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Quocca: A scalable quantum control and readout platform

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Universal quantum computing, requires a scalable system with millions of qubits. One of the current bottlenecks is a fast and high fidelity readout without limiting the scalability by area consumption, wiring, or power dissipation. We address this challenge by developing an integrated readout circuitry (IC), in a 22 nm FD-SOI technology, operating at deep cryogenic temperatures. The IC will be connected to a Single Electron Transistor (SET). The prototype is made for reading out two SETs. It implements a high speed mode, to perform a single bit readout to distinct ⊠0〉 and ⊠1〉 state and a high resolution mode for tuning, which amplifies the signal and passes it to the room-temperature electronics.

We characterize this IC inside a closed cycle Gifford-McMahon cryostat at a temperature of 6 K. The measurement shows a power consumption of 33.6 µW/SET for the single bit readout and 216 µW for the high-resolution mode. With a sampling time of 2×1 µs, the circuit shows low noise of 223 pA (1σ) for single bit readout, while the high-resolution mode has an input-referred noise level of 188 pA RMS (10 Hz to 1 MHz).

With its high bandwidth, low input noise and low power consumption, this IC paves the way for scalable integrated readout and is a decisive step on the way to universal quantum computing

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