Design, Development, and Experimental Validation of an H-bridge-Style Jc(B) Flux Pump

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Abstract

To date, centre-tap transformer rectifiers have been the primary focus of full-wave HTS flux pump development across research institutes and industry. This is a result of their relatively simple circuit topology and use of only two switch segments [1]. Although simple in switch design, construction of the secondary often requires an implicit electrical joint to form a manufacturable design. This becomes a practical limitation when targeting larger output currents, where reliability and minimisation of joint resistance are critical.

Adopting an H-bridge topology removes the requirement for a centre-tap and therefore reduces mechanical design complexity and eliminates the need for electrical joints internal to the secondary winding. Furthermore, potential magnetic symmetry and current imbalance concerns are eliminated with the use of a singular non-centre-tapped transformer winding. Together, these advantages make the H-bridge topology a promising pathway for scaling transformer rectifier flux pumps toward larger output currents.

This research presents the design, development, and validation of a superconducting H-bridge-style flux pump rectifier enabled through the use of Jc(B) switches. This work was completed to verify results produced in MATLAB Simulink on the functionality of an H-bridge-style flux pump rectifier presented at MT-29 [2]. Experimental results show qualitative agreement with the constructed model and validate the functionality of an H-bridge-style Jc(B) switch rectifier. Furthermore, the unit was shown to charge a superconducting non-insulated (NI) coil to over 100 A DC, as shown in Figure 1.

This research validates the feasibility of using an H-bridge-style transformer rectifier with Jc(B) switches to charge a superconducting NI coil.

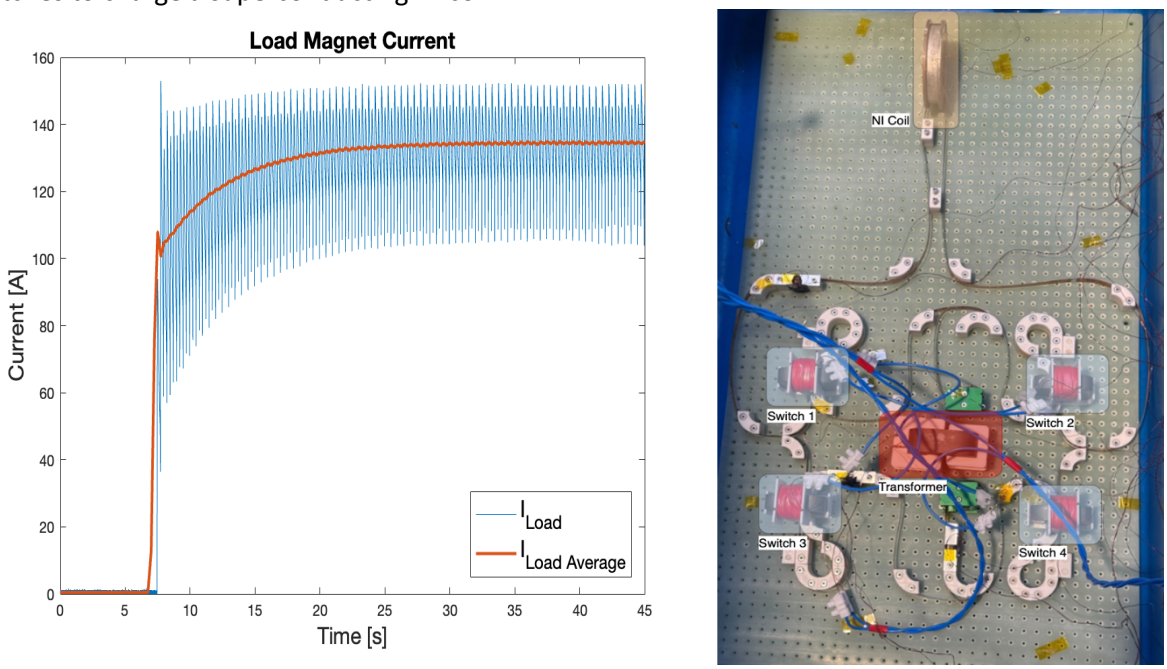

Figure 1, The rectified current seen in an NI coil load charged through the use of Jc(B) switched (left). An transformer H-bridge rectifier constructed with Jc(B) switches and an NI load coil.

References

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Keywords: HTS Flux Pump, H-bridge, Rectifier, Jc(B)

