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Benchmarking gates in a qubit-bus-qubit tunable transmon architecture JULIAN KELLY, R. BARENDS, J. BOCHMANN, B. CAMPBELL, Y. CHEN, B. CHIARO, E. JEFFREY, M. MARIANTONI, A. MEGRANT, J. MUTUS, C. NEILL, P. O'MALLEY, S. OHYA, P. ROUSHAN, D. SANK, A. VAINSENCHER, J. WENNER, T. WHITE, A.N. CLELAND, J.M. MARTINIS, UC Santa Barbara — Using a newly developed frequency tunable transmon qubit ("Xmon"), we are beginning to construct the fundamental gates and architecture for a quantum computer. We show experimental data for gates in a qubit-bus-qubit configuration. We quantify the fidelity of a set of single qubit gates with both randomized benchmarking and tomography. We also investigate the fast swap style cPhase gate [Strauch PRL 2003], where the control qubit is swapped into the bus and interacts dispersively with the target qubit, as a fundamental two-qubit interaction.

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