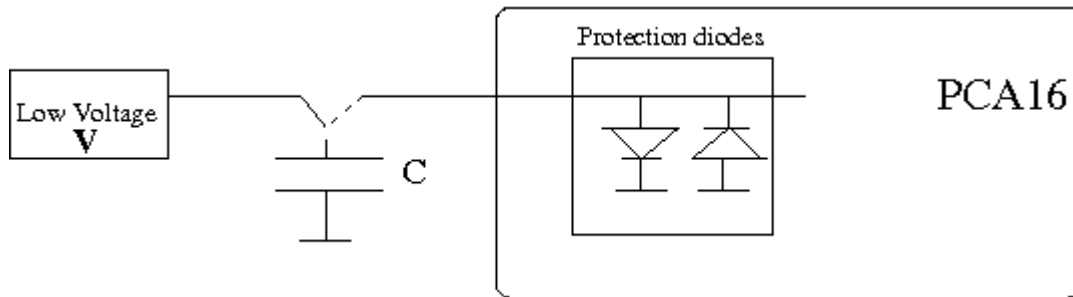


## Test of protection diodes

We have tested when the protection diodes in the PCA16 die due to “large” pulses. This was done by charging a capacitor and discharge it into the PAC16 channel.



We choose to use a FEC on which there were already a large number of dead channels and chips (FEC #74). First we measured if it was possible to see if a channel was alive or dead with a multimeter. **It was found that a dead channel had the protection diode(s) either short to ground or was broken.** Measured value for a working channel was a voltage drop of approx. 800 mV.

We tried different capacitors and voltages to investigate when the protection diode failed, where failed means either broken or short to ground:

| V   | C(nF) | failed | after number of discharges |
|-----|-------|--------|----------------------------|
| 20  | 10    | NO     | -                          |
| 20  | 22    | YES    | 6                          |
| 20  | 47    | YES    | 1                          |
| 40  | 10    | YES    | 1                          |
| -20 | 22    | YES    | 6                          |

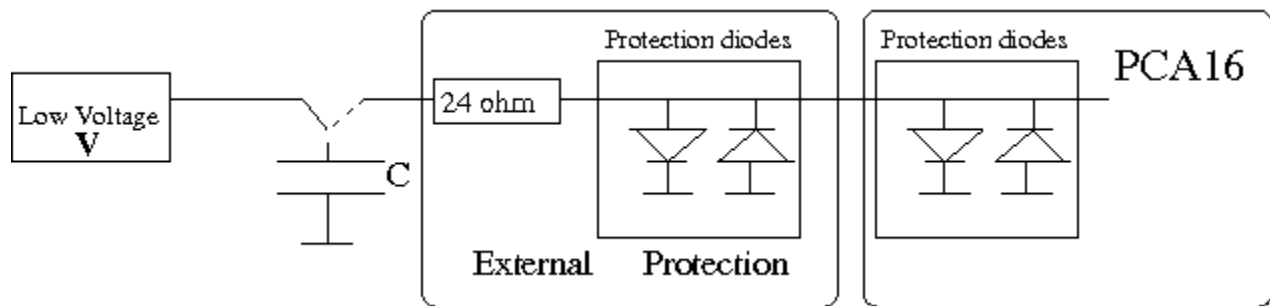
The diode for the opposite polarity than the injected signal survived.

We interpret that it is the energy that kills the diode, not the pulse height.

Afterwards the FEC was tested for bad channels with the normal test procedure. They appeared as channels with pedestals equal to zero, as is also the case for the channels that died during the beam tests.

## External protection

We then applied an external protection on one channel as in figure (24 ohm resistor, 1N4148 diodes):



All diodes in the tested channel survived 10 discharges with up to 10uF and 60V (which was the max available capacitor and voltage at the time of testing), i.e. more than 1000 times the energy that kills the internal diodes.

The signal distortion with the external protection diodes was not studied