# GEN2

# ADCS ACTUATORS

Our Gen 2 actuators are the next step towards a complete, unified ADCS solution for all sizes of satellites. It builds on the successes of Gen 1 and refines the most important aspects. The architecture behind the Gen 2 components allows for full scalability in size, unlocking the potential to apply our ADCS systems for much larger satellites. The new architecture ushers in better connectivity, more mechanically robust designs, and full in-orbit reprogramability.

## CubeWheel

### Robust, high-efficiency reaction wheels

CubeWheels are built using high-precision, high-load bearings with state-of-the-art space-rated lubrication. Despite its robust nature, each wheel is balanced to perfection to enable high precision and stability ADCS systems. Integrated into each wheel is a radiation tolerant electronic drive circuit, which makes controlling it extremely simple. The ease of use, together with the robust design, makes CubeWheel the perfect reaction wheel for satellites with strict requirements on reliability.

## CubeTorquer

### Ultra-low remanence magnetic torquers

Each of our torquers are built using a heat-treated ferrous core, which delivers ultra-low magnetic remanence and high linearity. Our torquers are built using automated machinery and goes through rigorous testing, which ensures absolute repeatability, and enables high volumes and low cost. With their compact design, and low-profile connector, they are perfectly suited for satellites where space and mass are of high

# PRODUCT INFORMATION

## CubeWheel

| Performance | CW0017 | CW0057 | CW0162 | CW0500* | CW1200* | CW2500* | CW5000* |
|---|---|---|---|---|---|---|---|
| Nominal Motor Supply Voltage | 8 | 12 | 12 | 12 | 16 | 24 | 24 |
| Max Speed [RPM] | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 | 10000 |
| Momentum @ 6000 RPM [mNms] | 1.77 | 5.7 | 16.2 | 50 | 120 | 250 | 500 |
| Saturation Torque @ 6000 RPM [mNm] | 0.23 | 2 | 7 | 16 | 20 | 27 | 37 |
| Dynamic Imbalance [g.cm²] | <0.005 | <0.014 | <0.014 | <0.05 | <0.05 | <0.05 | <0.05 |
| **Physical** | | | | | | | |
| Mass [g] | 60 | 115 | 144 | 310 | 450 | 750 | 970 |
| Dimensions [WxLxH] [mm] | 28x28x26 | 35x35x24 | 46x46x24 | 66x66x25 | 72x72x31 | 86x86x36 | 100x100x37 |
| **Power & Data** | | | | | | | |
| Data Bus** | CAN/UART/RS-485 **I2C available for custom solutions | | | | | | |
| Connector | Molex Micro-Lock Plus | | | | Harwin Gecko SL | | |
| Digital Supply Voltage [V] | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| Motor Supply Voltage Range [V] | 6.4-16.8 | 6.4-16.8 | 6.4-16.8 | 6.4-16.8 | 6.4-16.8 | 16-36 | 16-36 |
| Average Power [2000 rpm] [mW] (Includes digital power) | 180 | 336 | 336 | ~800 | 1100 | 2700 | 2700 |
| Average Power 6000 rpm] [mW] (Includes digital power) | 300 | 770 | 770 | 5300 | 4700 | 9000 | 9000 |
| Peak Power [Max Torque @ 6000 rpm] [W] (Includes digital power) | 0.85 | 2.7 | 7.2 | ~15 | 13 | 30 | 48 |
| **Qualification Level** | | | | | | | |
| Radiation [kRad] | 24 | | | | | | |
| Random Vibration [g RMS] | 14.16 (NASA GEVS) | | | | | | |
| Thermal vacuum [°C] | -20 to 80 | | | | | | |
| Thermal cold and hot start [°C] | -35 to 70 | | | | | | |

## CubeTorquer

| Performance | CR0002 | CR0003 | CR0004 | CR0006 | CR0008 | CR0010 | CR0012 | CR0020 |
|---|---|---|---|---|---|---|---|---|
| Max Voltage [V] | 5 | | | | | | | |
| Minimum Magnetic Moment [Am²] @ 5V | 0.20 | 0.30 | 0.40 | 0.60 | 0.80 | 1.00 | 1.20 | 2.00 |
| Magnetic Gain [Am²/A] | 2.3 | 4.3 | 3.3 | 5.8 | 7.0 | 7.8 | 8.6 | 13.2 |
| Linearity [0-5V] | 2.50 % | | | | | | | |
| Nominal Resistance [Ω] | 51.0 | 66.5 | 39.5 | 45.0 | 44.5 | 37.5 | 36.5 | 32.5 |
| **Physical** | | | | | | | | |
| Mass [g] | 16.5 | 23 | 23 | 31 | 28 | 37 | 45 | 54 |
| Dimensions [WxLxH] [mm] | 10.5x47x10.5 | 10.5x59x10.5 | 10.5x59x10.5 | 10.5x77x10.5 | 10.5x92x10.5 | 10.5x92x10.5 | 13x122x13 | 13x152x13 |
| **Power & Data** | | | | | | | | |
| Connector | Molex Pico-Lock | | | | | | | |
| **Qualification Level** | | | | | | | | |
| Radiation [kRad] | N/A | | | | | | | |
| Random Vibration [g RMS] | 14.16 (NASA GEVS) | | | | | | | |
| Thermal vacuum [°C] | -20 to 80 | | | | | | | |
| Thermal cold and hot start [°C] | -35 to 70 | | | | | | | |

# KEY FEATURES

## CubeTorquer



| | | | |
|---|---|---|---|
| COMPACT DESIGN | >95% HIGH LINEARITY | LOW PROFILE CONNECTOR | LOW REMANENCE |

## CubeWheel



## 2U - 27U

### 14.16g RMS | LOW IMBALANCE | INTERNAL MAGNETIC SHIELDING

| | | |
|---|---|---|
| INFLIGHT REPROGRAMABILITY | -20°C - 80°C EXTENDED TEMPERATURE RANGE | 5 YEARS LONG DESIGN LIFETIME |

# WHEEL CONFIGURATION

Depending on the application, a satellite may benefit from either 3 wheels mounted orthogonally or 4 in a pyramid configuration.

| CONFIGURATION | DESCRIPTION | TYPICAL USE CASE |
|---|---|---|
| 3-Wheel | Three orthogonal reaction wheels are used to enable full 3-axis control. | Nadir, sun and inertial pointing. |
| 4-Wheel | Four reaction wheels are mounted in a pyramid configuration to enable 3-Axis control, while providing redundancy for the loss of any one wheel. Wheels are biased to an offset speed to avoid zero crossings | Target tracking and fast slew manoeuvres. |



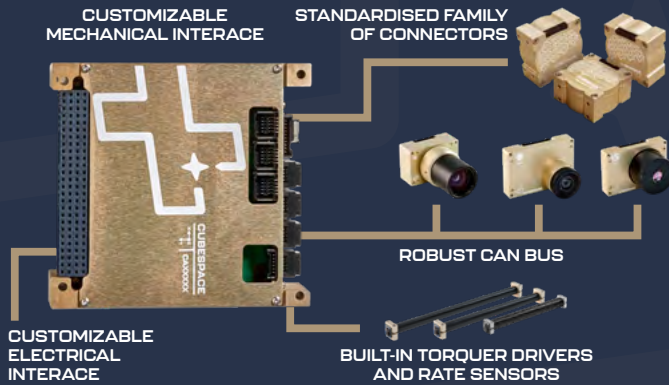3-Wheel configuration



4-Wheel configuration

# ACTUATOR SIZING

| SATELLITE SIZE | CUBEWHEEL | CUBETORQUER |
|---|---|---|
| 2U (2 kg) | 3x CW0017 | CR0002 |
| 3U (4 kg) | 3x CW0057 / 4x CW0017 | CR0002 / CR0003 |
| 6U (10 kg) | 3x CW0162 / 4x CW0057 | CR0004 / CR0008 |
| 12U (20 kg) | 3x CW0500 / 4x CW0162 | CR0012 |
| 27U (50 kg) | 3x CW1200 / 4x CW0500 | CR0020 |

These are typical configurations. Each satellite and mission are different. Please contact us if you need support to size and select your actuators.

# UPGRADE TO A TURN-KEY ADCS

Our integrated ADCS solutions combine our radiation tolerant computer, our flight-proven control system algorithms, our robust fault-detection and correction software, our comprehensive data and event logging mechanisms, with any selection of our sensors and actuators, with the option of also integrating third party components. We also assist with mission analysis and commissioning, effectively being your outsourced ADCS team.

CUSTOMIZABLE MECHANICAL INTERACE

STANDARDISED FAMILY OF CONNECTORS

ROBUST CAN BUS

CUSTOMIZABLE ELECTRICAL INTERACE

BUILT-IN TORQUER DRIVERS AND RATE SENSORS

## ADCS COMPUTER

- Simple API for interface to main OBC
- Bootloader with in-orbit reprogramability for all parts of the ADCS
- Non-volatile memory for permanent storage
- Firmware images for each component
- TLM and event logging and monitoring
- Sensor mounting configuration and calibration
- Range of estimators and controllers
- Synchronization of ADCS components (including PPS input)
- Power monitoring, regulation, and switching
- Fault detection, isolation and recovery (FDIR) mechanisms

# CUBESPACE

CubeSpace, a class-leading aerospace company with a decade of flight heritage, specializes in Attitude Determination and Control Systems (ADCS). With customized electrical and mechanical interfaces, integrated and distributed sensors and actuators, and 3rd party integration capabilities, our systems are designed for any mission and satellite size.

We prioritize personalized service, assisting each customer in achieving the optimal balance between powerful ADCS performance and reliable operations. Our expanded production and cleanroom facilities ensure more than double our previous production capabilities. It also houses cutting-edge equipment, including a dark optics calibration room, humidity-controlled thermal chamber, Helmholtz coil, ø 900 x 1300 mm thermal vacuum chamber, 8kN vibration shaker, auto-winding machine, wheel balancing machine, Kistler table, and high-precision 3-axis rotation stages, all aimed at providing shorter lead times to our valued clients.

The CubeSpace team, comprised of highly qualified aerospace technicians with IPC class 3 training and engineers specializing in control system R&D, has successfully delivered over 3,000 ADCS components to 150 clients, contributing to more than 300 satellites.

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