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Robust and Non-destructive Readout Card Installation Algorithm for MicroMegas Modules Cosmic Ray Tests

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The ATLAS Muon Spectrometer upgrade [1] is designed to cope with expected increase of LHC luminosity and to include the advanced particle detector technologies. The MicroMesh Gaseous Structure detectors - the MicroMegas are used now as a large area tracking detector in the endcap parts of ATLAS Muon Spectrometer. The whole construction is built from sectors subdivided into detector modules. MicroMegas modules of type LM2 were assembled and tested in Dubna, JINR [2]. The tests included geometry verification, high voltage and gas leakage tests and physical test at the cosmic stand. The final test included installation of multichannel readout cards with 8xVMM3 ASICs [3]. The goals of cosmic test were to fix the problems with electronics installation, to observe a longterm high-voltage stability of the module and to measure the module's efficiency map.

The voltage operation point of gaseous particle detector is close to the discharge region so that occasional discharges are possible. Discharge duration is limited inside the detector by integrated resistive strip coating but even with that the ROC channel will eventually stop working if its individual discharge protection circuits are mechanically damaged. The most damaged part of the ROC used to be the signal edge with contact density ~0.4 strip/mm and densely populated with SMD components of 0.5x1.0mm size.

At each installation a good electric contact between ROC and detector readout strips must be established. The contact is provided by so called Zebra-connectors: the soft rubber bands with aligned conductive microwires inside. The ROC with Zebra-connector is pressed against detector strips with a compression bar fixed on detector frame. The compression bar (CB) has 6 eccentric cams with a stepped helical surface so that pressure is transfered to the ROC by applying a certain torque to the cams.

It was found out that ROC damage was the result of not only having insufficient clearance between CBs and ROCs but also of repetitive trials and errors during connection tests, including ROC PCB deformation due to cams overpressure and PCB edge fixation with a plastic clip. A 3D mechanical engineering model was studied for better understanding of ROC and Zebra deformation. An algorithm was developed to clearly distinguish between different installation problems with solutions to fix each of them. This allowed us to switch from personal experience to a regular procedure so that other people can be trained thus reducing installation time. The number of available ROCs was limited not allowing to test the whole module in a single step. As a consequence in the end of production each of the ROCs was installed and removed >100 times. It was essential to keep electronics from electrostatic and mechanical damage.

The examples of module cosmic test results will be presented.

References

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3. VMM3, an ASIC for Micropattern Detectors, George Iakovidis for ATLAS Muon Collaboration, PoS MPGD2017 (2019)

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