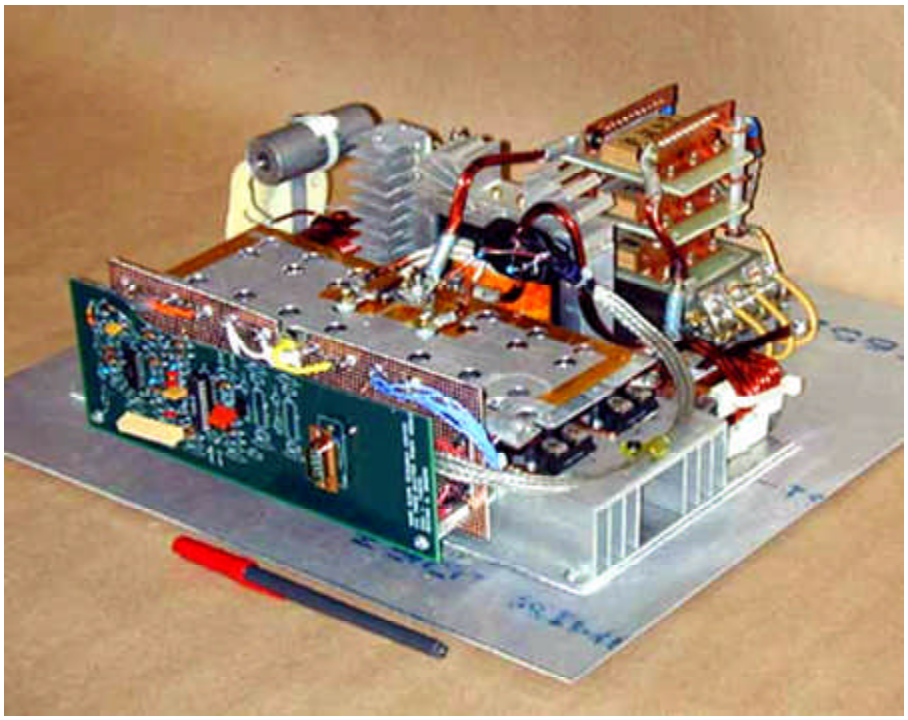
Multikilowatt Power Module Designed and Fabricated for High-Power Hall Thrusters

Previous efforts to develop power processing units (PPUs) for Hall thruster systems were targeted for the 1- to 5-kW power range and an output voltage of approximately 300 V. The NASA Glenn Research Center is developing new high-power Hall thrusters with a favorable combination of thrust, specific impulse, and efficiency to enable Earth-orbiting and Mars missions. These thrusters require up to 100 kW of power and a discharge voltage in excess of 800 V.

The implementation of power processors for this power level typically requires modular designs. Processing power in smaller blocks allows the use of more efficient semiconductors, and it simplifies packaging and thermal management. In addition, it reduces voltage and current stresses in components like MOSFETs, capacitors, and transformers. Modular PPUs can be easily scaled up to higher power or made redundant, connecting parallel or series combinations of modules. This can significantly reduce PPU development time and cost.



10-kW power module for Hall thrusters.

During program year 2003, a high-power breadboard power module for Hall thrusters was designed and fabricated. This high-frequency power converter, shown in the photograph, was operated from an unregulated 100-V input to a regulated 500-V output up to an

output power of 10 kW. Efficiencies in excess of 95 percent were measured. Mass projections indicate the possibility of this power module yielding 10-kW-class PPUs with a specific mass of 2 kg/kW, which is lower than the state-of-the-art PPU. The breadboard multikilowatt power module was used to study the issues of high-power PPU design. We plan to integrate it with a NASA-457M high-power Hall thruster and use it as a building block for higher power PPUs.

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