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High speed on-chip current measurement using a low-Q tunable LC resonator BROOKS CAMPBELL, Z. CHEN, B. CHIARO, A. DUNSWORTH, C. NEILL, P.J.J. O'MALLEY, C. QUINTANA, A. VAINSENCHER, J. WENNER, UC Santa Barbara, R. BARENDS, Y. CHEN, A. FOWLER, E. JEFFREY, J. KELLY, E. LUCERO, A. MEGRANT, J. MUTUS, M. NEELEY, P. ROUSHAN, D. SANK, Google, Santa Barbara, T.C. WHITE, JOHN M. MARTINIS, UC Santa Barbara and Google, Santa Barbara — Superconducting quantum computing technology requires precise high frequency analog waveforms to perform single and multi-qubit gates. Due to signal path irregularities, gates are tuned-up by perturbing the drive signal until qubit state populations indicate the desired gate function. A more direct approach is to measure the effect of circuit imperfections by sampling control waveforms directly, as seen by the qubits. We proceed by measuring the resonant frequency shift of a capacitively shunted SQUID and converting the control waveform to DC flux applied to the SQUID. By measuring the reflected phase of a CW tone applied to this resonant circuit while applying the resonance-shifting flux pulse, we are able to reconstruct the current waveform of the input pulse at the SQUID loop. This device's geometry is the same as the z-control lines used in qubit experiments to control the qubit frequency. I will present this method of on-chip waveform sampling for superconducting circuits in addition to proof of concept data. This technique opens the door for improved gate bring up and a deeper understanding of qubit control as well as the circuit parasitics that deform these waveforms.

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