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Ultra-precision DC source for Superconducting Quantum Computing

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The Superconducting Quantum Computing (SQC) is one of the most promising quantum computing techniques. The SQC requires precise control and acquisition to operate the superconducting qubits. Ultra-precision DC source is used to provide a DC bias for the qubit to work at its operation point. The commercial precise DC sources are used in single or few qubits experiments. With the development of the multi-qubit processor, to use the same DC source device is impossible for its large volume occupation. And it is also impossible to optimize the large commercial device into a small size or design a compact device to match the commercial performance in a short time.
We study the requirements of the experiments, and set a goal of 2 ppm precision and 10 ppm over all drift in -2.5V to +2.5V range to satisfy the demands of the experiments for our self-design device.
To keep the design as simple as possible to prevent any uncontrollable effects, we use a Zener diode as the voltage reference, low noise amplifiers to get the bipolar voltage references, 20-bit DACs to get a controllable output, ceramic PTC materials for temperature control, and one single chip for ethernet and DAC control.
The prototype is accomplished, and primary results show that the standard deviation of 2.5V is less than 2 uV, and the drift in 24 hours is less than 10 uV of 2.5V. We will try to optimize the long-term drift and present the design details and further test results in the paper.

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Yes

Description

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