

Centro Nazionale HPC, Big Data e Quantum Computing

Missione 4, Componente 2, Investimento 1.4 – Spoke 10

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UNIVERSITÀ DEGLI STUDI DI NAPOLI FEDERICO II - DIPARTIMENTO DI

FISICA “ETTORE PANCINI”

Cryogenic electronics for the Quantum Computing Lab

General Specifications:

Cryogenic electronics components for the implementation of quantum algorithms on superconducting quantum processors (QPUs) composed by at least twenty (20) quantum bits (qubits).

Detailed Specifications:

Specifications of ultra-low-noise InP HEMT (High-Electron Mobility Transistors) cryogenic amplifiers in a frequency bandwidth of 4 - 8 GHz (quantity: 15).

- Coaxial gold-plated aluminum module with standard two-ports female SMA connectors;
- Female Nano-D connectors for DC bias, compatible with DC bias lines of a dilution refrigerator;
- RF Bandwidth from 4 to 8 GHz, compatible with standard superconducting QPUs readout bandwidth;
- Noise Temperature of 1.5 K;
- Noise Figure 0.022 dB;
- Gain 44 dB;
- One gate and one drain supply only;
- Operating temperature < 3 K.

Ultra-low-noise InP HEMT (High-Electron Mobility Transistors) cryogenic amplifiers specifications in a frequency bandwidth of 4 – 16 GHz (quantity: 3).

- Coaxial gold-plated aluminum module with standard two-ports female SMA connectors;
- Female Nano-D connectors for DC bias, compatible with DC bias lines of a dilution refrigerator;
- RF Bandwidth 4 -16 GHz, compatible with standard superconducting QPUs readout bandwidth and R&D study of novel readout and computing schemes with superconducting circuits;
- Noise Temperature 3.1 K;
- Noise Figure 0.05 dB;
- Gain 36 dB;

- Operating temperature < 3 K;
- One gate and one drain supply only.

Room-temperature power supply for simultaneous regulation and adjusting of gate voltage and drain current of minimum 8 ultra low-noise cryogenic amplifiers (quantity: 2)

- Drain voltage regulated and adjustable within a range from 0.0 V_{DC} to 2.4 V_{DC}, compatible with both 4 - 16 GHz and 4 - 8 GHz ultra-low-noise cryogenic amplifiers, with trim potentiometers;
- Drain current regulated and adjustable within a range from 0.0 mA to 65 mA, compatible with both 4 – 16 GHz and 4 – 8 GHz ultra-low-noise cryogenic amplifiers, with trim potentiometers;
- Drain and gate ripple and noise must nominally be around 3 mV_{pp};
- It must be possible to monitor drain voltages and currents, so as the gate voltage;
- Any power supply required to power the aforementioned HEMT power supplies must accept 230 V_{AC}/50 Hz;
- Maximum ripple noise of the power supply must be of about 3 mV_{pp};
- In order to configure the instrument floating or non-floating, there must be access to circuit common and earth on the instruments. Jumper plug must be included.

Ultra-low insertion loss cryogenic dual junction isolators in a frequency bandwidth of 4 - 8 GHz (quantity: 14)

- RF Bandwidth from 4 to 8 GHz, compatible with readout bandwidth of standard superconducting qubits;
- Gold plated OFHC copper coaxial module with 2 female SMA connectors;
- Insertion Loss at 5 K 0.2 dB, and 0.28 dB at 77K;
- 42 dB isolation;
- Port Match 22 dB;
- Operating Temperature from 0.01 K to 100 K;
- Magnetic flux density with standard shielding of < 4 Gauss.

Ultra-low insertion loss cryogenic single junction circulators in a frequency bandwidth of 4 - 12 GHz (quantity: 14)

- RF Bandwidth from 4 to 12 GHz, compatible with standard readout bandwidth of superconducting qubits;
- Gold plated OFHC copper coaxial module with 3 female SMA connectors;
- Insertion Loss 0.2 dB;
- 20 dB isolation;
- Port Match 20 dB;
- Operating Temperature from 0.01 K to 100 K;
- Magnetic flux density with standard shielding of < 4 Gauss.

Ultra-low insertion loss cryogenic single junction isolators in a frequency bandwidth of 4 - 12 GHz (quantity: 14)

- RF Bandwidth from 4 to 12 GHz, compatible with standard readout bandwidth of superconducting qubits;

- Gold plated OFHC copper coaxial module with 2 female SMA connectors;
- Insertion Loss 0.2 dB;
- 20 dB isolation;
- Port Match 20 dB;
- Operating Temperature from 0.01 K to 100 K;
- Magnetic flux density with standard shielding of < 4 Gauss.

It is also required:

- 12 dual junction isolators circuit shields, compatible also with dual junction circulators;
- 24 single junction isolators circuit shields, compatible also with single junction circulators.

Lead time: four (4) months after order confirmation.