

## Advanced Calibration Kit for Better Accuracy of Microwave Measurements at Cryogenic Temperatures

**Background:** Characterization of microwave components at cryogenic temperatures is a challenging task due to difficulties associated with calibration, since no calibration kit operating at 4 K is commercially available, see, e.g., [1]. In cryogenic systems, long cryo-cables are used between the 300 K and 4 K stages to provide thermal isolation, but at the cost of higher RF losses. Room temperature calibration alone is therefore not sufficient, since there will be a substantial temperature gradient along the cable causing changes in material properties and cable geometry. Therefore, it is of great importance to properly calibrate the measurement setup at 4 K.

The TRL (through- reflection-Line) technique is famous for its calibration accuracy at room temperature. However, this is not true anymore at cryogenic temperatures, unless the calibration itself can be carried out at these temperatures, which is problematic with a 4-port measurement setup and requires several cooling cycles.

**Thesis project:** With this thesis, we propose for student to experimentally test a new approach for 4-port calibration with high accuracy at cryogenic temperatures. The project includes design and characterisation of a calibration kit based on Superconductor-Insulator-Superconductor (SIS) junctions allowing *in-situ* short and through calibration without need of thermal recycling. The calibration is intended for frequencies ranging between 2-14 GHz. For more details please contact the supervisor.

The master thesis is divided in to four different stages:

- Literature survey
- Microwave circuit design and simulation
- Circuit photomask design
- Microwave Characterization at 4 Kelvin

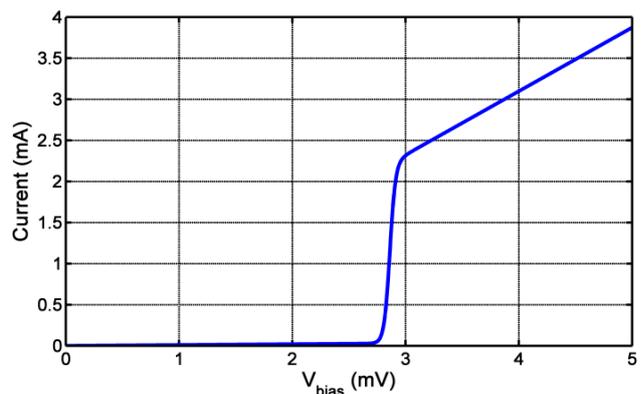


Fig.1: SIS junction IVC

### Prerequisites

Matlab programming

Course in Microwave engineering

Course in Superconductivity, low temperature physics, or THz electronics are not required, but good to have

### Supervisors

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[1] H. Rashid, D. Meledin, V. Desmaris, A. Pavolotsky, V. Belitsky, "Superconducting 4–8-GHz Hybrid Assembly for 2SB Cryogenic THz Receivers", IEEE Transactions on Terahertz Science and Technology, vol. 4, No. 2, p. 193-200, 2014.