

High Efficiency, Precision Motor Kits for Spacecraft Attitude Control

Satellites of all sizes require the ability to control their orientation in orbit, what is referred to as “Attitude Control.” Active control systems, such as Reaction Wheels Assemblies, require highly efficient motors for torque and actuation.

The rapid deployments cost-effective Low Earth Orbit (LEO) satellites, including “CubeSat” microsattellites, is being driven by the demand for global broadband communications, scientific missions, and the Military’s ongoing critical intelligence objectives. Whether commercial or defense in nature, these spacecrafts need Attitude Control that enables high accuracy pointing capabilities so that desired objects of interest, point-to-point communication or optical platforms can be effectively utilized.

Two of the most common techniques for providing active control solutions are Reaction Wheel Assemblies (RWA) and Control Moment Gyroscopes (CMG). These systems use a combination of actuators (spinning motors), sensors and software to accurately control the craft.



Different in their designs, RWAs use multiple motors on three-axis that each spin at varying speeds whereby creating inertia and movement in the desired axis. In contrast, CMGs use a single continuous, high-speed spinning flywheel and a gimbal mechanism to change the axis orientation, whereby directing momentum. RWAs are common on smaller craft, including CubeSat satellites, where CMG are common on large platforms, including as used on the International Space Station.

Both RWA and CMG use motors to create an exacting combination of torque and inertia. Desired motor performance for these systems is defined by smooth motion, a lack of jitter, torque linearity, a range of speeds, as well as weight, efficiency and reliability needed for mission critical, space programs.

Key considerations for motor selection by RWA and CMG makers include size, volume and weight, a highly linear output, the need for very smooth and precision motion. Additionally, parts must be made with low-outgassing materials, have a flight heritage and be from suppliers with that can support space-programs’ stringent requirements.

With two lines of high performance slotless motors -- both with space heritage, ThinGap’s patented technology is well suited for active control applications. The TG Series’ high-speed, high-efficiency is ideal for momentum-wheels in both RWA and CMG. The LS Series’ high-torque, lower-speed precision movement is perfect for gimbal applications, like those in a CMG architecture and related Satcom and Optical applications.

Since 2015, ThinGap has shipped thousands of space-grade or MIL-STD rated motor parts for use in commercial satellites, UAV, military and commercial aircraft, and flight-grade NASA programs. Using its proprietary design, very thin wire-wrapped stators and optimized permanent-magnet rotors, all ThinGap designs match the torque output of slotted motors while avoiding the cogging that plagues them. Cogging is an unwanted magnetic torque disturbance inherent in slotted motors.

ThinGap’s slotless architecture provides smooth motion that is critical to communication and optical systems that need precision aiming and pointing over long distances. The ring-shape mechanical design is a perfect form-factor for aerospace applications with their need for high efficiency, precision actuation, direct drive capability and open aperture.

ThinGap motors offer a very linear torque constant, as well as having torque-versus-angle curves with less than 1% harmonic distortion and phase balance making them output the smoothest motion available.



A framed version of the TG-5140 high speed motor kit, 4.8 N-m of continuous torque at 10,000 RPM.

For high-speed operations, like RWA and CMG momentum wheels, the TG Series’ patented ironless-stator allows for higher efficiencies; the output of the TG motor increases with speed, not declines, like a traditional iron-core motor that saturates.

TG Series: highly efficient, high-speed, patented designs naturally enable weight-optimized momentum storage.

Advanced gimbal systems, like those used in CMGs, require high amounts of torque, in some cases to quickly and precisely move in both azimuth and elevation, and in other cases, to quickly compensate for external “tumbling” disturbances common in orbit.

LS Series: the industry’s best torque-to-weight ratio, precession movement, low-profile Gimbal motors.

ThinGap’s LS line offers cogless performance with the advantage of a large through-hole, usually 65% of more of the device’s outer diameter. A large aperture saves both weight and provides valuable space for housing electronics or to pass through cabling. Its low profile is due to an efficient mechanical design and optimized components. LS motors offer high-torque performance equivalent to traditional frameless motors without the trade-off between torque output and smoothness.



The LS 105 (105mm OD) with 1.9 N-m continuous torque at 0-2000 RMP.

Product Guide	LS Series	TG Series
OD sizes	25 mm-267 mm	57 mm-190 mm
Peak Torque	0.04 N-m - 64 N-m	0.35 N-m - 23 N-m
Speeds	0-3,000+ RPM	0-10,000+ RPM

Hall devices, special configurations and custom, application- specific designs are also available.

Space-rated Slottless motor kits for Reaction Wheels Assemblies and Attitude Control solutions.

Space Heritage | Zero-Cogging | Very Efficient
High Torque-to-Weight Ratio | Large Through-Hole
Lightweight | Highly Engineered | USA-made