ANIMMA 2021

Prague, Czech Republic

June 21-25, 2021

Contribution ID: **139**

Type: **Poster**

#03-139 Design of Real-Time Electronics System for Two-Dimensional Hard X-Ray Diagnostics with Intensity Imaging and Energy Spectrum in EAST

Thursday, June 24, 2021 4:25 PM (5 minutes)

Hard X-ray diagnosis is the most important diagnostic in Experimental Advanced Superconducting Tokamak (EAST) for studying low-hybrid wave physics and fast electrons, which helps to improve the operating performance and guarantee the operation safety of EAST Tokamak. The Hard X-Ray diagnostics used 16×16-channels pixel array Cadmium Zinc Telluride (CZT) detector which has the features of high resolution, large absorption coefficient, high detection efficiency, small size, and can work under normal temperature conditions. A charge-sensitive pre-amplifier card is designed which is magnetic shielded and easy to maintain, with low noise and low signal crosstalk. The card has 32 channels and the actual conversion gain can reach up to 1mv/fc. Then, a compacted pre-amplifiers module is built which is composed of 8 preamplifier cards and one main-board (transform signal from detector to pre-amplifier). Moreover, the multi-channel high precision data acquisition and signal process system based on FPGA (made in China) and PXIe bus is designed, which solves the problem of time synchronization during the acquisition of multiple boards. The direct memory access(DMA) mode is used for hardware programming to achieve high-speed data transmission. Meanwhile, a software driver has been developed based on the Linux platform, and through the QT framework. The real-time display of the two-dimensional intensity distribution of hard X-ray radiation over time and the three-dimensional curve of the pixel signal spectrum over time have been realized, and the data is stored quickly to facilitate further offline analysis and processing. The electronics system has been tested and the results show that it has reached the design performance.

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Session Classification: 03 Fusion Diagnostics and Technology

Track Classification: 03 Fusion Diagnostics and Technology