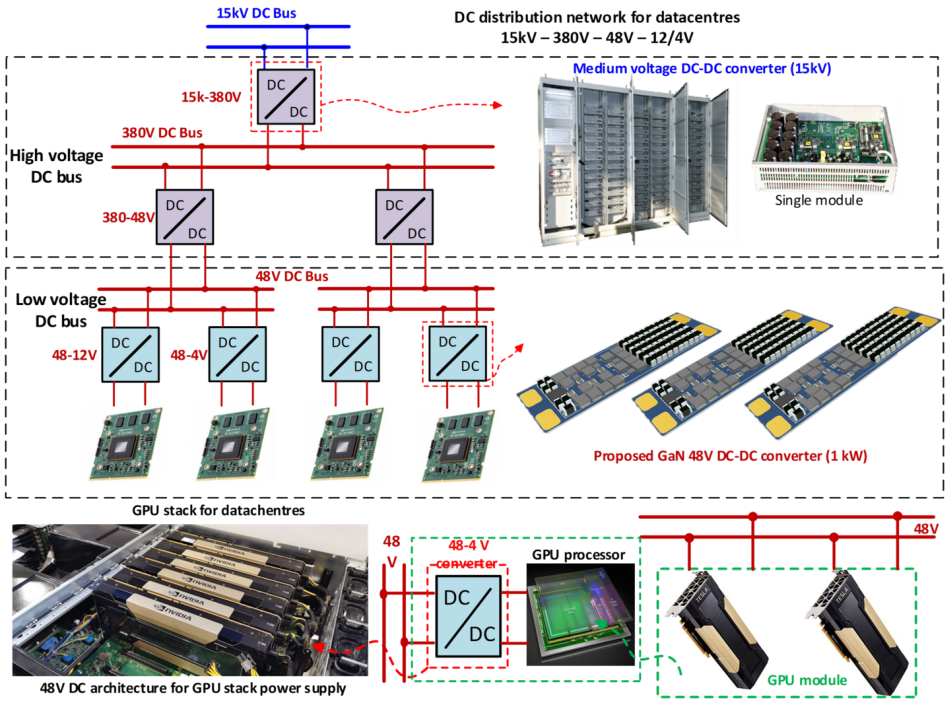
Knowledge Transfer Office
香港城市大學
City University of Hong Kong

Multi-Site Integrated Power Converters for DC Distribution Networks of Data Centers

Health & Wellness

Electricity and Power Electronics



IP Status
Patent filed

Technology Readiness Level (TRL) ? 6

Inventor(s)

Prof. JIANG Chaoqiang
Prof. LONG Teng
Mr. MA Tianlu
Dr. WEI Shusheng
Miss GENG Jiangyi

Enquiry: kto@cityu.edu.hk

Opportunity

More than 80% of total electricity in the US, 50% in the UK, and 43% in China need to be generated from renewables by 2050, and emerging DC loads such as data centers. More than 7% efficiency increase, 6% equipment cost reduction, and 33% equipment footprint reduction are achieved via DC systems for data centers. Due to the exponential demand for Machine Learning (ML), the next-generation data centers will largely adopt GPUs. However, high power consumption for GPUs has placed a great challenge for power supplies because of the large current (>200 A) at low voltage. To date, most GPU stacks use multiple power conversion stages. Multiple power converters have to be used for and located in dedicated compartments in the server cubicle, which will introduce lengthy cabling and complex systems causing significant losses.

Technology

This project aims to develop a 50 kW power conversion system by designing new circuit topologies and new materials for isolation transformers. Advanced DC-DC power converters at different stages of the DC network for data centers will be investigated, designed, and tested. By using Silicon Carbide (SiC) devices, the Nanocrystalline flake ribbon-based DC-DC converter for 380V to 48V conversion will be developed via a dual-active

bridge (DAB). Also, the new topology called Mixed Analogue and Digital (MAD) circuit will be adopted for 48V to 12V and 48V to 4V conversions by using Gallium Nitride (GaN) devices. The final applicable prototype is to achieve high energy efficiency (more than 99%), high power density (more than 3000 W/in3), and high reliability of DC networks for data centers with lower costs, which aligns with the sustainable energy theme.

Advantages

- The transformer is built with new nanocrystalline flake ribbons with higher magnetic saturation density and lower core loss.
- GaN MAD converter for low voltage DC Bus with high operating frequency, small size, high power density, and high energy efficiency.
- The new pattern of the quadrilateral current mode control guarantees generic ZVS for each SiC and GaN device to reduce switching loss.
- Robust load changing stability and fault ride-through.
- Low inductance integrated by the stray inductance of the PCB, fewer components.

Applications

- The devices are designed for data centers that feature with huge urrent and low voltage and support huge computations of AI, big data, machine learning, etc.
- The Nanocrystalline flake ribbon-based DC-DC converters can also be used for charging electric vehicles.
- GaN MAD converters can replace traditional converters with Si components due to their smaller size and higher power density.