Scalable i/o solutions for addressing 1000+ qubits: Proven capabilities and future directions

J.M. de Voogd
N. Kerkhof
B. Rovers
D. Kuitenbrouwer
S.J. Bosman

Delft Circuits, Schieweg 15A
2627 AN Delft, The Netherlands
marc@delft-circuits.com

As quantum processors scale towards 1000+ qubits, signal transmission and control become critical bottlenecks. In this presentation, we highlight how Delft Circuits' i/o solutions are designed to address these challenges and support large-scale quantum systems. Our current approach integrates multichannel laminates (fig. 1) with signal conditioning components (fig. 2), enabling high-density signal transmission.[1] The planar structure allows for uninterrupted i/o with efficient thermalization across temperature stages, ensuring robust performance at cryogenic levels.[2] At the qubit processor (QPU) side, we present a scalable flex-to-PCB interface that simplifies connections while maintaining performance. On the control side, our solution provides a seamless, scalable interface with control electronics. Looking forward we discuss future developments and essential building blocks needed for scaling to next-generation quantum processors.

References

[1] Monarkha, et al. "Equivalence of Flexible Stripline and Coaxial Cables for Superconducting Qubit Control and Readout Pulses." Applied Physics Letters 124, no. 22 (May 29, 2024): 224001.
[2] Patrick Paluch et al., "Thermalization of a Flexible Microwave Stripline Measured by a Superconducting Qubit," Applied Physics Letters 126, no. 3 (January 23, 2025): 034003,

Figures

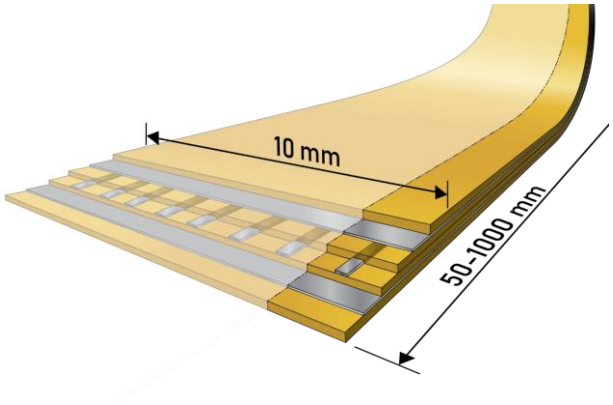

Figure 1: A flexible laminate incorporating multiple normal and superconducting RF channels within a stripline structure.

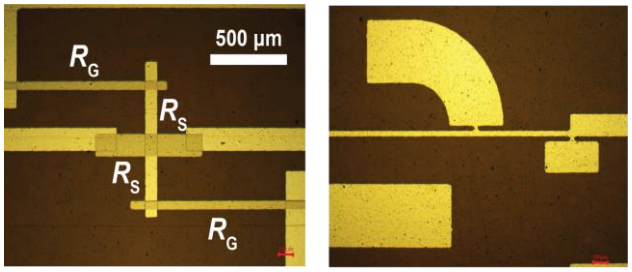

Figure 2: Scalable in-line signal conditioning achieved with in-flex fabricated attenuators (left) and low-pass filters (right).