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A novel scaling theory for inverted-T-shaped gate MOSFETs (ITFET) including effective number of gates

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This work presents a novel scaling theory for fully depleted, inverted-T-shaped gate MOSFETs (ITFET) MOSFET. The scaling theory is derived from the equation for effective number of gates (ENGs), $ENG_{ITFET} = \alpha\ ENG_{DG,1} + (1-\alpha) ENG_{DG,2} + \beta ENG_{SG,1} + (1-\beta) ENG_{SG,2}$, where the ITFET device can be genuinely broken into two equivalent double-gate (DG) and two single-gate (SG) transistors working in parallel based on the perimeter-weighted-sum method (PWSM). Numerical device simulation data for drain-induced-barrier-lowering (DIBL) were compared with the model to validate the formula. Using the scaling theory, the minimum effective channel length improvement factor shows an improvement of up to 30% in the minimum effective channel length for the ITFET in comparison with DG MOSFET. This theory can be easily used to scale the small-geometrical device for the low-power circuit application.

Keywords: inverted-T-shaped gate MOSFET (ITFET), effective number of gates (ENG), perimeter weighted-sum method (PWSM), drain-induced-barrier-lowering (DIBL), minimum effective channel length improvement factor.