The CBM MVD read-out electronics*

M. Wiebusch[1], *J. Michel*[1], *M. Koziel*[1], *B. Milanovic*[1], *S. Amar-Youcef*[1], *P. Klaus*[1], *J. Stroth*[1,2], *and the CBM-MVD collaboration*

[1]Goethe-Universität Frankfurt; [2]GSI, Darmstadt, Germany

Electronics

The CBM Micro-Vertex-Detector (MVD) front-end electronics serve as an intermediating device between the Monolithic Active Pixel Sensors (MAPS) and the DAQ system (based on the TRB3 system developed by HADES). In the current connection scheme, one TRB3 FPGA board can support up to 16 sensors of type ”MIMOSA-26” in parallel. The front-end electronics are necessary to supply the sensors with electrical power and to convert between different digital signal standards. The central element of these custom-built PCBs is the converter board. In addition to remote controlled power supplies, signal switches and drivers, it features an ADC section to monitor the sensor’s momentary electrical parameters. The sensors have to be supplied with a sensitive external biasing voltage, the so-called clamping voltage, which gets distributed to all sensor pixels. Several generation and distribution schemes were implemented to investigate which setup results in the best noise performance.

Measurements

The MIMOSA-26 provides a test mode to measure the discriminator transfer function[1] of all pixels. The slope steepness is directly related to the temporal noise of the sensor. The read-out sytem was extended to operate and read out the sensor in this test mode. The recorded data is evaluated by a dedicated ROOT-based analysis software. Noise tests with MIMOSA-26 are ongoing. However, preliminary results concerning the influence of the clamping voltage suggest that it is beneficial to generate this reference voltage as close to the sensor as possible and to use decoupling capacitors, if possible, next to the bonding pads on the flex print cable. These results are in particular important for the development of the next generation of cables[2]. Furthermore, the ADC section on the converter board can be used to perform systematic scans in order to characterize the sensors. As an example of such an automatic scan, Fig. 1 shows the dependence of the sensor’s current consumption on the discriminator threshold setting.

Laboratory instrumentation

When characterizing sensors, it is desirable to investigate the temperature dependence of certain sensor parameters. Until recently, such tests were conducted using a large cooling system which circulates coolant through a cooling block to which the sensors under test are attached. The sensors are now operated on a small copper platform which is cooled with a peltier element. A PID controller implemented on a microcontroller senses the temperature of the platform by means of a onewire temperature sensor and regulates the current through the peltier element. The device features a small display and a simple user interface, alternatively it can be remote controlled via a USB connection. The platform can be cooled down to circa $-10\,^{\circ}\mathrm{C}$ within few minutes while consuming $50\,\mathrm{W}$. Overall, the set-up was greatly reduced in size, while at the same time improved in usability.

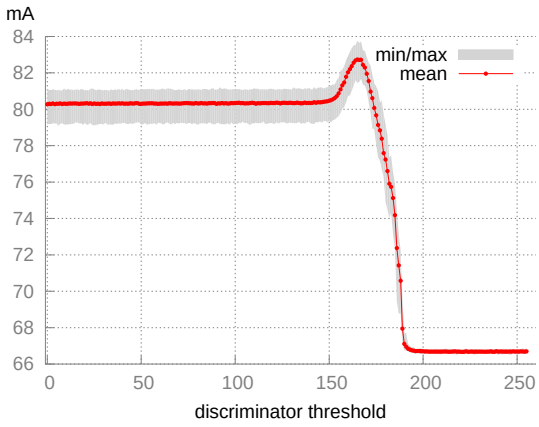

Figure 1: The current consumption (digital VCC) of a MIMOSA-26 sensor as a function of the discriminator threshold. Data acquired with front-end electronics on-board monitoring devices.

PRESTO

Current activities focus on bulding a prototype[1] of a quadrant of the second station of the MVD. For now, MIMOSA-26 sensors are used in this project though they do not qualify to be used in the final detector. Parts of the front-end electronics are currently redesigned to fit the spacial constraints of the set-up.

References

[1] M. Koziel, T. Tischler et al., PRESTO: PREcursor of the Second sTatiOn of the CBM-MVD, this issue.

[2] P. Klaus et al., Ultra-low material budget Cu-based flexible cable for the CBM-MVD, this issue.

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[1]The firing probability of a binary pixel as a function of discriminator threshold; usually has the form of a sigmoid function.

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