Improving the performance of the feedback charge capacitance–voltage method

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Abstract. The feedback charge capacitance–voltage method (FCM) (Mego 1986 *Rev. Sci. Instrum.* **58** 2798) is a pure time-domain technique originally used for measuring the quasi-static capacitance of semiconductor devices. The method is based on processing the output of a charge-to-voltage converter in response to a double-step (pulse) excitation of the device. Using a transient voltage processor comprising three gated integrators connected to a mixing unit, steady-state (leakage) current may be the source of severe experimental error in capacitance. First, there is a parasitic charge during the pulse that causes an error in sampling the baseline while activating the first channel for an aperture of finite duration Δt. Second, any uncompensated leakage present after the pulse leads to a charge increment representing what is called conduction loss in the frequency domain. Measures to be taken towards minimizing both errors are provided, based on a simultaneous action of active leakage current compensation and second-order filtering. A simple hardware solution for optimizing the dynamic range of the FCM under the leakage is provided. A non-instrumental FCM error connected with the *constant* dielectric loss in diamond thin films, due to the anomalous kinetics $j(t) \propto t^{-1}$ of the *transient* current, is analysed. The latter causes inaccuracy in assessing the instantaneous (geometrical) capacitance of diamond-based Schottky diodes. A proper gating of the charge-to-voltage converter is suggested for removal of the predicted error.

Keywords: time-domain capacitance, conduction losses, dielectric losses

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