Application Brief

Superconducting Fluxonium Qubits. Controlled.

Zurich Instruments provides integrated control and measurement solutions for quantum computing and research with fluxonium qubits. Scalable hardware and intuitive software deliver precise, low-noise signals and high-level quantum experiment control. This increases coherence times, boosts measurement fidelity, and accelerates research. Backed by developer support and collaborative partnerships, Zurich Instruments enables universities and industrial teams to achieve scalable, reliable quantum computing.

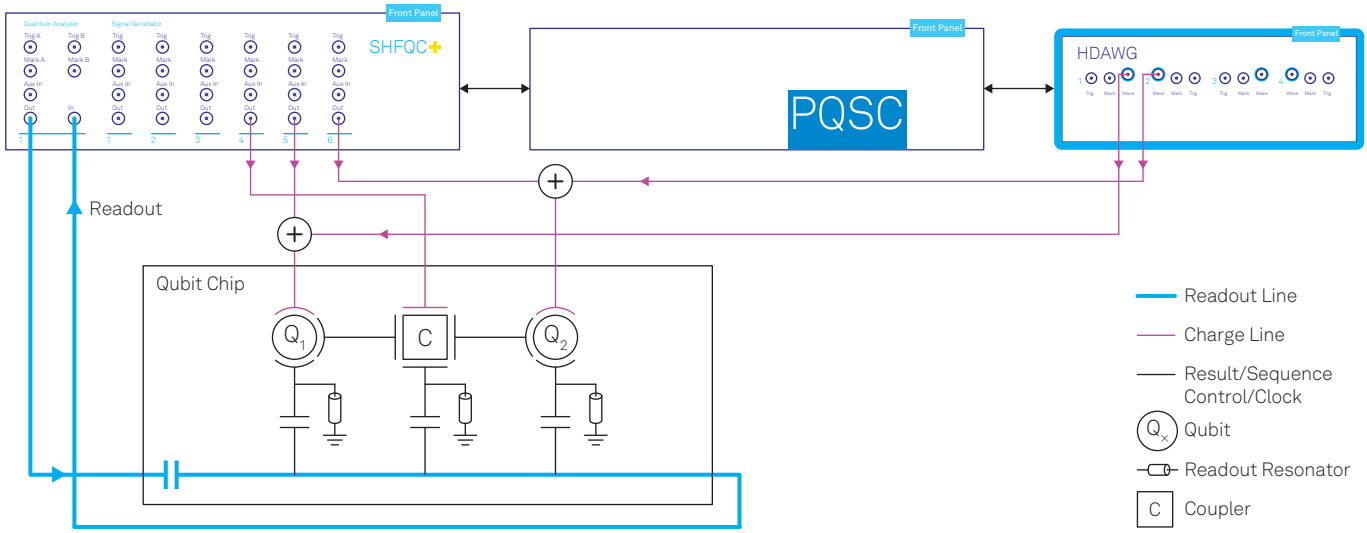

Figure 1. A typical setup using an SHFQC+ Qubit Controller and an HDAWG Arbitrary Waveform Generator for an experiment with 2 fluxonium qubits and a coupler.

Your Benefits

- Rely on excellent analog signal properties for fluxonium qubit control with the HDAWG: low noise floor, low crosstalk, high vertical resolution
- Benefit from the strong technical support provided by our quantum technology experts
- Get all microwave control and readout channels for fluxonium qubits in one solution, covering the full required frequency spectrum
- Save time with comprehensive software packages
- All experimental stages are covered: tune-up, characterization, calibration and computation
- Build on a clear roadmap for scaling and for integrating high-level quantum stack software, e.g. Qiskit

Your Application Resources

- Code examples: standard characterization measurements in LabOne Q, active reset.
- Blog posts: OpenQASM circuits, AWG precompensation, hands-on qubit characterization

Discover more online

High-fidelity Control Made Easy

- Intuitive, gate-level design of experiments and fast waveform upload thanks to the advanced feature sets of the LabOne Q software and of the control electronics
- Stable, low-noise output for high gate fidelity
- Fast phase control for x- and y-rotations, or anything in between
- Sample-precise waveform playback
- Get results quickly with our many predefined workflow examples for fluxoniums

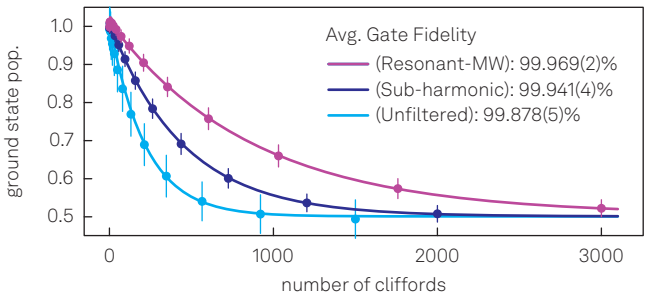

Figure 2. Single-qubit Randomized Benchmarking for resonant and sub-harmonic drive through a filtered flux line, and comparison with unfiltered flux line. Measurements performed with an SHFQC Qubit Controller and an HDAWG Arbitrary Waveform Generator.[1]

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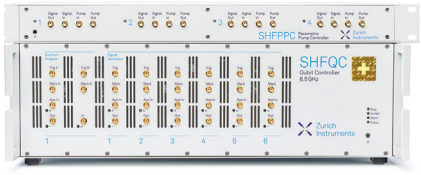
References

1 Schirk et. al., arXiv:2410.00495 (2024). Data courtesy of the Quantum Computing and Information Processing team at Walther-Meißner-Institute (WMI).

Product Highlights



SHFQC+
Qubit Controller

The SHFQC+ integrates high-frequency control, measurement, and processing in one instrument, generating both high-fidelity signals and low-latency feedback. Combine the SHFQC+ with an SHFPPC Parametric Pump Controller for high-fidelity readout at the quantum limit when using Josephson parametric amplifiers.

HDAWG
Arbitrary Waveform Generator

The HDAWG delivers low-noise control both for resonant and sub-harmonic qubit drive, and for fast flux control of fluxonium qubits and couplers. Thanks to the HDAWG-PC option, it can pre-compensate for distortion on the flux lines.

PQSC
Quantum System Controller

Perform low-latency feedback between any instrument in < 550 ns. Out of the box, sample-precise synchronization of up to 144 microwave channels.

All instruments are controlled by LabOne Q, an open-source Python-based software framework offering both high- and low-level access. Achieve results quickly with extensive code examples, documentation, and support.

Meet Our Quantum Technology Experts

Every member of our Quantum Technology team has a background in advanced scientific research, including quantum error correction, quantum sensing, quantum computing, and theory of quantum algorithms.

Our Customers' Accomplishments

- Andersen Lab (TU Delft): Fastest reported readout of a fluxonium qubit, arXiv:2411.13437 (2024)
- Filipp Group (Technical Univ. of Munich and the Walther-Meißner-Institute): High-fidelity fluxonium control with protection from qubit decay, arXiv.2411.13437 (2024)
- Simakov et al. (RQC/MISIS): CZ gates in 44 ns using microwave-driven coupler, PRX Quantum 4, 040321 (2023)
- Atlantic Quantum: Quantum computing with a fluxonium-based processor combining speed, accuracy, and scalability

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