TIGER ASIC characterization update

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Introduction: TIGER ASIC

TIGER ASIC architecture:

Each channel features a dual-branch architecture for ***timing*** and ***energy*** measurement.

- Sustained event rate = 100 kHz/ch
- Input dynamic range = 2 – 40 fC

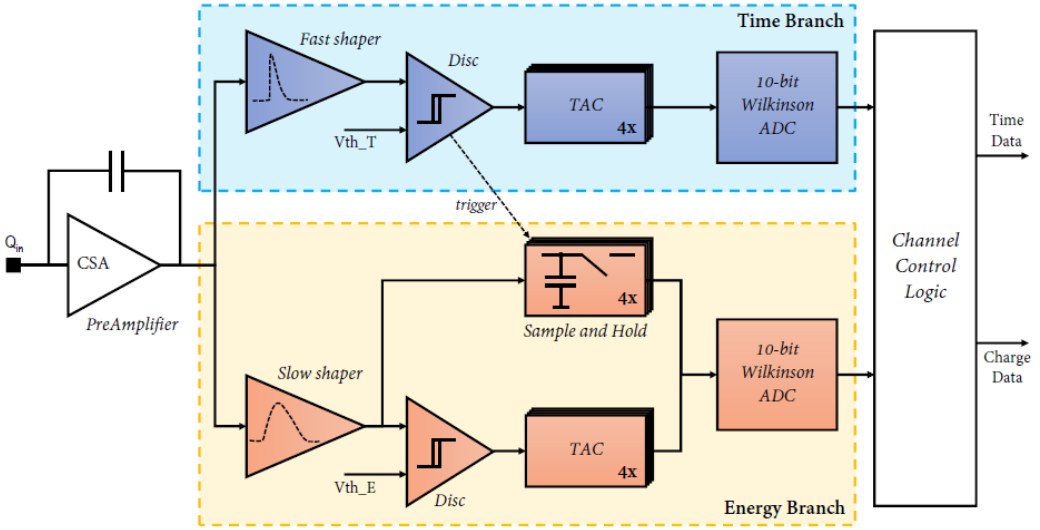
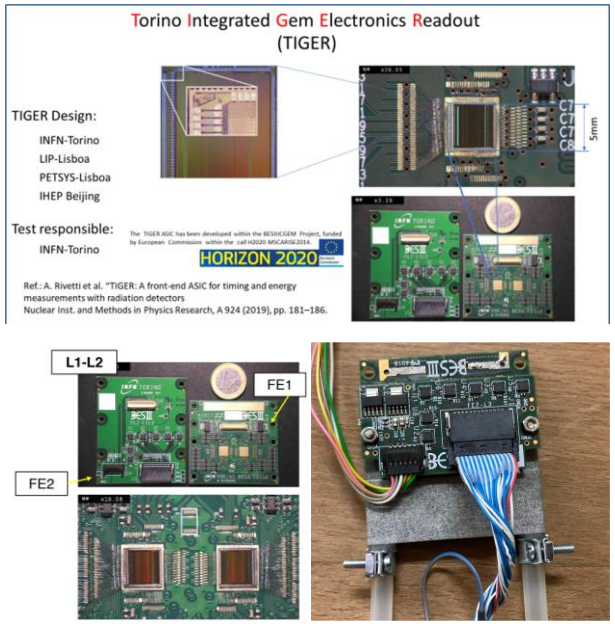
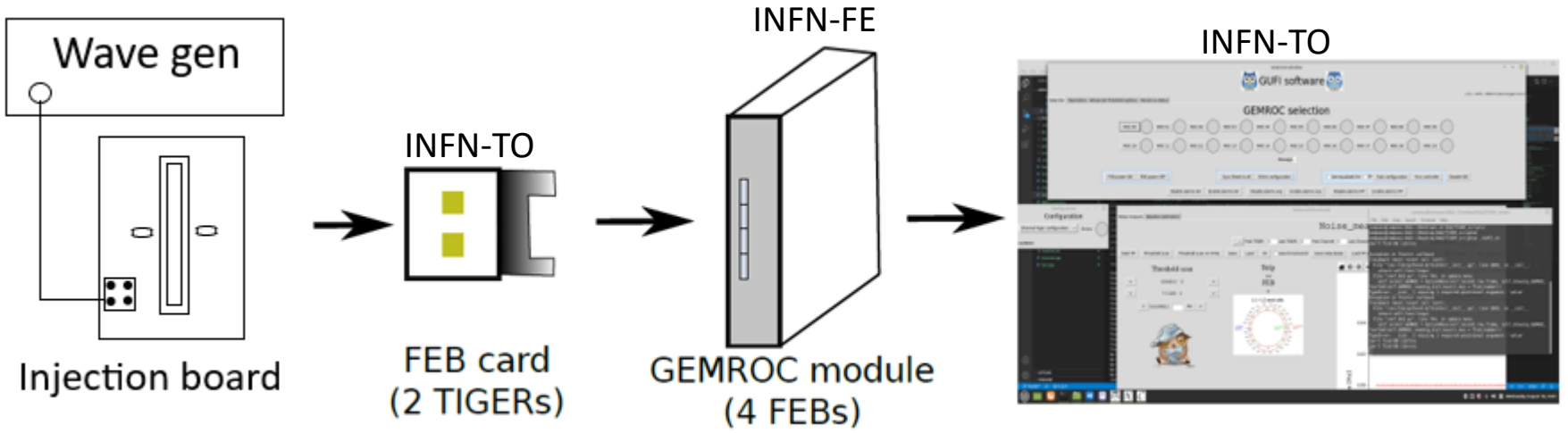


Figure 3.1: TIGER channel architecture scheme.



Test setup:



GUFI (General User Frontend Interface), developed by INFN-TO (Alberto Bortone):

- Controls GEMROC (INFN-FE) settings
- Allows threshold scans to evaluate the noise level and set the proper threshold on each channel.
- Controls data acquisition.
- Monitors FEBs status

Introduction: TIGER ASIC

TIGER timing reconstruction:

For each valid hit, a 64-bit event-word, is generated. Futhermore TIGER produces two other 64-bit word types, which are used as timing reference and to read several counters present inside the chip to monitor the acquisition status.

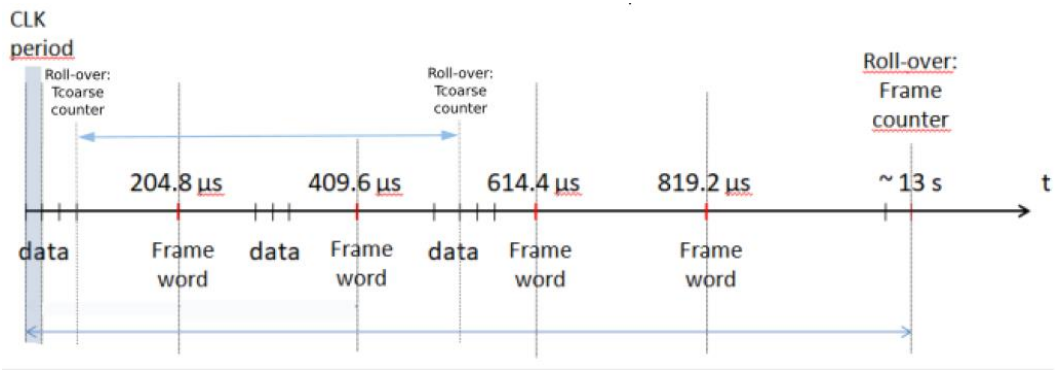
Event-word → data
Frame-word → timing reference

EVENT WORD

K28.1	0b10	ch_id 6 bits	TAC	Tcoarse 16 bits	Ecoarse 10 bits	Tfine 10 bits	Efine 10 bits

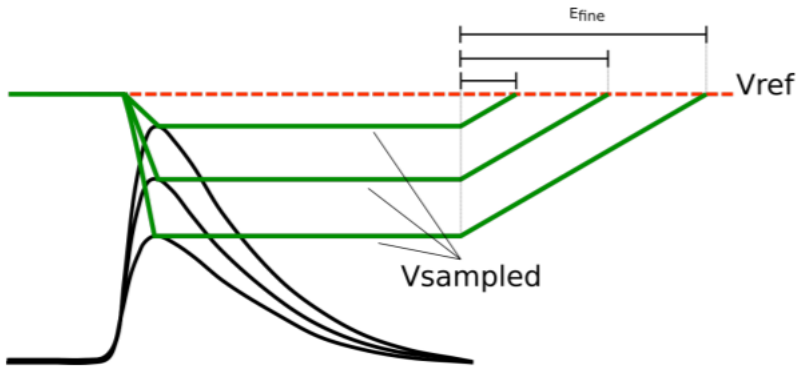
FRAME WORD

K28.1	0x00	reserved	frame count 16 bits	SEU count 15 bits



TIGER charge measurement:

S&H mode:

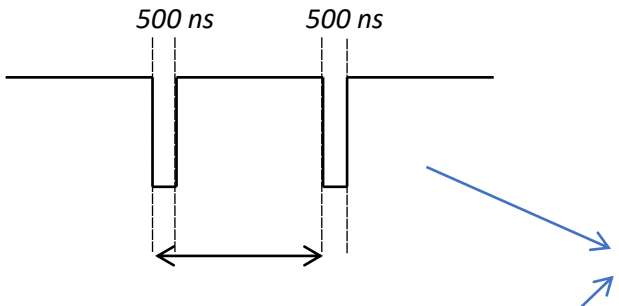


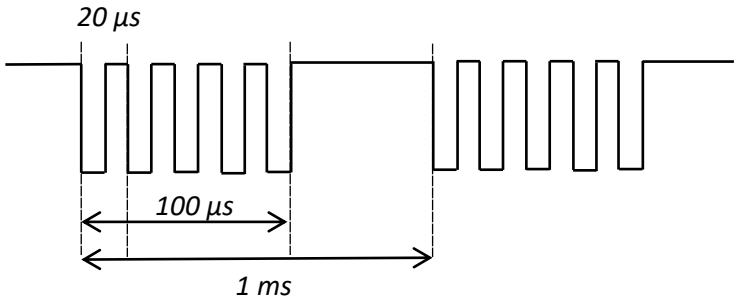
E_fine → Wilkinson ADC charge value
Reverse logic → higher E_fine means lower charge value

Timing correspondence test

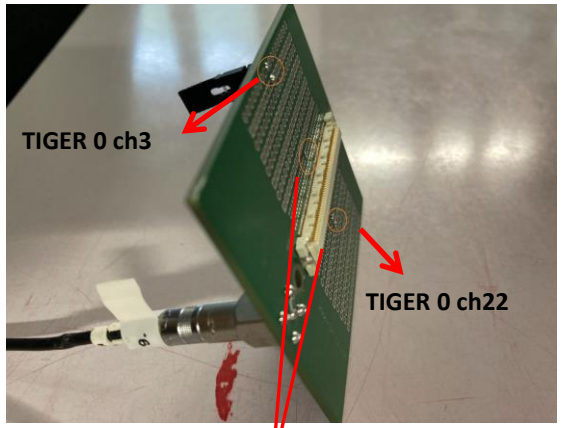
The first test was aimed to verify the timing correspondence between the signal fed to the TIGER-based FEB and the occurence of hits.

Test pulse waveform

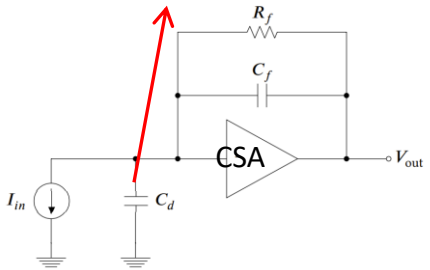


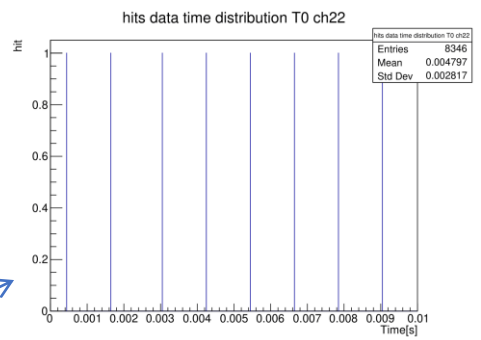


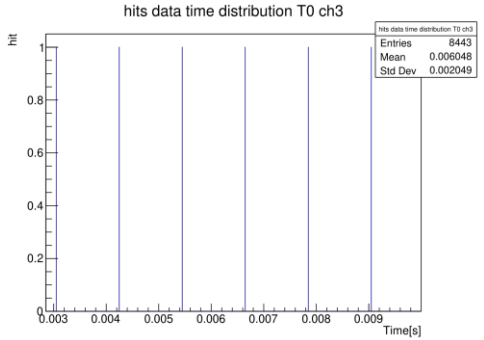
Injection board

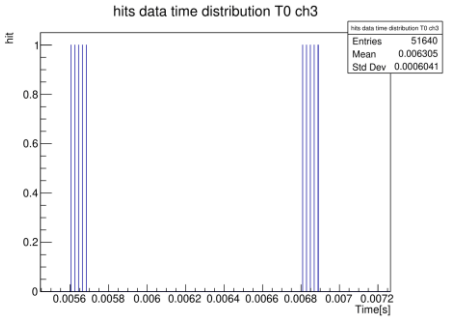


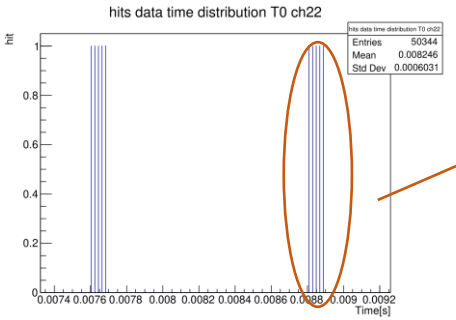
1 pF

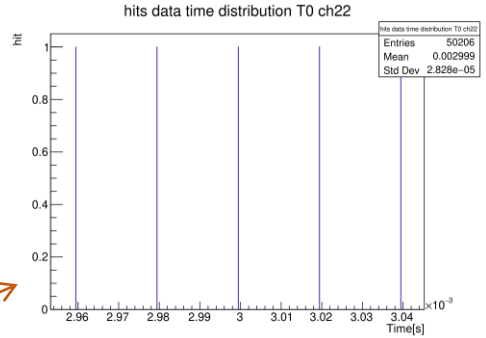








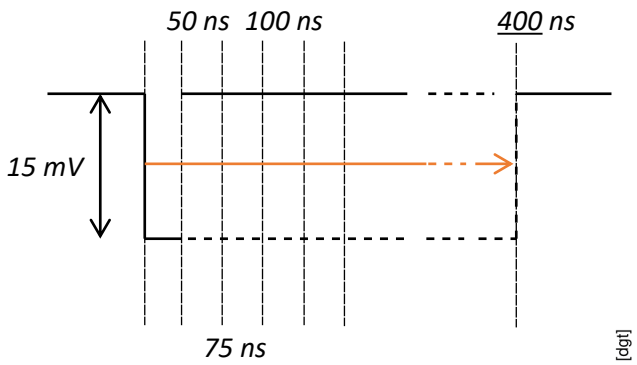


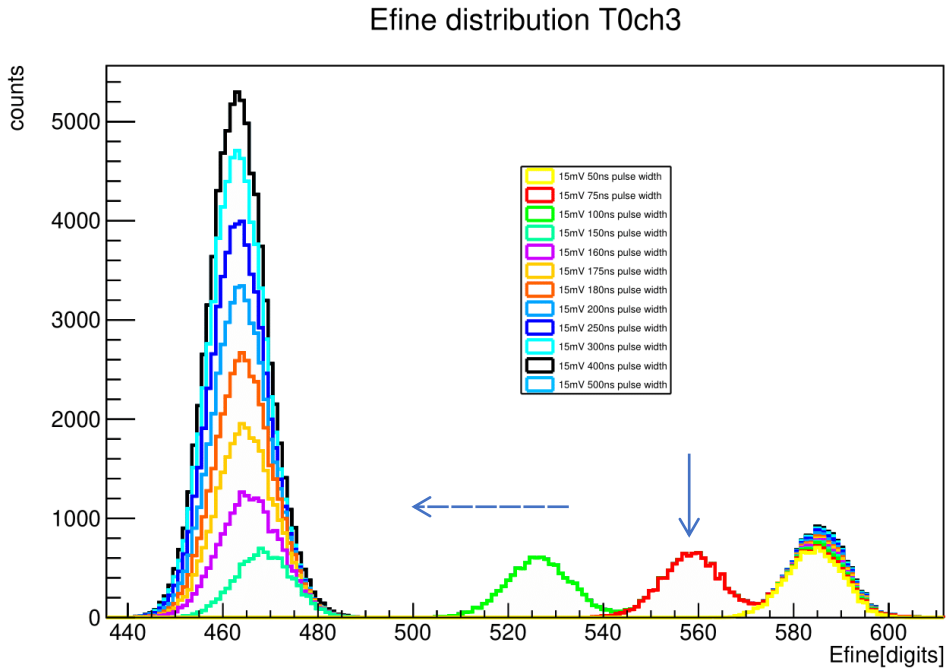


Pulse width test: Front-end linearity and gain

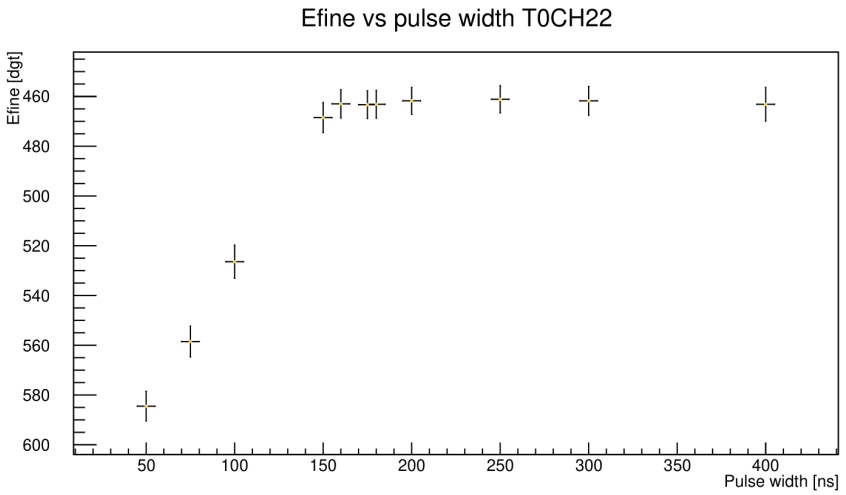
The next step was aimed to check the front-end linearity scanning the full dynamic range.
Test pulses of different durations were fed to the two channels and the respective Efine value was registered for each hit.

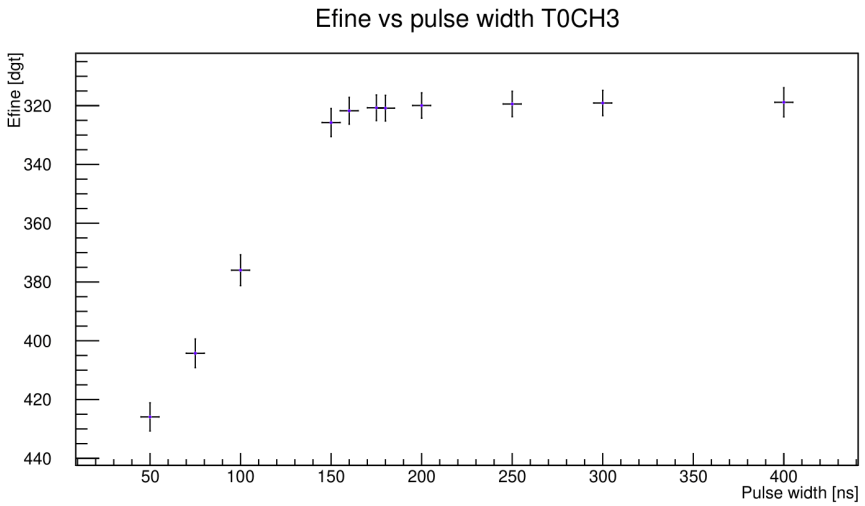
Injected test pulse



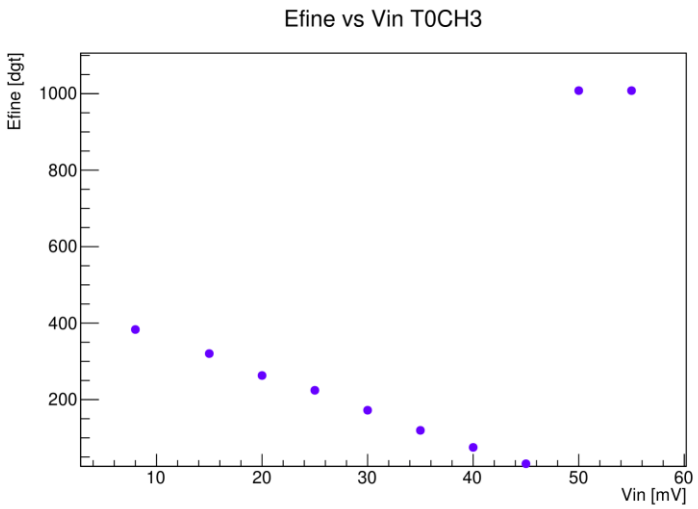


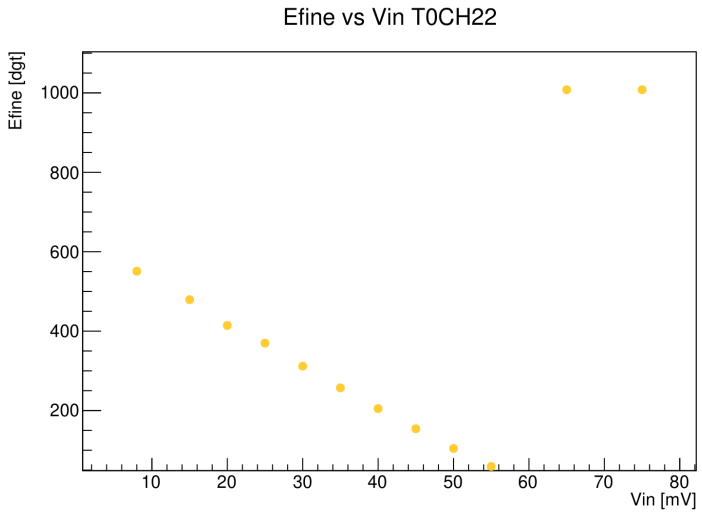
For signals above 170 ns pulse width the front-end saturation is reached as expected.

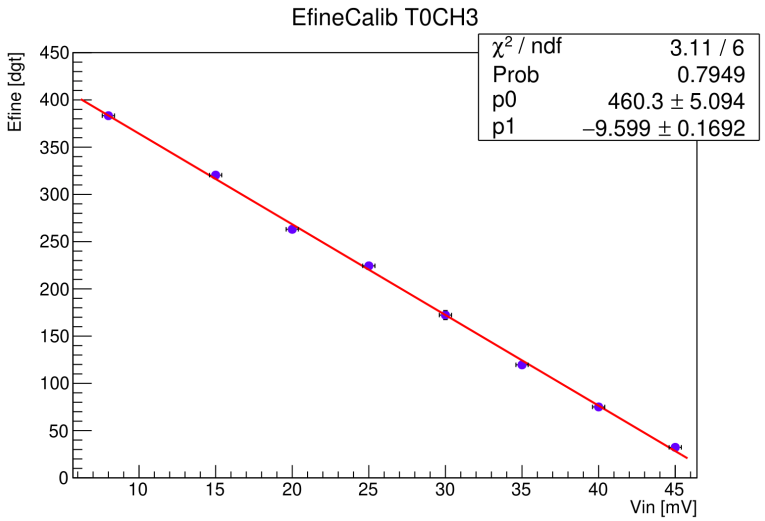


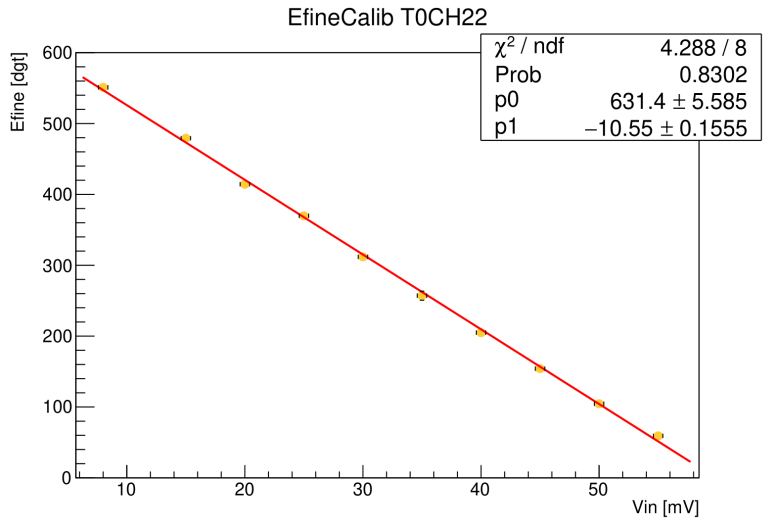


Energy calibration





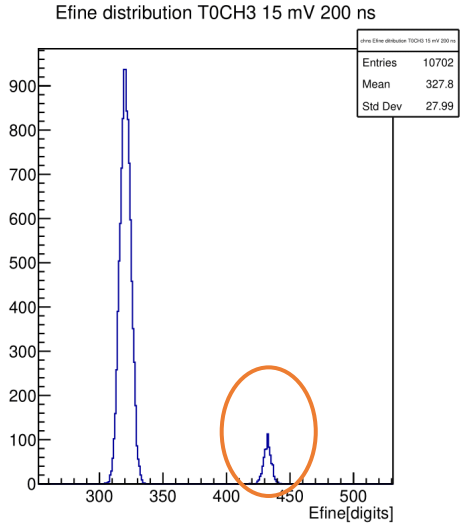


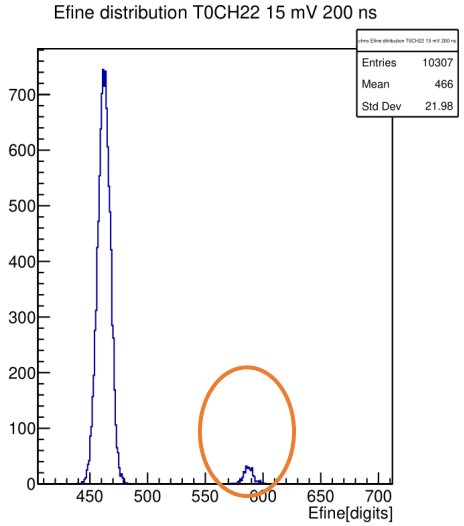


- The charge output Efine (the ADC code for S&H mode) as a function of the Vpkpk on the input signal is shown (i.e. the input charge)
- The response of the S&H is linear, but after the saturation point the digitized output value is not related anymore to the input signal. Efine = 1008.
- The good linearity of the circuit confirms that the discriminator time walk does not affect significantly the S&H circuit measurement

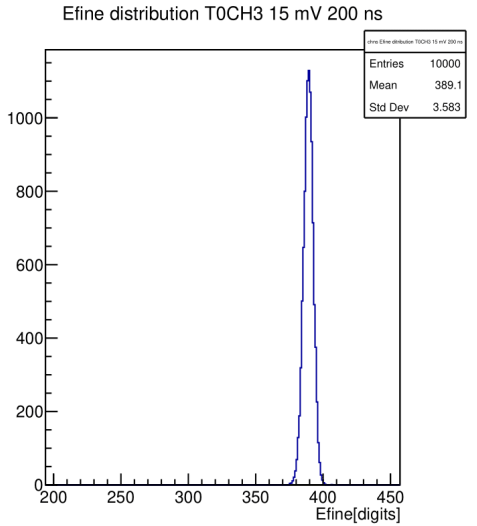
Injection board noise test

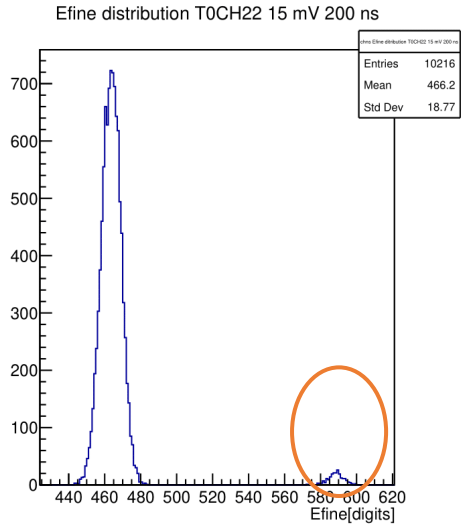
Both channels connected



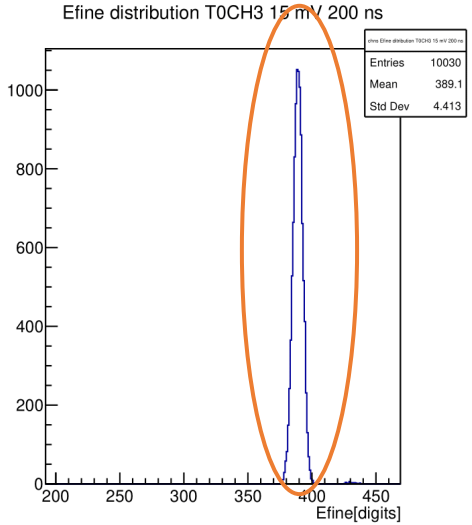


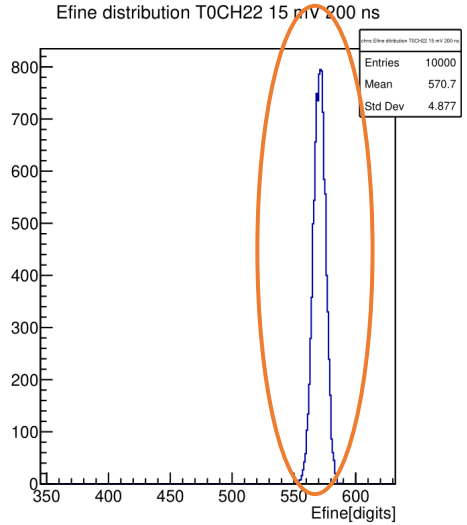
Channel 3 disconnected





Both channels disconnected

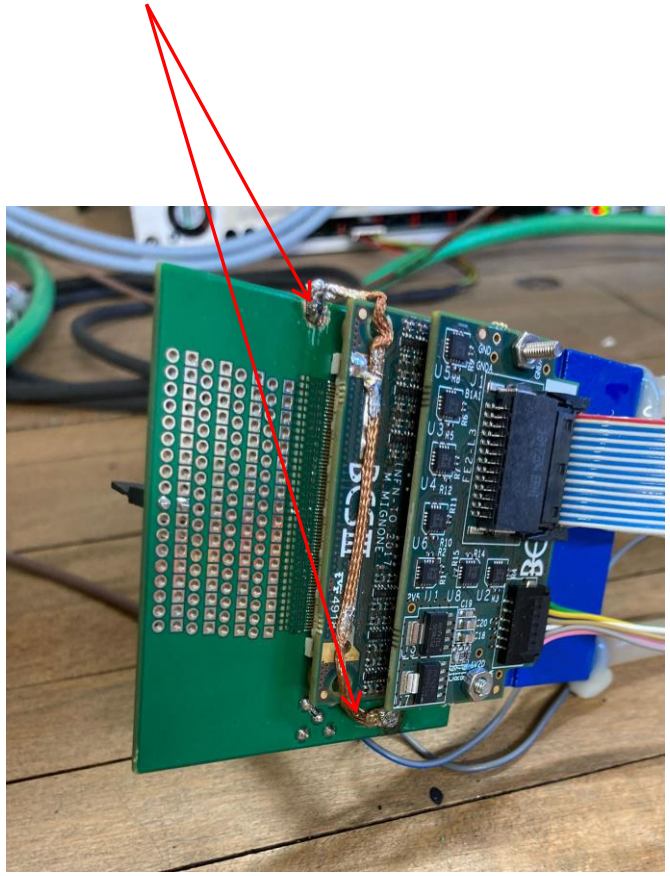


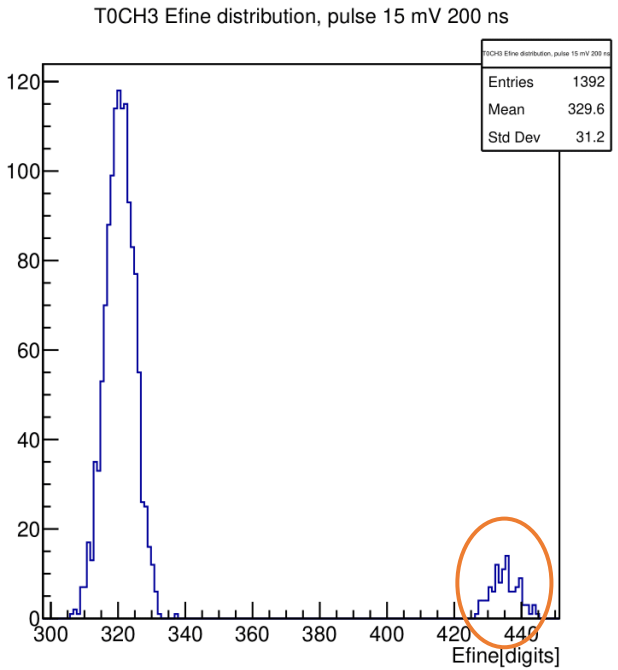


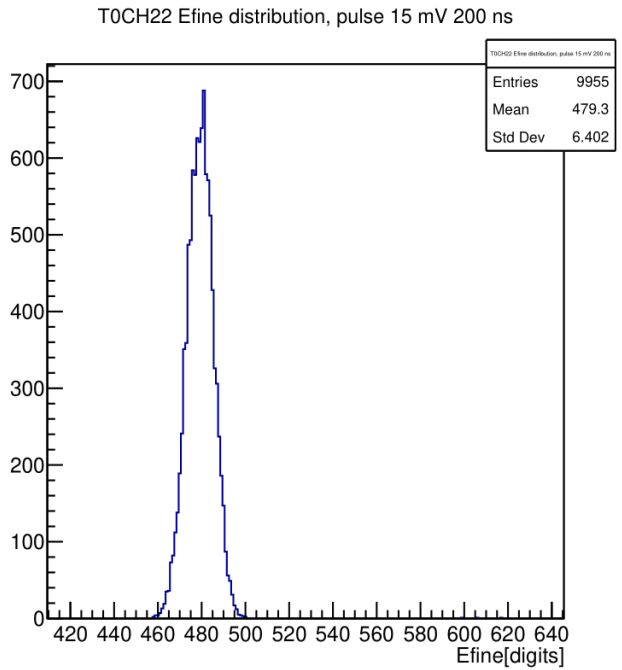
The highlighted peak is probably due to a grounding issue between the injection board and the FEB.

Injection board noise test

After soldering both ends of the GND copper braid







Noise-related peak has much lower counts for channel 3 and it is almost gone for channel 22