

# Space Radiation Hardened Star Tracker

Space Micro's MDE1300 is a space radiation hardened, high precision, agile star tracker for use in satellite attitude determination. The MDE1300 features multiple fields-of-view (FOVs) with the three optical assemblies utilizing three separate focal plane arrays (FPAs). Multiple FOVs eliminate the sun sensitivity that troubles traditional star trackers, as well as improves reliability and accuracy. Elimination of glass optics improves radiation tolerance. The optics are integrated with Space Micro's state-of-the-art radiation hardened space computer and power supply, with an image processing "Star Camera" option, to deliver a complete high performance, low power star tracking solution.

Baffle & FPAs

Proton200k™  
Space Computer,  
FPA processing,  
and Power Supply



MDE1300 Star Tracker fully integrated with space computer and power supply

## Features for Space

- Radiation Hardened for Space Applications
- Integrated Camera and Processing
- Miniaturized Electronics
- Three 1024 x 1024 Pixel FPA (CMOS APS) Imagers
- High Speed, Optimized, and Radiation Hardened Digital Signal Processor-Based Computer
- Dedicated Hardware/Software Integration
- Full Kalman Filtering
- Made in USA

## Applications

- Satellite Navigation & Guidance
- GEO and LEO Satellite Orbits
- Nano- and Small Satellites Requiring Low Power
- Long Duration/High Reliability Missions

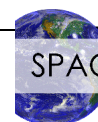
## *SM-MDE1300*



MDE1300 Opto-Mechanical Mirror and FPA Support Structure

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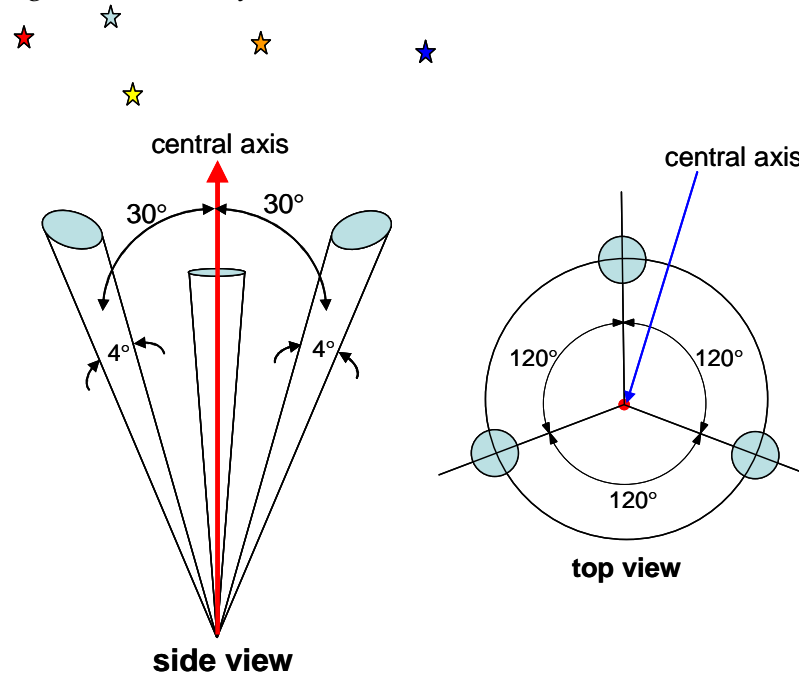
SPACE MICRO INC.

YOUR ACE IN SPACE

# Space Radiation Hardened Star Tracker

## Advantages over Traditional Single Field-of-View Star Trackers

- 3 individual Fields-of-View (FOVs) of  $4.5^\circ \times 4.5^\circ$  separated in azimuth by  $120^\circ$  and canted off the central geometric axis by  $30^\circ$



- Sunshade design amenable to shutter mechanism which can block out incoming bright light if the sun or other bright light source starts to enter one of the 3 FOVs
  - Eliminates the traditional "Sun exclusion zone" of traditional star trackers, which can be  $30^\circ$  or more off of the star tracker central optical (boresight) axis
- Provides much better measurement of attitude in the roll axis (5 to 10 arcsec)
  - Traditional star trackers typically have roll measurements on the order of 30 to 40 arcsec while 5 to 10 arcsec in pitch/yaw axes
- Internal Redundancy with 3 separate focal plane arrays (FPAs), one for each FOV
  - Sensor can provide accurate attitude determination with only 2 of 3 FPAs operating
  - Solutions with only 1 FOV possible (with reduced frequency and accuracy)
- Inherent Radiation Tolerant Design Features
  - Use of all reflective optics, eliminating need for glass lenses which can darken with radiation exposure
  - CMOS FPAs, which are inherently radiation tolerant
  - No direct line-of-sight radiation path to the FPAs,  $4\pi$  radiation shielding for entire electronics assembly, including detectors

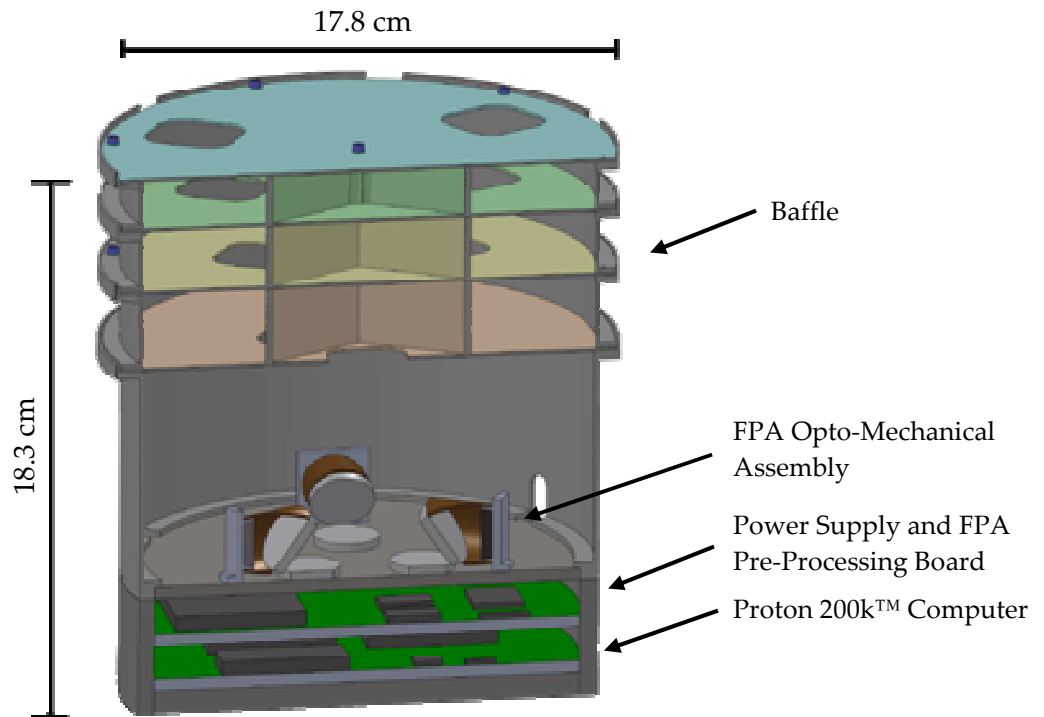
# Space Radiation Hardened Star Tracker

## Specifications

Instrument Mass (including support electronics)	1.85 kg
Radius	7.9 cm
Height	18.3 cm
Sensor Power Draw	7.5 W
Accuracy	1-10 arcsec
Update Rate	0.5-10 Hz
On-orbit Lifetime	5-15 years
Star Magnitude Limit	7 $M_v$
Sensor Interface	RS-422 (options: 1553B, Space Wire, etc.)
Acquisition Time (Lost in Space)	< 6 seconds
Maximum Slew Rate (full accuracy)	1 deg/sec
Sample Rate	10-20 Hz
Maximum Tumble Rate (estimate)	10 deg/sec
Star Catalog	10,000 stars

## Radiation Tolerance

Total Ionizing Dose (TID)	> 100 and 300 krad (Si) (option)
Single Event Latchup (SEL)	> 80 MeV/mg/cm <sup>2</sup>
Single Event Upset (SEU)	< 10 <sup>-3</sup> errors/system-day
Neutrons	> 2x10 <sup>12</sup> n/cm <sup>2</sup>



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# Space Radiation Hardened Star Tracker

## Supporting Electronics

The MDE1300 features proven, high-performance, radiation hardened supporting electronics to ensure accurate, reliable functionality in the harsh space environment. These electronics can be integrated into a single unit, or remotely mounted elsewhere on the spacecraft.

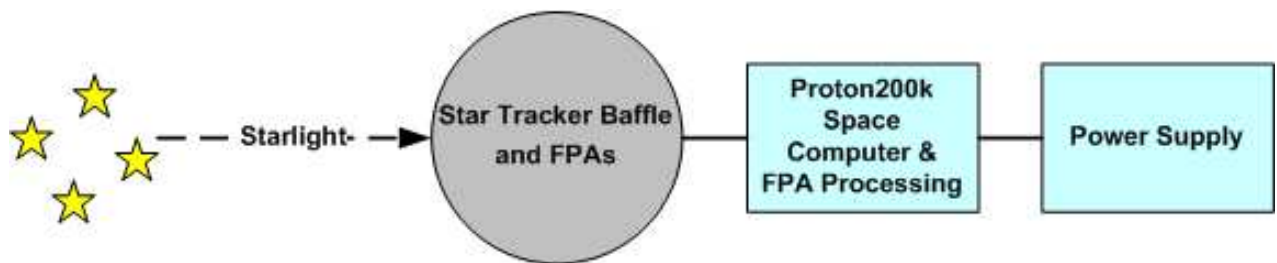
## Proton200k™ Radiation Hardened Space Computer

The Proton200k™ space computer is flight-proven, high speed, and radiation hardened to provide extraordinary performance benefits by removing the barriers associated with commercial processors offerings.

- Qualified Space Computer for onboard data processing and C&DH
- 1.8 GFLOPS @ 300 MHz Floating Point, 900 MFLOPS @ 300 MHz with SEU mitigated to 1E-4 errors/day

## Power Supply

- 3 isolated DC-DC converters
- Powered by external 28V spacecraft power (other voltages available by request)
- Produces 3.3V, 5V, and ±12V for PCI-104
- EMI filtering



MDE1300 Star Tracker Components

Please contact Space Micro Inc for application specific configurations or further details.