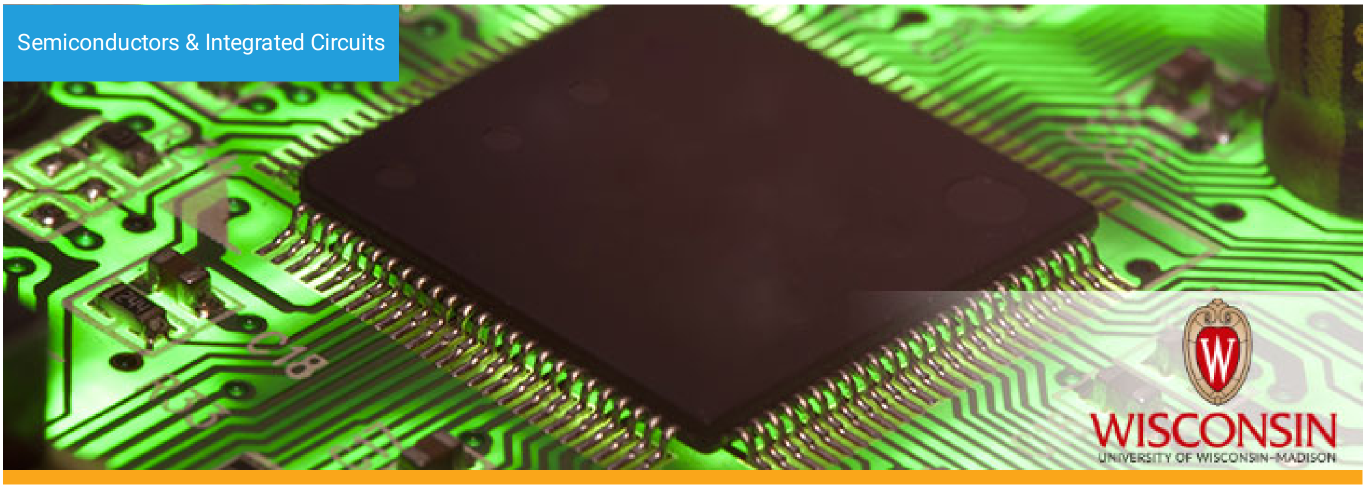

Low-Noise, Phase-Insensitive Linear Amplification at Microwave Frequencies

View U.S. Patent No. 8,861,619 in PDF format.

WARF: P120028US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing near quantum-limited microwave amplifiers for low-noise readout of qubits and linear cavity resonators.

Overview

Rapid development of superconducting quantum electronics has motivated a search for quantum-limited amplifiers for the low-noise readout of qubits and linear cavity resonators. Conventional approaches have relied on DC Superconducting Quantum Interference Devices (DC SQUID) that can achieve noise performance approaching the fundamental quantum limit imposed on phase-insensitive linear amplifiers. Although SQUID techniques are, in principle, capable of amplifying signals at frequencies approaching tens of GHz, it remains challenging to embed SQUID in a traditional transmission line environment.

For quantum information processing applications related to the low-noise readout of qubits and linear cavity resonators, ultrasensitive amplifiers operating in the radiofrequency (RF) or microwave range are needed. When used in higher-frequency applications, SQUID-based amplifiers tend to have substantially limiting characteristics that impede practical implementations, including relatively low gain-bandwidth product in the microwave frequency range. A system and method are needed for processing and amplifying readout signals having characteristics associated with quantum computing when the signals reach frequencies in the RF and microwave range.

The Invention

UW–Madison researchers have developed a system and method for a low-noise, phase-insensitive linear amplifier capable of accommodating readout signals from quantum computing applications, even when such signals reach frequencies in the RF and microwave range. The amplifier can improve signal-to-noise ratio significantly by incorporating a low-inductance device geometry that is compact, straightforward to model at microwave frequencies and readily integrated into an RF or microwave transmission line environment. The device's input and output can be matched to transmission-line impedances.

The amplifier system includes an input providing a direct coupling configured to receive a high-frequency input signal. The system also includes an amplifier containing a dielectric material separating superconducting layers, forming an amplifier loop configured to receive the input signal and deliver an amplified signal. The system includes an output providing a direct coupling configured to deliver the amplified signal. A quantum information processing network is configured to receive and relay high-frequency signals. The network includes a signal source, a source of qubits and a linear cavity resonator. The network also includes a transmission line communication system configured to transmit and receive the high-frequency signal, and an amplifier coupled directly to the transmission line communication system through an input and output.

Applications

- Measurement of hi... nd other low-level RF or microwave transmissions

Key Benefits

- Significantly improves the signal-to-noise ratio in quantum circuit readout and other sensitive measurements

Additional Information

For More Information About the Inventors

- Robert McDermott

Tech Fields

- Information Technology : Hardware
- Semiconductors & Integrated Circuits : Design & fabrication

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842