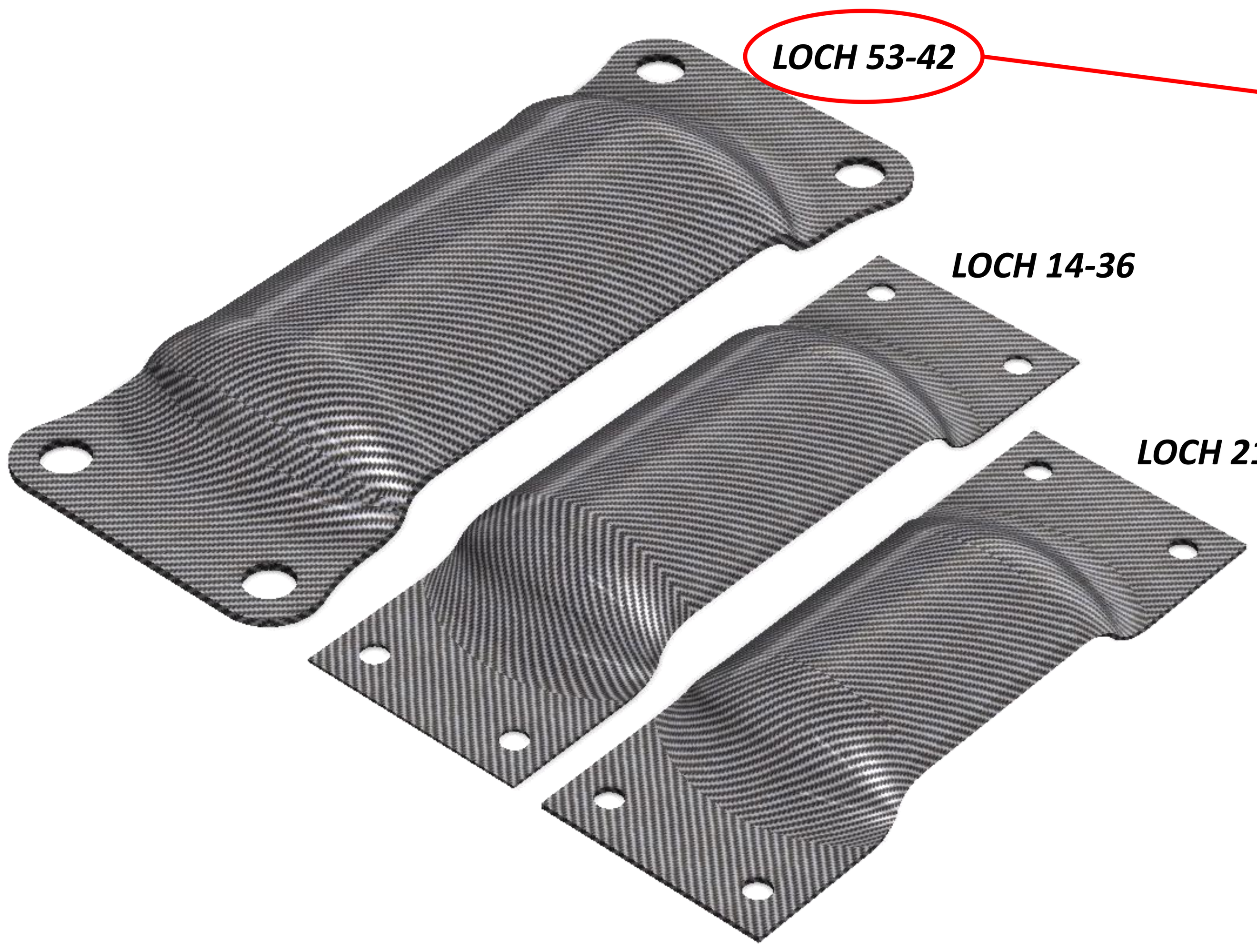
LOC HINGE

Lenticular Offset Composite Hinge

Opterus' LOC Hinges are a single component replacement for traditional, metallic hinges. 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 requirements. LOC Hinge variants are designated by two values with the first denoting the break-over torque and second denoting the overall length of the hinge.



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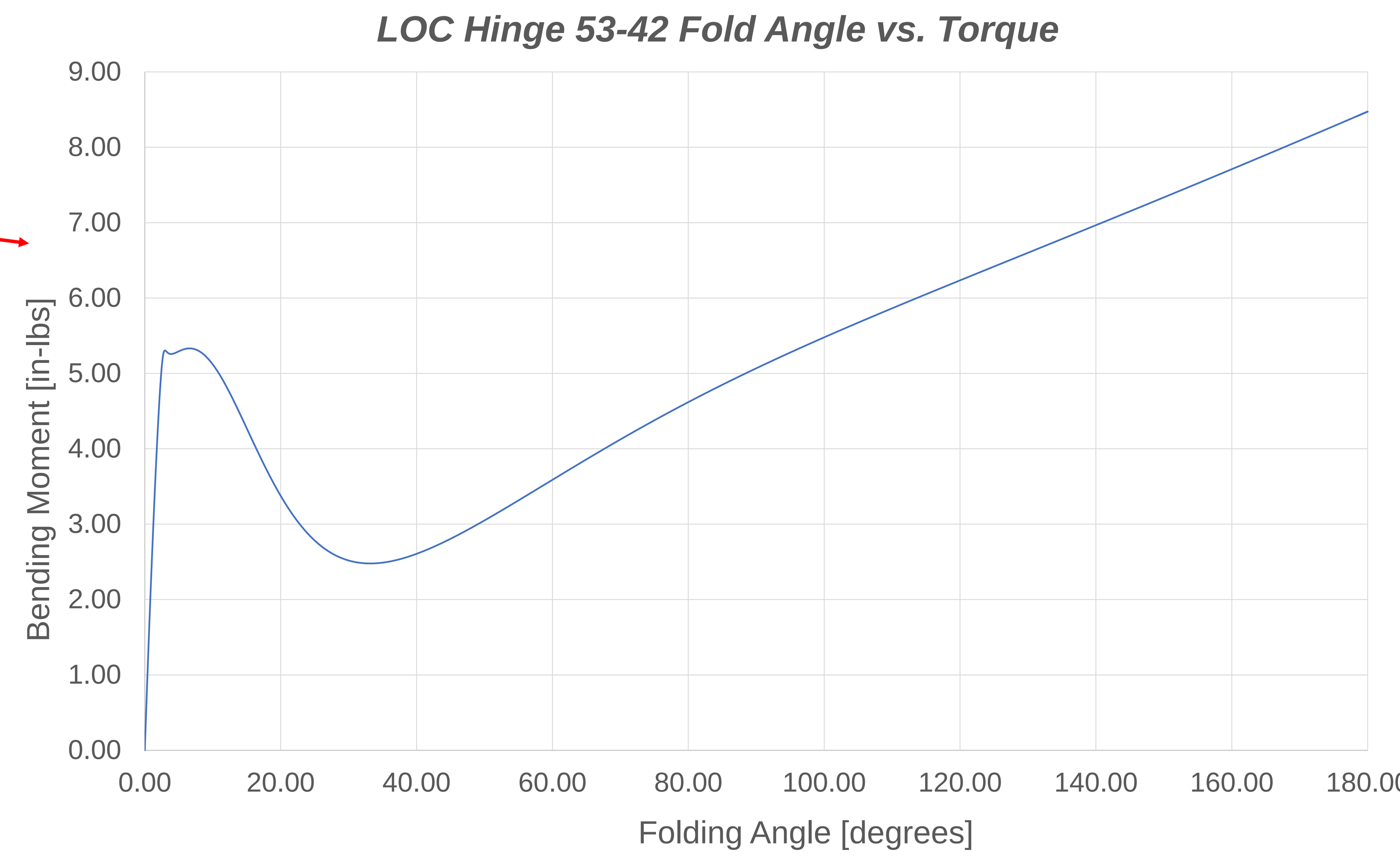
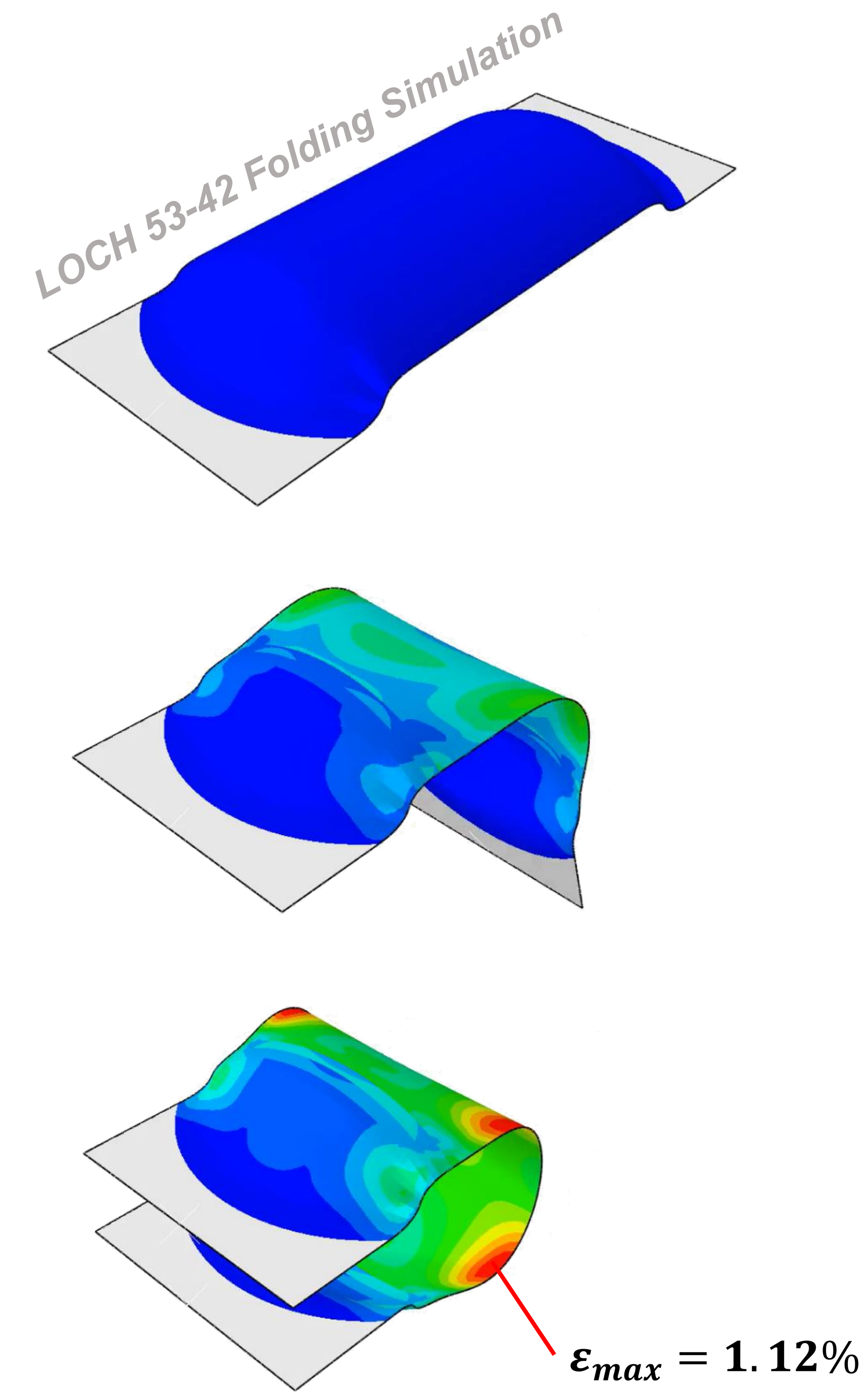
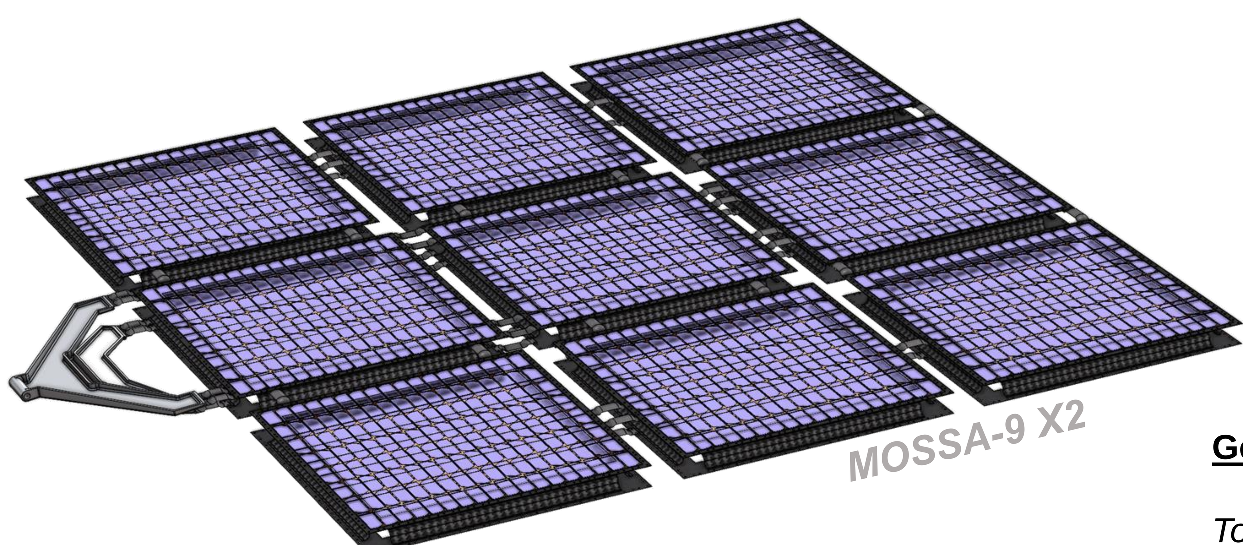




MOSSA

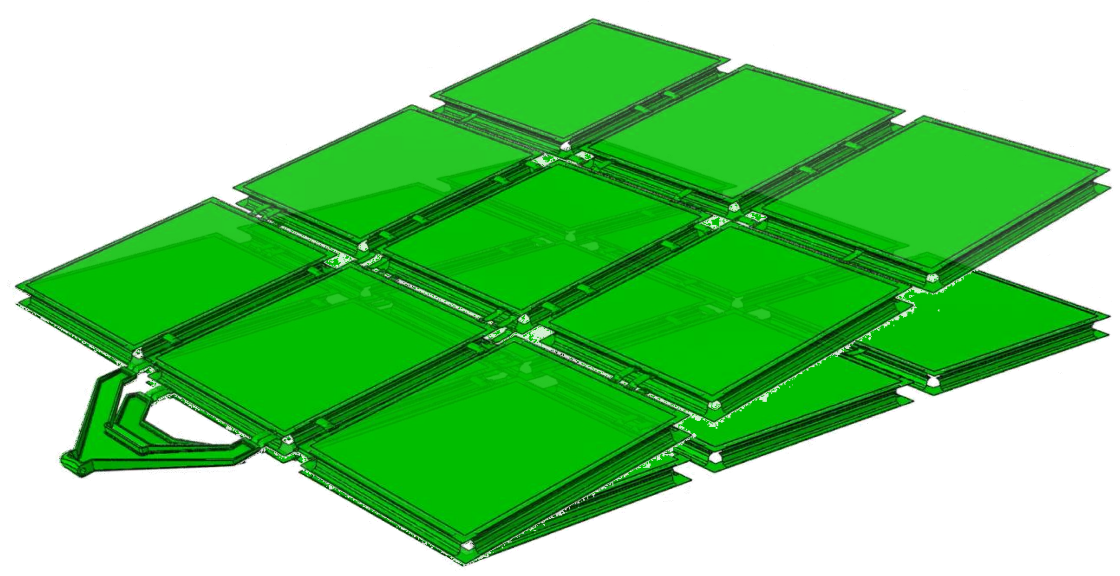
Modular Self-Stiffening Array

Opterus' MOSSA is a highly compactable, modular, and passively deployed solar array technology engineered for ESPA and ESPA Grande class spacecraft. The expanding cross-sectional depth of MOSSA allows for extremely high stowed power density, while permitting the deployed structure exceptional 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 1-3kW of power and conducting rapid pointing or attitude adjustment maneuvers. MOSSA can be easily (re)configured to have from 1 to 9 modules/panels by simply using LOC Hinges to add (or remove) panels.



STRUCTURAL PERFORMANCE

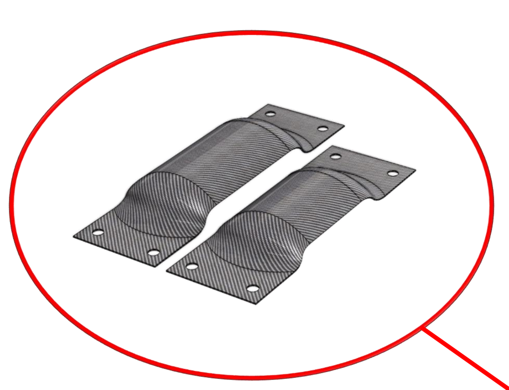
The modal simulations done against the original "X1" MOSSA-9 revision reached a first mode frequency of only 0.92 Hz. Over the last few months of MOSSA research and development, the first mode frequency has climbed to 2.04 Hz (MOSSA-9 X2). Given recent lessons learned, the MOSSA-9 X3 revision is expected to near the 5 Hz first mode frequency mark.

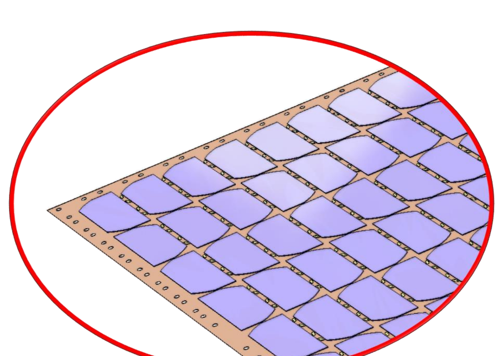


$f_1 = 2.04\ Hz$

POWER PERFORMANCE

Class	Panels per Wing	Wing Mass with Yoke [kg]	Wing Stowed Thickness [mm]	Wing Power [kW]	Deployed Area [m^2]	Areal Power Density [W/m^2]	Specific Power [W/kg]	Power Density [kW/m^3]
Single Panel	1	1.57	2.07	0.11	1.08	101.58	192.36	157.72
ESPA	3	2.72	6.22	0.33	1.08	304.75	192.36	157.72
ESPA	4	3.29	8.29	0.44	1.46	302.18	192.36	157.72
ESPA	5	3.86	10.37	0.55	1.83	300.66	192.36	157.72
ESPA	7	5.00	14.51	0.77	2.65	290.63	192.36	157.72
ESPA	9	6.15	18.66	0.99	3.49	284.02	192.36	157.72
ESPA Grande	3	8.38	9.00	1.06	3.13	339.52	143.88	117.96
ESPA Grande	4	10.84	12.00	1.42	4.19	337.80	143.88	117.96
ESPA Grande	5	13.30	15.00	1.77	5.25	336.78	143.88	117.96
ESPA Grande	7	18.22	21.00	2.48	7.51	329.95	143.88	117.96
ESPA Grande	9	23.14	27.00	3.19	9.78	325.73	143.88	117.96





Generic Space Power Module

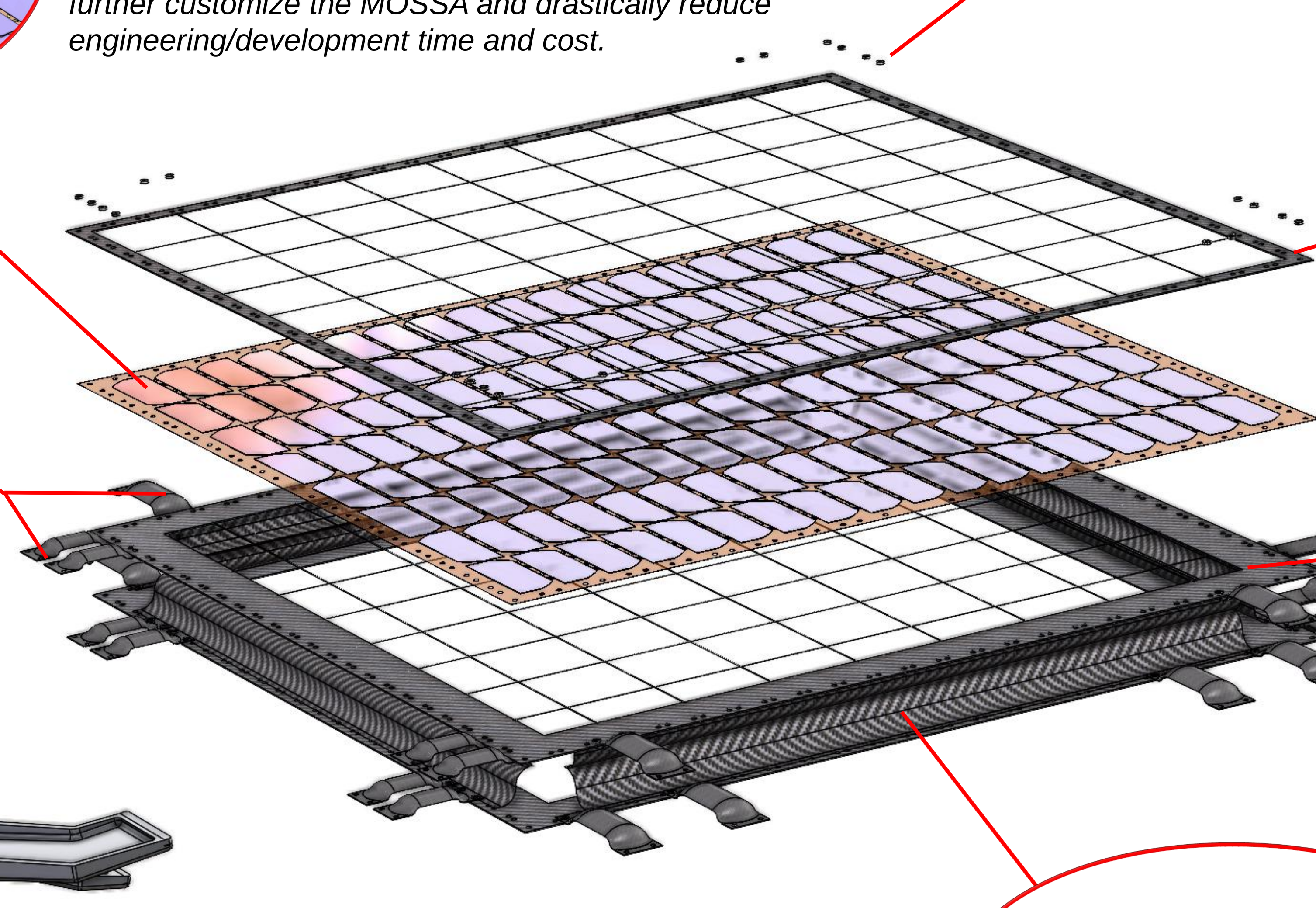
To achieve the modular design philosophy of MOSSA, Opterus has engaged multiple solar cell vendors and confirmed the feasibility of using cells or SPMs adhered to some form of polyimide backing sheet that has matching mounting holes with the MCS panels. This generic form of SPM facilities the ability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

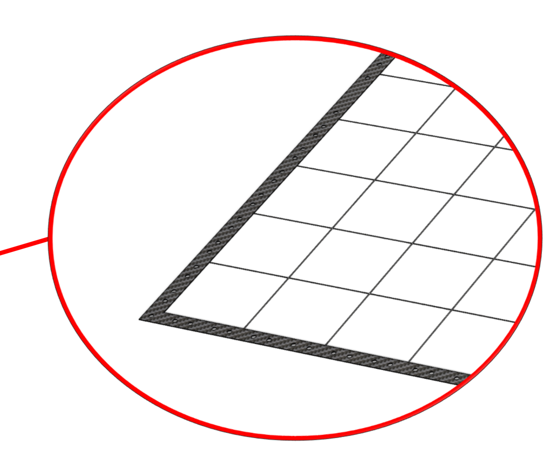
MOSSA Fasteners

Custom flush-mount, removable fasteners are used to mechanically fasten and bind the MCS and SPM together, as well as fasten the LOC Hinges to the MOSSA modules.

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.

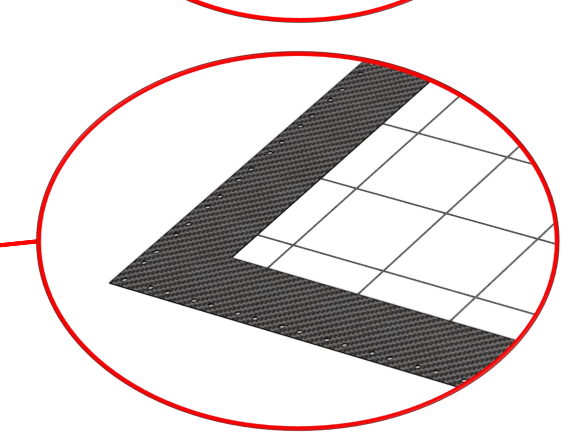




Top/Bottom Mesh Capture System (MCS) Panels

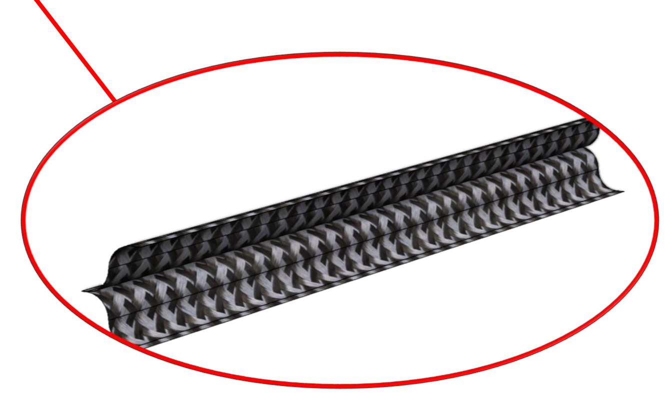
The MCS is used to mechanically fasten a space power module (SPM) to the MOSSA skeletal structure, thereby eliminating the need for adhesives and other cumbersome fastening techniques. The mesh is made of 1/32-inch-wide unidirectional glass fiber and mitigates drum modes and SPM deflection caused by launch vibrations and perturbations from spacecraft maneuvers.

The mesh can be reconfigured such that the UD glass cords can run along the interstitial spaces within the SPM. In the case that this cannot be done, the UD glass cords are somewhat transparent to much of the AM0 spectrum and, assuming full opacity, the cords will only attenuate a maximum of 2% of the incident radiation.



MOSSA Morphing Yoke

Due to the architecture and kinematic operation of MOSSA, the yoke is required to morph in its cross-section to match the increase in deployed cross-sectional depth of the rest of the structure.



Double-Sigmoid (DS) Spring

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.

Pat. https://www.opterusrd.com/vpm