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Understanding and improving the cross resonance gate in superconducting qubits[1] SARAH SHELDON, EASWAR MAGESAN, JERRY M. CHOW, JAY M. GAMBETTA, IBM T.J. Watson Research Center — We present improvements in both theoretical understanding and experimental implementation of the cross resonance (CR) gate that have led to shorter two qubit gatetimes and interleaved randomized benchmarking fidelities exceeding 99%. The CR gate is an all-microwave two qubit gate offers that does not require tunability and is therefore well suited to quantum computing architectures based on 2D superconducting qubits. The performance of the gate has previously been hindered by long gatetimes and fidelities averaging 96-97%. We have developed a calibration procedure that accurately measures the full CR Hamiltonian. The resulting measurements agree with theoretical analysis of the gate and also elucidate the error terms that have previously limited the gate fidelity. The increase in fidelity that we have achieved was accomplished by introducing a second microwave drive tone on the target qubit to cancel unwanted components of the CR Hamiltonian.

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