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CMS Phase-II Inner Tracker system tests

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The LHC will undergo an upgrade known as the High Luminosity LHC (HL-LHC), with the aim of delivering 3000 fb⁻¹. The Compact Muon Solenoid (CMS) detector will be upgraded during the Phase-II upgrade to profit from the increased luminosity delivered by HL-LHC. As a part of the Phase-II upgrade, the CMS tracking detector will be replaced. In the regions closest to the beam, the Phase-II Inner Tracker (IT) will face harsh conditions with high integrated radiation levels of 1.2Grad and $2.3 \times 10^{16} \text{ n}_{\text{eq}}/\text{cm}^2$, a high pileup of up to 200 collisions per bunch crossing, and hit rate up to 3.2 GHz/cm². Phase-II IT is designed to operate in these conditions while maintaining excellent performance. The IT hybrid pixel modules consist of planar or 3D silicon sensors with a pixel size of $25 \times 100 \text{ } \mu\text{m}^2$ that are bump-bonded to a readout ASIC developed by the RD53 collaboration and a high-density interconnect to connect power lines and readout signals. The modules are mounted on lightweight structures that provide serial power, cooling, and communication. The electrical signals from the modules are transformed into optical signals by the so-called portcards. The central (barrel) part of IT consists of four cylindrical structures, while the forward part is divided into two subsystems composed of eight small and four large disc-like structures per end. We present the results of the IT system tests from structures to portcards with prototype and final IT modules for the three subsystems and discuss their performance.

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