TENSOR TECH

ADCS100 & ADCS400-
Integrated
ADCS with Reaction Sphere

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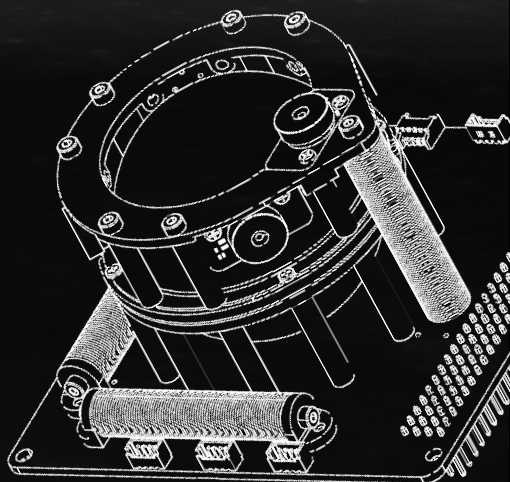


Introduction to ADCS100 with Reaction Sphere

CubeSat players used to build their satellites via contracting all design and integration jobs to a professional company or build the whole satellite by themselves with purchased components. However, the former method usually costs too much on budget; the latter cannot ensure the system's reliability and costs too many development times.

As a result, Tensor Tech proposes this integrated ADCS solution (Attitude Determination & Control System) with affordable prices and user-friendly interfaces. By adopting this offer, you don't have to program the complicated attitude determination and control algorithms yourself, but enjoy the quick integration process and instant customer support.

Moreover, a variable-speed, single-gimbal control moment gyro (CMG) driven by spherical motor technology serves as the attitude actuator for this ADCS100. It is comparatively lighter and has less power consumption than traditional solutions.

Features

- Components included: RS100- Reaction Sphere*1, 3-axis magnetorquer*1, FSS100- fine sun sensor*6, MEMS Gyroscope*1, 3-axis magnetometer*1 (need to be placed >100mm away from ADCS100)
- Optional accessories: GNSS receiver & antenna
- Pointing Knowledge: < +/- 0.1 deg @ sun capturable; < +/- 1 deg @ sun is not capturable
- Pointing Accuracy: < +/- 0.2 deg @ sun capturable; < +/- 1 deg @ sun is not capturable
- Max. Angular Momentum Storage: 10 mNms
- Maximum Torque: 1 mNm (adjustable)
- Rotor imbalance: better than G0.4

Electrical

- Supply voltage: 3.3V & 5V
- Power consumption: <1W

Mechanical

- Volume: 0.2U + > 64mm dia. tuna-can
- Mass: < 300 g

Reliability

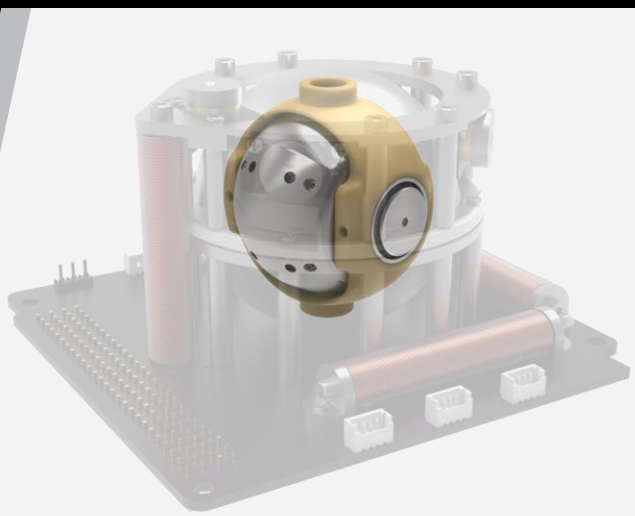
- Flight heritage since 2021
- Designed for CubeSats ranging from 1.5U to 6U in Low earth orbit for 3 years
- Operating temperature: -20 ~ 60 deg C

User Interface

- Controlled by the onboard computer (OBC) using I2C or UART with attitude command
- User-friendly customer support software for calibration, setting, and simulations on PC
- PC104 connector as the standard offer; able to customize mounting holes & pins & electrical connectors

Spherical Motor Technology

The spherical motor has 2 degrees of freedom on its mechanical structure. In terms of rotational dynamics, it works like a variable-speed, single-gimbal control moment gyro (CMG). With patented magnetic field design and control methodology, the spherical motor can provide angular momentum and torque in 2 axes. The spherical motor can bring your satellite ADCS the same performance but lower weight, volume, and power consumption than the traditional system.

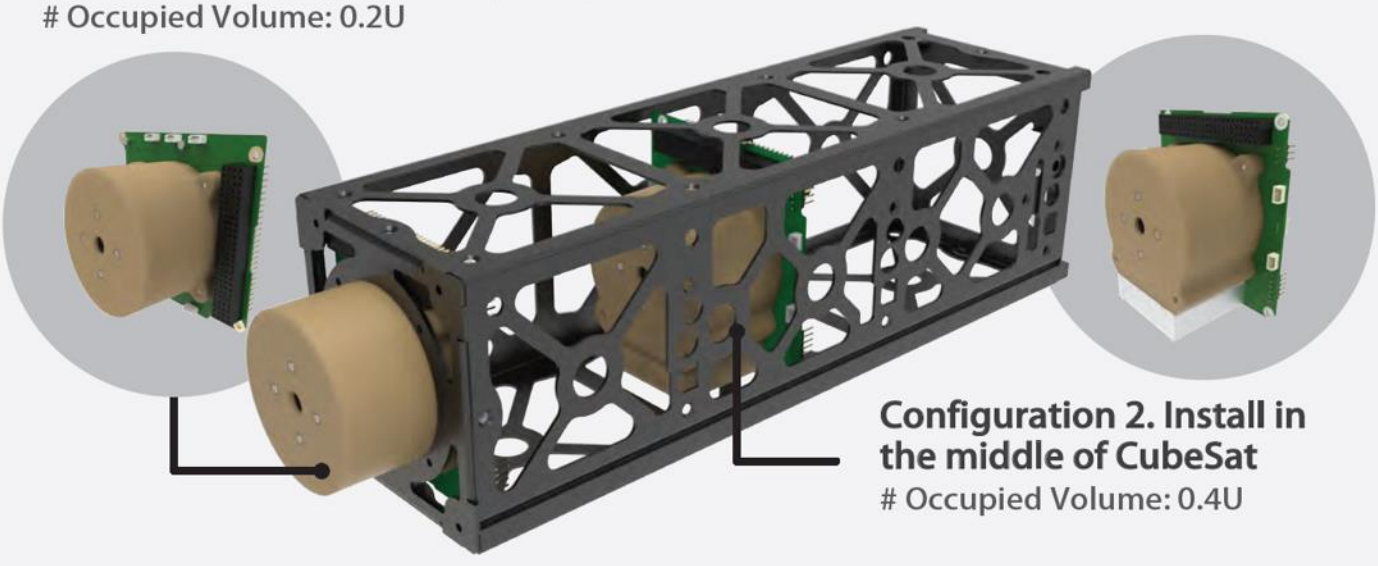


Installation Interfaces of ADCS100

We recommend installing ADCS100 in configuration 1. It takes the least space for users and makes the system more robust because Tensor Tech can do most installations before delivery. Only one 3-axis magnetometer and one fine sun sensor are left for the customer to integrate. Five fine sun sensors are installed right on the body of ADCS100 in configuration 1 and create a sufficient field of view (FOV); Furthermore, a GNSS antenna is installed on top of the tuna-can (hockey-part). Suppose the optional GNSS module is designated, Tensor Tech will deliver a compact system with all five fine sun sensors & one GNSS antenna pre-calibrated, which avoid users' trouble and lead to system errors in attitude determination. However, put the ADCS100 inside the CubeSat like configuration 2 is feasible, too. All users have to do is install six fine sun sensors and GNSS antenna (if ordered) on top of their satellite and calibrated following instructions.

Configuration 1. Install in the bottom of 3U+ / 6U+ Satellite (Hockey Part)

Occupied Volume: 0.2U



Configuration 2. Install in the middle of CubeSat

Occupied Volume: 0.4U

Introduction to magnetorquer based ADCS10

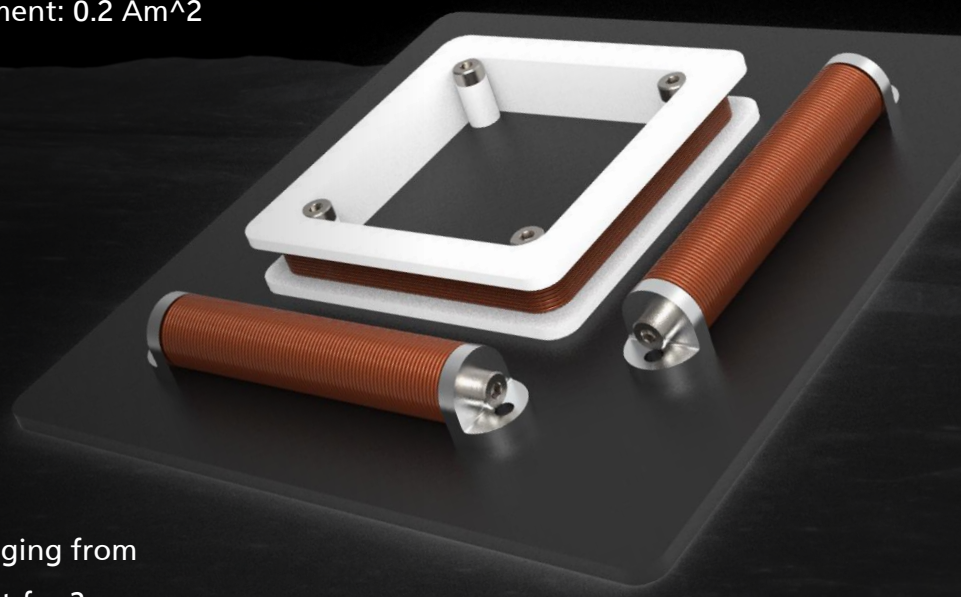
For smaller CubeSats ranging from 1U to 3U, power and volume are limited. In this case, a 3-axis magnetorquer based ADCS is recommended. It fits into users' requirements and delivers enough performance for solar panel pointing & UHF/VHF antenna.

Unlike reaction wheel based ADCS that consumes more power, torquer-based ADCS drives with 3-axis magnetorquers, which is the simplest architecture of ADCS. They generate torque via interacting the torquers' magnetic field with the earth's. Detumbling and a rough pointing mode are provided. However, "blind regions" occur while the commanded torque vector is closely vertical to the earth's magnetic field vector. In these cases, the torquer-based ADCS will have worse pointing accuracy.

To perform the rough pointing functions, GNSS information is required to feed in throughout optional modules or the user's system. Or, TLE information could work, too. Suppose users' mission only required simple functions like detumbling without the need for sun acquisition, the fine sun sensors could be taken away.

Features

- Components included: 3-axis magnetorquer*1, FSS100- fine sun sensor*6 (could be removed), MEMS Gyroscope*1, 3-axis magnetometer*1
- Optional accessories: GNSS receiver & antenna
- Pointing Knowledge: < +/- 0.1 deg @ sun capturable; < +/- 1 deg @ sun is not capturable
- Pointing Accuracy: < +/- 10 deg
- Max. magnetic dipole moment: 0.2 Am^2



Electrical

- Supply voltage: 3.3V & 5V
- Power consumption: <1W

Mechanical

- Volume: 0.2U
- Mass: < 300 g

Reliability

- Designed for CubeSats ranging from 1U to 3U in Low earth orbit for 3 years
- Operating temperature: -20 ~ 60 deg C

User Interface

- Controlled by the onboard computer (OBC) using I2C or UART with attitude command
- User-friendly customer support software for calibration, setting, and simulations on PC
- PC104 connector as the standard offer; able to customize mounting holes & pins & electrical connectors

Introduction to pyramid cluster- ADCS400

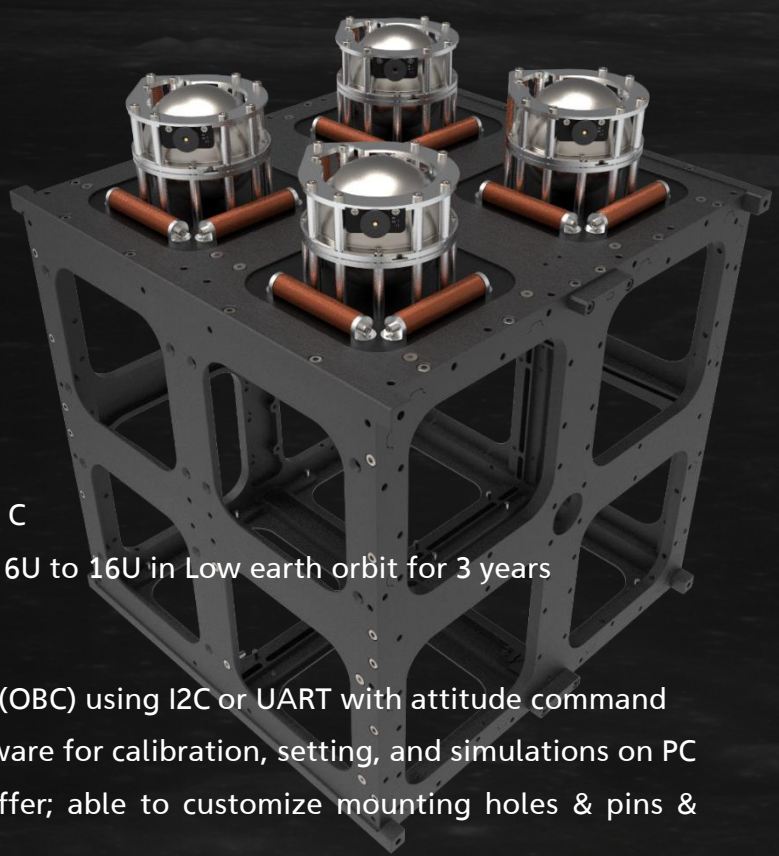
For larger CubeSats ranging from 6U to 16U, ADCS needs larger output torque to achieve a certain slew rate and angular momentum storage large enough to prevent quick saturation. Here we recommend users to consider this ADCS400 composing of 4 ADCS100 forming as a pyramid cluster.

In this case, the reaction sphere can be thought of as a control moment gyro (CMG). The greatest benefit of using CMG as your attitude actuator versus using a reaction wheel is its high torque-to-power ratio. How do they, CMG induces gyroscopic torque while tilting instead of inducing torque via the acceleration/deceleration of the rotor like reaction wheels. In contrast, the control of CMG is less straightforward and requires more complicated steering algorithms.

However, users don't have to worry about the complicated control methodologies behind it. This integrated ADCS solution is aimed at providing a user-friendly interface. Simply command the ADCS400 with attitude requirements in every time step, the system will complete the job for you.

Features

- Components included: RS100- Reaction Sphere*4, 3-axis magnetorquer*1, FSS100- fine sun sensor*6, MEMS Gyroscope*1, 3-axis magnetometer*1 (need to be placed >100mm away from ADCS100)
- Optional accessories: GNSS receiver & antenna
- Pointing Knowledge: < +/- 0.1 deg @ sun capturable; < +/- 1 deg @ sun is not capturable
- Pointing Accuracy: < +/- 0.2 deg @ sun capturable; < +/- 1 deg @ sun is not capturable
- Max. Angular Momentum Storage: 20 mNms; Maximum Torque: 4 mNm (adjustable)
- Rotor imbalance: better than G0.4



Electrical

- Supply voltage: 3.3V & 5V
- Power consumption: <4W

Mechanical

- Volume: installing 4 ADCS100
- Mass: < 1200 g

Reliability

- Operating temperature: -20 ~ 60 deg C
- Designed for CubeSats ranging from 6U to 16U in Low earth orbit for 3 years

User Interface

- Controlled by an onboard computer (OBC) using I2C or UART with attitude command
- User-friendly customer support software for calibration, setting, and simulations on PC
- PC104 connector as the standard offer; able to customize mounting holes & pins & electrical connectors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