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Radiation hard Regulator circuits for the ALICE ITS Upgrade

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In the ALICE ITS upgrade project[1], serial powering of the modules of the detector is proposed. Serial powering scheme has its own advantages: It brings power at low currents and high voltage drastically reducing material budget. Serial powering of detectors has been proposed before[2]. A shunt LDO is designed for this purpose to regulate the power. The ITS is in radiation environment (˜100 kRad). The shunt regulator and other building blocks were designed in Towerjazz 180 nm technology as a test chip named ALPOSE. This work will present the electrical characterization and radiation results of ALPOSE.

Summary

ALPOSE :
The Stave in the ALICE ITS is made up of 7 modules. Each module contains 14 MAPS (Monolithic Active Pixel Sensors) chips. Serial powering of the pixel chips is proposed at the stave level i.e. seven modules are connected serially in the stave. Inside the module, the pixel chips are connected in parallel between the power supply lines. A shunt LDO is an integral part of a serial powering scheme. It regulates the power supply to a given voltage if the source current is larger than the load current. The loads –in this case pixel chips between the power supply rails, draw a certain amount of current for their operation, the rest of the current should flow through a parallel shunt element and regulate the supply voltage. A test chip named ALPOSE containing regulators and other building blocks for the pixel chip was designed in the Towerjazz 180 nm technology. The building blocks include several flavors of the bandgap circuit, a rail to rail opamp and few flavours of the temperature sensor. The temperature sensor is required on the pixel chip to monitor the temperature on the chip and feedback the power supply and/or cooling mechanism of the staves. For the traditional voltage powering scheme, a serial LDO was also designed as an alternative. This paper will discuss the electrical characterization of the ALPOSE and its behavior under irradiation conditions. The chip was subjected to X-ray radiation under bias to account for TID and to neutrons to look at bulk damage.
References :
[1] “Technical Design Report for the Upgrade of the ALICE Inner Tracking System”B. Abelev et al. http://dx.doi.org/10.1088/0954-3899/41/8/087002
[2] M. Karagounis et al., An integrated Shunt-LDO regulator for serial powered systems, in proceedings of ESSCIRC ’09, September 14–18, 2009 Athens, Greece.

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