Contribution ID: **133** Type: **Poster**

Wed-Mo-Po.12-03: An automatic HTS flux pump driven from a 24V NiMH battery

Wednesday 2 July 2025 09:15 (2 hours)

Flux pumps are gaining traction as alternatives to traditional power supplies for HTS magnets due to their reduced heat-leak and compactness. Automatic flux pumps are the simplest embodiment and rely on a section of superconductor parallel to the load magnet, known as the bridge, being driven outside its critical surface by an induced voltage on the secondary of a transformer. Most previously reported automatic HTS flux pumps have been experimental prototypes, using programmable laboratory power supplies to drive the transformer primary. Here we report on an automatic HTS flux pump driven from a compact 24 V Nickel Metal Hydride (NiMH) battery pack, by a custom half-bridge inverter through a 1000:1 transformer. This configuration achieved DC load current above 120 A in a small inductive HTS load when operating at 1 Hz. We replicate several previously reported results, including the benefits of using copper in the transformer secondary loop and having a non-inductive bifilar bridge section made from REBCO tape. We also introduce several simplifications, including driving the transformer primary with a rectangular voltage pulse waveform and replacing the primary-side power supply with a battery and discrete power semiconductors. Further, we develop a clear model of the automatic flux pump, which demonstrates the relationships between the secondary-side fixed resistance, leakage inductance, operating frequency, charging rate and maximum current. Our results show that automatic HTS flux pumps are simple, well-understood and are ready for application as HTS magnet power supplies in demonstration systems.

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Session Classification: Wed-Mo-Po.12 - Diodes, Flux Pumps, and Switches