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Minimizing the heat losses of a self-switching kA-class rectifier flux pump

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The superconducting electrical machines are going to be widely used in many modern transport applications in near future. In fact, their great features such as high efficiency, high torque density, high power density, and lighter weight make them an excellent fit for electric aircraft and marine applications. The fully superconducting machines built with superconducting magnets requires a current carrying leads which increases not only losses due to copper conductor also complicate the insulations.
Flux pumps are the promising means of energising closed superconducting magnets without direct electrical contact. By doing so we can opt out the resistive heating of the leads carrying the current to the cryogenic magnet coil from the current source at room temperature. In this work, we developed the self-rectifying flux pump device to deliver a maximum of direct current greater than 1 kA to the HTS coil with minimised heat loss. A passive self-switching flux pump is achieved by applying asymmetric current waveform to the primary windings, instead of any active switching component, reducing the complexity of the system significantly comparing to the other flux pump architectures and removes the need for dissipative electronics components in the cryogenic environment.

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