CS-004

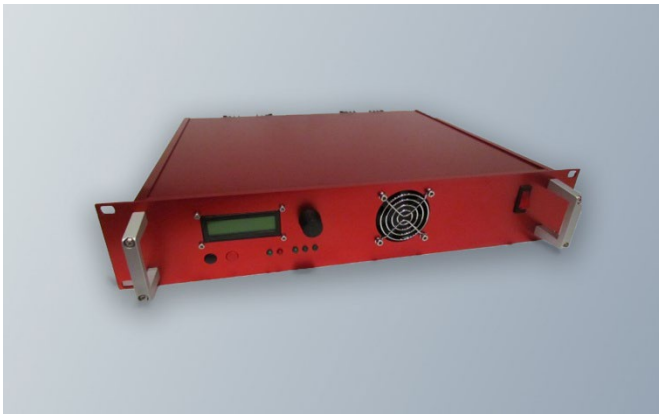
Sveta high-voltage pulse PSU

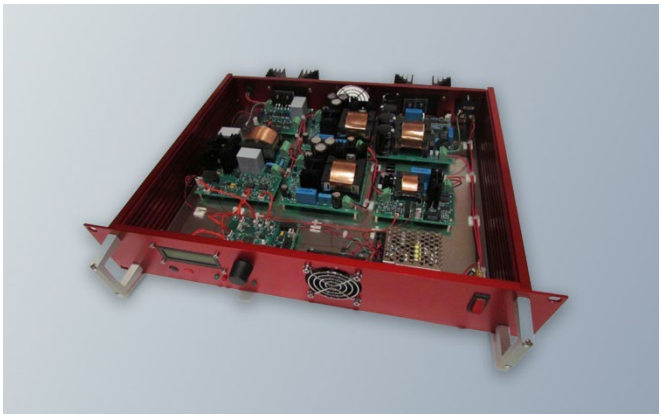
Synertronic designs

Sveta-III was specifically designed for thin-film production using a pulsed DC Argon sputtering technique. The pulsed DC technique significantly increase the manufacturing reliability of superconducting SQUIDs.

Challenge

Sputtering is a technique to manufacture thin films (nano-scale). One example is the manufacturing of superconducting thin films for SQUIDs. In order to achieve sputtering of the target material an Argon plasma is generated. Older techniques used DC voltages between 200 V and 600 V. A more modern approach is to used pulsed DC. In this case the energy density of the plasma is much higher and faster deposition rates can be achieved. It was also found that pulsed DC generates a more stable plasma and greatly increases the sputtering quality and repeatability. In addition pulsed DC makes sputtering of non-conducting materials (e.g. silicon-dioxide) is possible.





Engineering Approach

A third-generation pulsed DC power supply (Sveta-III) was developed to address these challenges, initially for the University of Stellenbosch and later delivered to KAUST. The design features a modular architecture with power factor correction (PFC), DC-DC isolation, and a hybrid analogue/digital control system for stable output in power, current, or voltage modes.

The supply provides a large negative voltage (0–780 V), a positive reset voltage (0–50 V), adjustable pulse frequency (10–100 kHz), and duty cycle (5–95%), with low output capacitance to prevent arcing. Adjustable over-current arc detection further enhances safety and reliability.

Outcome & Impact

The new power supply dramatically improved the reliability and repeatability of thin-film production, enabling higher quality and more consistent films. Pulsed DC operation resulted in more stable plasmas, higher deposition rates, and the ability to sputter both conductive and non-conductive materials.

The system's flexibility and advanced control led to denser, harder coatings with improved impact resistance and minimized arcing, supporting advanced research and industrial applications.

Tools & Configuration

- Power Supply: Modular pulsed DC supply (0–780 V negative, 0–50 V positive, 0–2.5 A, 0–850 W)
- Pulse Control: Frequency 10–100 kHz, duty cycle 5–95%, hybrid analogue/digital regulation
- Safety Features: Low output capacitance, adjustable over-current arc detection
- Integration: Compatible with various sputtering systems for thin-film and oxide deposition

Summary

The project involved close collaboration between the University of Stellenbosch's Department of Electronic Engineering. The development process included feedback from end-users to refine the modular design and control features, ensuring the power supply met the evolving needs of advanced thin-film research and production.