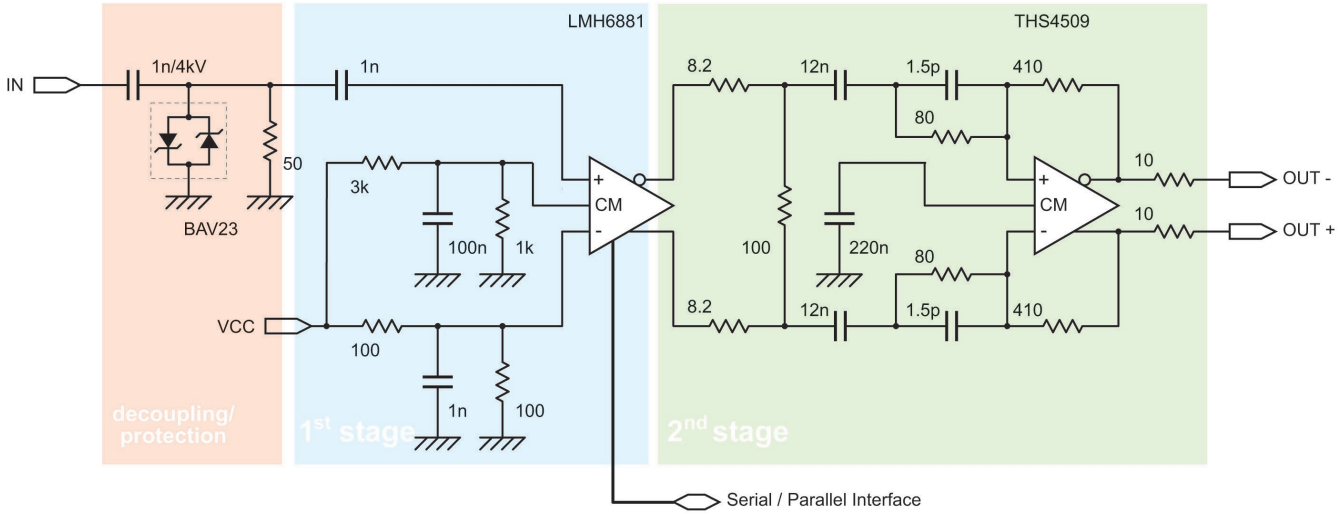
A variable gain front-end electronics for drift chambers

M. Panareo[a,b], G. Chiarello[c], F. Cuna[a,b], A. Corvaglia[b], F. Grancagnolo[b]

(a) Dipartimento di Matematica e Fisica, Università del Salento, Italy
(b) Istituto Nazionale di Fisica Nucleare, Lecce, Italy
(c) Istituto Nazionale di Fisica Nucleare, Pisa, Italy

The cluster counting/timing technique in a drift chamber allows to have a bias free impact parameter estimate. The application of this technique requires to measuring and counting the arrival times of each individual ionization cluster to a sense wire. The rise time of the signal from a cluster is approximately 1ns, therefore a readout electronic front-end with high linearity, low distortion and sufficiently high bandwidth is required. Furthermore, it would be useful for the readout electronics to be able to easily adapt its gain to the detector's operating point. The use of a variable gain amplifier (VGA) allows to meet the needs arising from the changed operating conditions of the detector. Market offers components capable of satisfying all these needs with dimensions compatible with high-density drift chambers. A high linear, low distortion, remotely controllable, about 1 GHz bandwidth and compact VGA is presented together with the measurements performed.



Bandwidth of the front-end is 1.0GHz. In order to balance the attenuation of the output cable, a pre-emphasis on the second gain stage can be been implemented by increasing the value of two capacitors.

Linearity for each channel of the FE board has been measured:

- Gain (Vout/Vin) is variable from 37dB to 49dB (midband) on 100 Ω load
- Mean non-linearity is order of 1 % (Vin: 2mV ÷ 10mV)

Output noise level measured is less then 2.5mV on a 100 Ω resistive load.

A readout channel based on commercial active components has been developed to detect individual ionization clusters in a drift chamber. The reading channel is characterized by a high linearity, low distortion, and a bandwidth adequate to the expected spectral density of the signal.

Furthermore, the readout electronics have been designed to have an easily variable amplification (via SPI interface) to have a signal that is always suitable for the digitizer, despite the changes in the working point of the detector. The gain stage support gain settings up to about 50dB with small accurate 0.25dB gain steps.

High-speed layout design techniques have been implemented to ensure optimum stability and performance.