SPACE POWER SYMPOSIUM (C3)
Small and Very Small Advanced Space Power Systems (4)

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# THE SFL MODULAR POWER SYSTEM (MPS): A SCALABLE MULTI-PURPOSE POWER SYSTEM FOR 1W TO 1KW-CLASS MISSIONS

**Abstract**

As the number and scope of small satellite missions has increased, the utility of scalable, modular and standardized avionics has become evident. The electrical power subsystem is among the most critical elements of any spacecraft bus, but unfortunately is typically the last system aspect to be frozen and the first required for integrated testing. A power system offering standard interfaces, high efficiency across wide power throughput ranges, and late-stage expandability is clearly advantageous for a wide range of missions—particularly responsive ones.

In order to address this need, the University of Toronto Space Flight Laboratory (SFL) has developed a modular power system (MPS) to facilitate missions with power requirements spanning two orders of magnitude. The MPS implements a battery bus with series regulators performing charge management and solar array regulation. The system consists of four primary types of unit: Solar Array/Battery Regulators that can be used for solar panel isolation or current sharing with efficiencies in excess of 95%, Switched Power Nodes providing programmable switched power, Smart Battery Modules integrating batteries and charge/discharge protection, monitoring and thermal regulation, and a Power System Interface backplane that connects modules and distributes power and communication.

The central backplane enables the various MPS modules, as well as mission-specific modules such as DC/DC converters, on-board computers, and torquer drivers, to either draw from or energize distributed power buses and digitally interface to the system. The large number of shared I/O provides a wide range of configuration options, and any MPS card can be plugged into any slot as per the needs of inter-bus wiring and mechanical layout.

The MPS is designed to provide "only as much power system as needed", and the ultra-high efficiency of each card makes the system suitable for missions ranging from the 1-10W nanosatellite class (such as SFL's CanX-7) to the 100-500W class microsatellite (such as SFL's NEMO-HD). The first MPS deployment, on the Canadian Space Agency's Mars Exploration Science Rover (MESR), developed by MacDonald Dettwiler and Associates Ltd., was configured to run sustained loads of 1.5 kW.

This paper provides a high-level overview of the MPS and how the system can be configured for missions ranging from cubesats to kW-class small spacecraft.