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Single-charge pump based on a silicon quantum dot TUOMO TANTTU, University of New South Wales, ALESSANDRO ROSSI, Cavendish Laboratory, University of Cambridge University, KUAN YEN TAN, KUKKA-EMILIA HUHTINEN, AKSELI MÄKINEN, Aalto University, KOK WAI CHAN, University of New South Wales, MIKKO MÖTTÖNEN, Aalto University, ANDREW S. DZURAK, University of New South Wales, ISNS, CQC2T, SCHOOL OF ELECTRICAL ENGINEERING AND TELECOMMUNICATIONS, UNIVERSITY OF NEW SOUTH WALES TEAM, QCDLABS, DEPARTMENT OF APPLIED PHYSICS, AALTO UNIVERSITY TEAM — Semiconductor nanoscale single-electron pumps can precisely transport precisely an integer number of electrons at a fixed frequency resulting in a quantized current. The most appealing application for such pumps is the realization of the emerging definition of the SI ampere based on a fixed value of the electron charge. We perform electron counting in a silicon-based single-electron pump that can be operated with high accuracy. Importantly, we show that the electron counting and the output current of the pump agree within the experimental accuracy. The electron counting scheme can be upgraded in our system into an error counting scheme where we detect only the error events, where an undesired number of electrons is transferred. Furthermore, a three waveform pumping protocol is introduced to demonstrate bidirectional pumping, where the pumped current can be reversed simply by tuning the phase of one of the waveforms. We conclude that the sensitivity of our charge sensor should be increased for the future experiments.

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