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Superconducting Qubit with Integrated Single Flux Quantum Controller Part I: Theory and Fabrication MATTHEW BECK, EDWARD LEONARD JR., TED THORBECK[1], SHAOJIANG ZHU, University of Wisconsin - Madison, CALEB HOWINGTON, JJ NELSON, BRITTON PLOURDE, Syracuse University, ROBERT MCDERMOTT, University of Wisconsin - Madison — As the size of quantum processors grow, so do the classical control requirements. The single flux quantum (SFQ) Josephson digital logic family offers an attractive route to proximal classical control of multi-qubit processors. Here we describe coherent control of qubits via trains of SFQ pulses. We discuss the fabrication of an SFQ-based pulse generator and a superconducting transmon qubit on a single chip. Sources of excess microwave loss stemming from the complex multilayer fabrication of the SFQ circuit are discussed. We show how to mitigate this loss through judicious choice of process workflow and appropriate use of sacrificial protection layers.

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