B-TOF Hardware

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Latest News

Sebastian Zimmermann
On behalf of the Panda SciTil group

Panda Meeting Stockholm, 05.06.2018

Overview

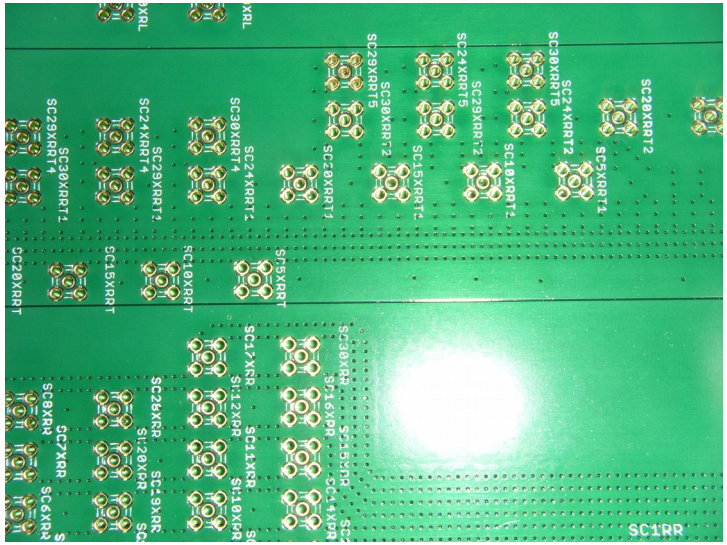
- TOFPET ASIC Readout
- Railboard_v2.0 measurement plan

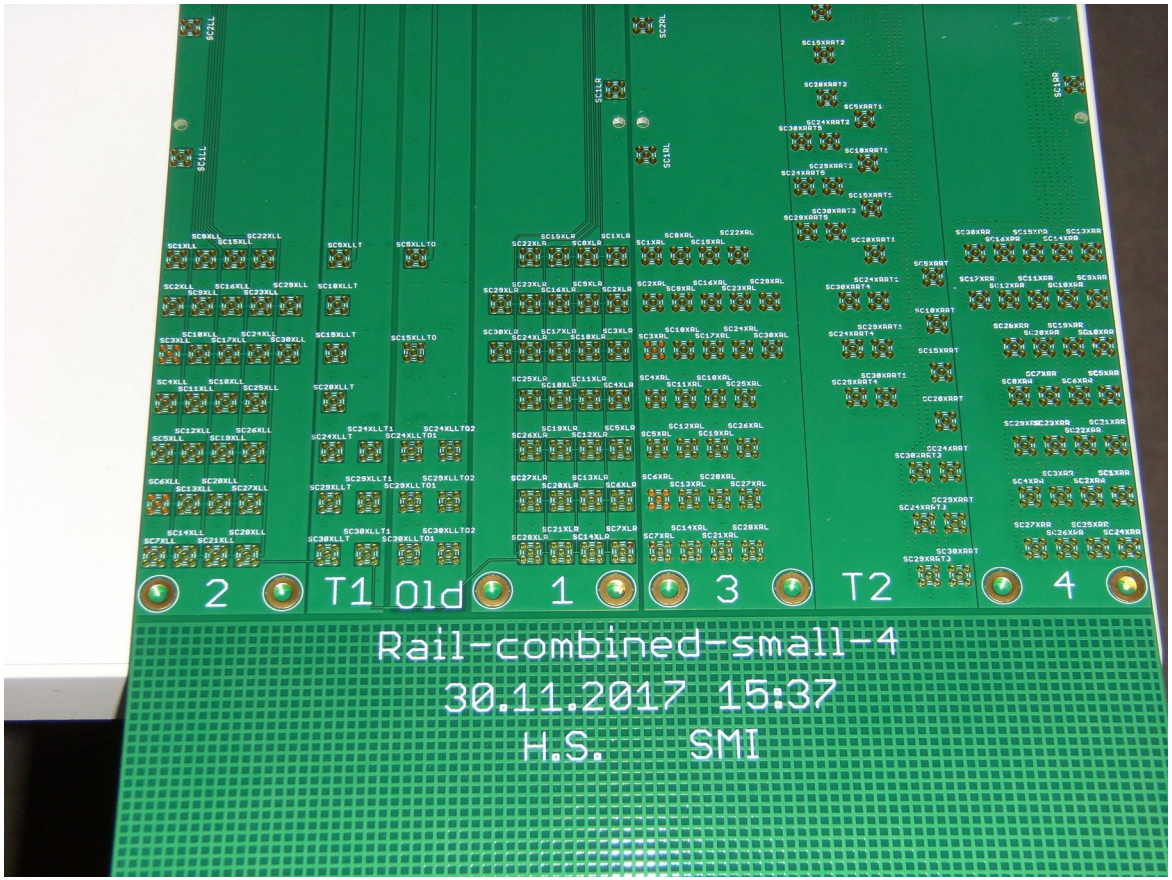
Railboard v2.0

- Arrived yesterday (04.06.2018)
- Crosstalk and attenuation will be thoroughly tested in the upcoming months

Railboard v2.0

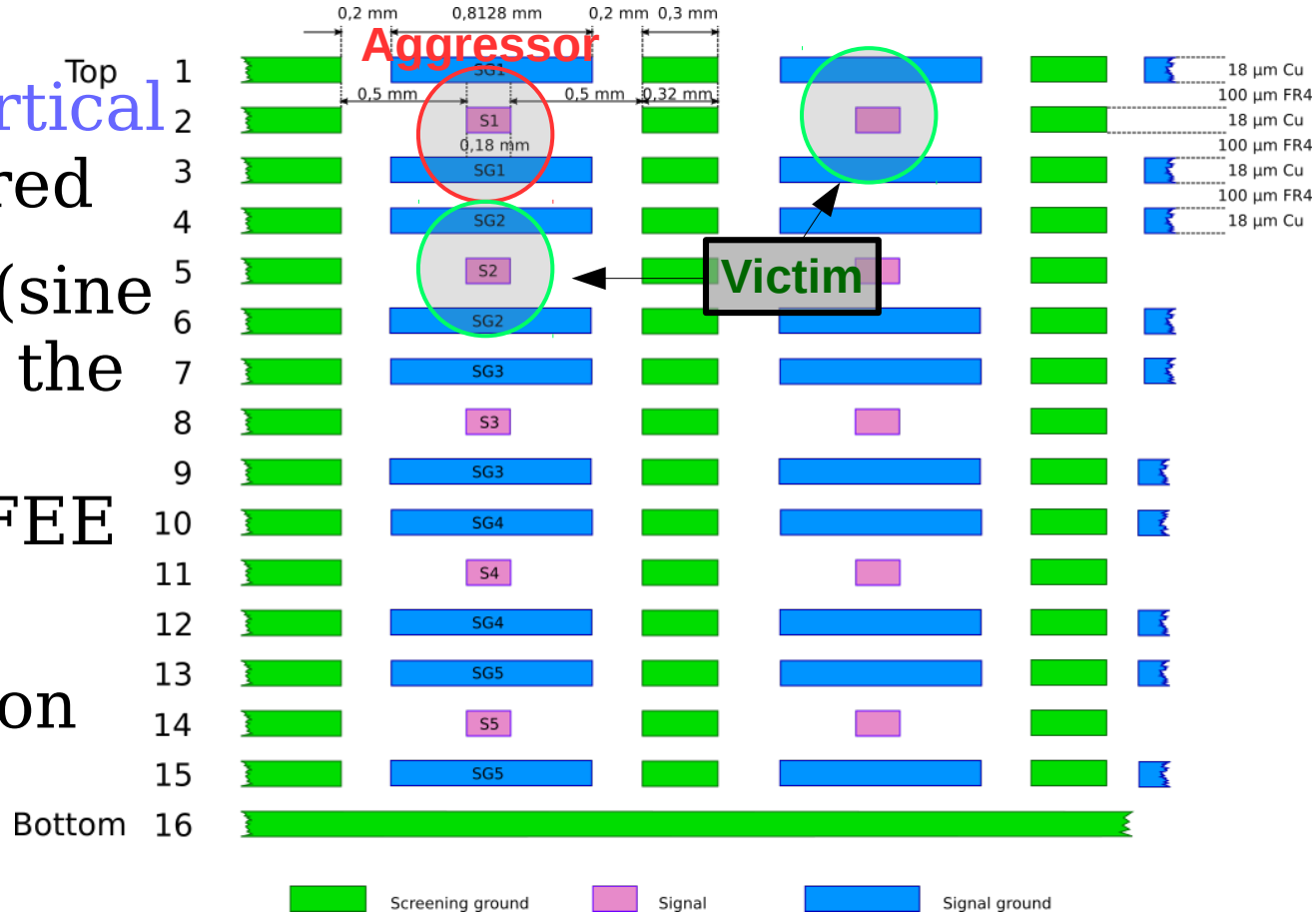
- 7 different layout are implemented
- Different via densities will be tested





Crosstalk measurement

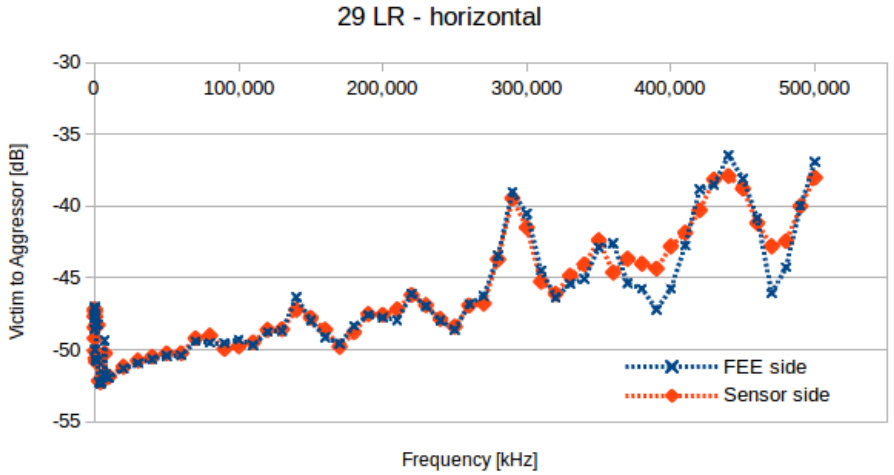
- Crosstalk to horizontal and vertical neighbors measured
- Aggressor signal (sine curve) induced at the sensor side & measured at the FEE side
- Victim measured on both sides by an Oszilloscope

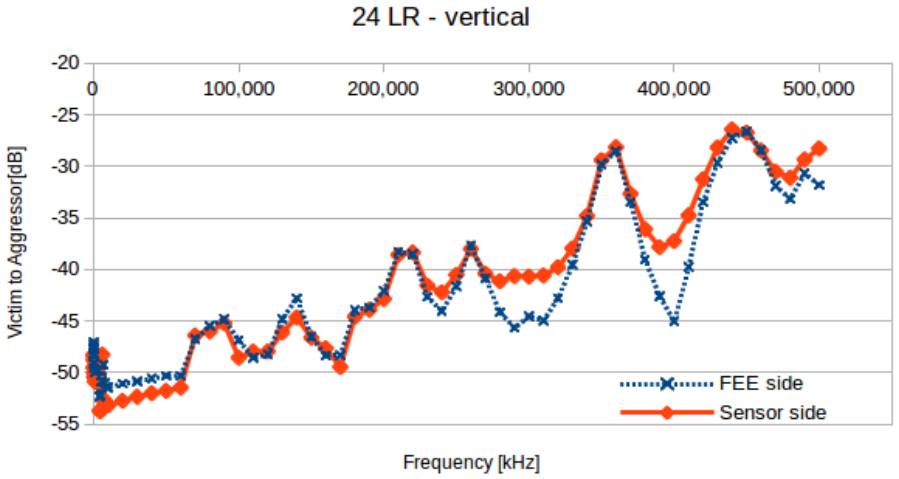


Crosstalk Measurements

- Measured as aggressor amplitude (F_0) vs victim amplitude (F)
  - Measured as mean of peak to peak for >1k events
- Plotted in decibels against the aggressor frequency:

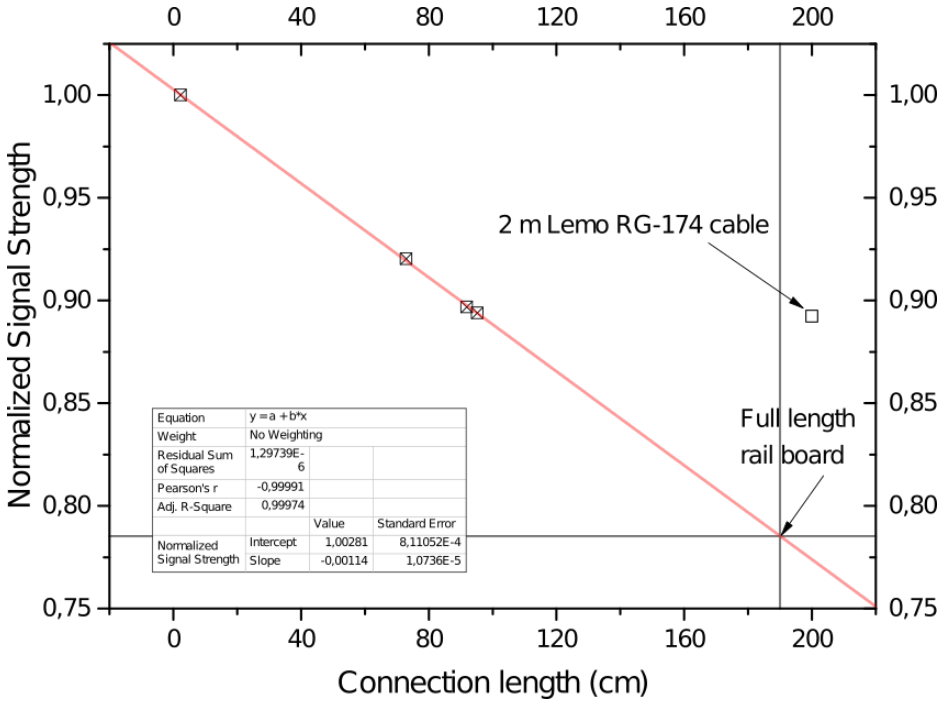
$$20 \log_{10}\left(\frac{F}{F_0}\right) \text{dB}$$





Signal Attenuation

- Measured with a pulse of about 3.4 V and a rise time of 10 ns and a falloff over 40 ns
- Multiple connections measured
- Extrapolated to full length railboard (190 cm)
  - Loss of ~23%



Motivation

- For the first iteration of the Railboard we measured crosstalk of around 2.5% with a sine curve and had no visible crosstalk (on noise level) for SiPM signals

- Board was however over the goal for the material budget
  - 1.5 X_0 instead of < 1 X_0
- To reduce the used material the amount of passive conductor should be reduced
  - From Two layer of separate ground for every signal line to one layer
- In addition we are trying to optimize the crosstalk performance

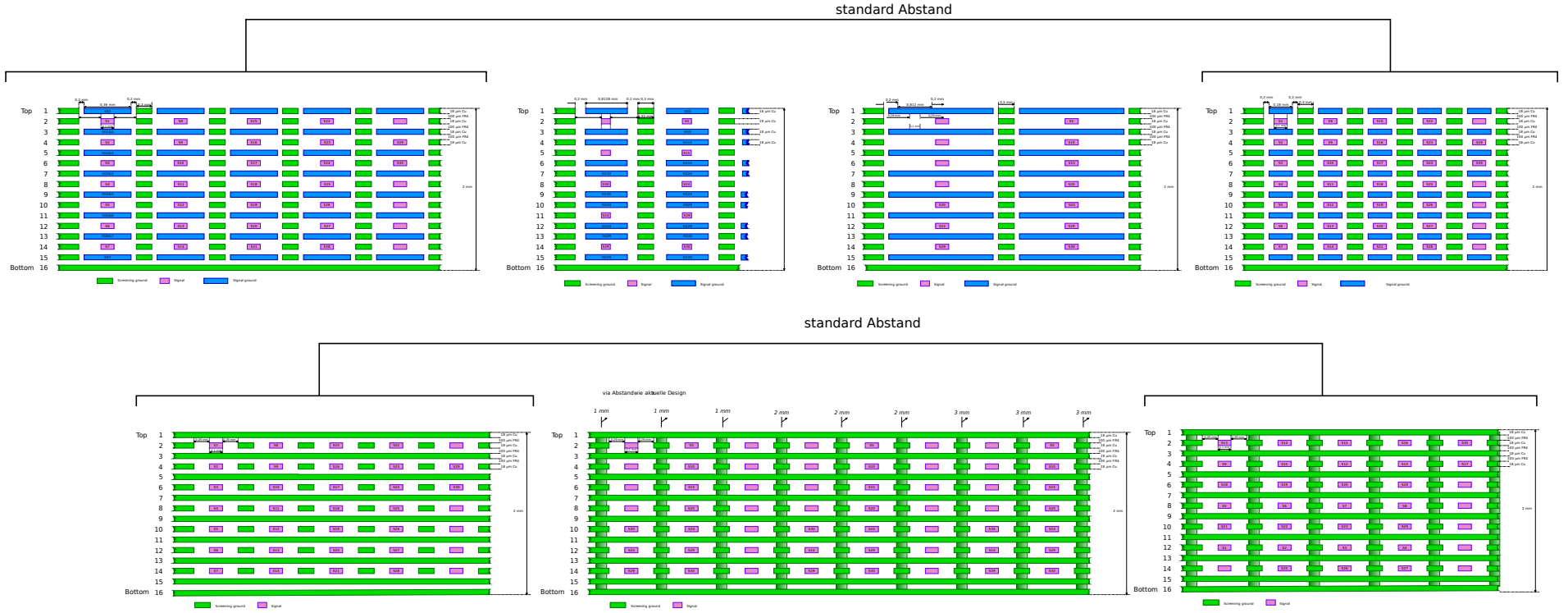
How to study Crosstalk

- Terminate Aggressor & Victim lines (in Oszi)
- Send pulses through longest line from Sensor side into scope
  - Sine
  - Square
  - SiPM
- Measure crosstalk on both ends of the victim using Spectrum Analyser
  - FEE side most relevant (FEXT)

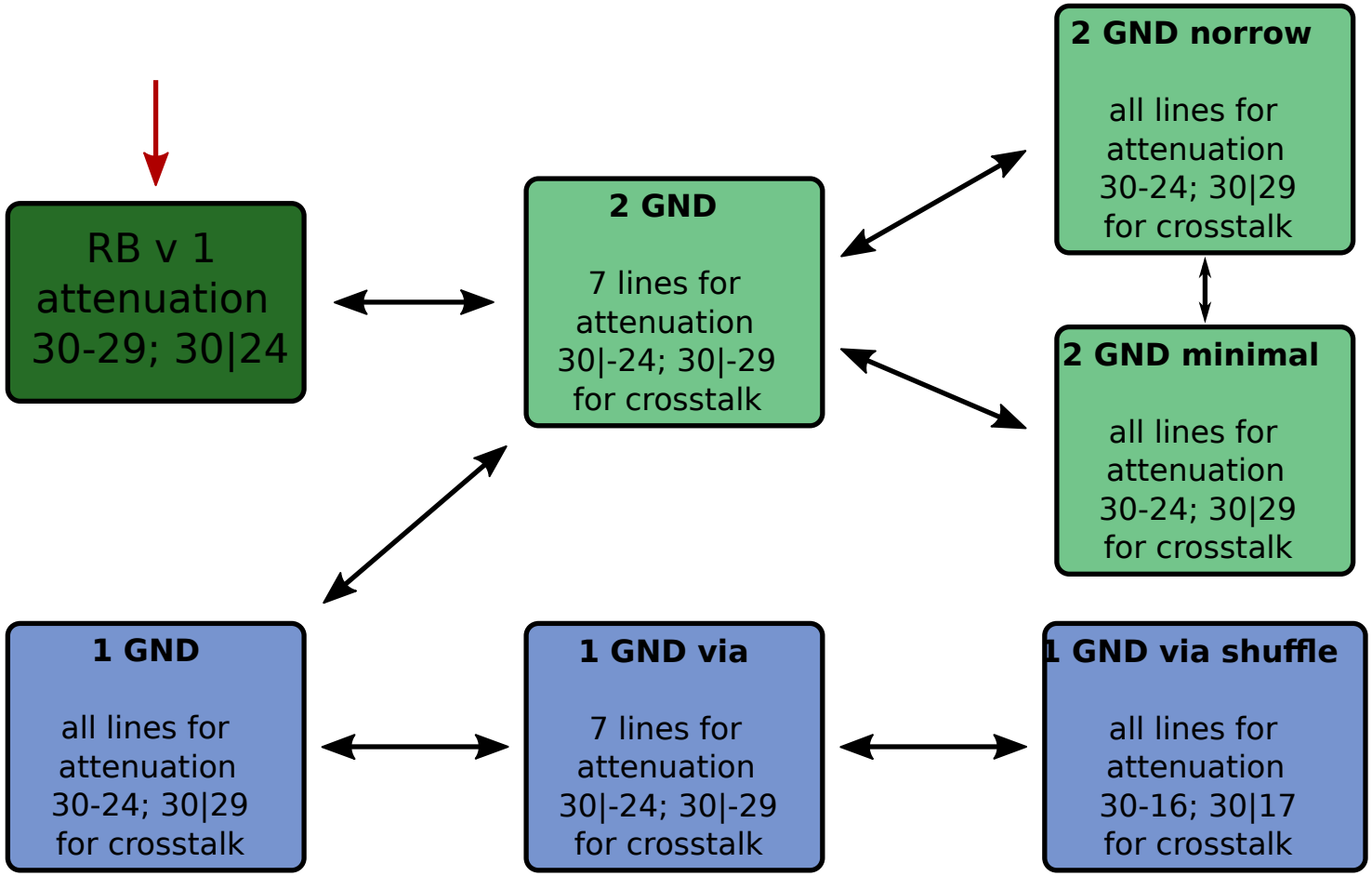
- Compare amplitude (dBmV) of aggressor frequency in the aggressor line to the victim line

We are dealing with analogue signals only, so we are interested in the crosstalk in the frequency domain (not in the time domaine).

Railboard v 2.0



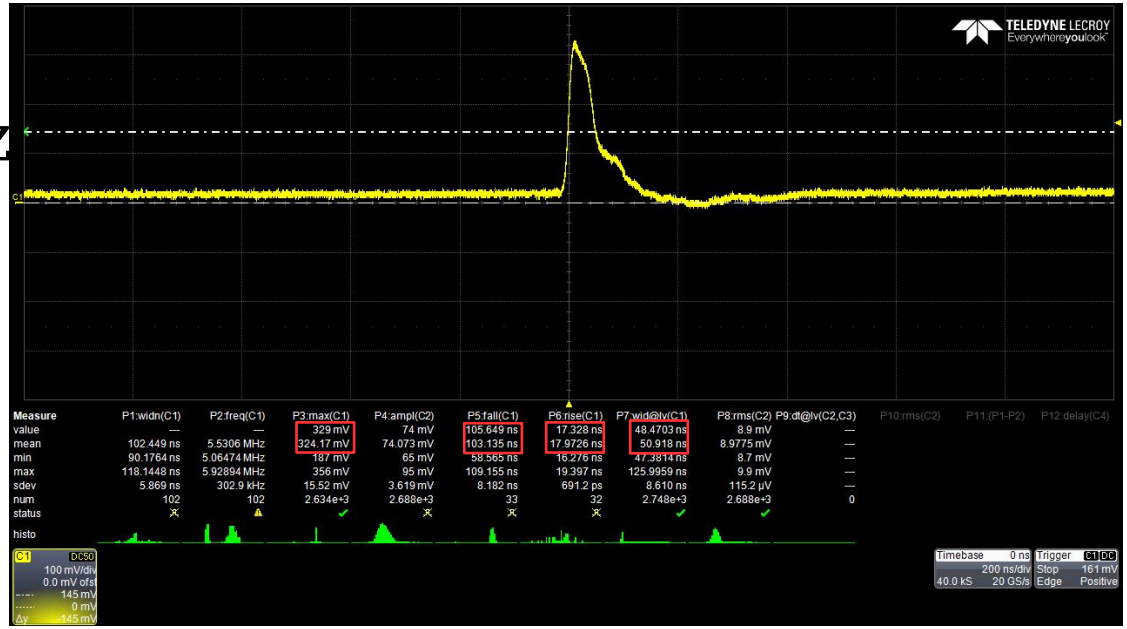
How to Structure the Measurements (Crosstalk)



Tests of the TOFPET ASIC v2

Signal used

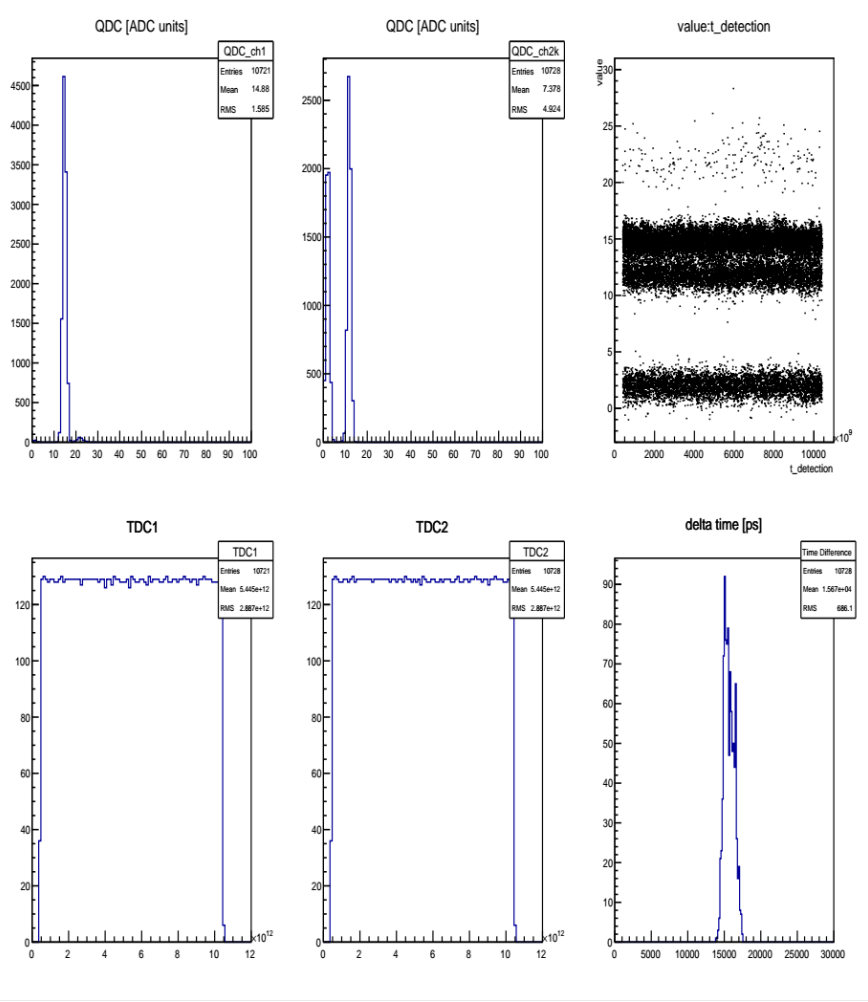
- NIM pulse generator
- Max amplitude at 1kHz = 490 mV
- Rise time: 18 ns
- Fall time: 105 ns
- Width at 50%: 50ns

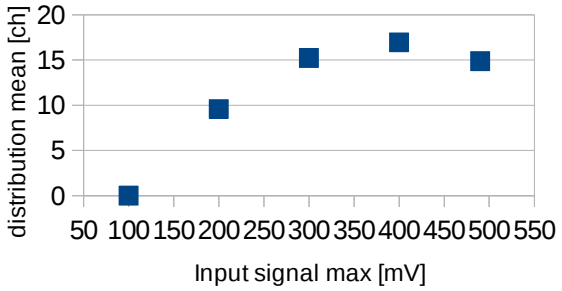


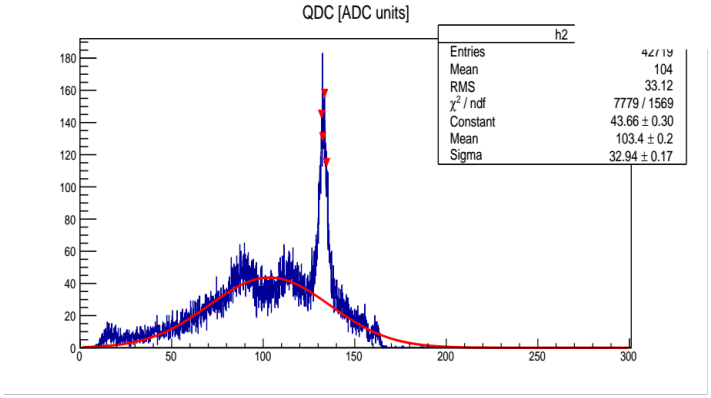
QDC Measurements

- Without increasing the width the signal does not go beyond ~20 ch

490 mV





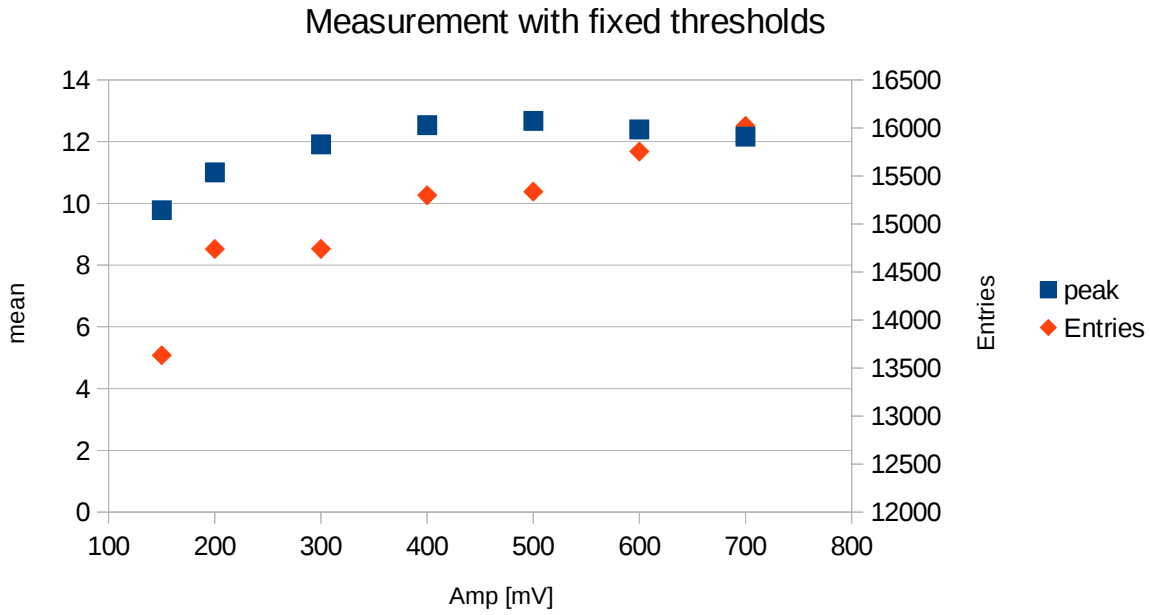


Na22

Amp scan redone

- Fixed thresholds at

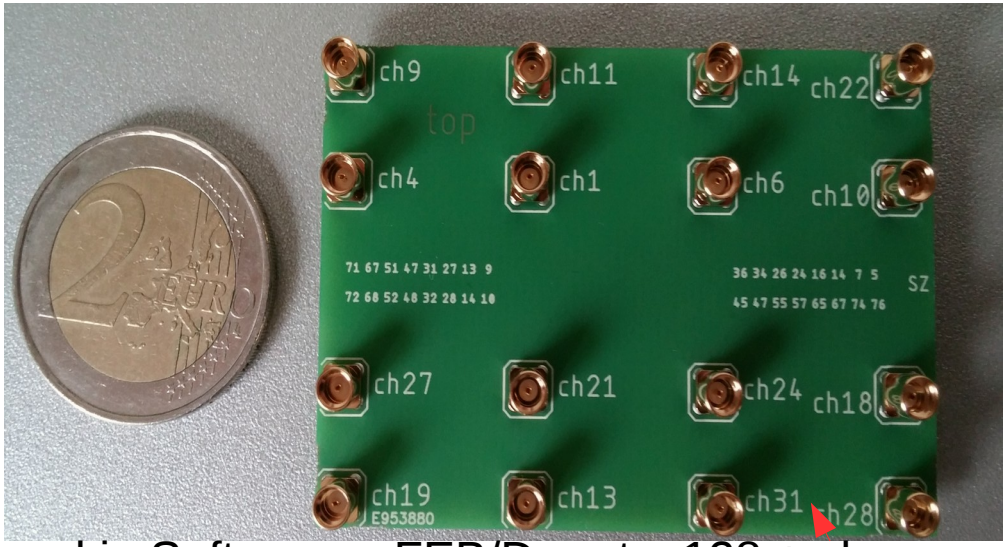
  t1 = 5; t2 = 5;

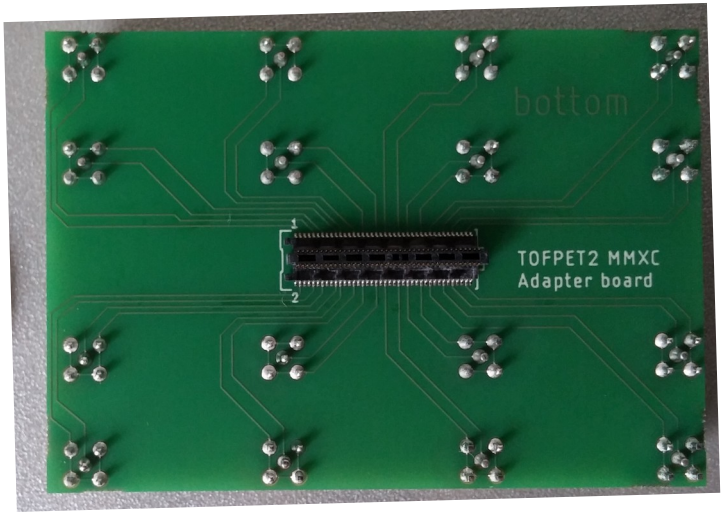


Saturation of Signal from ~400 mV at ~12 ch

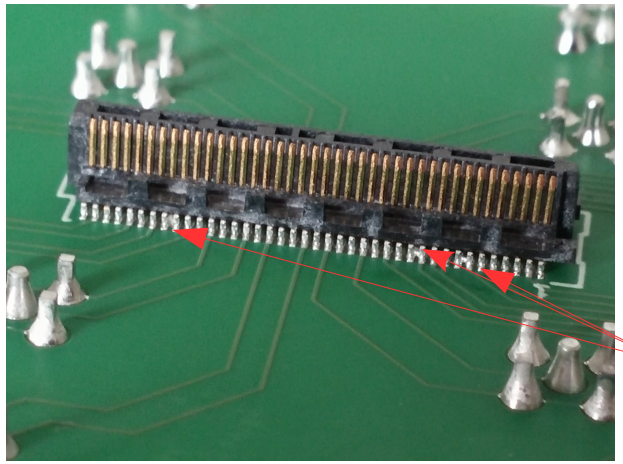
- Too low for my expectation (comparison with Na22 measurement)

TOFPET Adapter Board



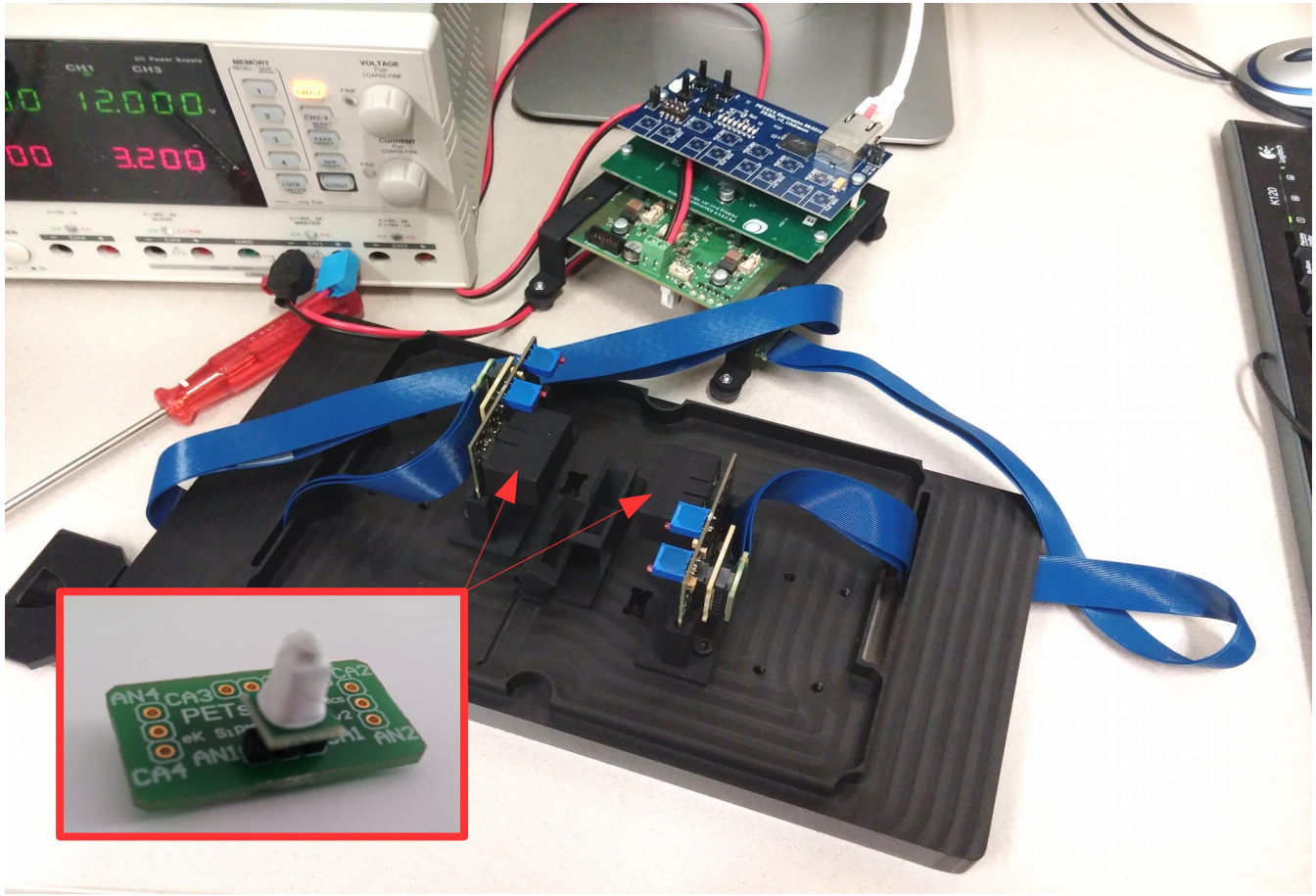


Channel in Software = FEB/D port x 128 + ch



Unclean soldering
But most other boards are fine

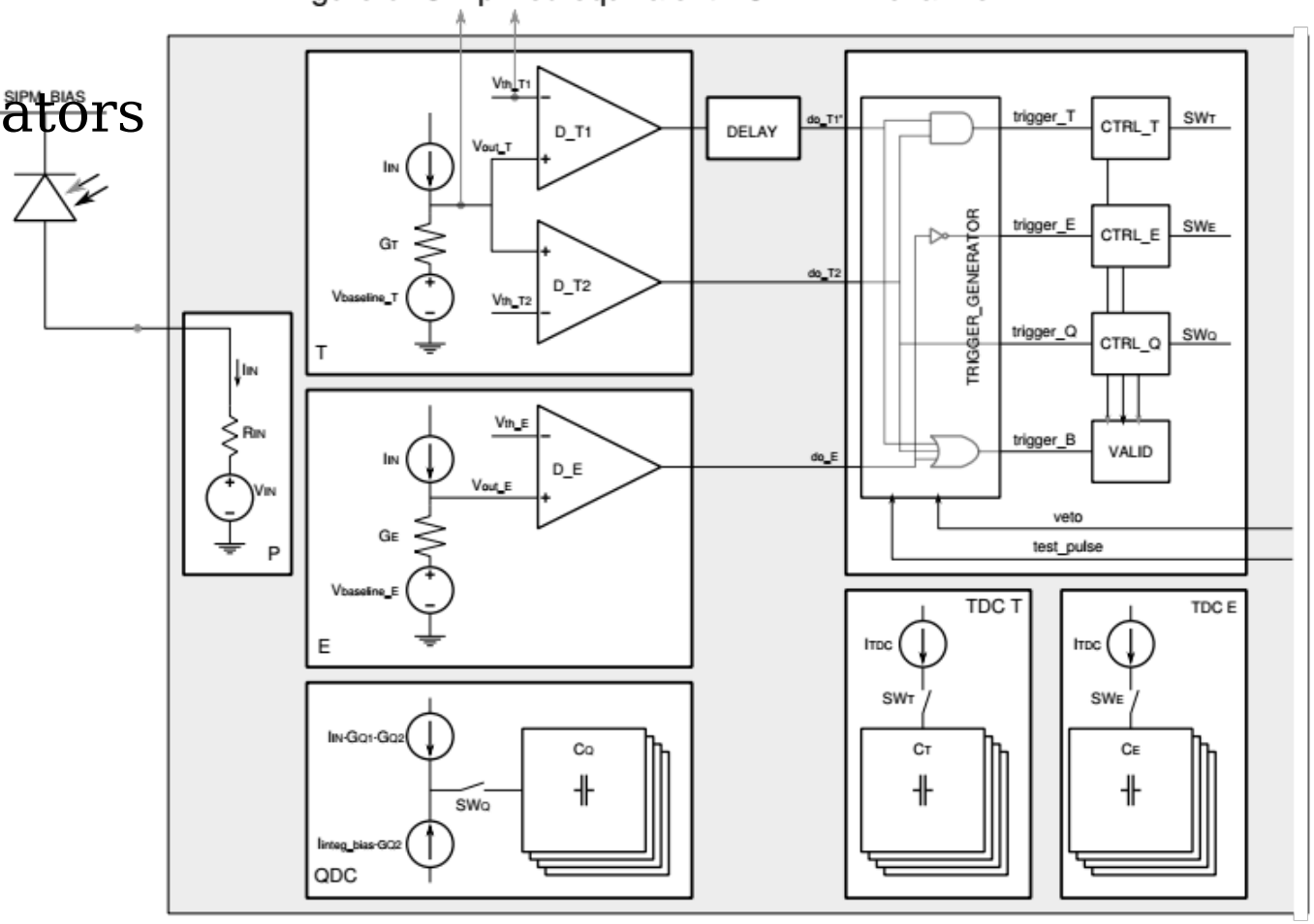
TOFPET2 Readout



Trigger Setup

- 3 Triggers
  - != 3 Discriminators

Figure 6: Simplified equivalent TOFPET 2 channel.



Trigger Process

Nominal trigger mode

TOFPET 2 implements a multi-level event trigger and rejection scheme. In the nominal operation mode:

- Event time is measured at a low threshold (vth_t1), which can freely be set as low as 0.25 p.e.
- Events which do not trigger threshold vth_t2 are rejected without any dead time from the TDC/QDC.
- Events which trigger vth_t2 but not vth_e are reject with 5 clock dead time from the TDC/QDC.
- Only events which trigger all 3 thresholds are considered valid and digitized.

Figure 10: Event trigger (nominal mode)

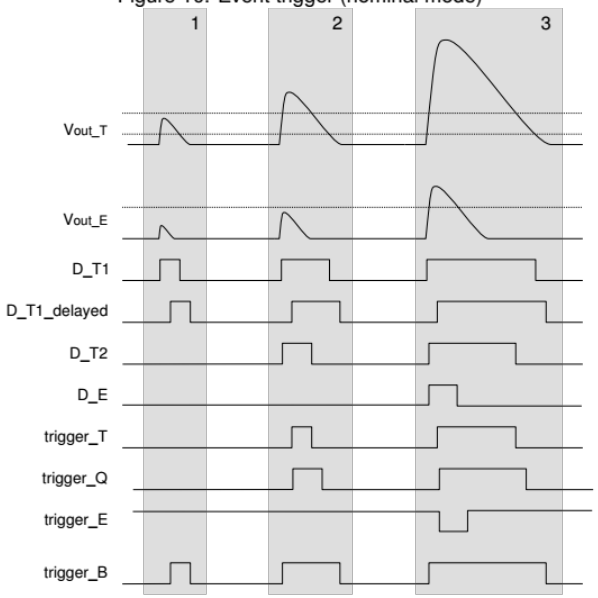
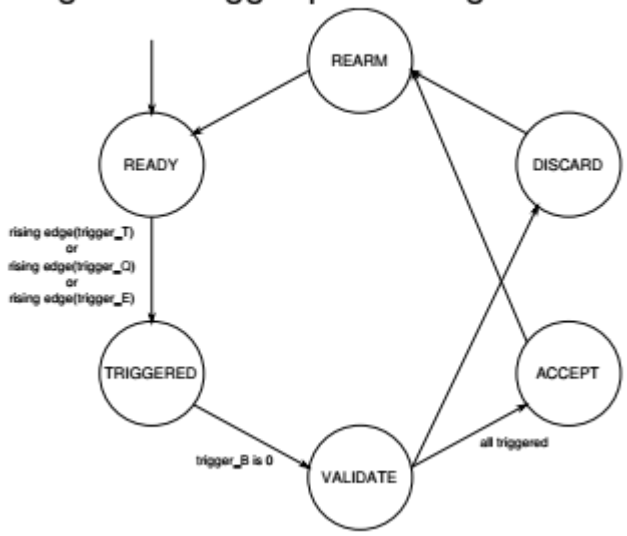


Figure 9: Trigger processing states.



Thank you for your attention

Backup