Single event upset test of the voltage limiter for the ATLAS Semiconductor tracker

TSL Experiment Number: F151

- distance between power supplies and modules is large (100m) in the ATLAS detector
  - ⇒ voltage drop on the cables (~3V)
    - ⇒ voltage at power supplies larger than the maximum allowed for the readout electronics

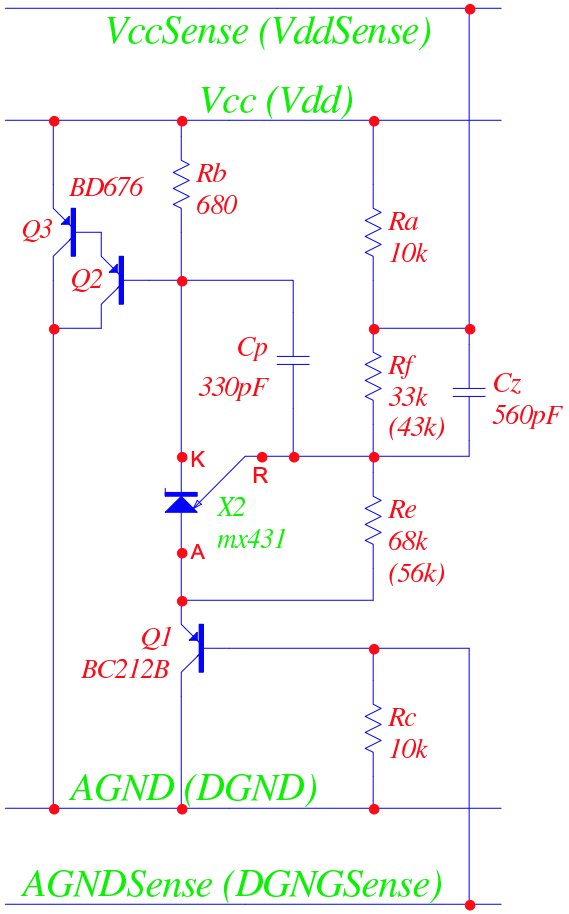
- in case of sudden current drop (loss of clock due to broken fiber, mistake at loading values of DACs ...)
  - ⇒ danger of damaging the readout electronics with too high voltage

- hardware protection of electronics against overvoltage needed

- voltage limiter:
  voltage at the shunt regulator (431) larger than 2.5V opens the transistors q3 and q2 which pass the current from Vdd(or Vcc) line to the return lines. This current increases voltage drop on cables and thus protects the FE electronics.

- voltage limit at the module is set by the R_f and R_e resistors
  $V_{lim} = 2.5V(1+R_f/R_e) + 0.65V$

- limiters are there to guard the electronics before power supplies react (few ms)



- voltage limiters will be on PP3 inside experimental are UX15
  - ⟹ will be exposed to increased level of radiation which include high energy particles
    - ⟹ must be tested for radiation hardness

- total dose tests have been done: 35krad and 6×10^{11} n/cm² (1MeV NIEL) in the reactor in Ljubljana

- must be tested for SEE with ~ 10^{11} p/cm² ; E_p>60MeV

- components that could be damaged by interaction of a high energy particle:
  - ⟹ integrated circuit (TL431): bipolar IC can be very sensitive to latch-up

TEST:

- voltage limiters will be exposed to the proton beam
- performance will be periodically checked

- scheme of the voltage limiter test system:
  - opening the switch ST1 causes current drop
    - ⇒ measure maximal voltage on the module

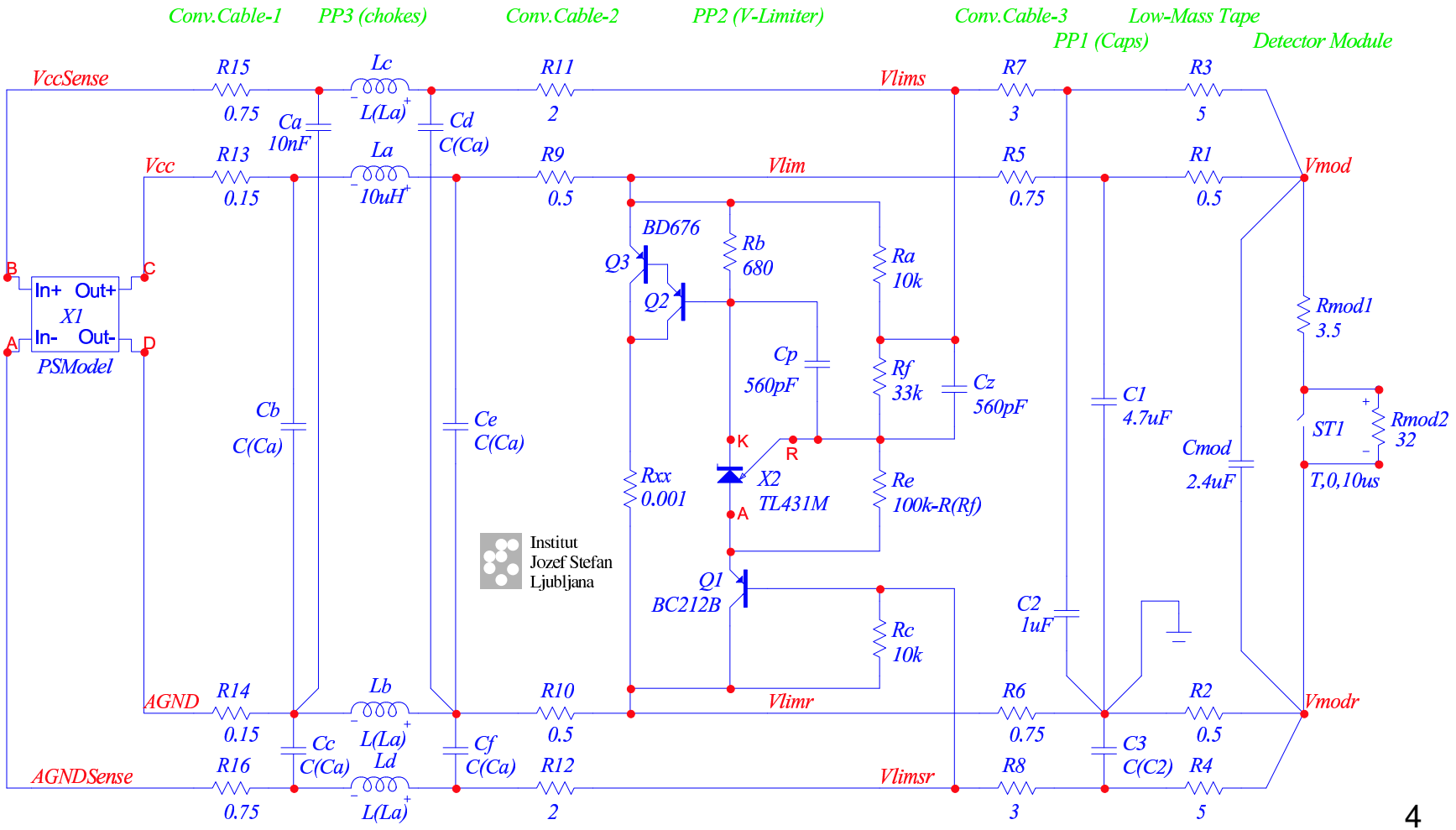


Fig. 3 : Simulation Setup With The Voltage Limiter At PP2

- 4 limiter circuits must be irradiated
- dimension of a limiter PCB ~ 2x4 cm^2 (area of sensitive part little smaller)
- could irradiate all at once (arrange them in 5x5 cm^2 area or put them one behind another?)
- limiters must be biased during irradiation (connection cables needed)
- 1 table in the lab (outside of the beam area) needed for the power supplies and readout equipment
- total fluence (10^{11} p/cm^2) should not be reached faster than in ~ 1h in order to perform several measurements during irradiation