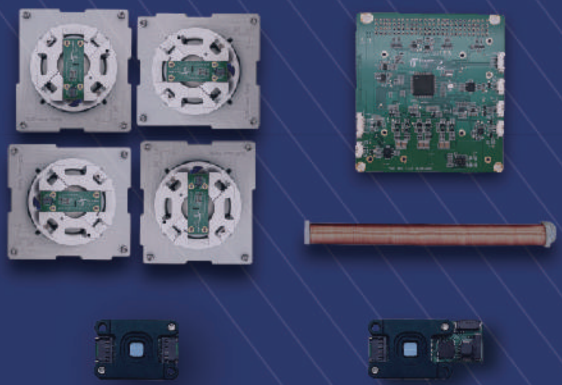
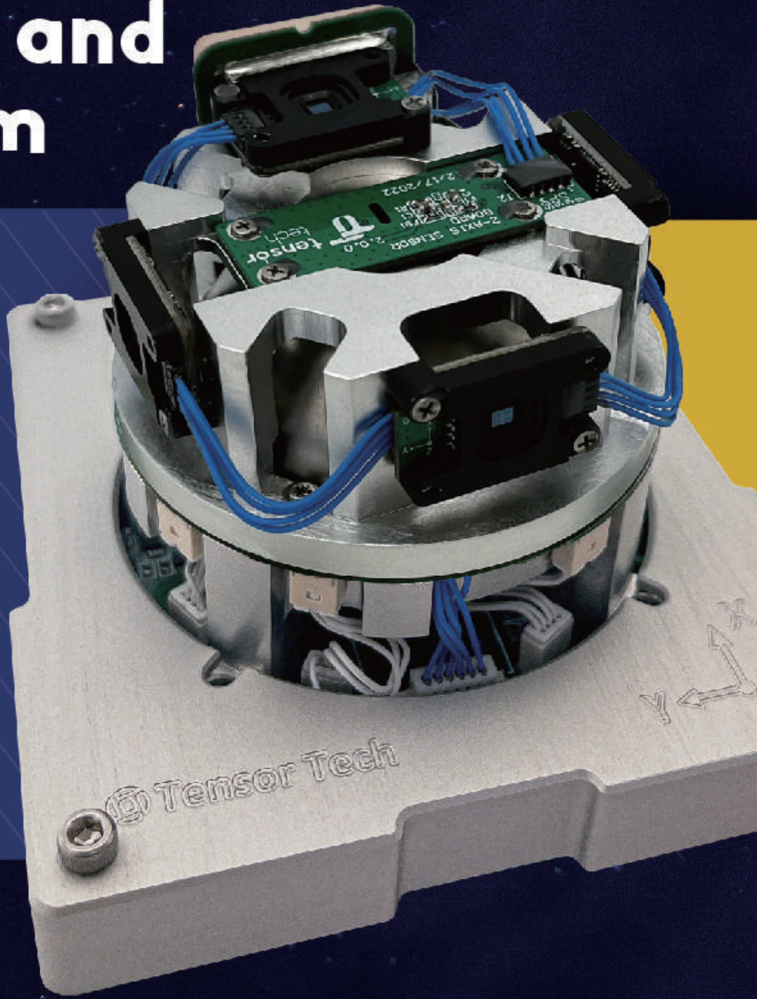
ADCS SERIES

Integrated Attitude Determination and Control System

Flight Heritage Since Jan. 2022





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The integrated Attitude Determination and Control Systems (ADCS) is designed for various CubeSat and SmallSat applications. It has multiple operating modes for various conditions:

1. Safe Mode: ADCS computer stays in sleep mode with the lowest current consumption and accessing sensor readouts including temperature and current.

2. Sun Tracking Mode: Orienting the face of the solar panel to the direction of the sun.

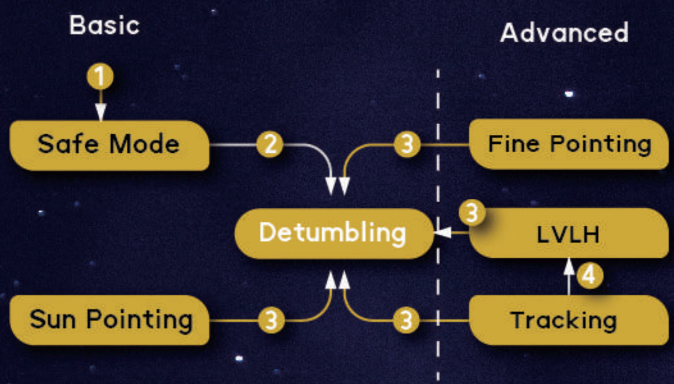
3. LVLH (Level-vertical Level-horizontal) Mode: Align the body frame with the orbital velocity and the earth pointing vector.

4. Fine Point Mode: At each time stamp, the Onboard Computer (OBC) assigns an attitude quaternion and reference frame to control.

5. (Terrestrial Object) Target Tracking Mode: Control to target a ground object.

Operation Modes

Condition 1	Soft error or tumbling rate > 360 deg/second
Condition 2	Tumbling rate between 5 deg/ second to 360 deg/ second and rotor speed > 5 rpm
Condition 3	Tumbling rate > 5 deg/second
Condition 4	Target lost



Variable-speed, single-gimbal CMG

Using gyroscopic moment instead of reaction wheel torque only

The rotor, spinning at a variable speed (Ω)and therefore provide reaction-wheel-torque, is mounted inside a gimbal (the golden part in the picture, a gimbal reference frame is defined upon it). The gimbal allows the rotor's spin axis ($\hat{g}_s$) to be tilted in different directions.

Therefore the direction of the angular momentum is changed and the spacecraft will experience a torque due to the conservation of angular momentum, this is called "gyroscopic moment".

The gyro moment can be provided in $\hat{g}_t$ direction when the gimbal is rotated in $\hat{g}_g$ direction. The gyro moment in $\hat{g}_t$ direction consumes far less mechanical power compare to reaction-wheel-torque because of its perpendicularity to the angular velocity vector.

ADCS-MTQ

Included Hardware

ADCS MCB + MTQ1 Suite
Main Control Board

FSS-15M x 1

FSS-15 x 5 (optional)

Optional Accessories	GNSS Receiver
Pointing Knowledge	0.1 deg @ Sunlight 1 deg @ Eclipse
Sun Pointing Accuracy	5 deg @ Sunlight
Power Consumption @ 5V bus	0.63 W
Power Consumption @ 3.3V bus	0.4 W
Mechanical	0.2 U (< 140 g)
Torque	0.01 mNm @ SSO
Interface	RS485 or UART

Integrated ADCS Specifications

for up to 30 kg satellites

ADCS-10m

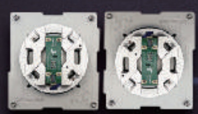
ADCS MTQ

CMG-10m

FSS-15M x 1 FSS-15 x 5

ADCS-20m

ADCS MCB x 1



CMG-20m

MTQ-200m Suite

FSS-15M x 1 FSS-15 x 5

ADCS-40m

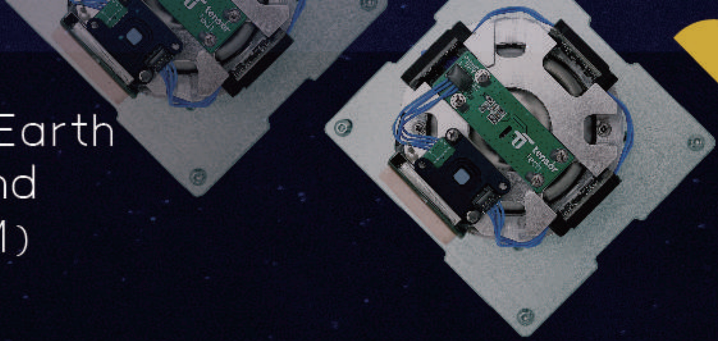
ADCS MCB x 1

CMG-40m

MTQ-2 Suite

FSS-15M x 1 FSS-15 x 5

	ADCS-10m	ADCS-20m	ADCS-40m
Included Hardware	ADCS MTQ; CMG-10m; FSS-15M x 1; FSS-15 x 5	ADCS MCB x 1; CMG-20m; MTQ-200m Suite; FSS-15M x 1; FSS-15 x 5	ADCS MCB x 1; CMG-40m; MTQ-2 Suite; FSS-15M x 1; FSS-15 x 5
Optional Accessories	GNSS Receiver and Star Tracker		
Pointing Knowledge	0.1 deg @ Sunlit 1 deg @ Eclipse	0.1 deg @ Sunlit 1 deg @ Eclipse	0.1 deg @ Sunlit 1 deg @ Eclipse
Pointing Accuracy	0.2 deg @ Sunlit 1 deg @ Eclipse	0.2 deg @ Sunlit 1 deg @ Eclipse	0.2 deg @ Sunlit 1 deg @ Eclipse
Power Consumption @ 5V bus	1.2 W	2.4 W	4.8 W
Power Consumption @ 3.3V bus	1 W	1.5 W	2.9 W
Mechanical	Tuna-can & 0.2U (< 450 g)	2 × Tuna-cans & 0.4U (< 1 kg)	4 × 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	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



ADCS designed for Earth Observation (EO) and Communication (CM)

for over 30 kg satellites

Satellite Motion Control Capabilities	ADCS-1EO	ADCS-1CM	ADCS-10EO	ADCS-10CM
Absolute Pointing Accuracy (3-axis, 1-sigma)	< 50 arcsec	< 300 arcsec	< 50 arcsec	< 300 arcsec
Relative Pointing Accuracy (3-axis, 1-sigma, 0.1s window time)	< 1 arcsec	< 10 arcsec	< 1 arcsec	< 10 arcsec
Pointing Knowledge (3-axis, 1-sigma)	< 10 arcsec	< 100 arcsec	< 10 arcsec	< 100 arcsec
Max. Angular Acceleration	> 1 deg per second			
Max. Slew Rate	> 10 deg per second			
Attitude Acutuation Capabilities				
Max. Torque	0.5 Nm	0.5 Nm	5 Nm	5 Nm
Max. Angular Momentum Storage	1 Nms	1 Nms	10 Nms	10 Nms
Mechanical Characteristics				
Total Mass	10 kg	9 kg	30 kg	28 kg
Dimension for the ADCS suite (cm)	~ 20 x 20 x 30	~ 20 x 20 x 25	~ 40 x 40 x 30	~ 40 x 40 x 25
Operation Temperature Range	-20 ~ 80 deg C			
Total Ionizing Dose (TID)	> 25 krad			
Random Vibration	> 8 Grms			
Electrical Characteristics				
Communication Interface	RS485			
Attitude Determination Update Rate	> 10 Hz			
Require Voltage Bus	28 V			
System Power Consumpiton, IDLE	< 5 W			
System Power Consumption, Max.	< 100 W	< 100 W	< 400 W	< 400 W
System Power Consumption @ 100% full angular momentum	< 20 W	< 20 W	< 100 W	< 100 W
Suitable Satellite Mass	50 ~ 100 kg		100 ~ 300 kg	

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