HaWK Solar Array Technology
Advanced Deployable Satellite Power Solution

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MMA Design LLC

Date Stamp

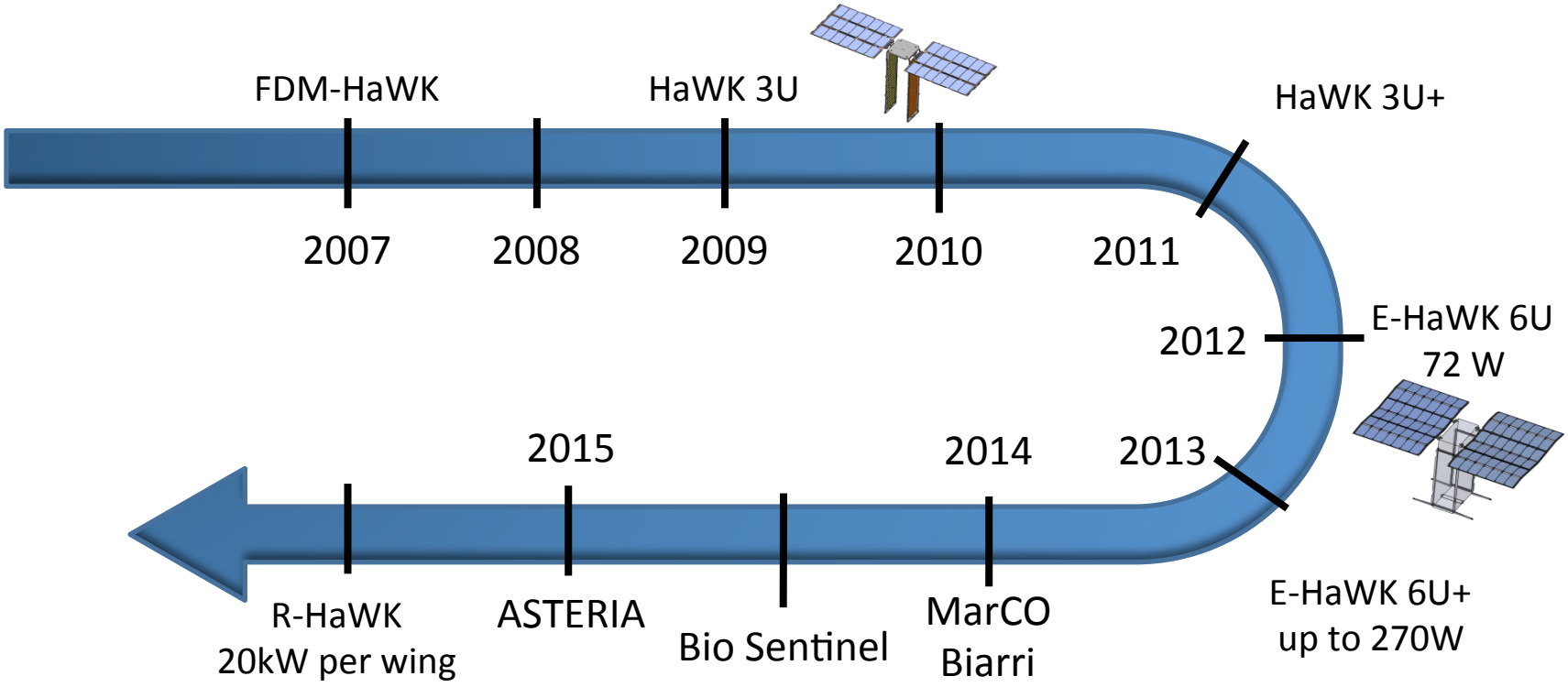
Technology Overview

HaWK Series of Solar Arrays (High Watts per Kilogram)

- Portfolio of advanced deployable solar array technologies for next generation space-flight applications
- Modular, scalable and reconfigurable to meet mission power requirements
- Innovative stowage and deployment schemes minimize stowed volume, provide positive hold-down restraint and enable multiple degrees of panel articulation
- Provides a redundant and simplified approach to deployable solar power technology that greatly improves system reliability

Timeline of Technology Maturation

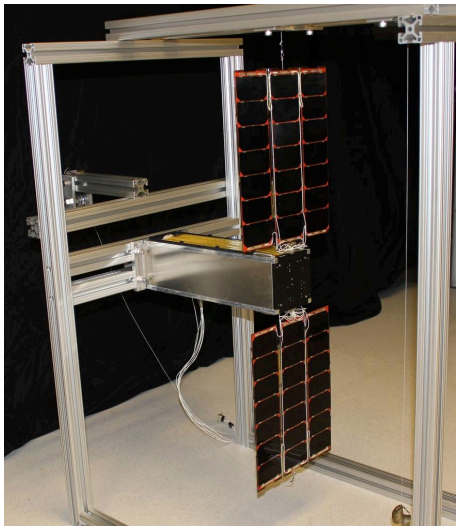
- HaWK technology largely supported by SBIR funding
- MMA Design solar array product portfolio continues to push the state of the art (SOA) in space power performance



Portfolio of Designs

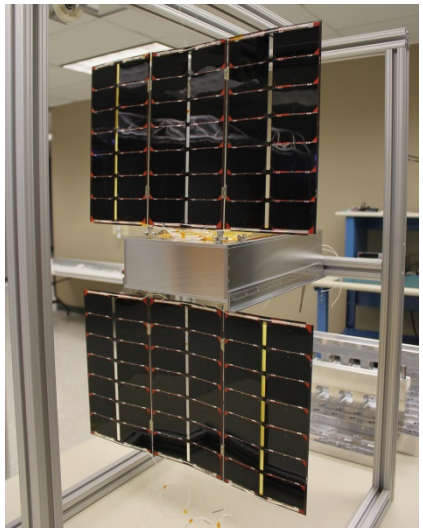
- HaWK solar array architecture provides a building block approach allowing modularity and scalability
- Focus is on maintaining standard components for cost attractive power solutions

36W BOL @ 70°C Peak Power



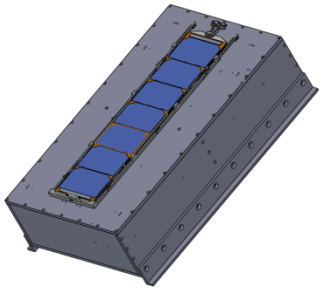
HaWK

72W BOL @ 70°C Peak Power



E-HaWK

Advanced proprietary embodiments at >72W and targeting >40kW peak power

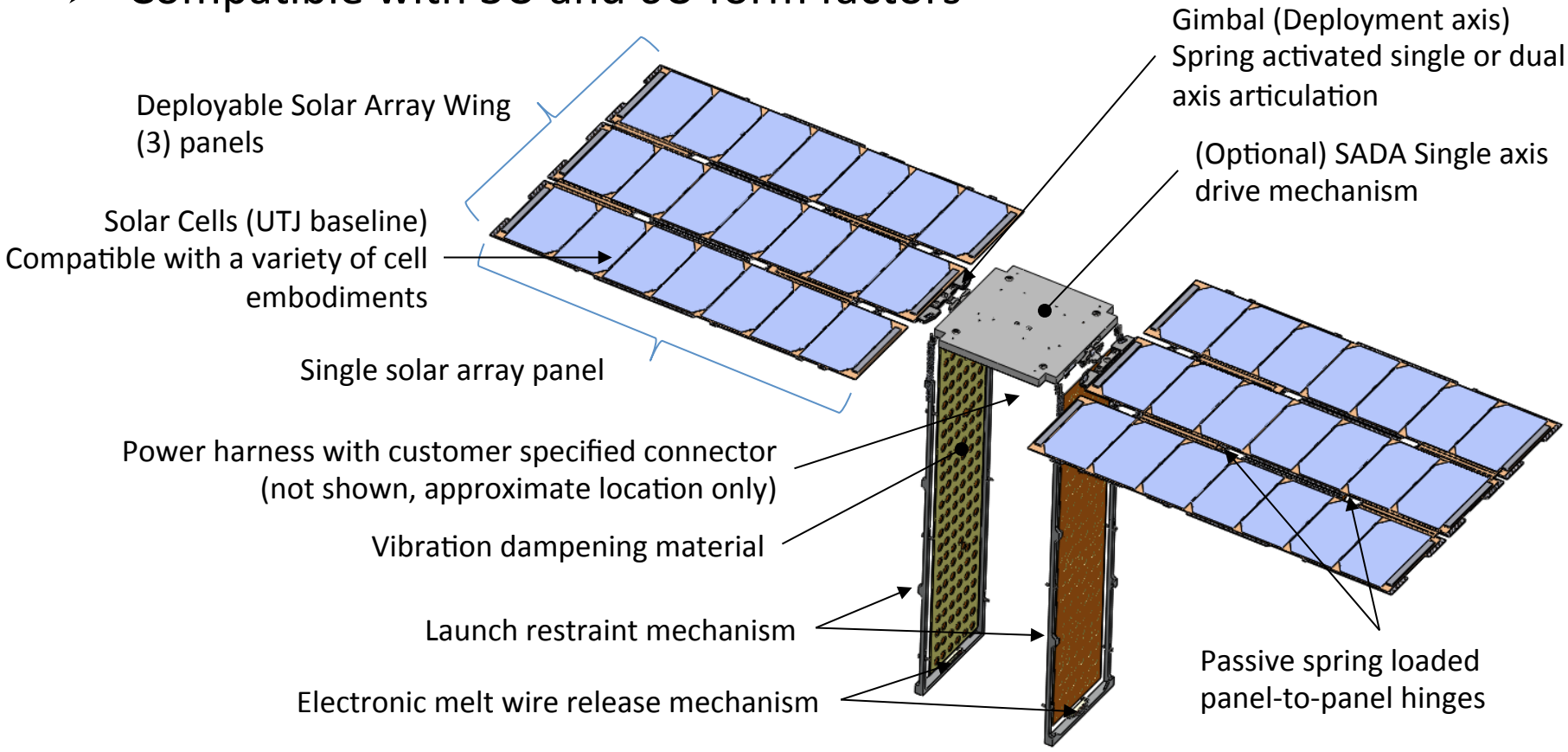


Mission Specific HaWK Configurations

HaWK System Details

HaWK modular high performance solar array

- Compatible with 3U and 6U form factors



HaWK Specifications

Power Specs

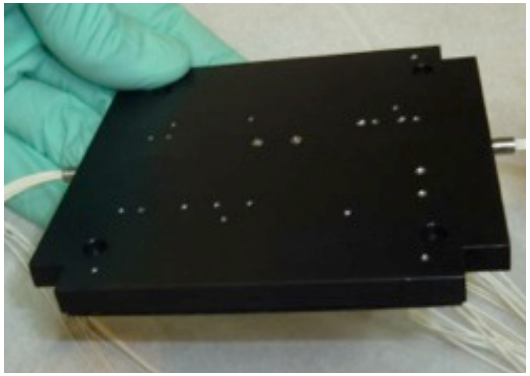
- 36 Watts BOL @70°C Peak Power
- 130 W/kg BOL Specific power
- 99 kW/m^3
- Spectrolab UTJ 28.3% at 28°C, AM0
- Discrete integrated by-pass diode

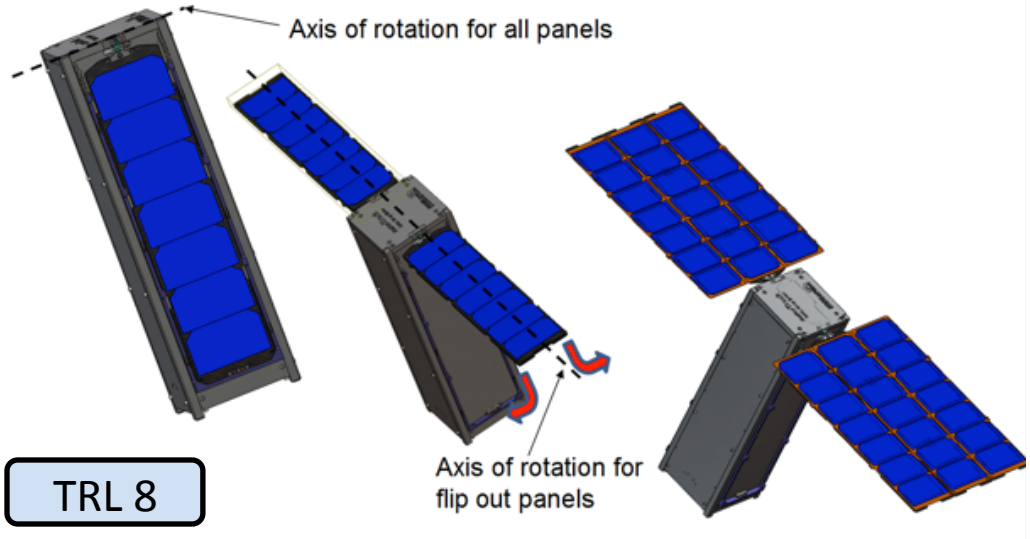
Structural Specs

- 1st mode >1.5 Hz deployed (estimated)
- Deployment duration (t_0) from launch lock release to full deployment (t_f)
  - <1.0 second
- Solar array system mass – 276.0 grams

Options

- SADA 1U form factor
  - (10cm) 6.5mm thick
- Motion is +/- 180degrees
- Sun tracking

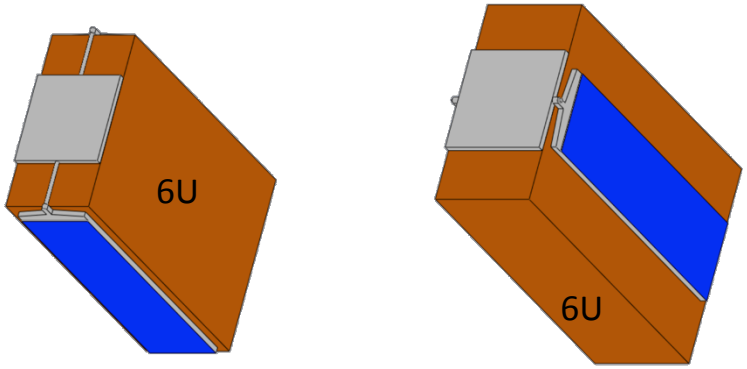




TRL 8

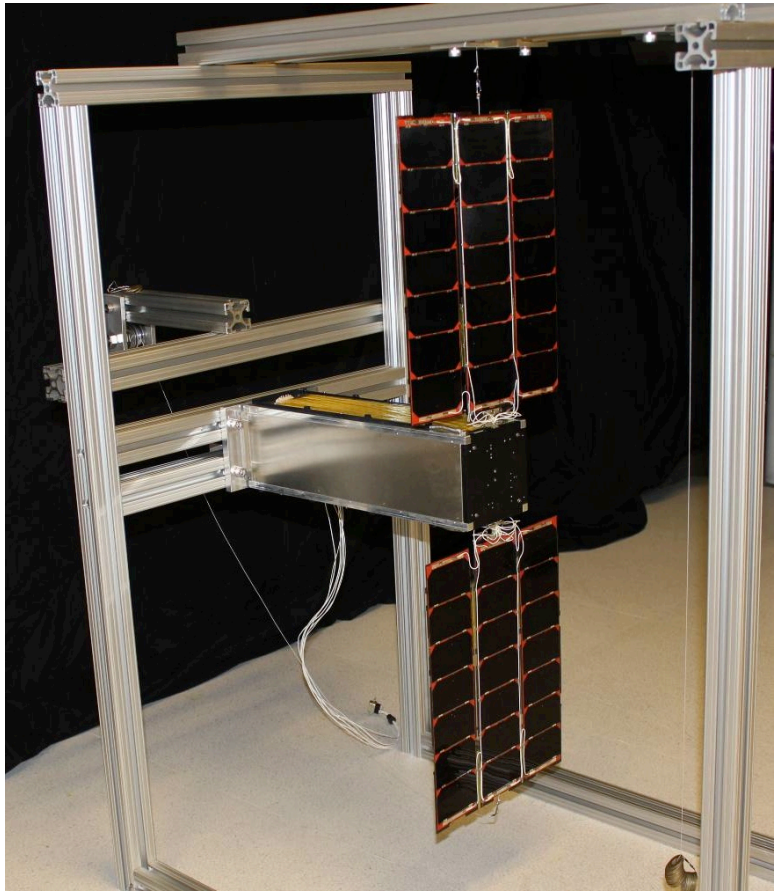
HaWK - Specific Applications

- HaWK 3U deployable panels are adaptive to the 6U form factor
- HaWK deployable solar arrays will provide power for the AFRL Biarri Mission



Alternative Configuration of HaWK 3U on a 6U

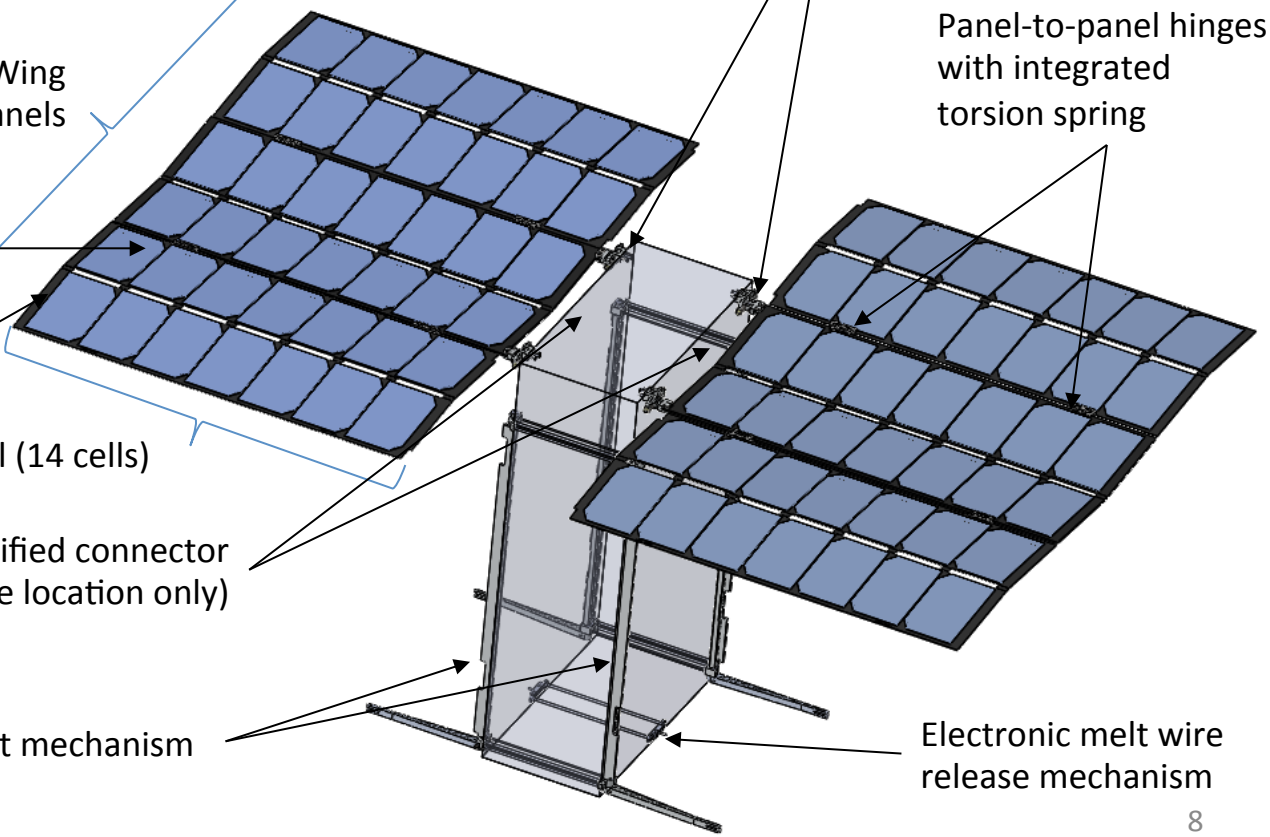
Biarri HaWK Protoflight Unit (**TRL 8**)



E-HaWK System Details

E-HaWK high power solar array

- Multi-panel design for high power missions



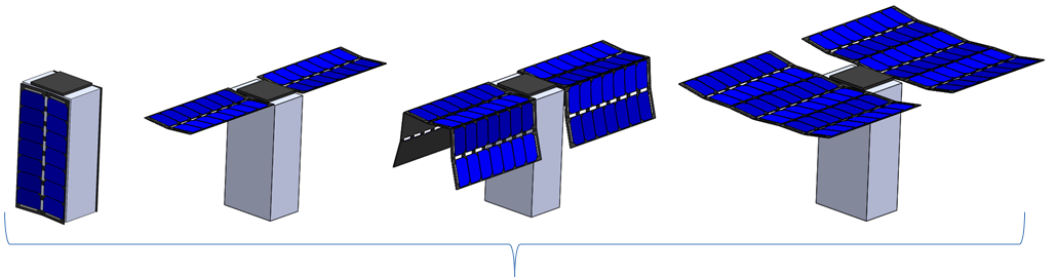
E-HaWK Specifications

Power Specs

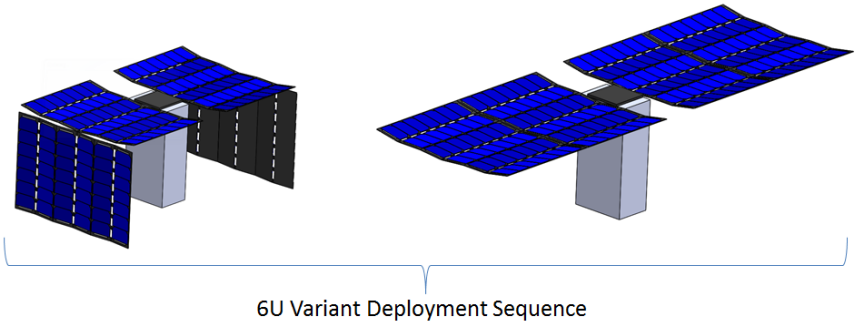
- 72 W BOL @70°C (3) panels per wing config.
- 144 W BOL @70°C (6) panels per wing config.
- 120 W/kg BOL Specific power
- 80-90 W/m^3
- Spectrolab UTJ 28.3% at 28°C, AM0
- Discrete integrated by-pass diode

Structural Specs

- 1^{st} mode >1.5Hz deployed (estimated)
- Deployment duration (t_0) from launch lock release to full deployment (t_f)
  - <1.0 second
- Solar array mass –approx. 600 grams
  - Complete system with launch restraint



6U Deployment Sequence



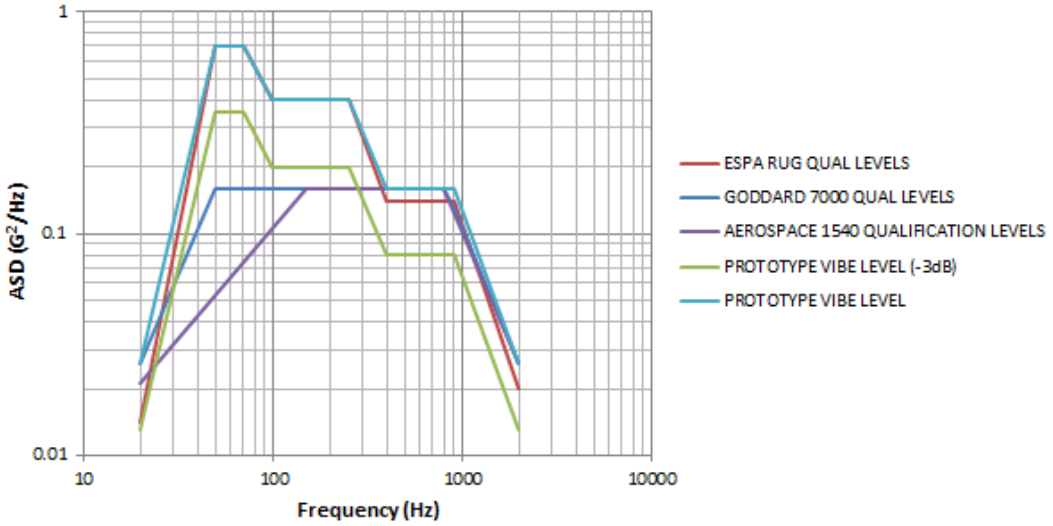
6U Variant Deployment Sequence

TRL 8

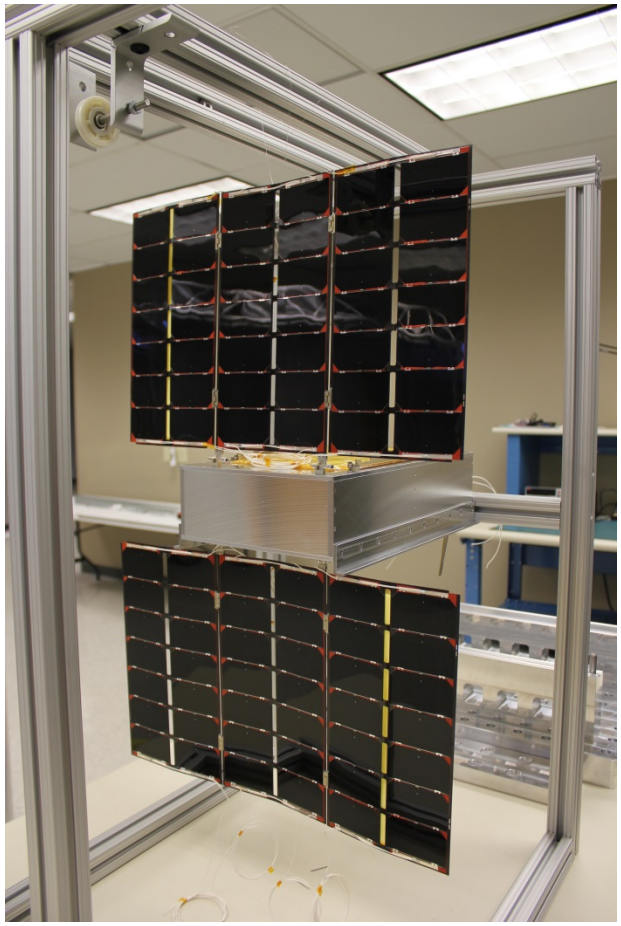
E-HaWK Development Status

Qualification Testing

- Random vibration testing performed to enveloped industry standards
- Thermal Cycle testing
  - 80°C to -35°C, 8 cycles 1 hours dwell



Protoflight Unit (**TRL 8**)



Conclusion

- Overall readiness level (TRL 8)
- Flight heritage 2015
- HaWK portfolio of solar array platforms is establishing state of the art technology which will enable current and future high power mission requirements
- Providing best-in-class power solutions with demonstrated reliability, efficient packaging, modularity and scalable power
- Offering component commonality and innovative mechanisms aimed at providing elegant solutions at a competitive price point
- Continuous development toward new HaWK configurations to provide power up to 40kW (20kW per wing)