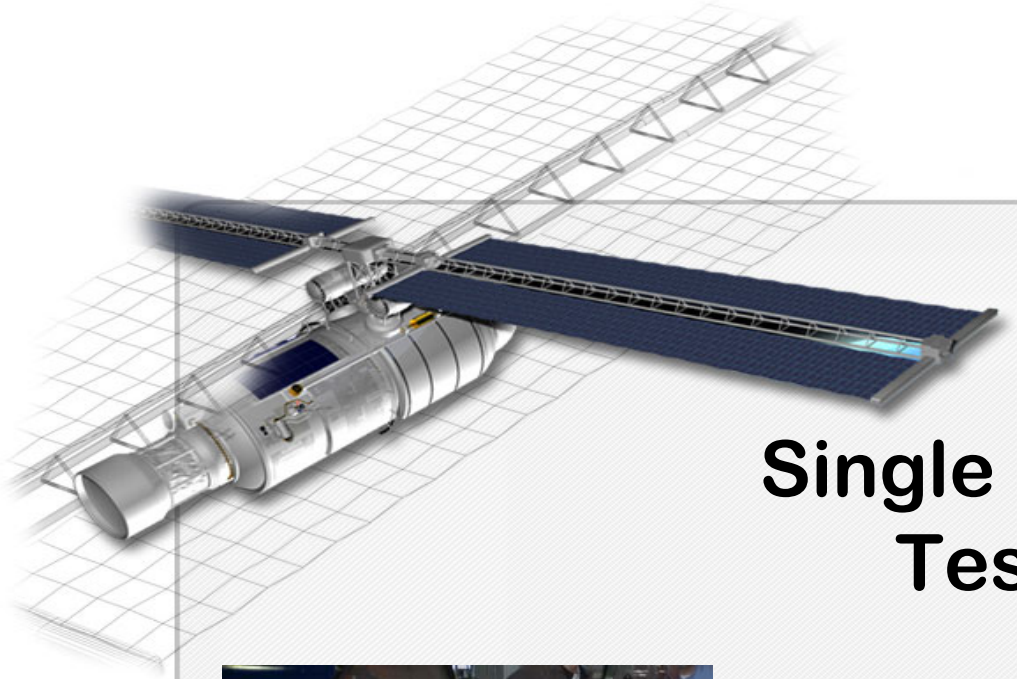
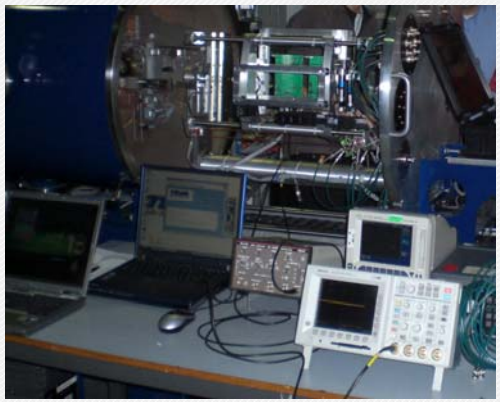
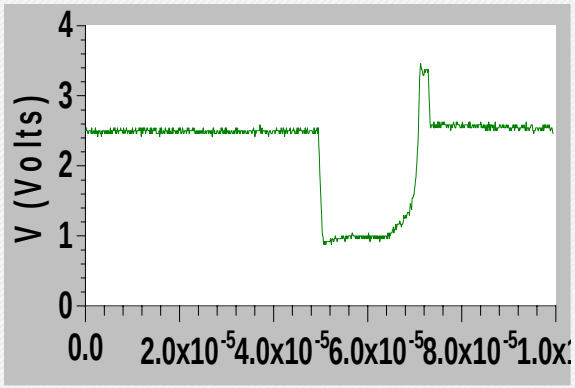
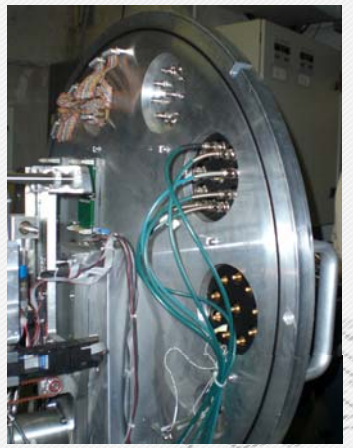


Single Event Transient Test laboratory







Outline

- Customer requirements
- Test setup
- Achievement of radiation test
- Test analysis and application software
- Test Report
- Examples
- Conclusion

SET definition

- The Single Event Transient (SET), or Analog Single Event Upset (ASEU), or soft error for analog
- The SET consists of a transient voltage pulse generated at that node that propagates to the device output and his propagation on the electrical circuit.
- SETs in linear devices differ significantly from other types of SEE, because SET depend on multiples parameters
  - Bias conditions and application
  - Ion energy and range impact localization
- **and could have different and complexes shapes (short or long duration, high or low amplitude, bipolar behavior…)**
- **Is not possible to define worst case bias conditions,** So, It is necessary to test the parts in their application conditions. and …. we must testing all the applications ! Of course it's beam time consuming and difficult to apply
- So laser testing and simulation may be useful to check other bias conditions.

Customers requirements

- **Description of the board functionality**
  - Power supplies,
  - Input signals (amplitude, frequency, waveform, pattern…)
  - Clocks,
  - Output signals, (amplitude, frequency, waveform, pattern…)
  - Representative loads outputs
- **Selecting measurement points**
  - Outputs of DUT, Outputs of board,
  - Trig on output devices and catch all channels

Test setup

- **Test Lot**
  - 5 samples before delidded
  - after this operation check functionality,
  - minimum 3 samples ok for the test
- **Irradiation facility**
  - Check information on the technology to select irradiation facility :
    - Ions specifications, LET value and dose deposited on active volume
    - Energy, penetration range of ions : 30 µm -100 µm?
    - Don’t use of tilted beam

Test setup

- **To catch the events, digital oscilloscope is the main powerfull tool but be carefully to :**
  - Bandwith from analog input amplifier and acquisition rate used
  - Probes (passive and active), check your signal integrity
  - Triggers capabilities, don't forget events too short but also too long
  - Memory for store all events with enough informations (all the transients collected must be recorded for further analysis).
  - Dead time between two triggers events (very important if not you could lose events or)
  - Number of inputs to store several signal and optimize beam time
  - But also ….
    - The cables and PCB using in real conditions (with vacuum chamber, connections template, electrical environment during the irradiation
    - ofen the test bench working on clean environnent and didn't work properly on irradiation site ! …

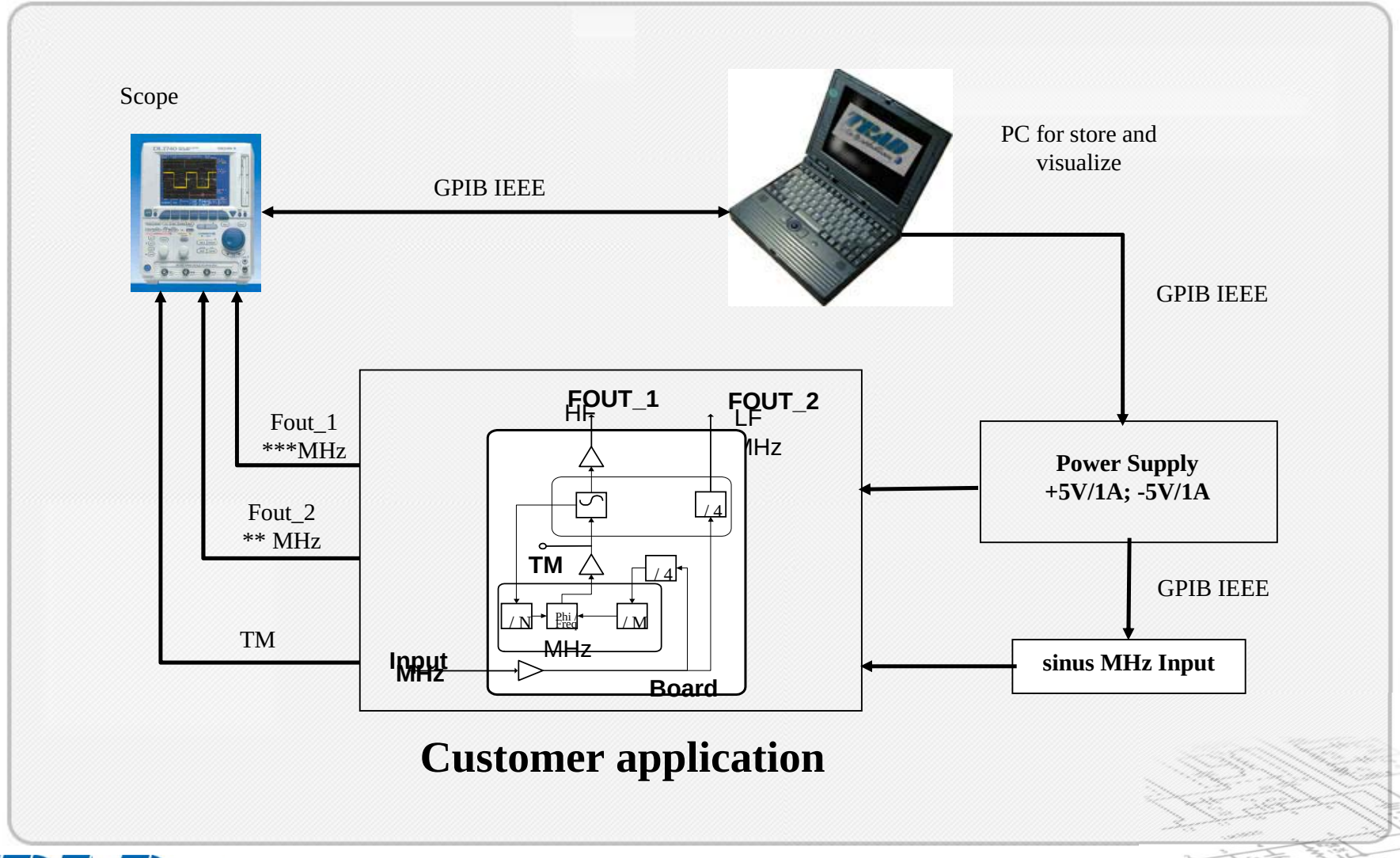
Achievement of radiation test

- **Flux must be adjusted to have maximum 1 events /second (but depend of your test bench)**
- **A sufficient number of SET needs to be collected to get a significant number > 200 events for each class of events**
- **Strategy for the test:**
  - Cary out the first test with the high LET of the facility for detect all the differents class of events
    - First without ion beam ! (check you circuit detection !)
    - With different timebase
    - With different trigger level (positive, negative)
    - And adapt the flux for catch all events

Tests report

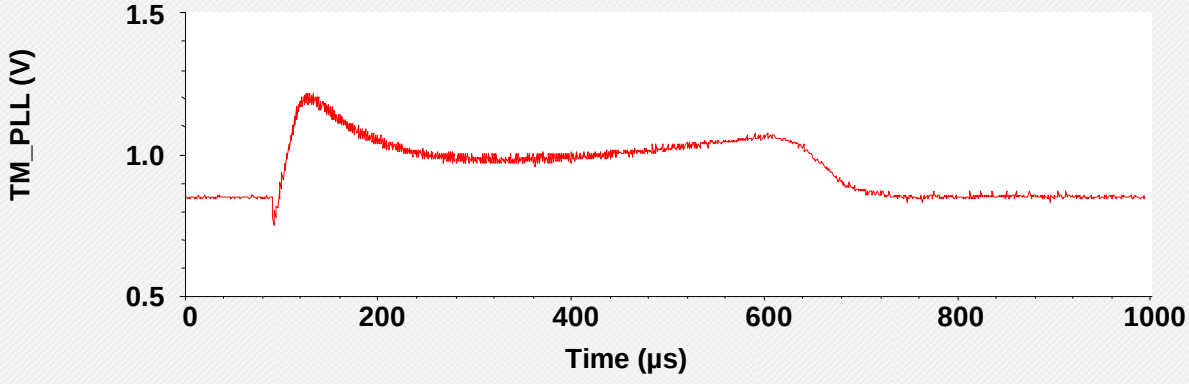
- **The test report must contain :**
  - All informations on DUT, picture of the die,
  - Electrical conditions for tests
  - Ions Beam used
  - Equipments used
  - In First approach the total envelop of SET detected
  - But also all Plots of cross section versus LET in active area for all class of events
  - + CD with all waveforms recorded and software for further analysis

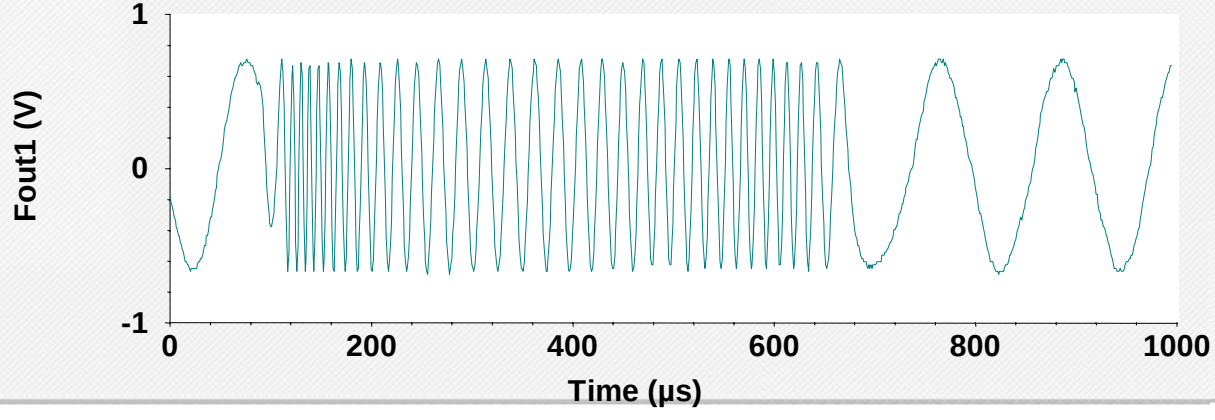
SET test bench: example



SET Curves

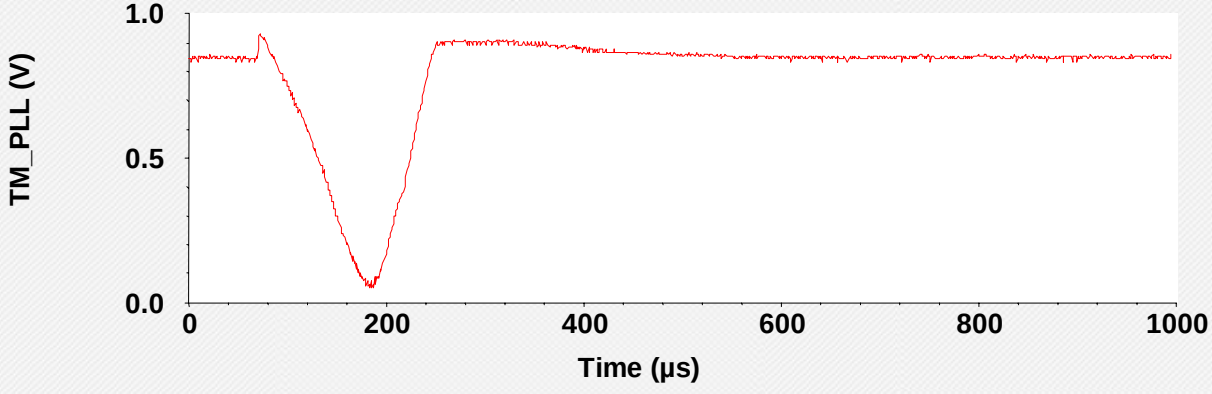
Positive detection

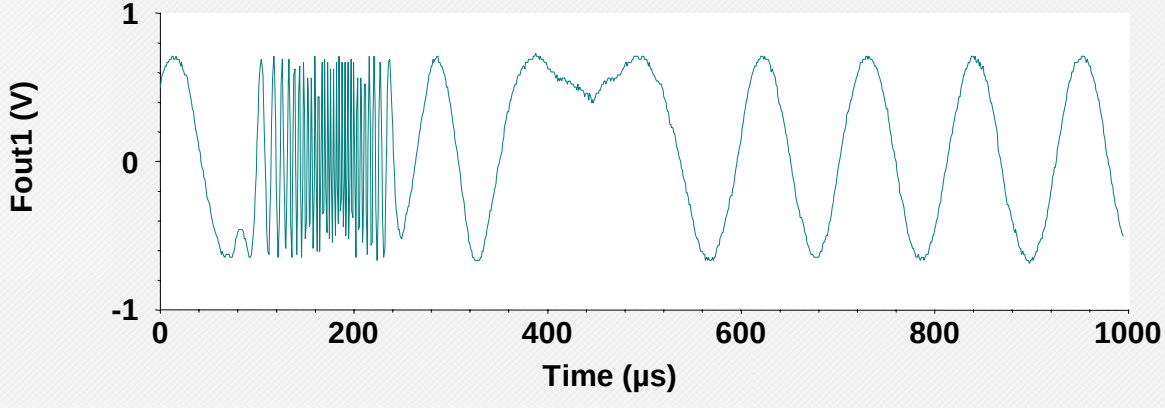




SET Curves

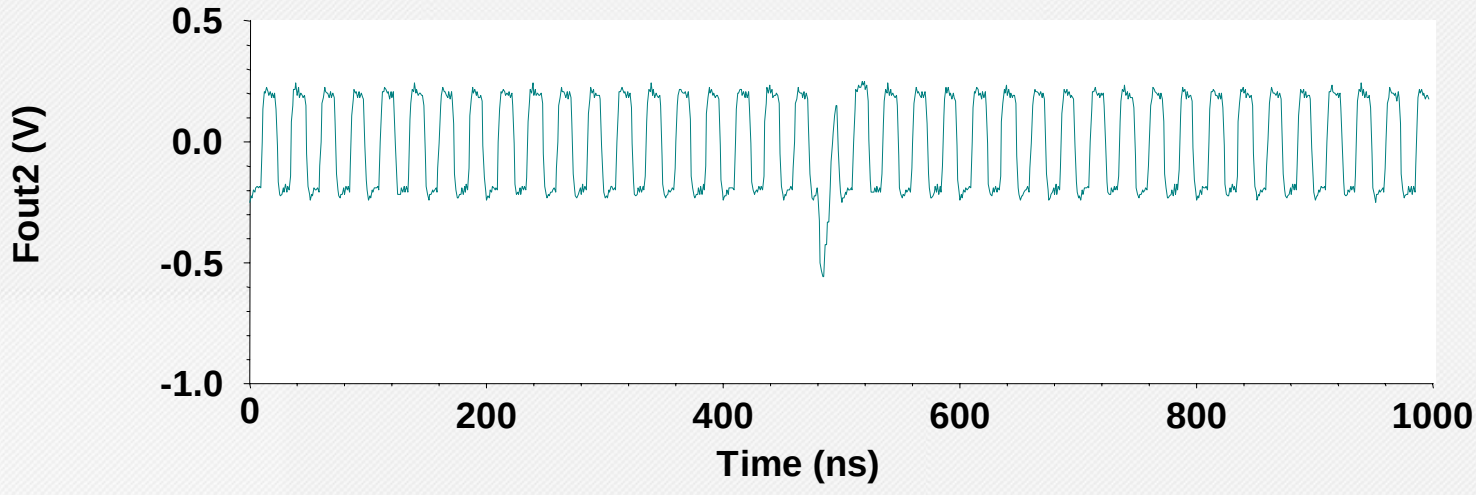
Negative detection



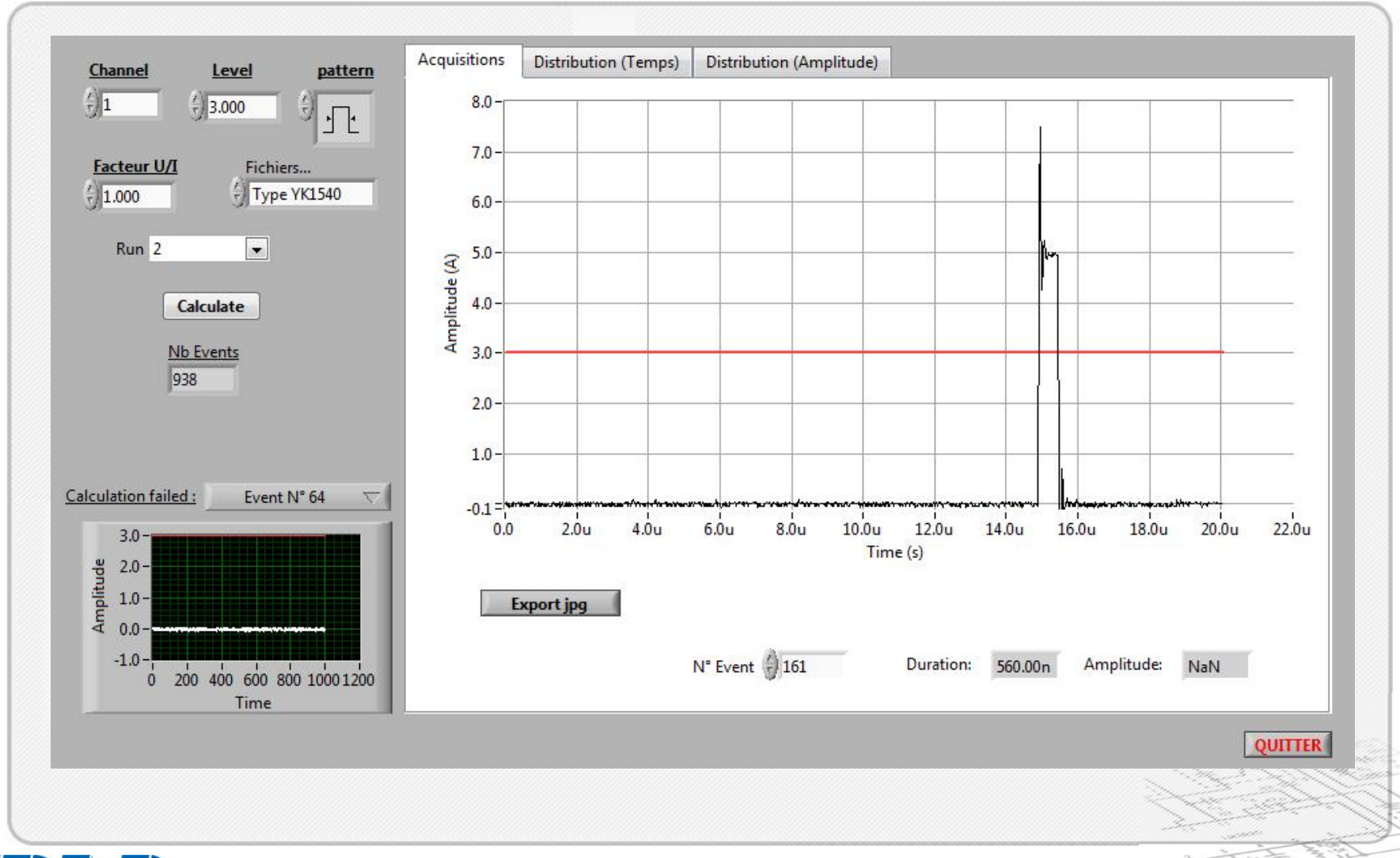


SET Curves

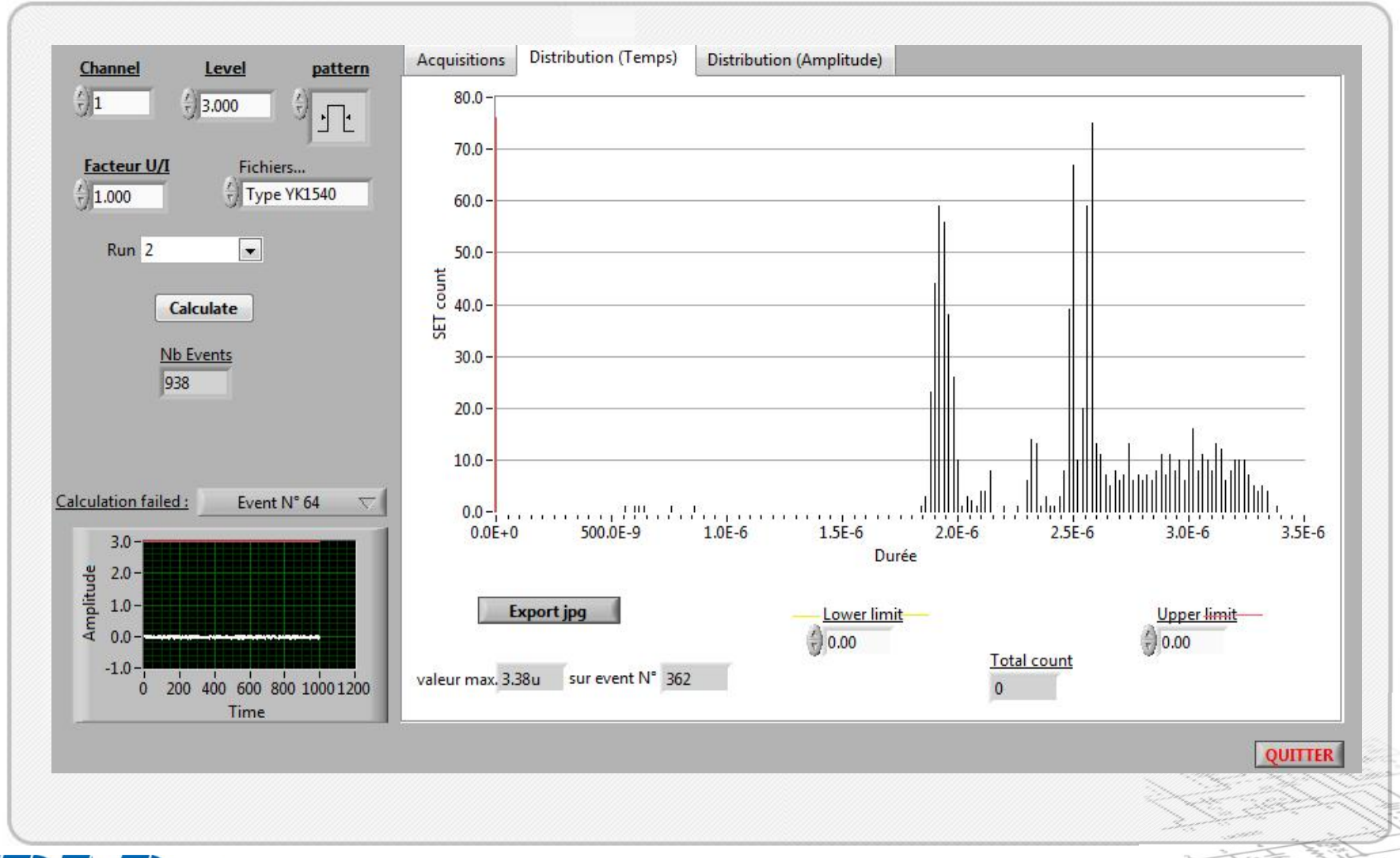
Frequency disturbance



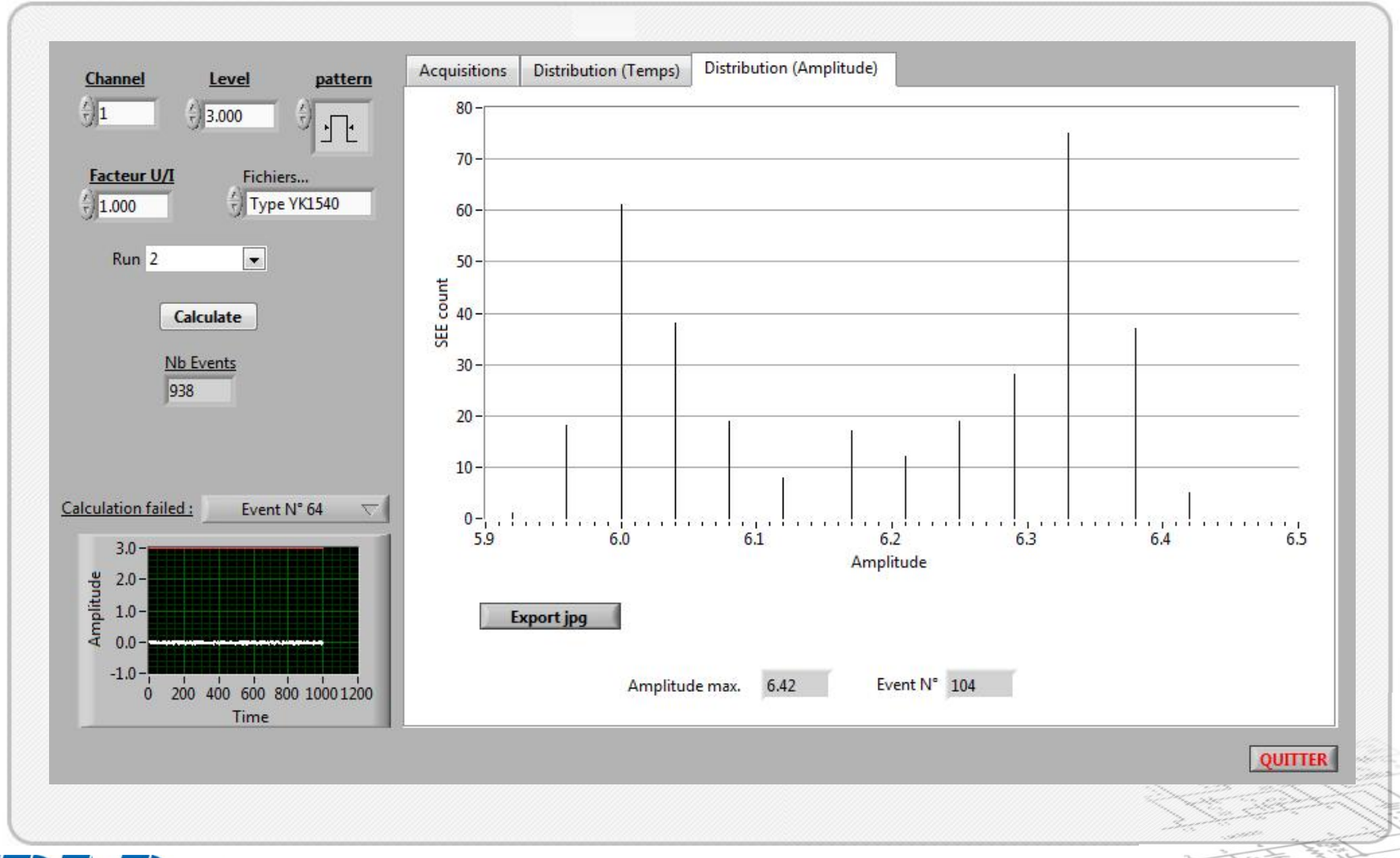
SET software



SET software



SET software



Conclusion

Performing SET experiment need some experience

Pulsed laser beam may be use for extra test or re-test application evolution.

We suggest to read for more details :

The guideline from NASA : Testing Guidelines for Single Event Transient (SET) Testing of Linear Devices From C.POIVEY 2003.

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Thank you