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Efficient one- and two-qubit pulse gates for an oscillator stabilized Josephson flux qubit FREDERICO BRITO, D.P. DIVINCENZO, R.H. KOCH, MATTHIAS STEFFEN, IBM Research Division — We present schemes for one- and two-qubit dc pulse gates for the IBM qubit. As reported previously by our group, the qubit consists of three Josephson junctions, three loops, and a superconducting transmission line. The qubit-qubit coupling is assumed to be inductive. We show that there are settings of the flux control parameters for which the effective qubit-qubit coupling can be made negligible, allowing one to perform high fidelity single qubit gates. Assuming the presence of no decoherence processes, we are able to reach gates of 99% fidelity for pulse times in the range of 20-30ns. Our T_2 estimates indicate coherence times long enough to perform approximately 50 of those gates. The control of leakage plays an important role in the design of our dc pulses, preventing shorter pulse times. Also, we look for schemes which may alleviate the errors due the $1/f$ noise. In addition, we show how to perform two-qubit gates in the system, demonstrating a controlled phase operation.

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