

Development of a laser test system for the characterization of prototype silicon micro-strip sensors*

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For the characterization and quality assurance of prototype micro-strip sensors produced for the CBM Silicon Tracking System (STS), a semi-automated infra-red pulsed laser test system has been developed [1]. The amount of energy deposited by the laser light is chosen such, that it is equivalent to charge created by a minimum ionizing particle. The purpose of this investigation is to understand the charge sharing and uniformity of sensor performance in the inter-strip regions. Two prototype sensor, namely CBM02 (double-sided, 256 strips/side, pitch = 50 μm , full read-out) and CBM05 (double-sided, 1024 strips/side, pitch = 58 μm , one-eighth read-out) have been investigated [2]. The strips on the sensors are read-out via self-triggering n-XYTER based front-end electronics.

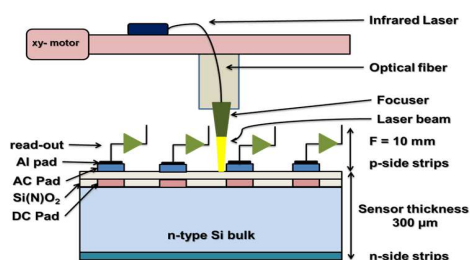


Figure 1: Schematic representation of the laser set-up

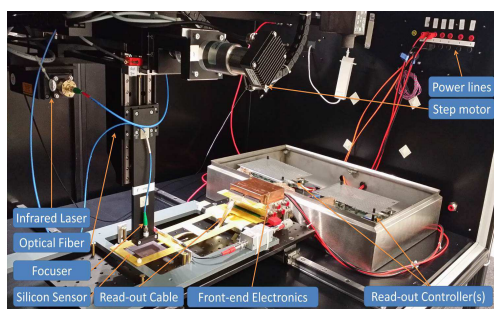


Figure 2: Components of Laser Test Stand.

The automated tests are performed at several positions across the sensor. The laser beam is focused to a spot-size of (σ_{spot}) $\approx 12 \mu\text{m}$. The duration ($\sim 5 \text{ ns}$) and power (few mW) of the laser pulses are selected such that the absorption of the laser light in the 300 μm thick silicon sensors produces about 24 000 electrons, which is similar to the charge created by minimum ionizing particles (MIP). The

wavelength of the laser is chosen to be 1060 nm because of the absorption depth being of the order of the thickness of the silicon sensors [3]. Figure 1 shows the measurement set up in a schematic view. Figure 2 shows various components installed in the laser test stand. The laser beam is transmitted through a 6 μm thick optical fibre to a single focusing system, which focuses the light to a spot of about 12 μm diameter. The working distance is about 10 mm [1]. The

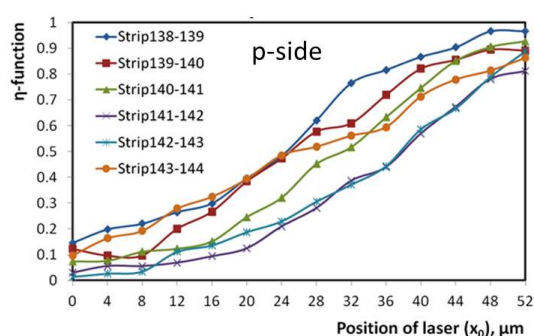


Figure 3: Charge sharing function (η) as a function of the position of the laser spot on one side of the sensor.

laser focuser is calibrated to a focused position on the sensor surface as a function of the number of strips fired with a signal just above threshold. At this reading the proper focal distance has been achieved. Figure 3 shows a measurement of the charge sharing function (η) in the inter-strip region. The η function is defined as the ratio of charge collected by either strip divided by the sum of both. The EPICS device control is used to control the step motor. A special program with a user interface has been developed to operate and move with the laser over the active area of the sensor to perform several measurements automatically. The data acquisition software DABC accesses the motor position information from EPICS. The on-line and off-line analysis is performed using the Go4 analysis tool.

References

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