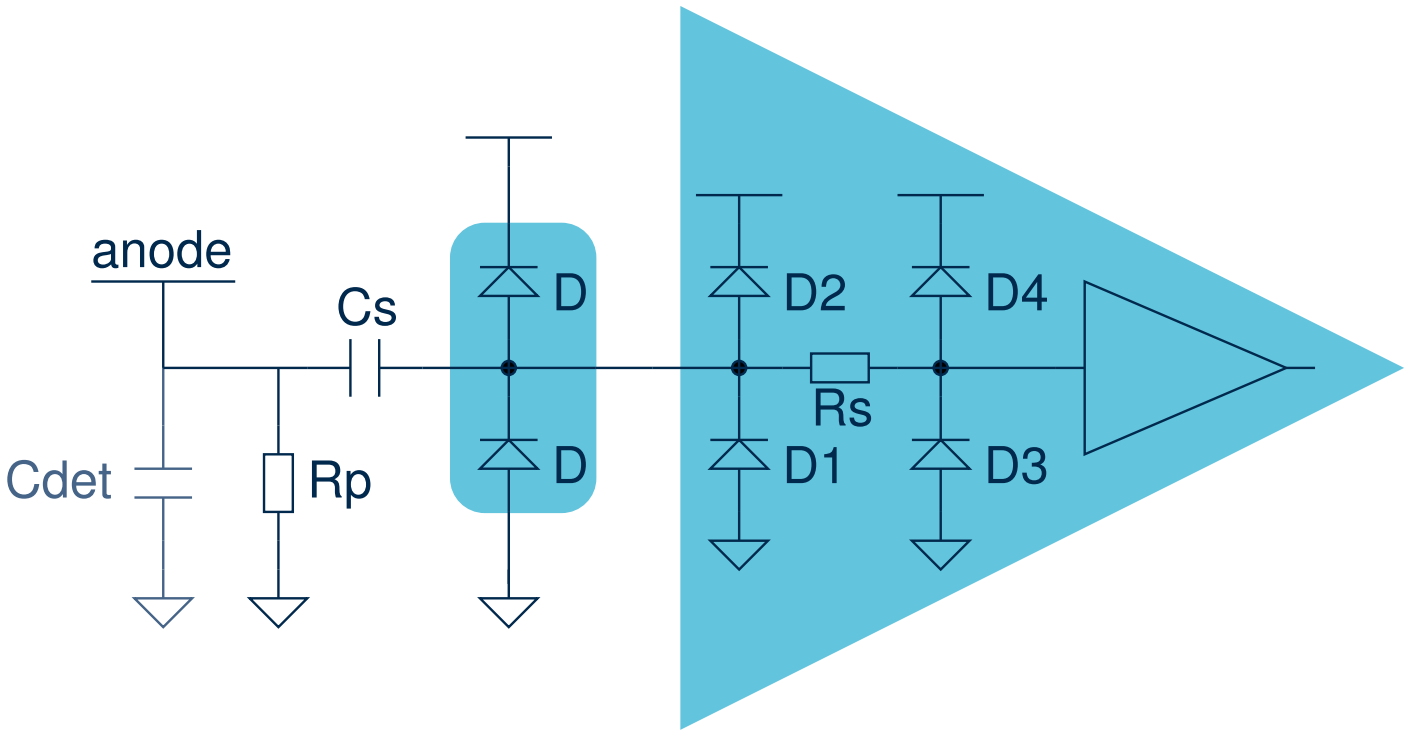
Global architecture



Performances

- Technology: AustriaMicroSystem SiGe 0.35 µm
- Die size: 4.85×4.3 mm
- Dynamic range: 500 fC
- C_{det}: 80 pF
- Preamplifier gain: 2.38 mV/fC
- Noise rms: 1 fC at preamplifier output, 0.24 fC with 200 ns shaping
- Peaking times: 30, 50, 100 and 200 ns
- Minimum threshold: ∼2 fC

Protection against sparks

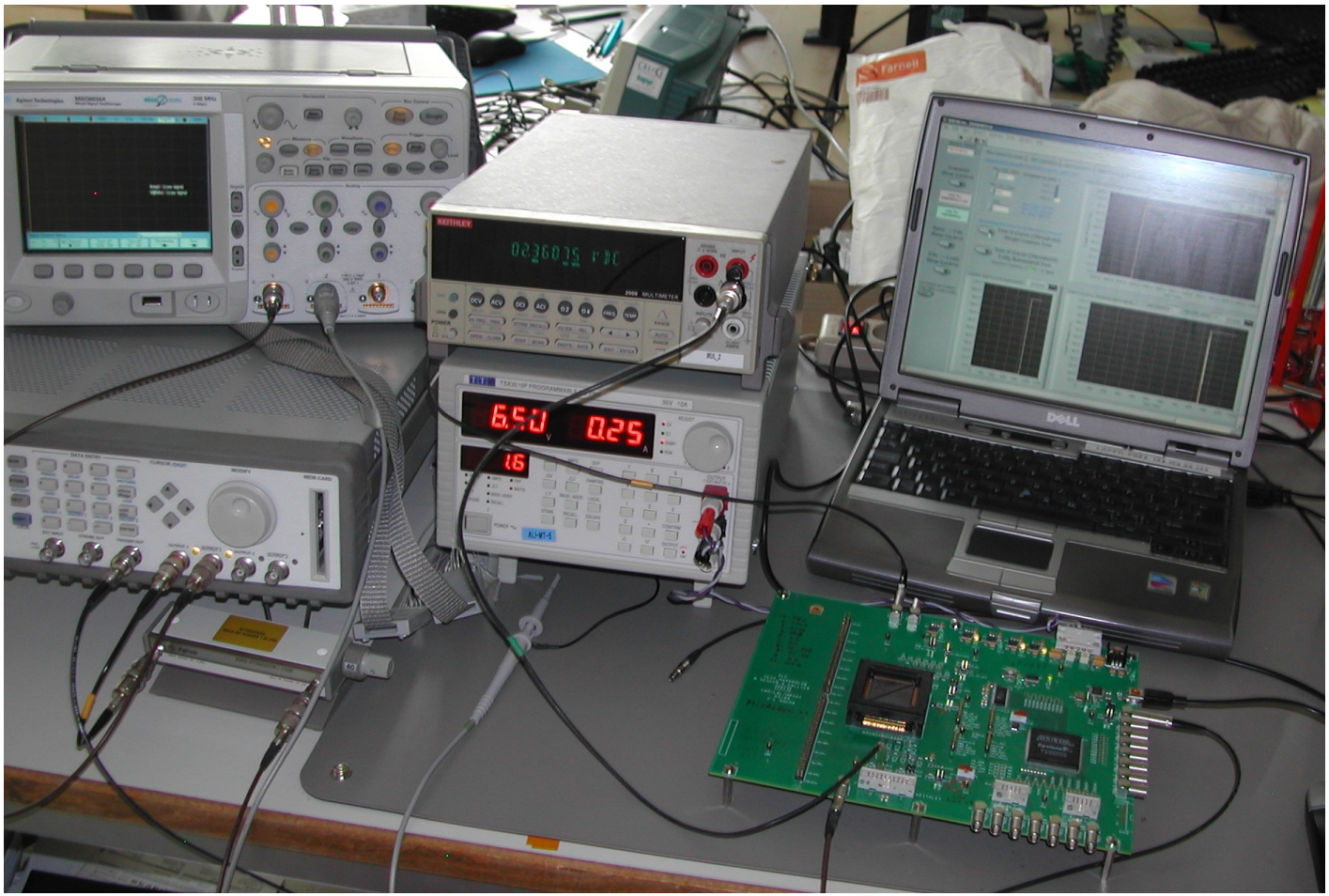


Rp=1 MΩ, Rs=10 Ω, Cs=470 pF, D are ON-Semiconductor NUP 4114, Dx are integrated fast diodes.

Outline

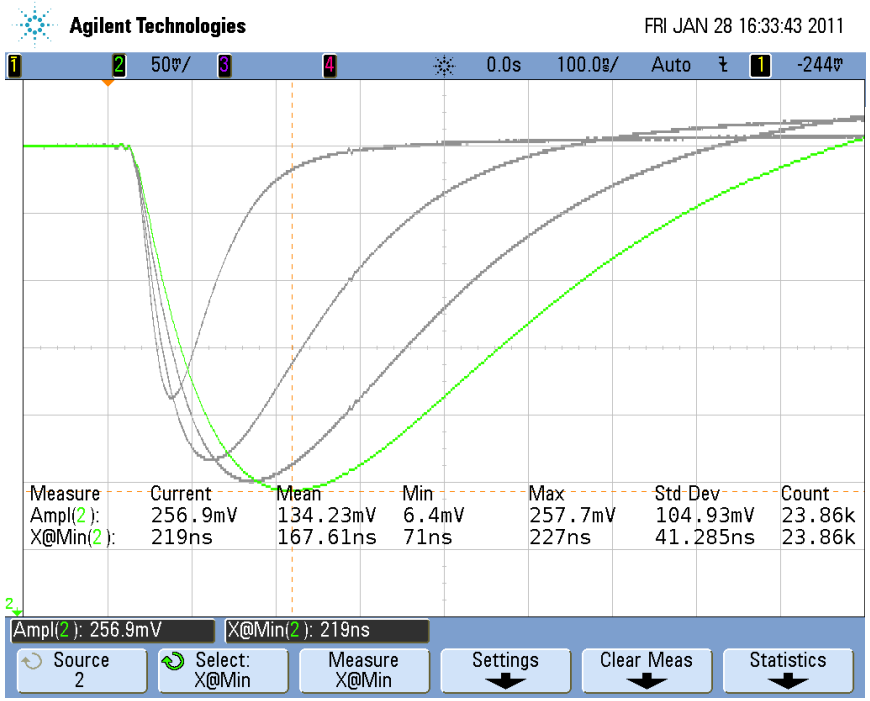
Test bench

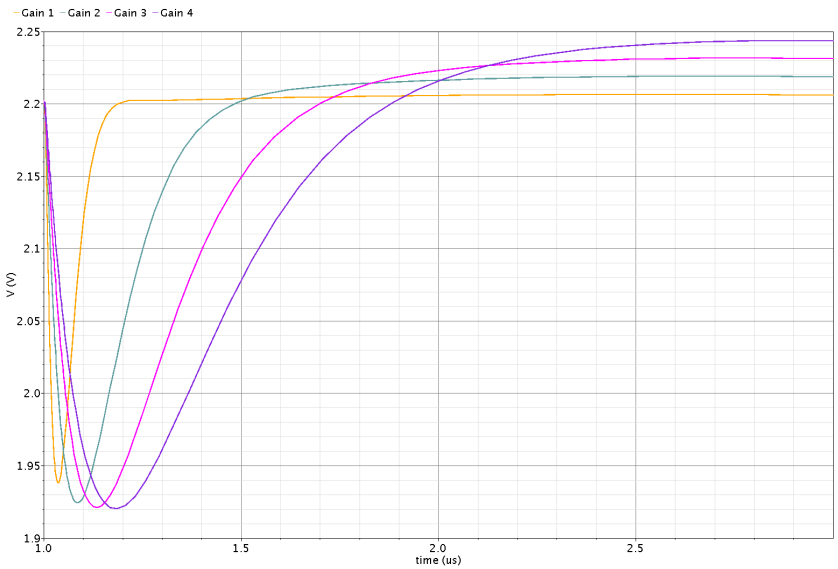
The test board and labview software have been provided by OMEGA/LAL.



Waveforms

This is the output of high gain shaper, for the for settings (measure against simulation), with 25 fC charge injection (MIP-MPPV):

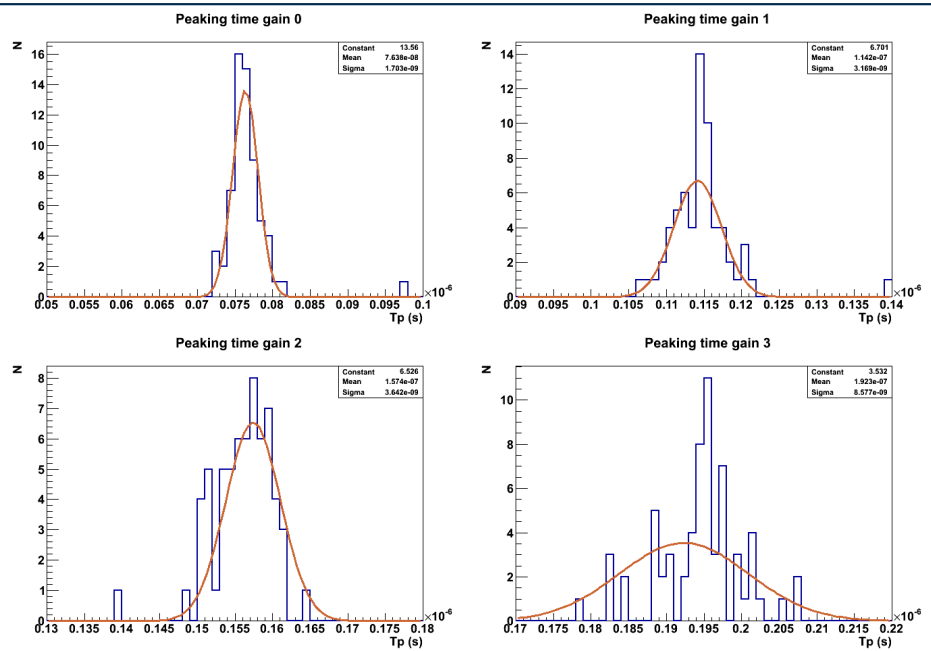




Good agreement between simulation and real behaviour.

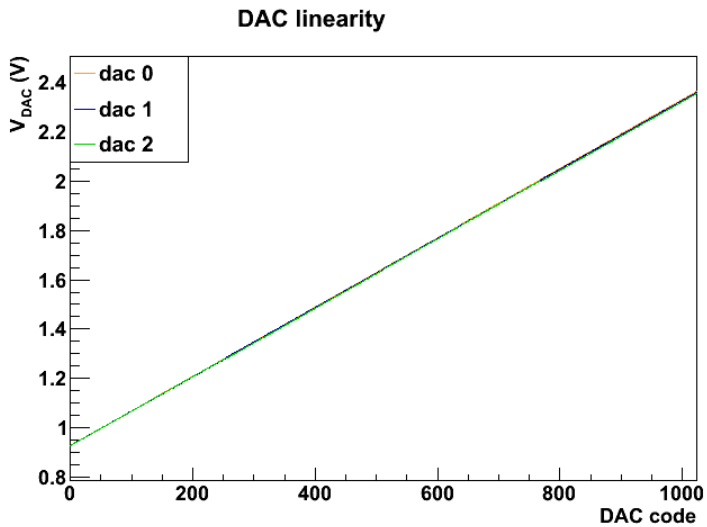
Shapers

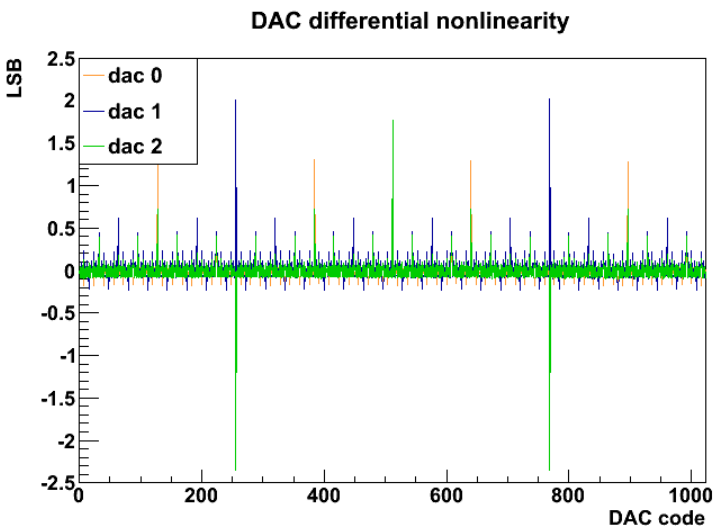
Setting	Measure Gain (mV/fC)	Measure Tp (ns)	Simulation Gain (mV/fC)	Simulation Tp (ns)
00	7.6	76.3	10.5	30
01	9.7	114.2	11.0	100
10	9.8	157.4	11.1	150
11	10.2	192.3	11.2	200

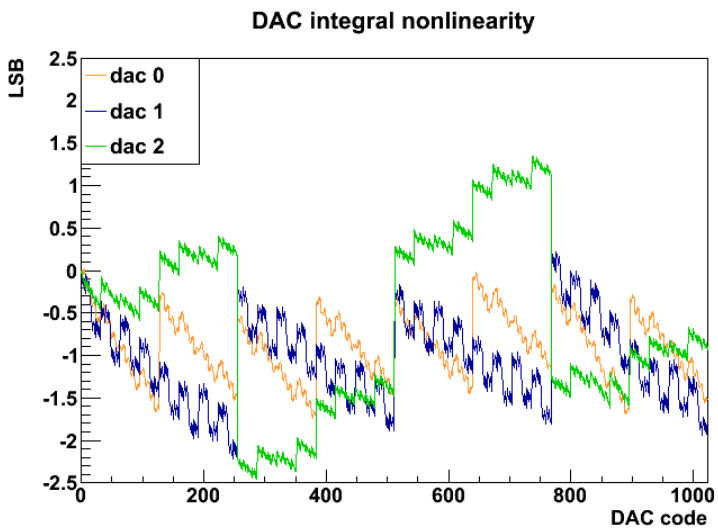


Good agreement between simulation and real behaviour.

Thresholds DAC

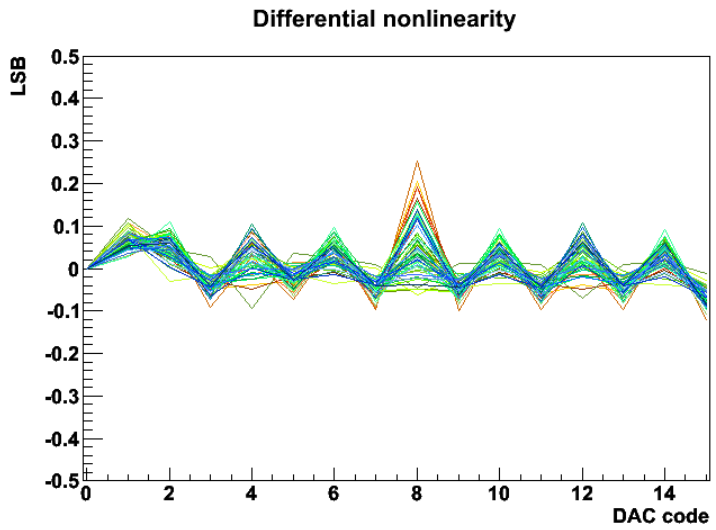


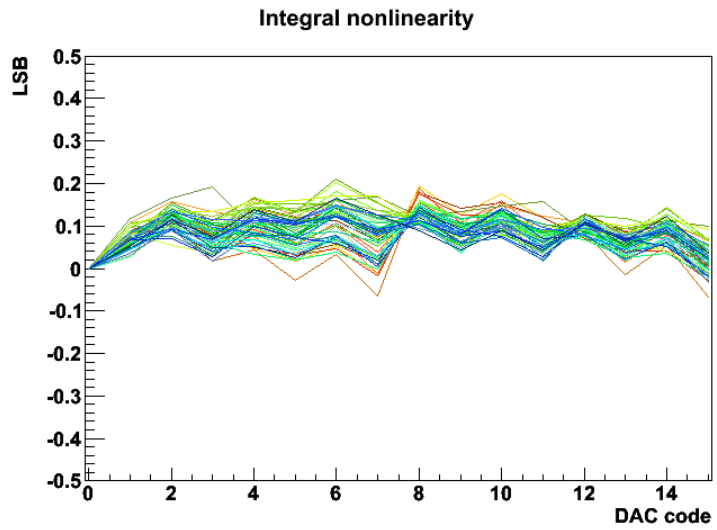


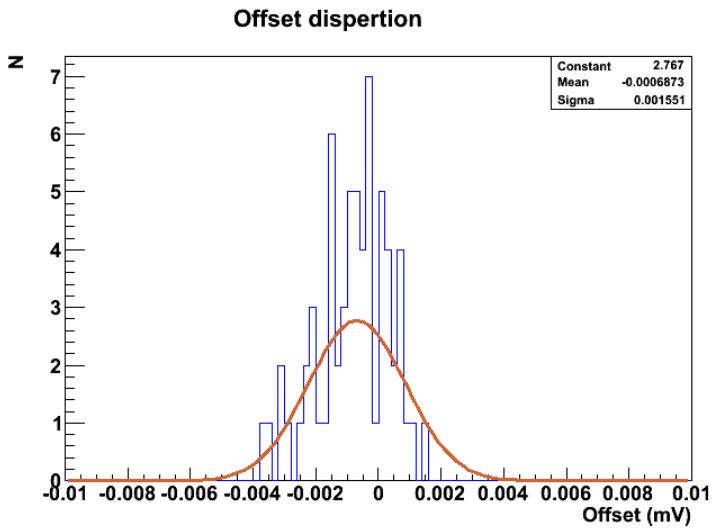


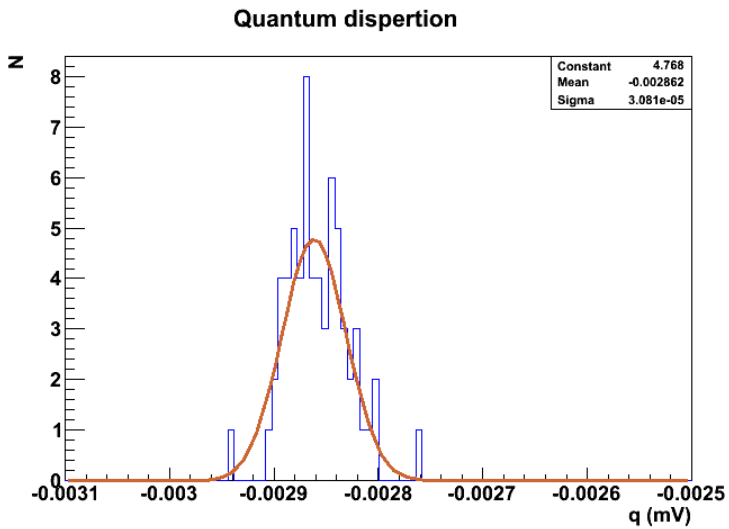
For each DAC, the linearity is about 3 DACU.

Offset correction DAC









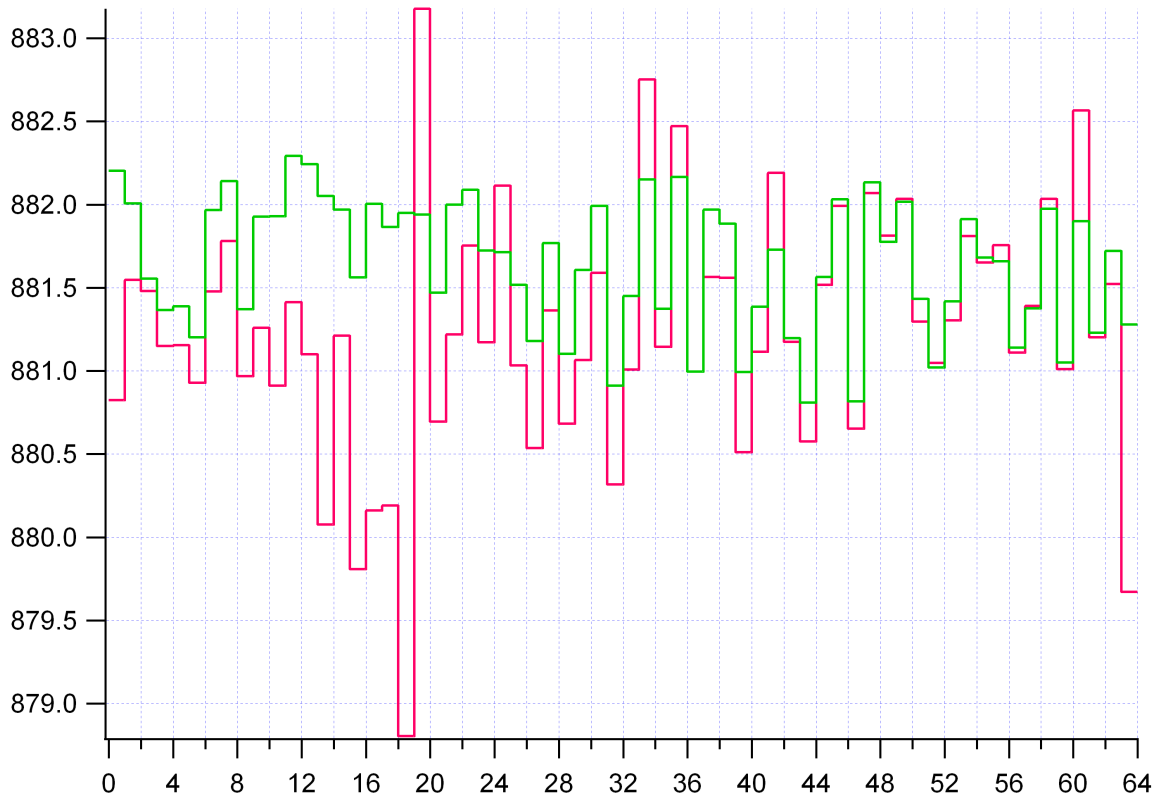
The linearity is better than 1 DACU and q=2.8 mV.

Outline

Pedestals compensation

V_avg= 881.2 DACU
V_sdev= 0.74 DACU

V_avg= 881.6 DACU
V_sdev= 0.4 DACU



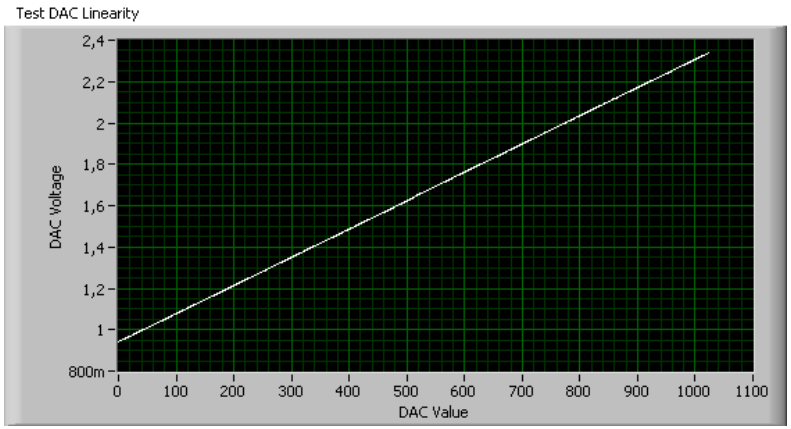
Difference before and after correction, for high gain shaper: 2 factor on pedestal dispertion !

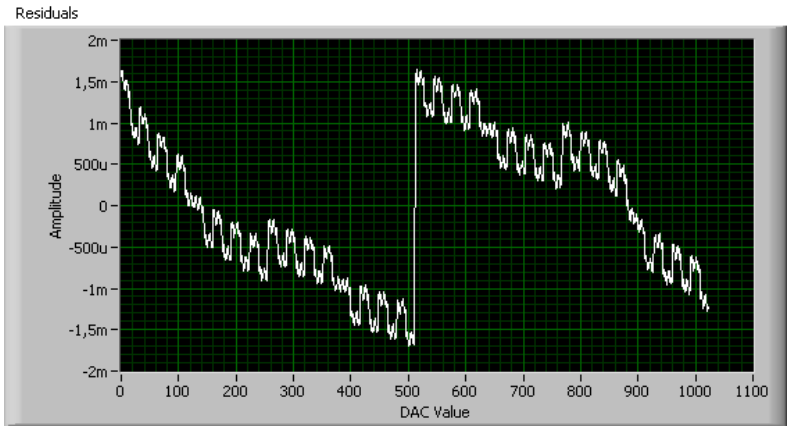
Threshold DAC tests

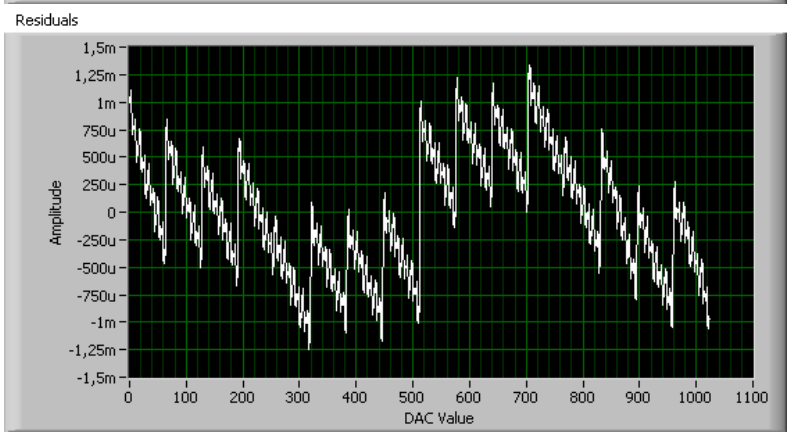
dac0 slope:
1.37 mV/*DACU*
942.06 mV to 2.34 V

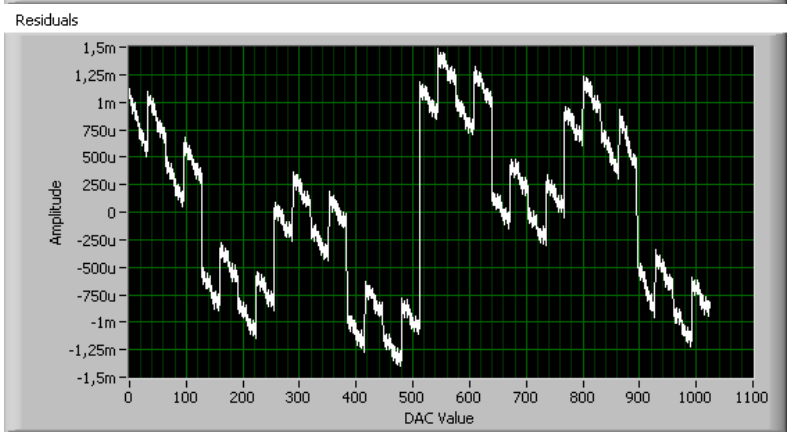
dac1 slope:
1.38 mV/*DACU*
943.32 mV to 2.35 V

dac2 slope:
1.37 mV/*DACU*
943.35 mV to 2.34 V



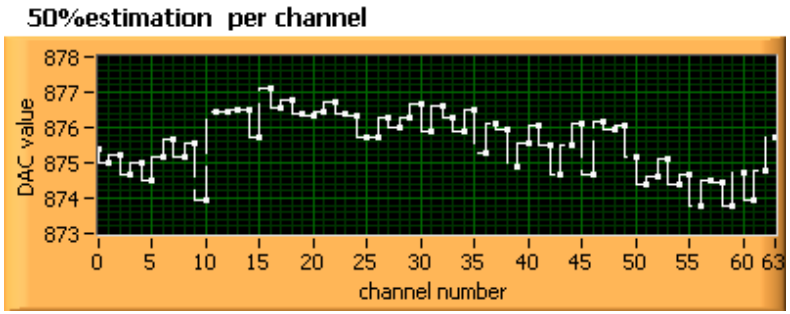


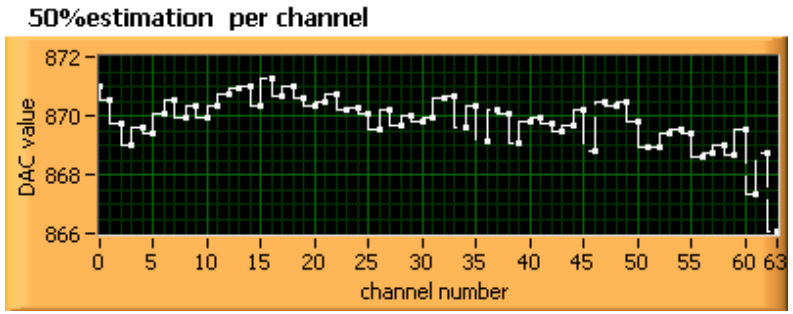




INL: $\pm$ 1.5 mV

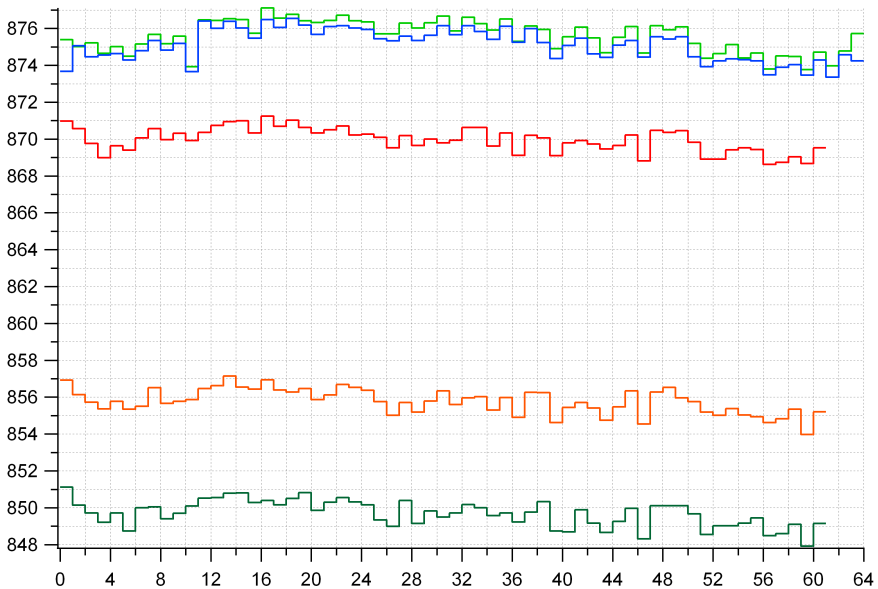
Scurves measurements Cdet=88 pF

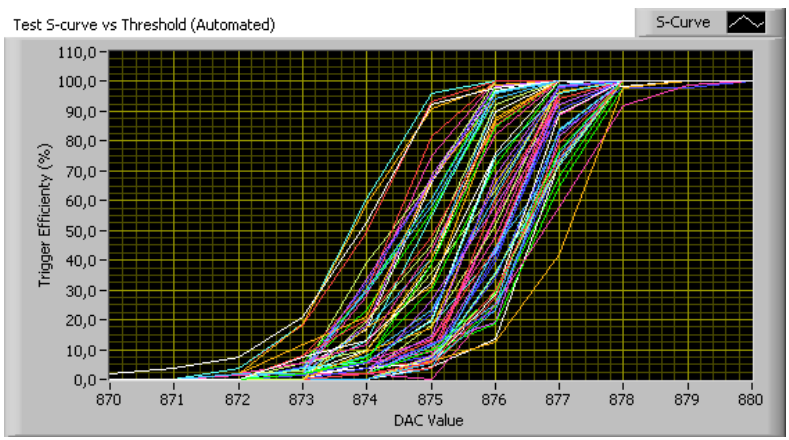




Pedestal: V_avg= 875.6 ; V_sdev= 0.85

2 fC: V_avg= 869.9 ; V_sdev= 0.65





pedestal, 1 fC,2 fC, 4 fC,5 fC

Outline

Status

Prototypes tests

The chip has been sent in MPW run in June 2010 and 5 prototypes have been received in September 2011. The behaviour of the prototypes is very satisfaying.

Production

After prototypes tests in LAL and LAPP, an order has been placed for 350 chips. 341 chips have been received last week, and tests should be started very soon !
A production HR2b board has been flashed with Guillaume's DIF firmware and is used with Cyril's Labview to test the 341 chips.

Tests results

144 chips have been hand-tested and selected to equip the first square meter. For the second square meter, possibilty to use Mind's robot...
To be discussed !

Test procedure

Maximum gain, offset correction at 7 for all channels.

- Test all inputs bonding (exept channel 8: bad connection on socket) ;
- S-Curves without injection (pedestal) ;
- S-Curves with 25 fC.

Gain for each channel is extracted with framework. If any channel has a bad bonding or a wrong gain, chip is rejected.

Issues

Very poor yield (168/195:86%), but:

- Bonding tests seems not repeatable (socket?) ;
- Some corrupted data ;
- When Labview is launched, data of fist chip are not correct (bad dif id) ;
- Socket bound some pins: manually repaired !

All suspicious chip will be retested, and we hope a better yield !