Application Brief

Quantum Computing with Superconducting Qubits. Controlled.

Superconducting qubits are one of the most promising technologies for the realization of a scalable, fault-tolerant quantum computer. Zurich Instruments offers all the classical hardware and software that are needed to connect physical superconducting circuits to the higher levels in the quantum stack. Backed by developer support and collaborative partnerships, Zurich Instruments enables universities and industrial teams to achieve scalable, reliable quantum computing.

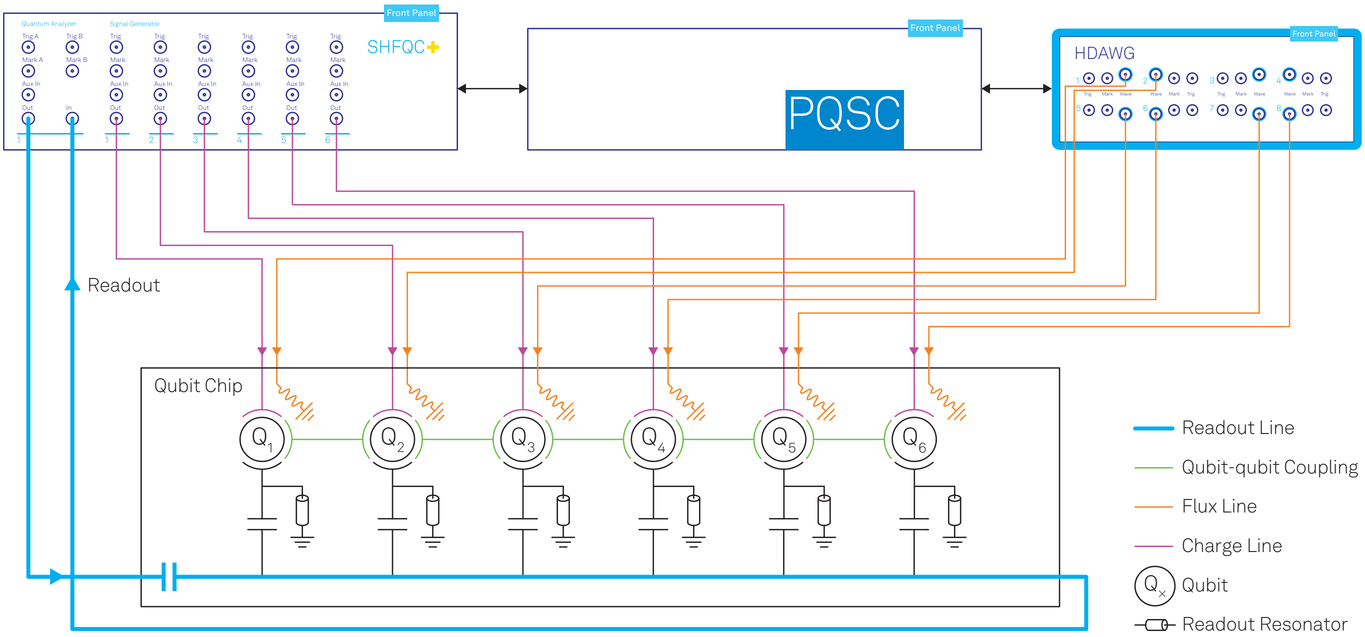

Figure 1. Typical 6-qubit setup for flux-tunable transmons using an SHFQC6+, an HDAWG8, and a PQSC.

Your Benefits

- Excellent analog signal properties for high-fidelity gate operations: low noise, low crosstalk, high vertical resolution
- Get all microwave control and readout channels for transmon 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, and more.
- Blog posts: OpenQASM circuits, synchronization over 52 meters, hands-on qubit characterization

Discover more online

Randomized Benchmarking 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 pre-defined workflow examples for transmons

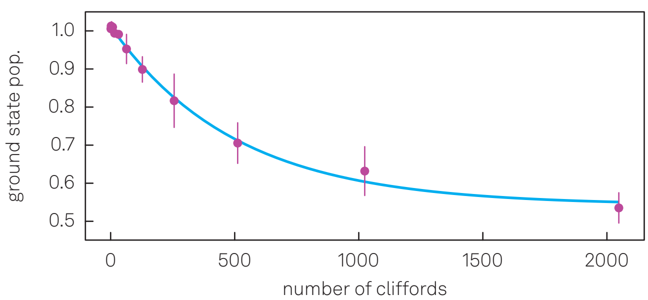

Figure 2. Single-qubit Randomized Bechmarking measurements yielding an estimated single-qubit gate fidelity of 99.8%. Measurements performed with an SHFQC+ Qubit Controller.[1]

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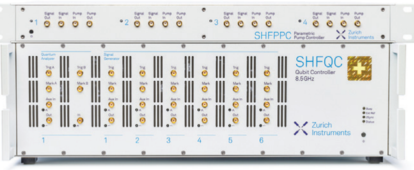
References

1 Data courtesy of the Quantum Computing and Information Processing team at the Walther-Meißner-Institute (WMI).

Product Highlights

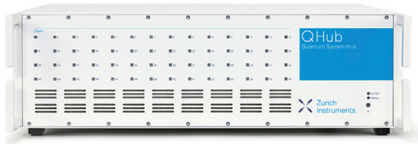


SHFQC+
Qubit Controller

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-frequency control, generating flux pulses for frequency tuning of transmon qubits and couplers. Thanks to the HDAWG-PC option, it can precompensate for distortion on the flux lines.



QHub
Quantum System Hub

QHub precisely times the control and measurement signals, enabling scalable, synchronized operation, real-time feedback, and error correction across multiple instruments.

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

- Quantum Device Lab (ETH Zurich): Realizing repeated quantum error correction in a distance-three surface code, Nature **605,** 669-674 (2022)
- Filipp Group (Technical Univ. of Munich and the Walther-Meißner-Institute): Efficient decoupling of a nonlinear qubit mode from its environment, Phys. Rev. X **14,** 041007 (2024)
- Institute for Functional Quantum Systems (PGI-13, Forschungszentrum Jülich): Dispersive qubit readout with intrinsic resonator reset, arXiv:2406.04891v2 (2024)
- Kontos Group (Ecole normale supérieure): Observation of quantum oscillations in the extreme weak anharmonic limit, Phys. Rev. B **109**, 064505 (2024)
- IQM Quantum Computers: Reducing leakage of single-qubit gates for superconducting quantum processors using analytical control pulse envelopes, PRX Quantum **5,** 030353 (2024)

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