

DC to DC Power Conversion Module for the All-Electric Ship

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The MIT end to end electric ship model is being developed to study competing electric ship designs. This project produced a model of a Power Conversion Module (PCM)-4, DC-to-DC converter which interfaces with the MIT model. The focus was on the Medium Voltage DC (MVDC) architecture, and therefore, the PCM-4 converts a MVDC bus voltage of 3.3, 6.5 or 10 kVDC to 1 kVDC. The design describes the transient and steady-state behavior, and investigates the naval architecture characteristics. A modular architecture, similar to SatCon Applied Technology's Modular Expandable Power Converters, was selected as the best balance for the wide variation in loads experienced. The model consists of a standard module that can be paralleled internally to provide for a wide range of system power requirements. Naval architecture parameters, such as weight, volume, efficiency, and heat load, were compiled into a parametric format allowing a reasonable approximation of actual weight and volume as a function of rating and efficiency and heat load as a function of loading. All of the parameters were evaluated for dependence on the MVDC bus voltage. Verification of the model was pursued through comparison to available simulations of similar power electronics to ensure that the model provided reasonable time response and shape. Finally, the model met all requirements with the exception of efficiency which was slightly lower than the requirement although several ideas were presented to improve efficiency.

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