



Launch your Vision

2023 Space Power Workshop

Energy Generation III session

„Multi-panel deployable wings, from standardization to series production“

Manhattan Beach

April 27th



Short overview of STI SA product

- The origin and present
 - Mechanical design
 - Electrical design
 - SA Drives
- Main challenges
 - Mechanical margins
 - Simplification of the electrical network

Beginning of Series Production

- OneWeb experience
 - Lessons learnt
- One step forward
 - Running constellations

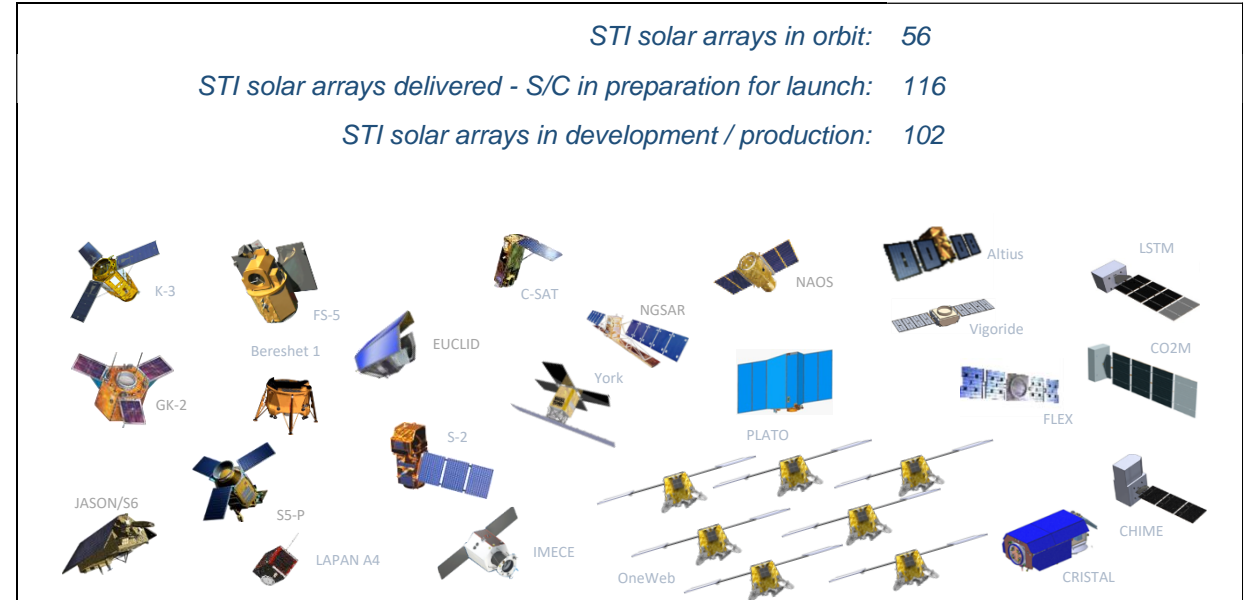
STI SA standard

- Overview of the SA design
- Standard product and limits

Future development

- Semirigid panels
- Combination of different solar cell technologies

Acknowledgments

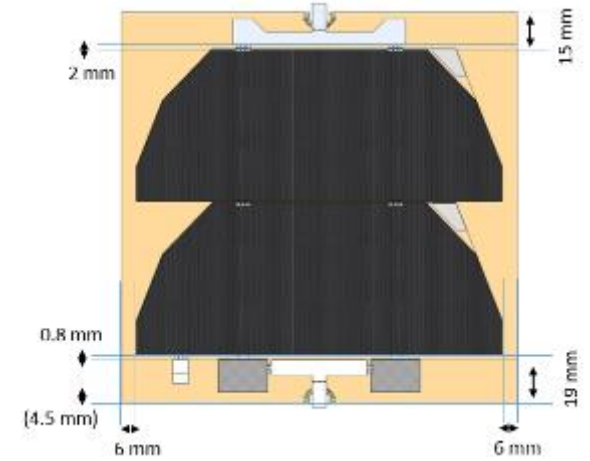
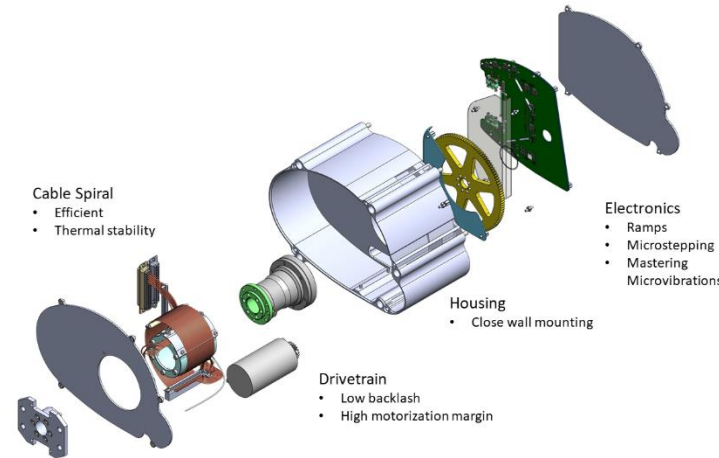
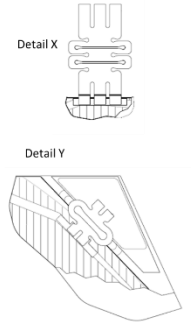
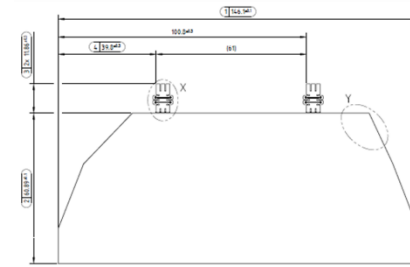
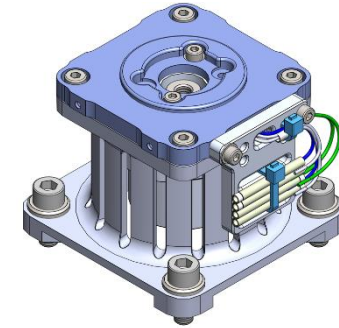
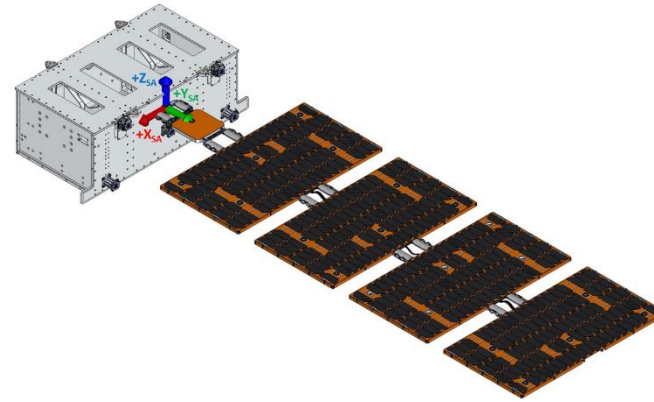


STI Solar Array Product (1 of 3)

The origin and present

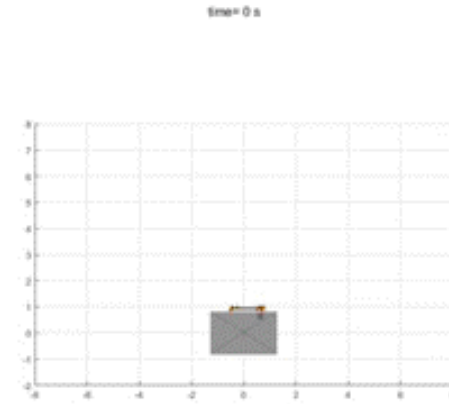
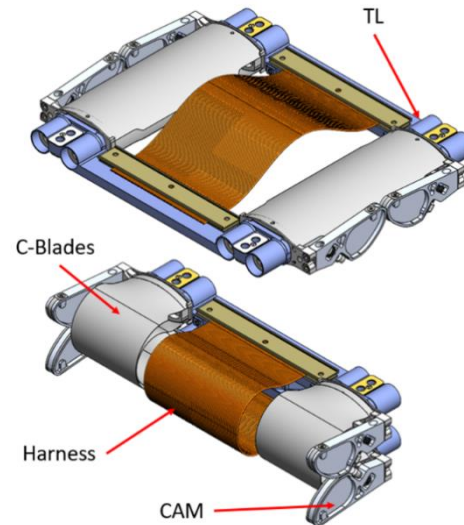
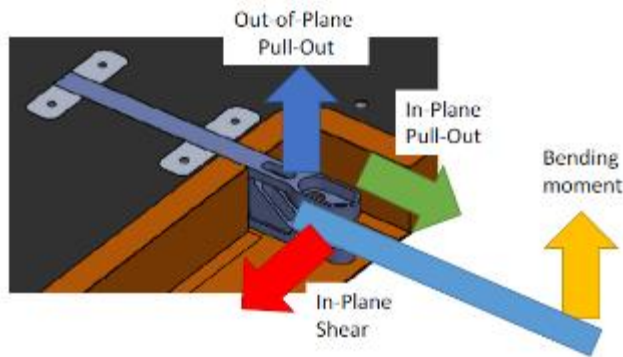
Technical overview

- Mechanical design
 - Simple multi hinge, rigid array
 - Tape spring hinges with torque limiters
 - Demonstrated up to 6 axes
- Electrical design
 - Large area multi-junction cells
 - Suitable for alternative low cost cell technologies
 - Minimal rear side harness thanks to the planar front side blocking diode technology
- SA Drives
 - Twist capsule drive assembly
 - 42 AWG22 lines available



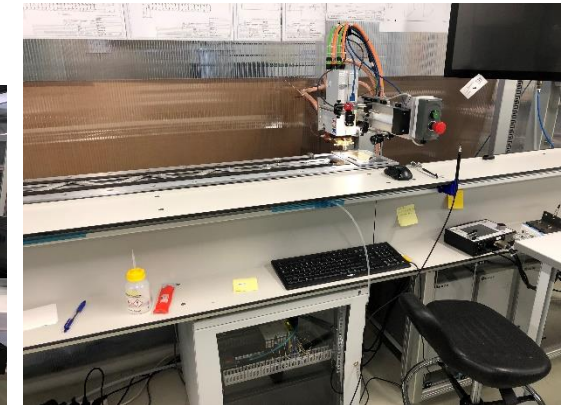
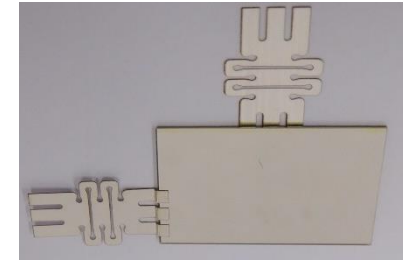
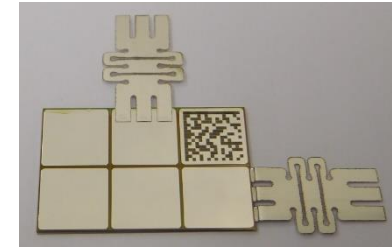
Main challenges

- Mechanical design
 - Unsynchronized but controlled
 - Deployment torque margins
 - First eigenfrequency in stowed and deployed
 - Reduction of mechanical stress on hinges during launch
 - Minimize panel gapping with a safe dynamic clearance



Main challenges

- **Simplification of the electrical network**
 - Compatibility with a full automated laydown process
 - Avoid string meandering
 - Simplify binning
 - Simplify the rear side cabling and harness
 - Standardize the components



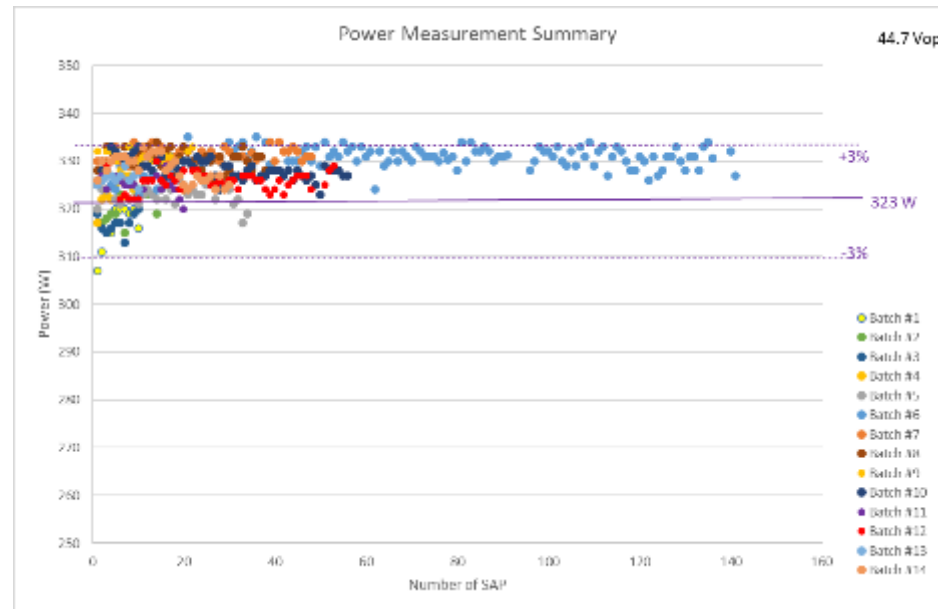
Beginning of Series Production (1 of 3)



OneWeb experience

Beginning of Series Production

- OneWeb experience
 - SCA binning
 - Simplified approach
 - Two current classes
 - Best engineering vs minimum average performance
 - Minimum average requirement
 - Average performance



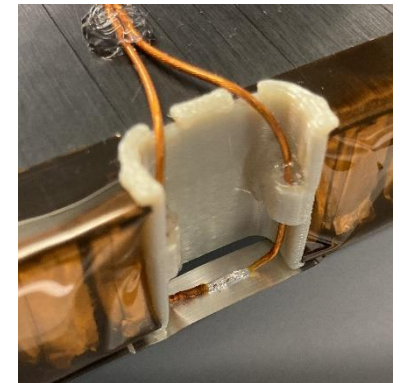
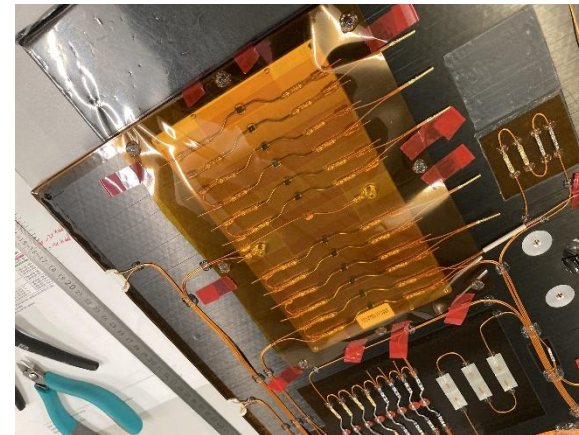
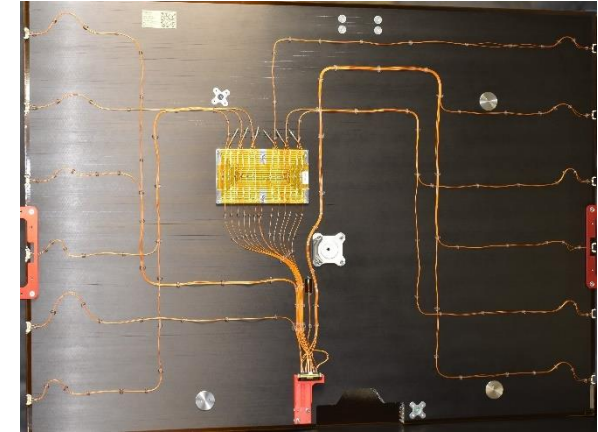
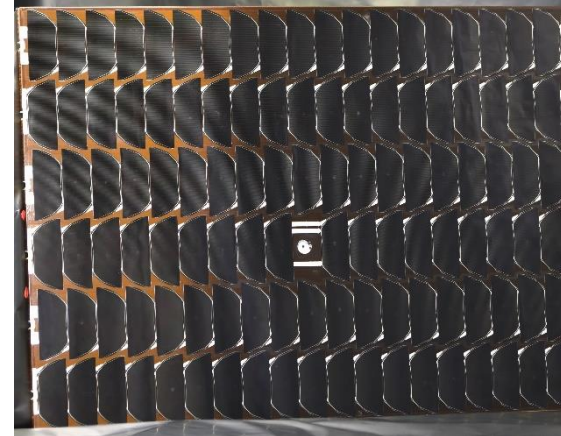
Beginning of Series Production (2 of 3)



OneWeb experience

Beginning of Series Production

- OneWeb experience
 - String layout and joining technique
 - Antiparallel string placement
 - Heritage PGRW process
 - Automated laydown
 - Automatic identification of string position and geometry
 - Placement and accelerated curing
- Harnessing and testing
 - Pre-assembly of the rear side harness
 - Diode board
 - String terminal welding



Beginning of Series Production (3 of 3)



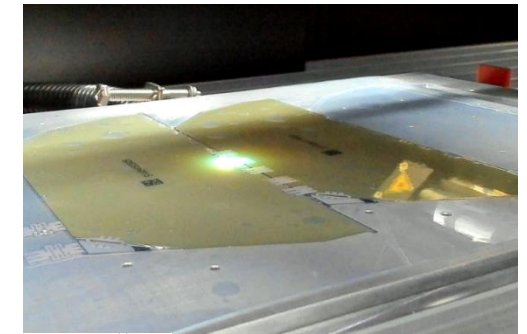
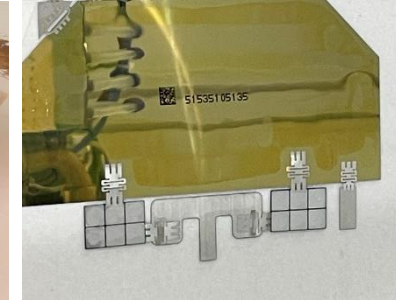
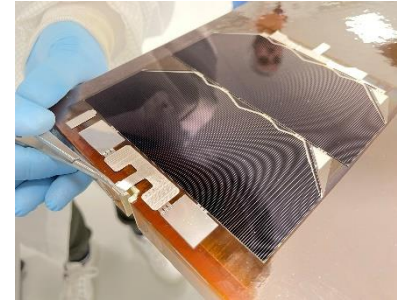
A further step into the constellation business

Beginning of Series Production

- One step forward – running constellation programs
 - Front side planar blocking diode solution
 - Blocking diode heat dissipation issue
 - Simplification of harnessing

 - Laser welding
 - Laser welding process
 - Adaptation to a large integration portal

 - Wing mechanical integration and testing
 - Mechanism integration
 - Alignment
 - Deployment test
 - Lot acceptance test

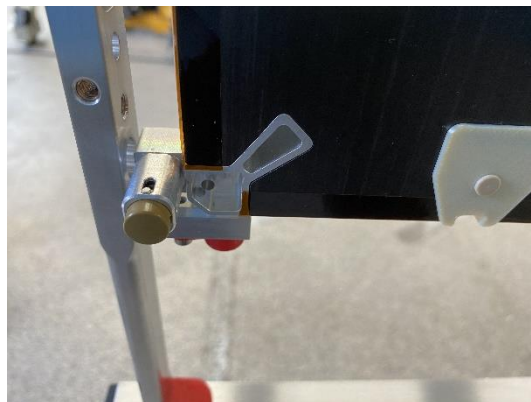
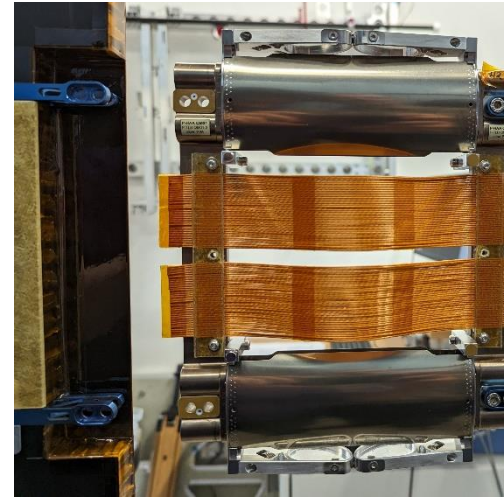


STI SA standard (1 of 2)



Overview of STI SA technology

- **Overview of the SA design**
 - Substrate panel
 - Hinge assembly
 - Hold down points
 - Snubber points
 - Release actuators
 - Solar array drive mechanism

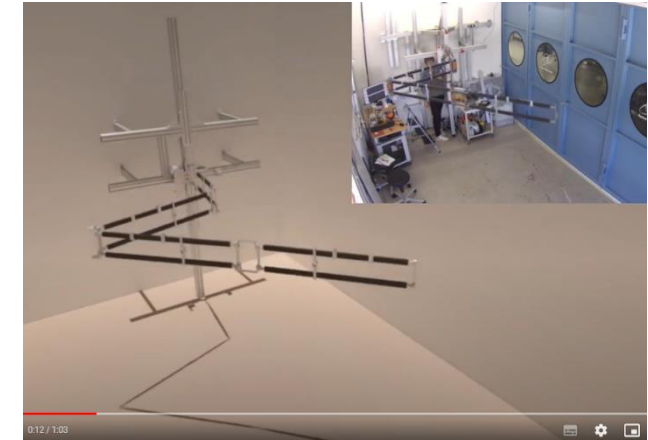
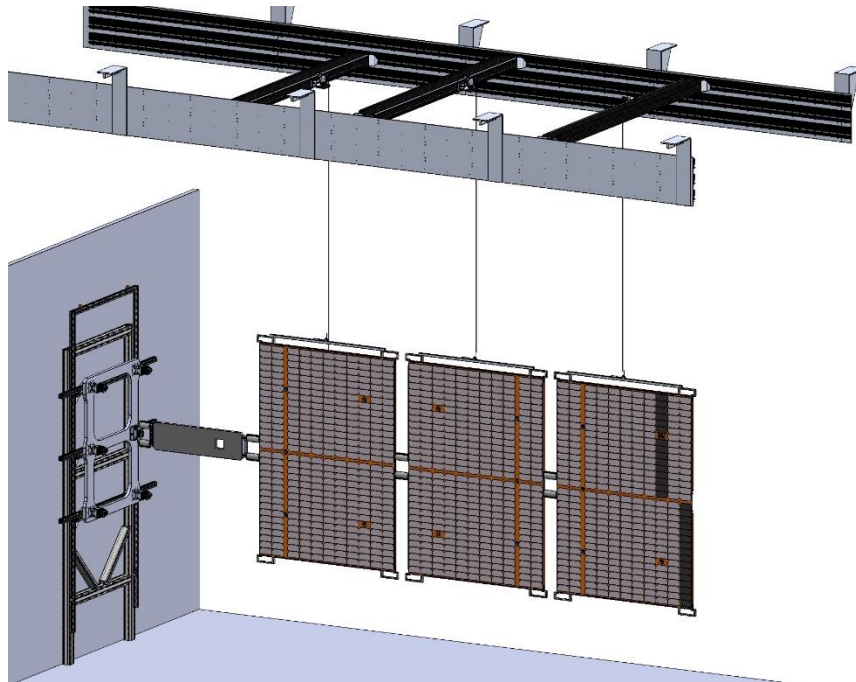


STI SA standard (2 of 2)



Overview of STI SA technology

- **Standard product and design constraints**
 - Maximum number of deployment axis
 - Deployment corridor and margins
 - First deployed EF

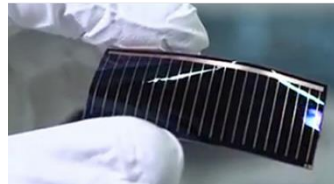
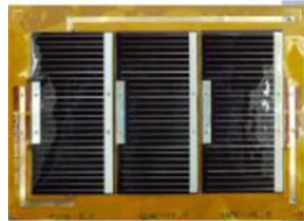
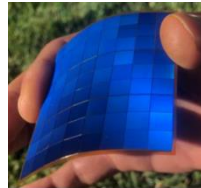


Future Development (1 of 2)



Trade off between a more sophisticated mechanical part vs PVA

- Trade off between the additional cost of a more sophisticated mechanical part vs PVA
- Use of cells alternative to GaAs state of the art
 - Low-cost GaAs (dual or triple junction)
 - New generation Si cells
 - Perovskite cells
 - Thin film cells (CIGS)



Technology	η BOL @ 80°C	η EOL @ 80°C	PVA Mass [kg / sqm]	Packing factor	Actual TRL
Reference (III-V MJ)	22%	16%	1.3	79%	9
C-Si today	16%	13%	0.8	92%	5
C-Si potential	19%	16%	0.8	92%	2
CIGS today	17%	14%	0.7	95%	3
CIGS potential	19%	16%	0.7	95%	1
ELO GaAs today	18%	13%	1.0	86%	5
ELO GaAs potential	21%	15%	1.0	92%	2

Future Development (2 of 2)

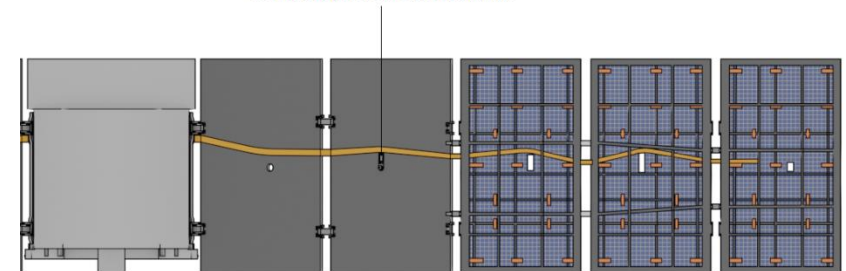


Trade off between a more sophisticated mechanical part vs PVA

- **Trade off between the additional cost of a more sophisticated mechanical part vs PVA**
- **Combination of rigid and semi-rigid panels**
 - Same launch volume, more panels stacked on to of each other
 - Rigid panels are necessary to protect the thin ones during launch
- **Combination of different solar cell technologies**
 - State of the art cells installed on rigid panels
 - Alternative cells on semi-rigid panels



HDRM cup cone interface and secondary release mechanism.



System engineering

Steffen Pfohl, Martin Frosch, Philipp Neumann, Matthias Baader, Thomas Ruck, David Fehrenbacher

Quality

Henning Kaufer, Lars Tiedemann, Thomas van't Klooster

Mechanical

Alexander Fuchs, Mario Gentner, Lukas Hägele

Electrical

Arif Sinan Alagoz, Andrea Albertin

MAIT

Bastian Spiegelhalter, Maximilian Steiner, Tammo Rombach



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Seelbachstr. 13
D-88090 Immenstaad
Tel: +49 7545 932 84 86
www.spacetech-i.com

