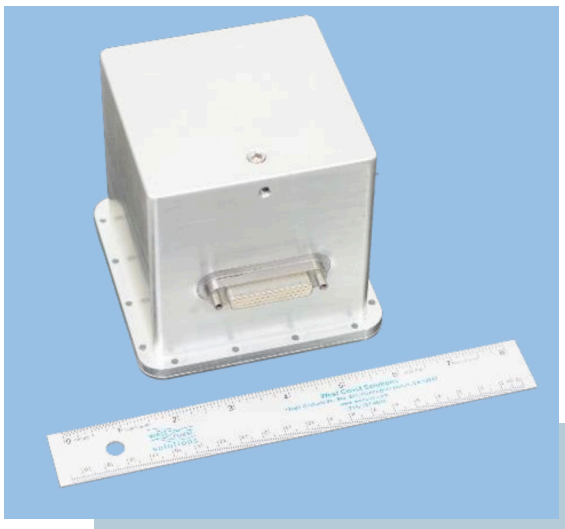
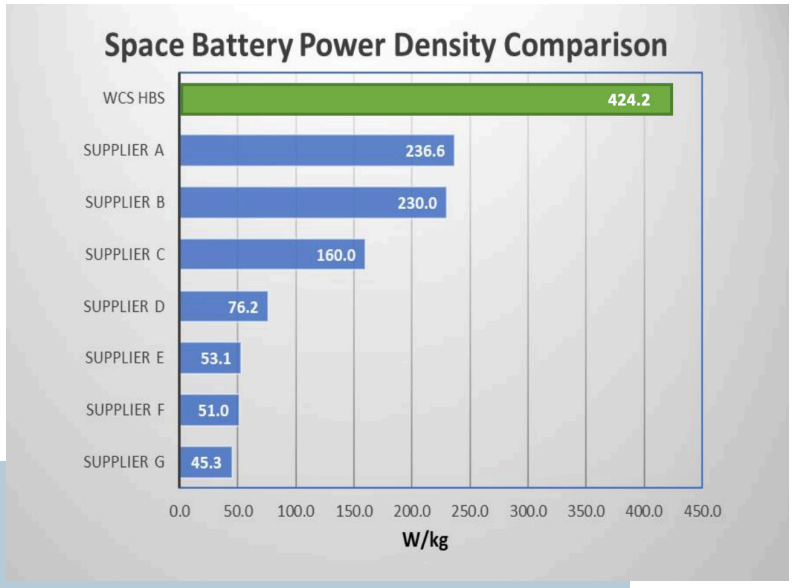
HYBRID BATTERY SUPERCAPACITOR (HBS)

The West Coast Solutions Hybrid Battery Supercapacitor (HBS) is a revolutionary system that combines the high power capability of supercapacitors with the energy storage benefits of traditional lithium-ion batteries to create a system that provides uniquely-high power density while maintaining high energy density in comparison to traditional batteries.

HBS, primarily intended for use as an auxiliary power source charged off the main bus, enables a new generation of high power payloads on SmallSats by providing 700 W of sustained power from a compact 1 U hybrid battery. Targeted applications include synthetic aperture radar (SAR), advanced propulsion technologies, lasercom, high data rate downlink transmitters, large array infrared sensors, and directed energy.





Features of HBS:

- TRL 6
- High-power battery for SmallSats
- High reliability, radiation tolerant, fully hermetic space design
- 150 Wh energy and >700 W sustained power output in a 1U form factor
- Cycle life > 30,000
- Scalable for higher energy and/or higher power applications

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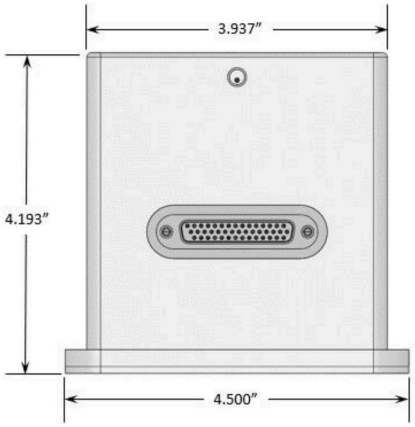

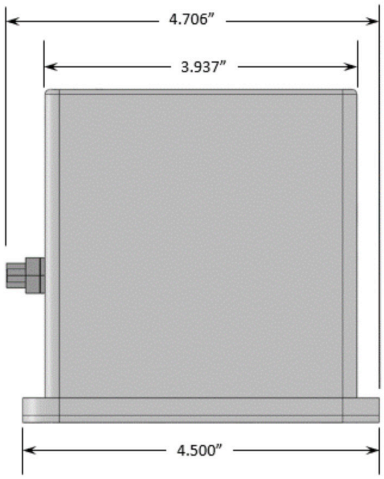

Summary of HBS Specifications

Specification	Value
Operating Voltage	17.6-33.6 V
Capacity	5 Ah
Energy Storage[1]	150 Whr @ 0.2 C charge/discharge
Cycle Life[2]	> 30,000 cycles
Charge Rate	1 C to 95% State of Charge from 10 - 40 °C (derated elsewhere)
Discharge Rate[3]	5C min to 15% State of Charge from 10 - 40 °C (derated elsewhere)
Maximum Continuous Current	> 25 A
Module Mass	1.65 kg
Module Volume	~1 U (11.4 cm X 10.7 cm X 12.0 cm, 4.50" x 4.19" x 4.71")
Energy Density	91 Wh/kg
Power Density	> 424 W/kg
EMI (MIL-STD-461)	Meets / exceeds MIL-STD-461F CE101 and CS116
Applied Random Vibration Capability	GEVS Spec for Component Qualification (14.1 grms)
Shock Testing	1210 g peak, excitation range 900 Hz to 10 kHz
Operating Temperature	-20 to 50 °C
Storage Temperature	-20 to 55 °C
Total Ionizing Dose	15 krad (Si)
EEE Parts	EEE components meet or exceed EEE-INST-002 Level 2

[1]The HBS provides the specified energy storage at Beginning of Life based on a 0.5 C charge and discharge with thermal interface temperature of 25 °C

[2]The HBS retains at least 80% of its Beginning of Life Energy Storage capacity after the specified number of cycles under the following operating conditions:

- Charge and discharge cycles between 30% and 80% State of Charge
- Charge and discharge rate of 0.5 C with 1% of the uniformly-distributed cycles occurring at 5 C discharge
- A thermal interface temperature of 25 °C

[3]2 C discharge down to 15% State of Charge safe at extended temperature range of -20-50 °C