RADIATION RESISTANCE TESTING OF COMMERCIAL COMPONENTS FOR THE NEW SPS BEAM POSITION MEASUREMENT SYSTEM

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Abstract

A new Front-End (FE) electronics is under development for the SPS Multi Orbit Position System (MOPOS). To cover the large dynamic range of beam intensities (70 dB) to be measured in the SPS, the beam position monitor signals are processed using logarithmic amplifiers. They are then digitized locally and transmitted via optical fibers over long distances (up to 1 km) to VME acquisition boards located in surface buildings. The FE board is designed to be located in the SPS tunnel, where it must withstand radiation doses of up to 100 Gy per year.

Analogical components, such as Logarithmic Amplifiers, ADC-Drivers and Voltage Regulators, have been tested at PSI (Paul Scherrer Institute) for radiation hardness, while several families of bidirectional SFP, both single-fiber and double-fiber, have been tested at both PSI and CNRAD. This poster gives a description of the overall system architecture and presents the results of the radiation hardness tests in detail.

Simplified MOPOS Block Scheme

The devices Under Test (DUTs), Logarithmic Amplifiers, ADC drivers and voltage regulators, are all soldered on the same analogue test board. Since the working total dose foreseen in the SPS is about 100 Gy/year, the total dose targeted for the irradiation is 1 kGy per DUT. The devices have been tested at PSI-PIF.

The analogue test board is composed of 3 units of each DUT for reproducibility and statistical reasons. The test is performed moving the proton beam across the board over 7 different zones.

The analogue test board is powered by a custom-made power supply located in an adjacent technical room and therefore not exposed to radiation.

Logarithmic Amplifier, ADC Driver and Voltage Regulator Radiation Testing @ PSI — Proton Irradiation Facility (PIF)

The acquisition of each DUT output voltage is performed every 3 minutes using a Keithley multimeter, remotely controlled by LabView.

Test Results

At CNRAD, Huilong SFPs have been rejected, since they had a mechanical issue with the fiber connection, producing error counts even without radiation. Ligent SFPs work up 250 Gy, but produce many step-errors.

SFP Radiation Test @ PSI-PIF and CNRAD

Three 8-bit counters are implemented for each DUT to monitor both single (SEU), multiple (MBU) and the total numbers of errors. An unexpected behaviour (referred herein as step-error) has been observed, which refers to consecutive readings of a FULL on the "total-error counter" with an error rate > 8.16 10^-4.

For the MOPOS electronics upgrade we are now considering to use specifically designed radiation hard optical transceivers.