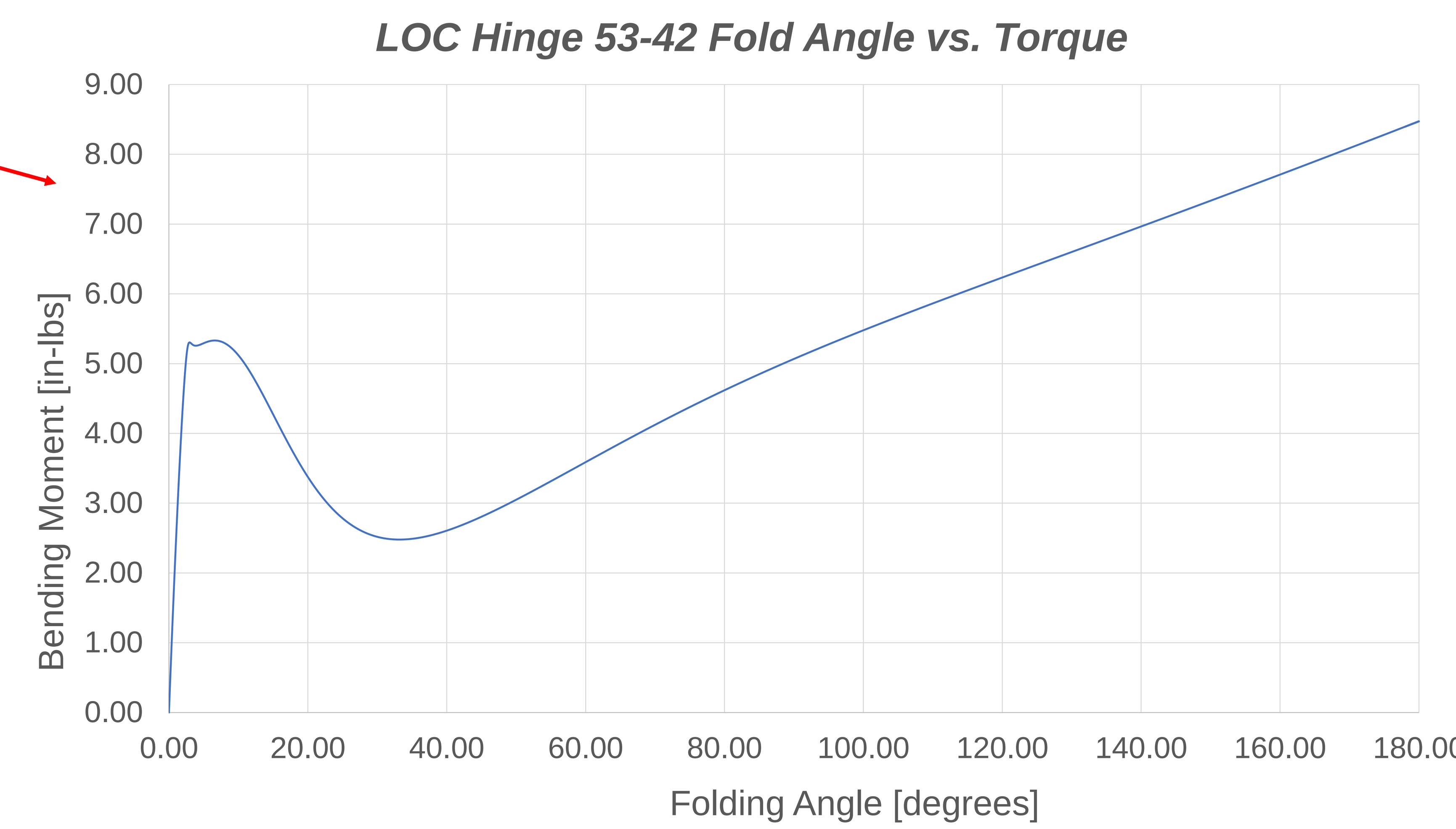
OPTERUS

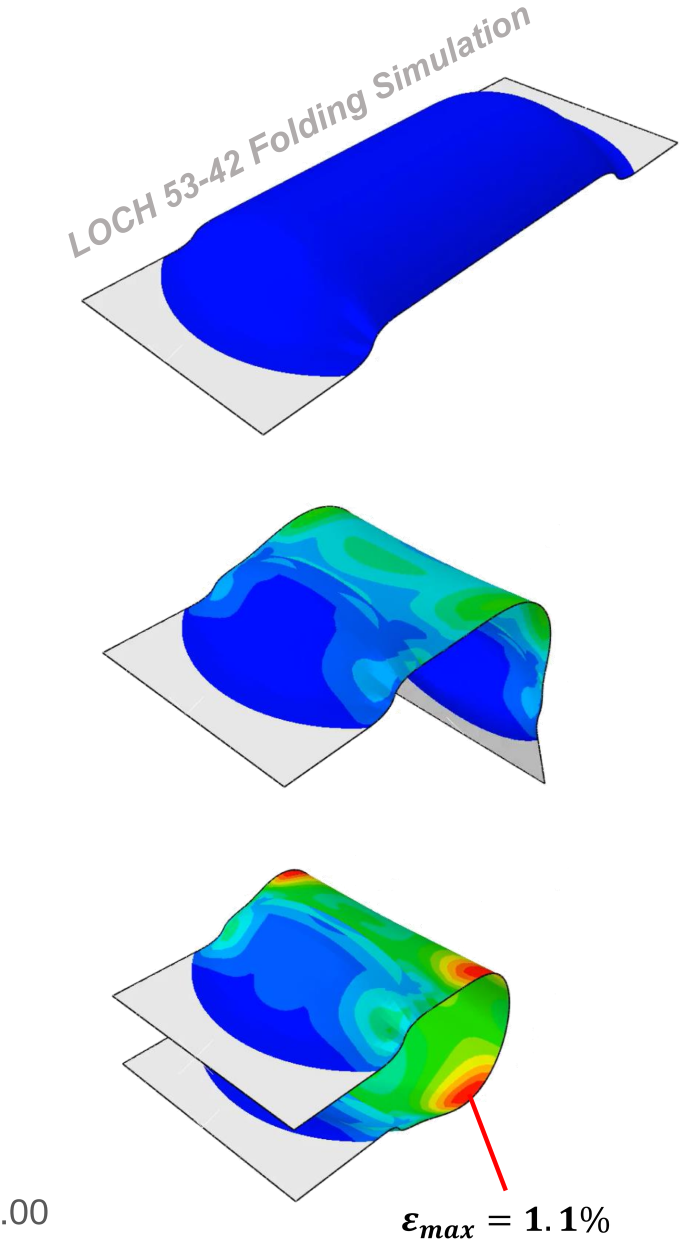
info@opterusrd.com | (970) 822-7874 | Loveland, CO

LOC HINGE

Lenticular Offset Composite (LOC) Hinge

Opterus' LOC Hinge is a single component hinge technology made of high strain composite materials, meant to replace traditional multi-component hinges on spacecraft vehicles. LOC Hinges can be rapidly designed to suit deployment torque, lock-out torque, shock, size, kinematic, and interface requirements. A rigid flange provides a platform for any custom interfacing features that may be required, while the composite flexure region can be independently tailored to meet structural performance, size, and kinematic needs.





MOSSA

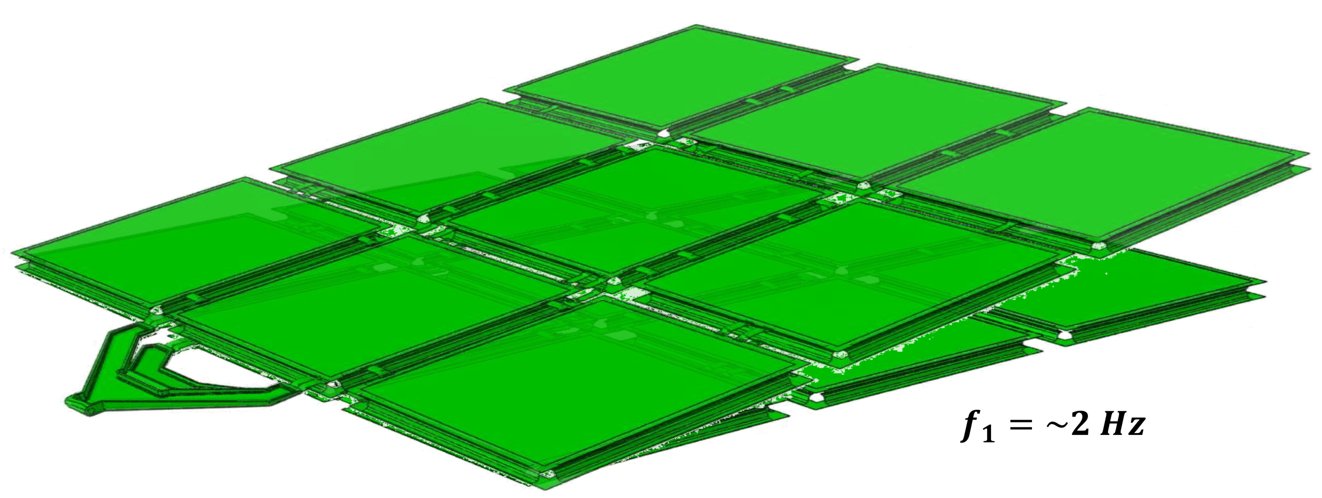
Modular Self-Stiffening Array

Opterus' MOSSA is a passively deployed solar array engineered for ESPA and ESPA Grande class spacecraft. Each of the MOSSA modules stows extremely compactly and can be configured to have from 1 to 9 modules/panels by simply using LOC hinges to add (or remove) panels.

The expanding cross-sectional depth of MOSSA allows for extremely high stowed power density, while permitting the deployed structure exceptional deployed stiffness. The low inertial mass of the MOSSA structure paired with its high stiffness, positions MOSSA as an excellent solar array architecture for spacecraft/missions requiring 0.1-3.2 kW of power and rapid pointing or attitude adjustment maneuvers.

STRUCTURAL PERFORMANCE

Original modal simulations done for the MOSSA-9 reached a first mode frequency of only ~1 Hz. With most recent design changes, the first mode frequency has climbed to over 2 Hz. Given lessons learned from Structural testing, The next MOSSA-9 revision is expected to near the 5 Hz first mode frequency mark and significantly reduce in mass.

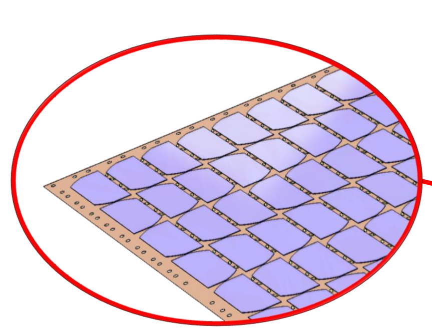


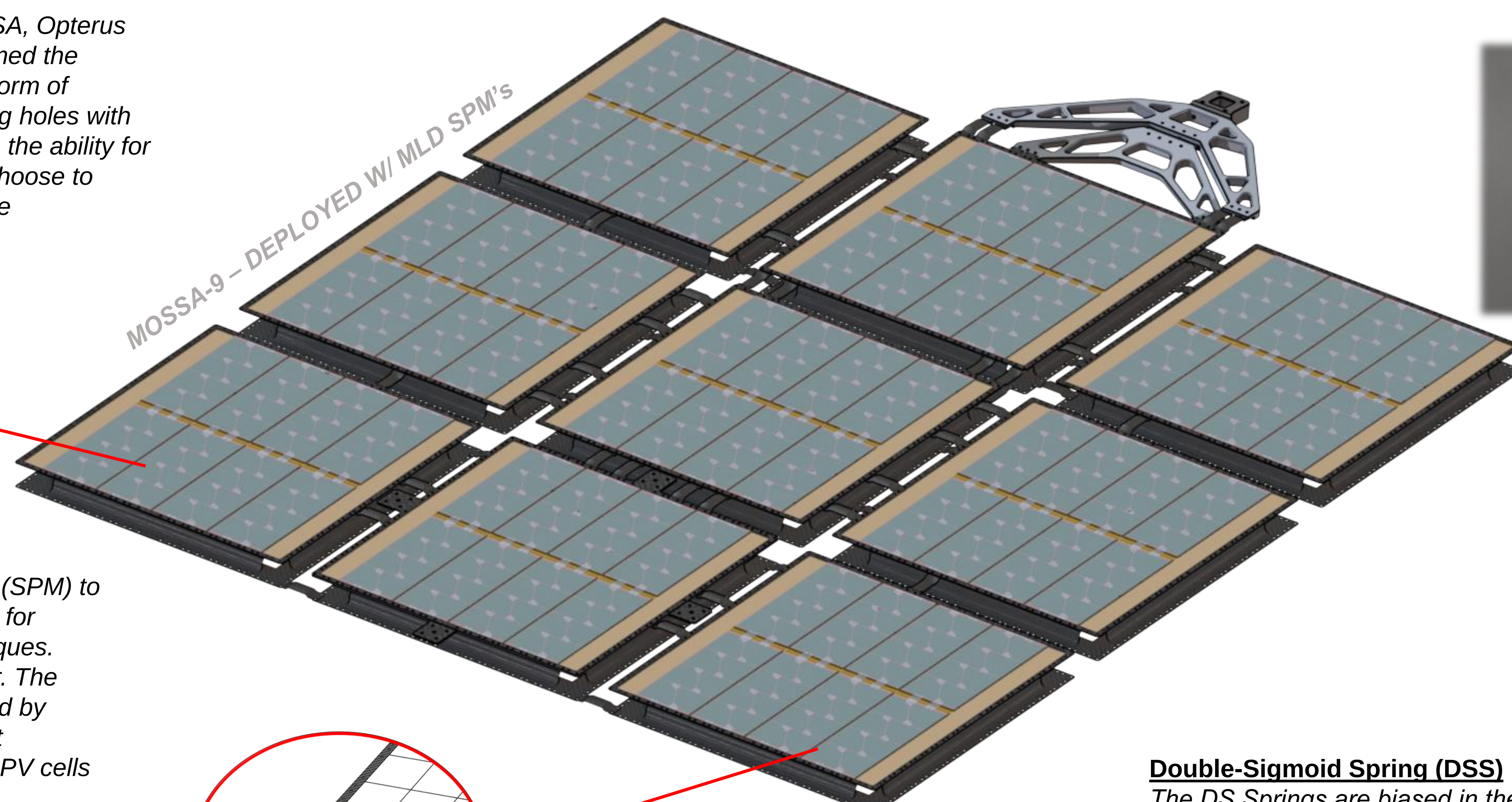
POWER PERFORMANCE

Class	Panels per Wing	Wing Mass with Yoke [kg]	Wing Stowed Thickness [mm]	Wing Power [kW]	Deployed Area [m^2]	Deployed Areal Power Density [W/m^2]	Specific Power [W/kg]	Stowed Power Density [kW/m^3]
Single Panel	1	1.6	2.1	0.11	1.1	102	192	158
ESPA	3	2.7	6.2	0.33	1.1	305	192	158
ESPA	4	3.3	8.3	0.44	1.5	302	192	158
ESPA	5	3.9	10.4	0.55	1.8	301	192	158
ESPA	7	5.0	14.5	0.77	2.7	291	192	158
ESPA	9	6.2	18.7	0.99	3.5	280	192	158
ESPA Grande	3	8.4	9	1.1	3.1	340	144	118
ESPA Grande	4	10.8	12	1.4	4.2	338	144	118
ESPA Grande	5	13.3	15	1.8	5.3	337	144	118
ESPA Grande	7	18.2	21	2.5	7.5	330	144	118
ESPA Grande	9	23.1	27	3.2	9.8	326	144	118

Generic Space Power Module

To achieve the modular design philosophy of MOSSA, Opterus has engaged multiple solar cell vendors and confirmed the feasibility of using cells or SPMs adhered to some form of polyimide backing sheet that has matching mounting holes with the MCS panels. This generic form of SPM facilities the ability for a customer to utilize almost any cell provider they choose to further customize the MOSSA and drastically reduce engineering/development time and cost.

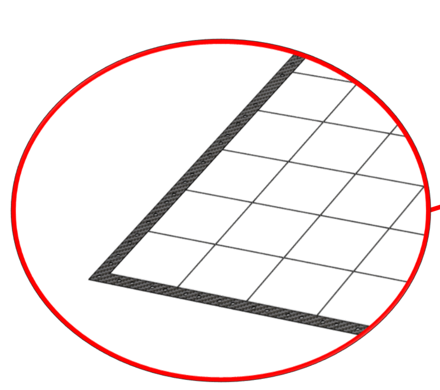


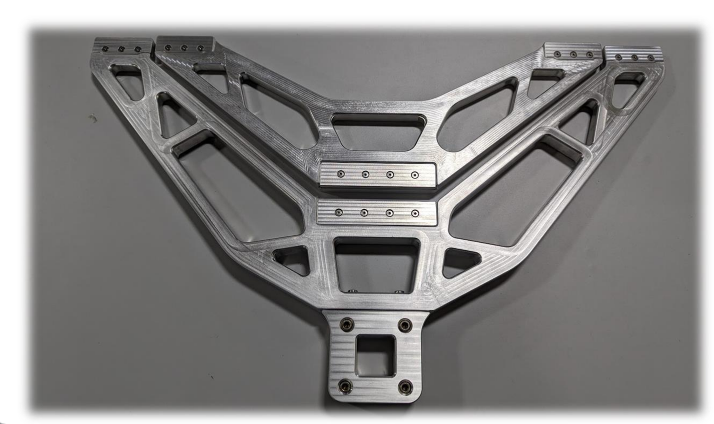


Mesh Capture System (MCS)

The MCS is used to restrain space power modules (SPM) to the MOSSA skeletal structure, eliminating the need for adhesives and other cumbersome fastening techniques. The mesh is made of 1/32-inch-wide UD glass fiber. The MCS mitigates drum modes, SPM deflection caused by launch vibrations and perturbations from spacecraft maneuvers, and isolates CTE differences between PV cells and the MOSSA panels.

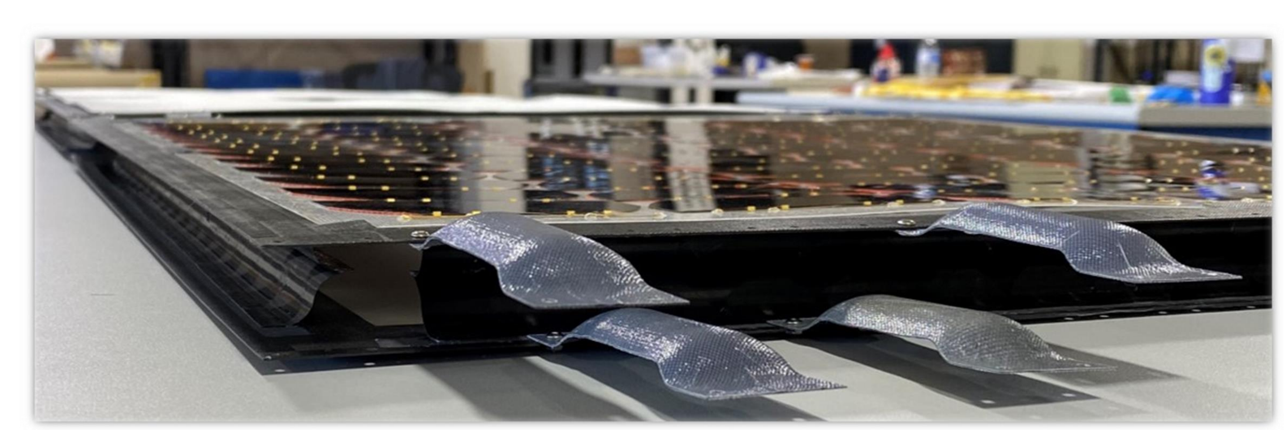
The mesh can be configured so the UD glass cords run in the interstitial spaces of the SPMs. If not in between SPM's, the MCS would only attenuate a maximum of 2% of the incident radiation if fully opaque and fully blocking SPM's. The UD glass cords are also somewhat transparent.





MOSSA Morphing Yoke

Depending on operational requirements of the mission, the yoke may be required to morph MOSSA in its cross-section to match the increase in deployed cross-sectional depth of the rest of the structure.



Double-Sigmoid Spring (DSS)

The DS Springs are biased in the "open" position and provide the strain energy that expands MOSSA's cross-section upon deployment. This increase in structural depth increases the array's moment of inertia, drastically increases the stiffness of the deployed array. The four DS Springs also work to fix the top and bottom hinge plane relative displacement in all DOFs.

MOSSA LOC Hinges

MOSSA utilizes 21-31 LOC Hinges at the root and a 14-36 LOC Hinges throughout the structure to connect the MOSSA modules together, assist with passive deployment sequencing, and to provide the strain energy and hinging action required for MOSSA to deploy from its stowed state and remain locked out once fully deployed.

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