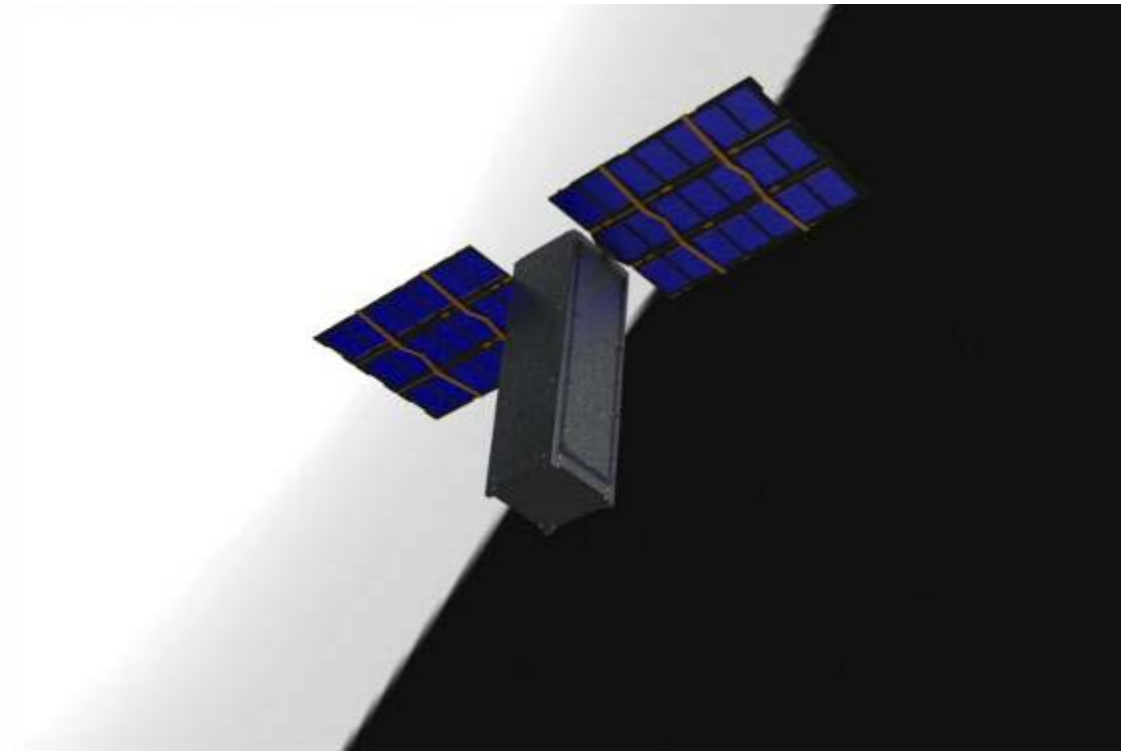
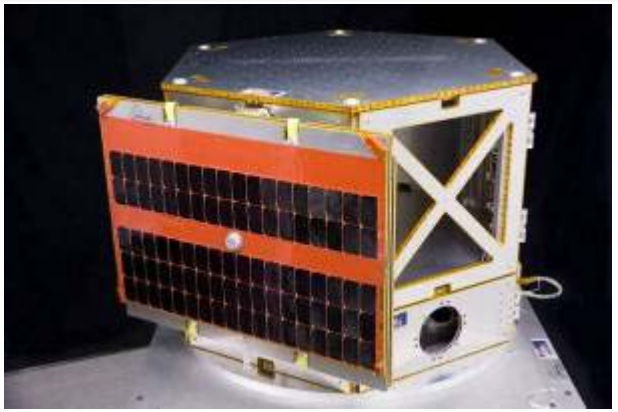
Innovative High Specific Performance (HaWK) Solar Array



MMA Design LLC
6 August, 2011

MMA Design Overview

- Company Details
  - Colorado company
  - Founded in 2007
  - Aerospace and Design Engineering Firm
  - Nederland, Colorado Engineering Facility
  - Boulder, Colorado Test Facility
  - Broomfield, Colorado Machine shop
- Three Primary Business Areas
  - Space Power Systems
  - Space Structures
  - Electro-Mechanical Systems
- Current System Engineered Products
  - dragNET De-orbit Modules
  - HaWK High Performance Solar Arrays
  - Modular Bus Structures
  - ESPA-Class Modular Solar Arrays
  - Gimbals

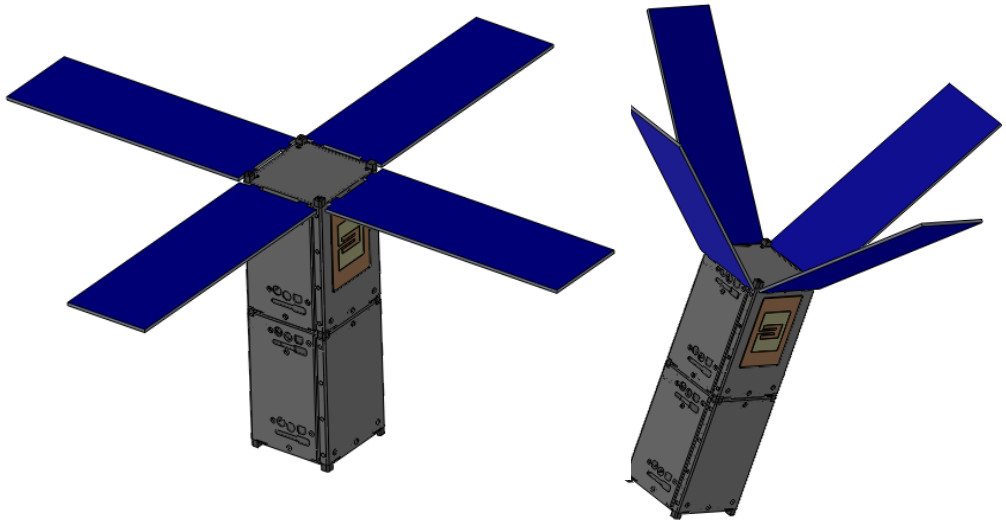


MMA's PnP Bus and MDSAS Solar Array

MMA's dragNET De-orbit Module

Current State of the Art NanoSat Solar Array

- Typical Features
  - No Sun Tracking
  - Body mounted or deployed fixed wings
  - 60 W/kg
  - 21 W Peak Power
  - 5 W OAP



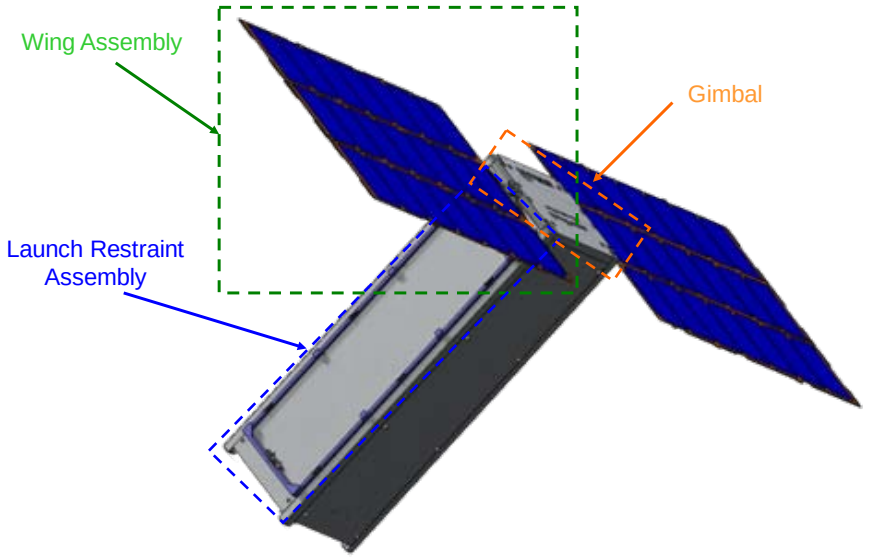
System Performance Metrics

- Specific power ≥ 125 W/kg
- Ability to sun track to dramatically increase Orbital Average Power (OAP)
- Peak power ≥ 35 W using existing triple junction CICs
- Stowed position volume using only the unused space between P-Pod and CubeSat
- Highly modular and PnP compatible, reconfigurable based on mission needs

MMA Design LLC

NanoSat HaWK Solar Array

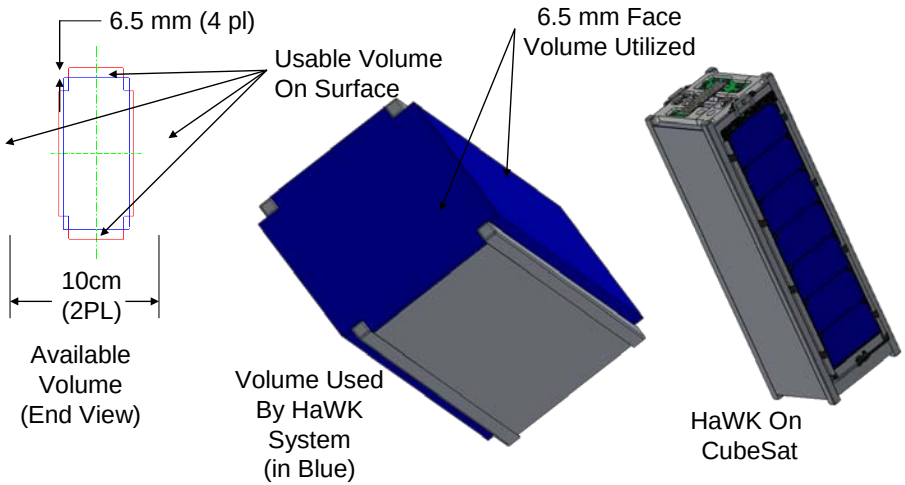
- Features
  - Sun tracked continuous high power
  - De-orbit < 25 years from 700 km orbit
  - Maximizes volume and mass for payloads
  - 130 W/kg (>200% increase)
  - 36 W Peak Power
  - 22 W OAP (>300% increase)
  - 0.6 kg System Mass
  - Standard or IMM CICs
  - Modular and scalable to 100 W peak power and 50 W OAP



MMA's NanoSat HaWK is Patent Pending

CubeSat HaWK Packaging

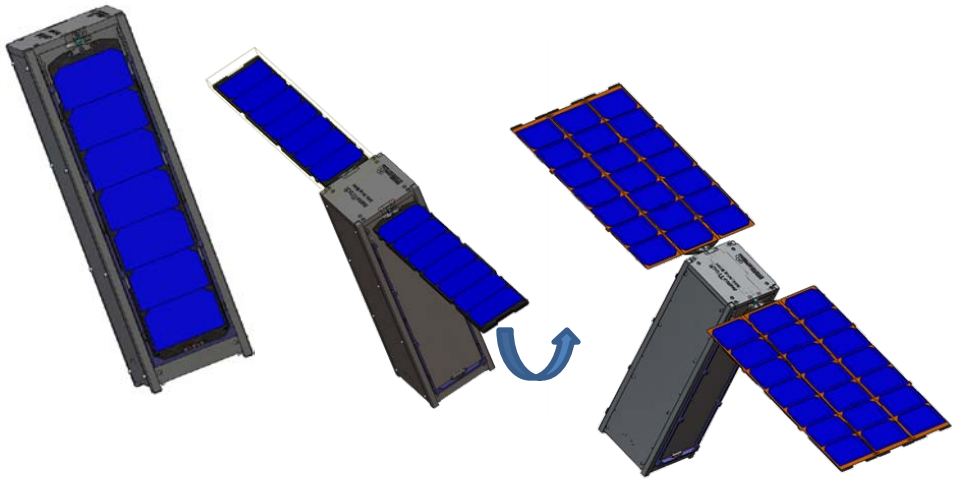
- Innovative system packaging
- Uses available 6.5 mm space between P-Pod and CubeSat
- Maximizes mission payload volume and mass
- High mass and volume efficiency
- Highly modular architecture



HaWK Stowed Packaging

HaWK Deployment Sequence

- Initiate launch release, simple heater circuit power
- Root spring rotates center panel
- Spring pre-loaded Flip-out side panels unfold
- Deployed state reached at hinge hard stop
- Enable and command SADA to articulate in sun tracking mode



Stowed to Deployed and Tracking Mode

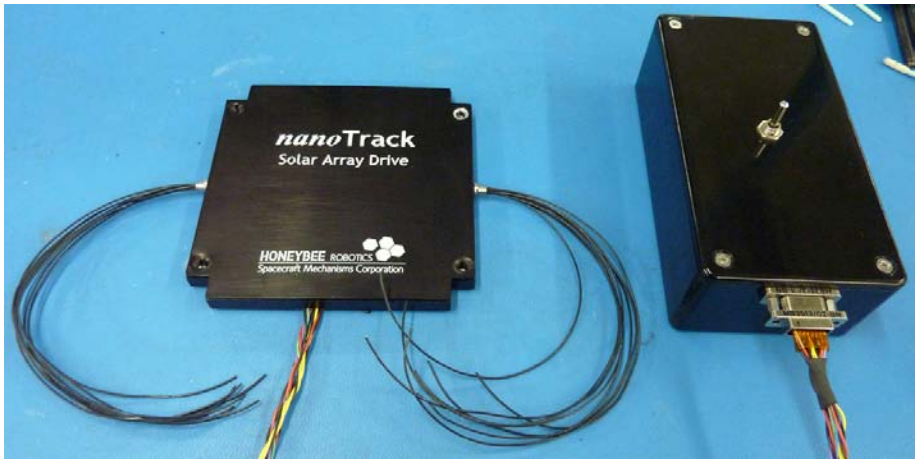
HaWK Wing

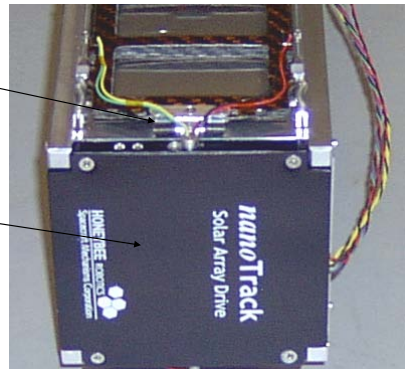
- Graphite panel
- Kapton overlayment
- Spectrolab UTJ CICs or equivalent
- Soldered interconnects (typically < 2 year missions)
- Mass efficient deployed structure

HaWK Engineering Unit

HaWK SADA

- Partnered with Honeybee Robotics to jointly develop nanoTrack
- Patent Pending
- 3U CubeSat bus form factor – fits in 6.5 mm unused space on end
- Dual wing single axis rotation
- ± 180 deg range of motion

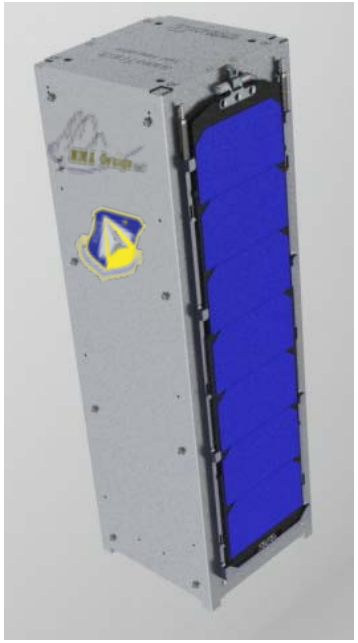




HaWK SADA Engineering Unit and Test Box

HaWK Hold Down Release Mechanism (HDRM)

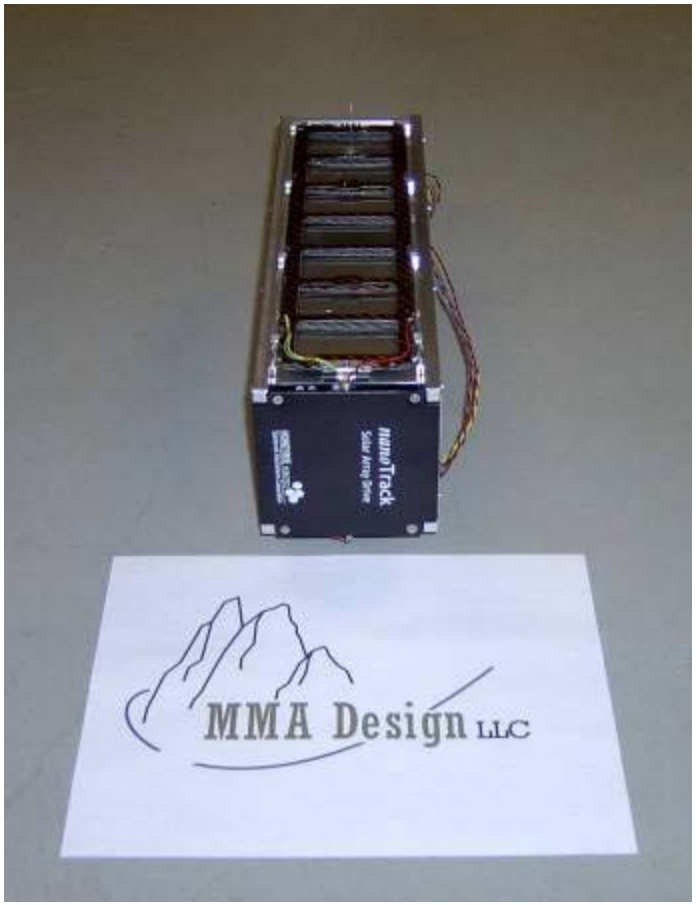
- High margin release design
- HDRM supports wings during launch environment
- Initiate simple heater circuit
- HDRM releases for wing deployment



HaWK Stowed

HaWK Engineering Unit Deployed

HaWK Engineering Unit Stowed



Conclusion

- HaWK establishes State of the Art performance exceeding all system performance metrics
  - 130 W/kg
  - 22 W OAP
  - 36 W peak power
  - Efficient packaging
  - Sun tracking
- Technical Readiness Level 4/5
- Currently under Phase II SBIR development with AFRL
- Space Act Agreement with NASA to apply to future NASA missions