

Energy-Efficient Single Flux Quantum Technology

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Abstract - Figures of merit connecting processing capabilities with power dissipated (OpS/Watt, Joule/bit, etc.) are becoming dominant factors in choosing technologies for implementing the next generation of computing and communication network systems. Superconductivity is viewed as a technology capable of achieving higher energy efficiencies than other technologies. Static power dissipation of standard RSFQ logic, associated with dc bias resistors, is responsible for most of the circuit power dissipation. In this paper, we review and compare different superconductor digital technology approaches and logic families addressing this problem. We present a novel energy-efficient single flux quantum logic family, ERSFQ/eSFQ. We also discuss energy-efficient approaches for output data interface and overall cryosystem design.

Index Terms - low power, power efficient, RSFQ, SFQ, cryogenic, exascale, ballistic, switching energy, voltage regulator.

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