

# Nano Satellite



together  
we go further

ADCS



A Attitude

D Determination

C Control

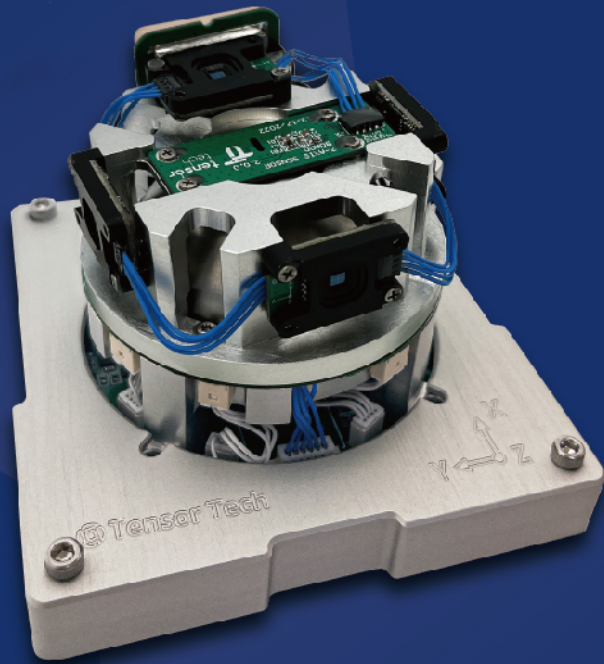
S System

together  
we go further

Tensor tech is leading innovation attitude determination and control systems, with expertise in guidance, navigation, and control.

We offer a complementary suite of space-qualified products and subsystems based on scalable and reliable components that can adapt to our diverse customer requirements.

# ADCS



## Integrated Attitude Determination And Control System

 Flight Heritage Since Jan. 2022



Tensor Tech's ADCS uses variable speed control moment gyroscopes (CMG) for pointing and tracking, a solution more power efficient than traditional reaction wheels.

The CMG actuators are scalable and can be combined in various configurations to adapt to different mission profiles. The ADCS includes estimator and control algorithms with a wide variety of sensors for all ADCS control modes.

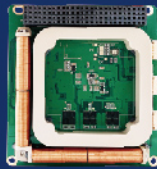


ADCS

Specifications

Included Hardware

ADCS-MTQ



ADCS MCB + MTQ1 Suite  
Main Control Board



FSS-15 x 5

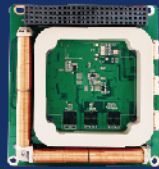


FSS-15M x 1

ADCS-10m



CMG-10m



ADCS MTQ

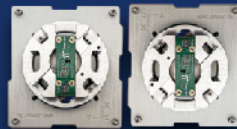


FSS-15 x 5



FSS-15M x 1

ADCS-20m



CMG-20m



ADCS MCB x 1



MTQ2 Suite

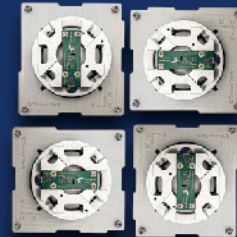


FSS-15 x 5



FSS-15M x 1

ADCS-40m



CMG-40m



ADCS MCB x 1



MTQ3 Suite



FSS-15 x 5



FSS-15M x 1

Optional Accessories

GNSS Receiver

GNSS Receiver

GNSS Receiver

GNSS Receiver

Pointing Knowledge

0.1 deg @ Sunlight  
1 deg @ Eclipse

0.1 deg @ Sunlight  
1 deg @ Eclipse

0.1 deg @ Sunlight  
1 deg @ Eclipse

0.1 deg @ Sunlight  
1 deg @ Eclipse

Pointing Accuracy

5 deg @ Sunlight

0.2 deg @ Sunlight  
1 deg @ Eclipse

0.2 deg @ Sunlight  
1 deg @ Eclipse

0.2 deg @ Sunlight  
1 deg @ Eclipse

Power Consumption @ 5v bus

0.63 W

1.2 W

2.4 W

4.8 W

Power Consumption @ 3.3v bus

0.4 W

1 W

1.5 W

2.9 W

Volume

0.2U (< 140 g)

Tuna-can & 0.2U (< 450 g)

2 x Tuna-cans & 0.4U (< 1 kg)

4 x Tuna-cans & 0.8U (< 2 kg)

Angular Momentum Storage

—

10 mNms for 2-axis

20 mNms for 1-axis;  
10 mNms for 2-axis

30 mNms for 2-axis;  
20 mNms for 1-axis

Torque

0.01 mNm @ SSO

1 mNm for 2-axis

2 mNm for 1-axis;  
1 mNm for 2-axis

3 mNm for 2-axis;  
2 mNm for 1-axis

Interface

RS485 or UART

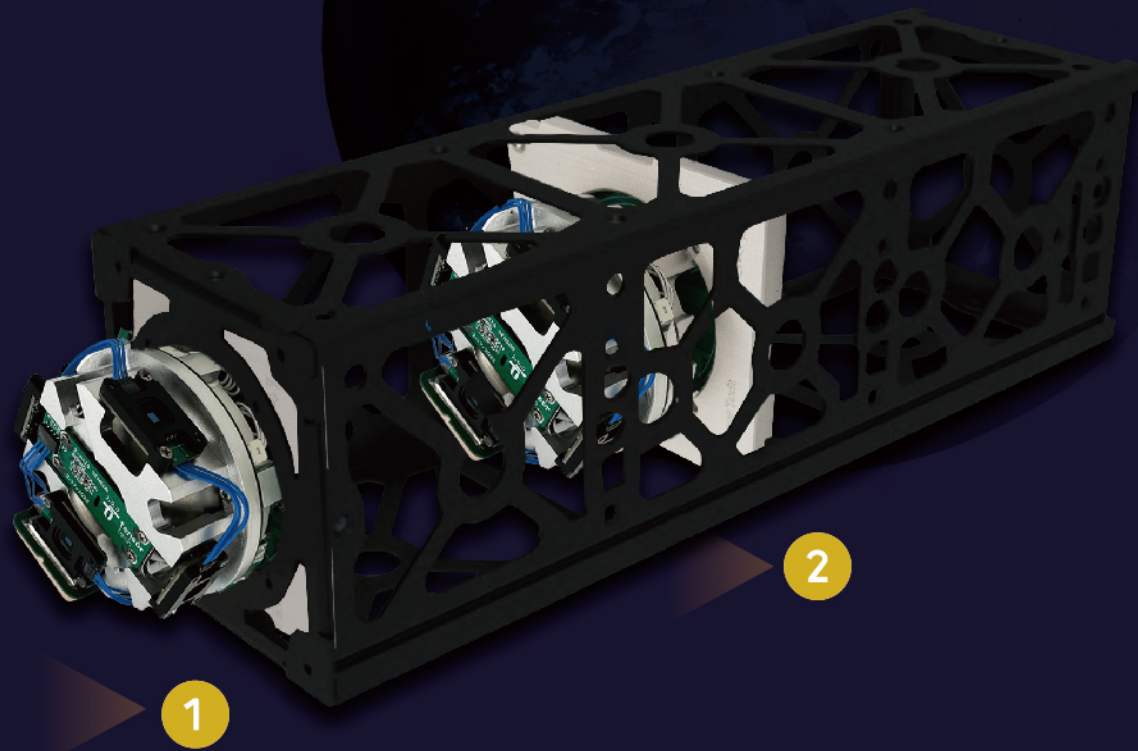
RS485 or UART

RS485 or UART

RS485 or UART

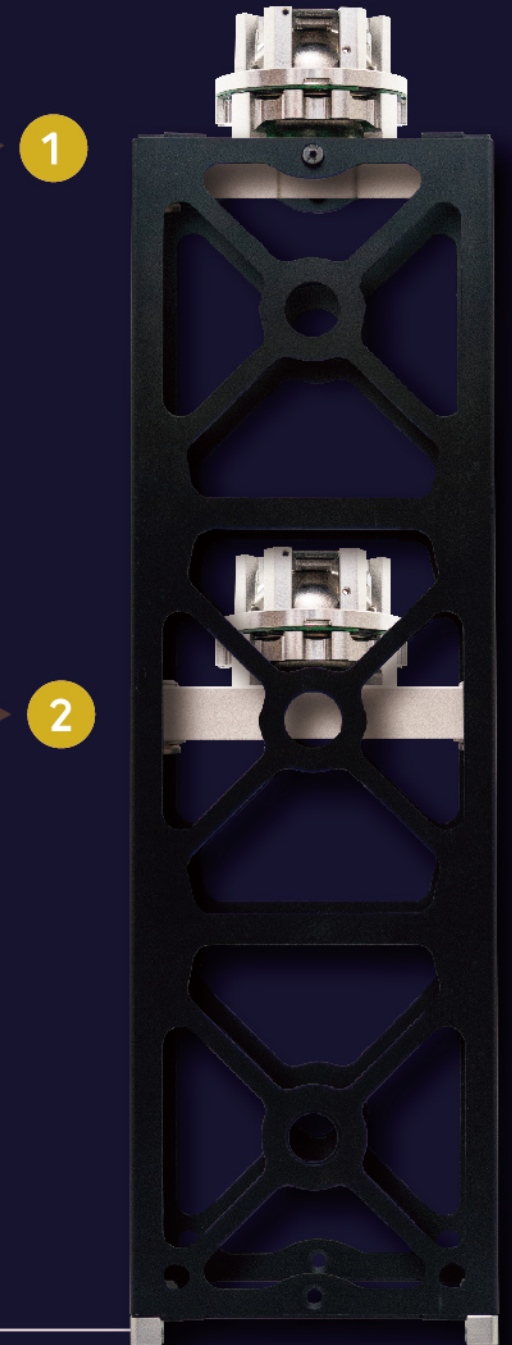


## Installation Interfaces

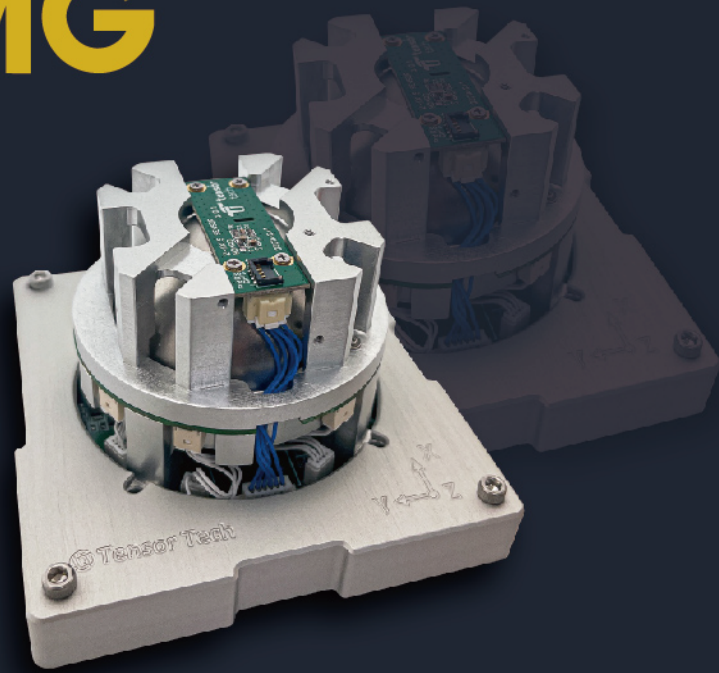


Installing the CMG in the tuna-can (configuration 1) is recommended, as it will maximize the available space within the satellite.

It is also feasible to integrate the CMG near the center of mass of the satellite, or at any other location within the CubeSat's structure.



# CMG



## Control Moment Gyroscope

 Flight Heritage Since Jan. 2022

Tensor Tech's maximizes performance for small satellites users by miniaturizing its variable speed control moment gyroscopes (CMG). It offers additional power efficiency compared to traditional reaction wheels solutions.

The CMG includes speed and torque modes, allowing users to control the CMG directly by simply setting speed or torque output values.





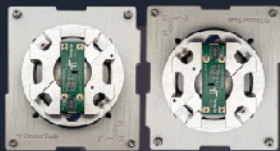
# CMG

Specifications



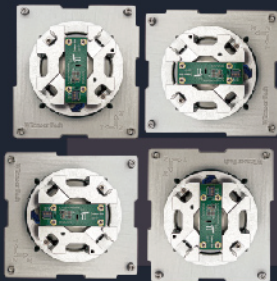
CMG-10m

CMG-10m is a variable speed control moment gyroscope (CMG) which is suitable for satellites up to roughly 3U.



CMG-20m

CMG-20m is a scissored pair, variable speed control moment gyroscope (CMG) which is suitable for satellites up to roughly 6U.



CMG-40m

CMG-40m is a pyramid cluster, variable speed control moment gyroscope (CMG) which is suitable for satellites up to roughly 12U.

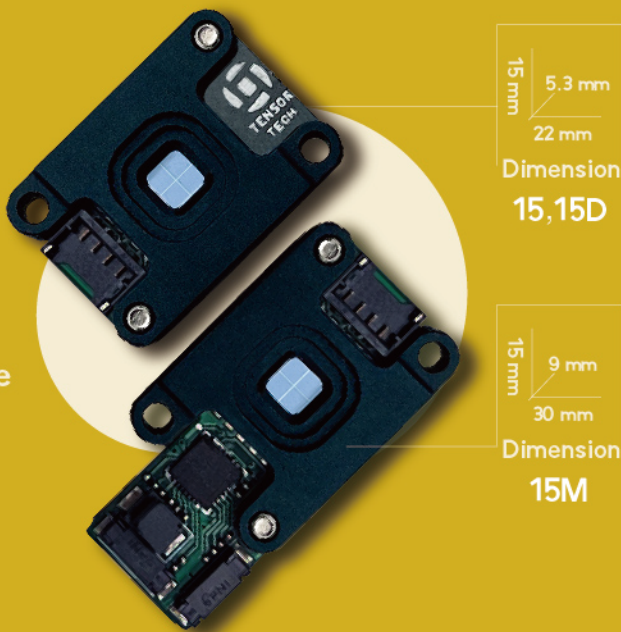
Angular Momentum Storage	10 mNms for 2-axis	20 mNms for 1-axis; 10 mNms for 2-axis	30 mNms for 2-axis; 20 mNms for 1-axis
Torque	1 mNm for 2-axis	2 mNm for 1-axis; 1 mNm for 2-axis	3 mNm for 2-axis; 2 mNm for 1-axis
Inner Rotor Speed Control Accuracy	< 5 rpm	< 5 rpm	< 5 rpm
Tilting Angle Control Accuracy	< 1 deg	< 1 deg	< 1 deg
Rotor Imbalance	ISO 1940 G0.4	ISO 1940 G0.4	ISO 1940 G0.4
Power Consumption @ 5v bus	1 W	1.5 W	3 W
Power Consumption @ 3.3v bus	0.6 W	1.2 W	2.4 W
Mechanical	Tuna-can & 0.1U (< 290 g)	2 x Tuna-can & 0.2U (< 580 g)	4 x Tuna-can & 0.4U (< 1160 g)
Interface	RS485 or UART	RS485 or UART	RS485 or UART

# FSS-15

## Fine Sun Sensor

Flight Heritage Since Jan. 2022

- ❖ FSS-15M with Magnetometer
- ❖ FSS-15D with Higher Update Rate



### Feature

1. High accuracy 2-axis digital sun sensor
2. Low power consumption design
3. Small form factor
4. I2C Bus stuck protection
5. Environmental test follows ECSS standard

Field of View (FOV)	$\pm 60$ deg
Accuracy	0.1 deg, 1-sigma for FSS-15 & FSS-15M 2 deg, 1- sigma for FSS-15D
Sampling Rate	4, 8, 16 Hz. 32 Hz for FSS-15D only
Current Consumption @ 16Hz	< 5.5 mA
Mechanical	22.00 × 15.00 × 5.26 (< 4 g)
Radiation Tolerance	> 10 krad
Interface	I <sup>2</sup> C and UART
Tri-Axis Magnetometer(FSS-15M only)	Range: +-1100 uT, Noise: 15 nT



# CSS-10

## Coarse Sun Sensor

CSS-10 is a coarse sun sensor with a simple and robust design. It is suitable for spacecrafts who need robust inputs for sun-acquisitions, with low pointing requirements or as a part of a more advanced solution in combination with the FSS-15.

### Specifications

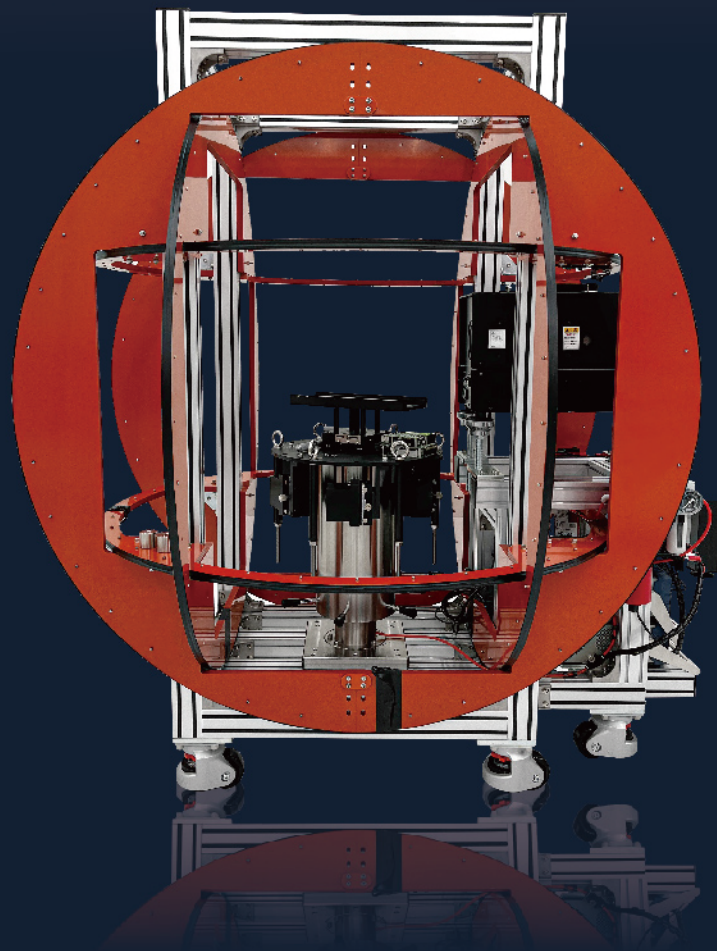
- ❖ 1-axis analog coarse sun sensor
- ❖ < 5 deg (1-sigma) of sun determination accuracy calibration instructions
- ❖ Hardware protection to prevent short circuit system failures
- ❖ Six coarse sun sensors can provide a full sky (4 $\pi$ ) FOV coverage ( $\pm 60$  deg for each sensor)
- ❖ Requires analog to digital converter.
- ❖ Three pins including Vcc, GND, and output line.

Field of View	$\pm 60$ deg
Power Consumption	< 0.1 mA
Mechanical	15.00 × 7.00 × 6.00 mm (< 0.5 g)
Radiation Tolerance	> 10 krad



# ADCS -Testbed

Attitude  
Determination  
Control  
System  
Testbed



The ADCS testbed supports satellite missions which require advanced pointing and attitude determination capabilities, by facilitating calibration, measurements of the mass properties, and ADCS algorithms tests and validations. The testbed consists of an air-bearing platform, a triaxial Helmholtz cage, and a solar simulator. It is easily customizable and can be adapted to fit customer specific requirements.

## Specifications

### Triaxial Helmholtz Cage

Max. Magnetic Flux Density	3 Gauss
Working Area	350 × 350 × 350 mm

### Air Bearing Platform

Manual Adjusted x/y Axis Platform	
Turbine Torque	5 μNm
Travel Angle	± 45 deg; Max. load 30 kg
Center of Mass Estimation Error	0.1 mm
Moment of Inertia Estimation Error	2 %
Attitude Estimation Error	1 deg

### Solar Simulator

Spectral Matching	AM0, Class A, ASTM
Spatial Non-uniformity of Total Irradiance	< 2%
Time Instability	< 1%
Light Spot Dimension	40 x 40 mm
Collimation	< 4 deg

# ADCS

## Air Bearing Platform



Single board computer and tactical grade inertia measurement unit (IMU) are integrated onto the air bearing platform. With the help of the IMU, the single board computer estimate the attitude of the platform every timestep.

The determined attitude can be remotely accessed using the Testbed-TYF, a customer support software, to improve the robustness of the tested ADCS system.

### Specifications

Mass Estimation Error	10 mg
Center of Mass Estimation Error	0.1 mm
Moment of Inertia Estimation Error	2 %
Attitude Estimation Error	1 deg

Space has defined some of humanity’s most outstanding achievements, and it continues to shape our future today.

We are motivated by the impact we can have by bringing reliable technologies to our customers, as the company’s core spirit, “**together, we go further.**”



### Our Service

- 

ADCS Hardware in the Loop
- 

Jitter Analysis and Measurement
- 

ADCS Integration
- 

Processor in the Loop
- 

AOCS Performance Analysis
- 

Original Equipment Manufacturing
- 

Mass Properties Measurement
- 

Original Design Manufacturing





# **ADCS** together we go further

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