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Replacing MOSFETs with Single Electron Transistors (SET) to Reduce Power Consumption of an Inverter Circuit

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Abstract : According to the rules of quantum mechanics there is a non-vanishing probability of for an electron to tunnel through a thin insulating barrier or a thin capacitor which is not possible according to the laws of classical physics. Tunneling of electron through a thin insulating barrier or tunnel junction is a random event and the magnitude of current flowing due to the tunneling of electron is very low. As the current flowing through a Single Electron Transistor (SET) is the result of electron tunneling through tunnel junctions of its source and drain the supply voltage requirement is also very low. As a result, the power consumption across a Single Electron Transistor is ultra-low in comparison to that of a MOSFET. In this paper simulations have been done with PSPICE for an inverter built with both SETs and MOSFETs. 35mV supply voltage was used for a SET built inverter circuit and the supply voltage used for a CMOS inverter was 3.5V.

Keywords : ITRS, enhancement type MOSFET, island, DC analysis, transient analysis, power consumption, background charge co-tunneling
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