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Data Chain Reconstructing Technology for the front-end electronics of the BESIII muon identification system

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To reduce the cost and minimize the occupying volume of the transmission cables in the spectrometer, some middle and low energy particle physics experiment employ serial daisy-chain techniques, which organize the front-end cards (FECs) in a daisy-chain topology, and data is transferred in a serial mode from FECs to the rear-end electronics. However, this technique has an obvious limitation in that the failure of a single component will disable the entire data chain. As the only solution, a data chain reconstruction technology is proposed based on the front-end electronics of the Beijing Spectrometer (BESIII) muon identification system. This technology can automatically disconnect malfunctioning front-end cards and reorganize the data transmission channel to minimize the loss of data. In this paper, we report our work on the design of data chain reconstruction, focusing on the realization of data reconstruction using highly reliable anti-fuse field programmable gate arrays (FPGAs), on the prevention of short circuits, and on fault tolerance improvement. A prototype of the reconstructing data chain designed for the front-end electronics of the BESIII muon identification system has fulfilled the requirements of a laboratory environment and is able to now be applied in an actual experiment.

Author: Mr XI, Jianbo (University Of Science And Technology Of China)

Co-authors: Mr LIANG, Hao (University Of Science And Technology Of China); Mr XIANG, Shitao (University Of Science And Technology Of China); Mr ZHANG, xiaoguang (University Of Science And Technology Of China)

Presenter: Mr ZHANG, xiaoguang (University Of Science And Technology Of China)

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