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The Design of an 8-channel, 41.7-ps Resolution Time-to-Digital Converter for STCF ECAL

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The Super Tau-Charm Facility (STCF) under construction in China demands for a new Electromagnetic Calorimeter (ECAL) with good time measuring capability to realize background suppression and gamma-neutron discrimination. The time measurement requirements include high resolution, large dynamic range and multi-channel integration. Therefore, we adopted a 3-level-structure based Time-to-Digital Converter (TDC) which can realize large dynamic range with a coarse counter as the first level and high resolution with a modified Vernier Delay Loop (VDL) as the finest level. The proposed VDL can get a stable and sub-gate resolution utilizing differentials between two kinds of unit delay locked by different Delay Locked Loops (DLLs). The proposed VDL is also characterized with the cyclic structure for linearity improvement and the automatic restoration for continuous measurement. The proposed 8-channel TDC was fabricated with standard 180-nm CMOS process and it can reach a resolution of 41.7-ps and dynamic range of 2.56- μ s under the reference clock frequency of 100-MHz. According to test results, the precision of asynchronous measurement is 47.0-ps in the best situation and all channels have good linearity with $DNL < 1$ LSB and $INL < 1.5$ LSB.

Minioral

Yes

IEEE Member

No

Are you a student?

Yes

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