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Kerr-free, 3-wave mixing Josephson dipole element[1] N.E. FRATTINI, U. VOOL, S. SHANKAR, A. NARLA, Department of Applied Physics, Yale University, K.M. SLIWA, Quantum Circuits, Inc., M.H. DEVORET, Department of Applied Physics, Yale University — A necessary requirement for any quantum computation architecture is the ability to perform efficient quantum operations. For superconducting qubits, quantum-limited amplification and conversion operations can be realized with a quadrupole Josephson junction element behaving as a lossless three-wave mixer, the Josephson Ring Modulator (JRM). A recent approach for through-only amplification requires the application of multiple strong microwave pump tones to the JRM. In practice, unwanted fourth order Kerr nonlinearities jeopardize delicate frequency matching conditions. We present a novel dipole circuit element with third order nonlinearity, which implements three-wave mixing without the addition of harmful Kerr terms. In addition to reducing power dependent frequency shifts, such a pure three-wave mixer can be tessellated for increased dynamic range or bandwidth. Experimental results for a non-degenerate amplifier based on the proposed pure third order non-linearity will be reported.

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