



Maximize Design in Robotics, Automation, and Motion Control — With New Electrostatic Clutch and Brake Technology

Proven innovation
**delivers dramatic
benefits** previously
not available.



Robotic, motion control and automation

manufacturers must constantly pursue technological, process, workflow, and design improvements to meet colossal competitive pressures and exponential market growth. Product design is central to the effectiveness of a customer solution, and actuator selection is genuinely at the core, causing cascading impacts on task completion time, energy use, human safety, and other critical metrics.

This report highlights how next-generation electrostatic brakes, clutches, and torque limiters can be specified and designed to create the highest level of performance.

Engineering managers, engineering directors, and CTOs worldwide report problems finding rotary and linear components that can fill the form, fit, and function needs of their next-generation products. Requirements are becoming more restrictive, requiring lighter, more efficient, and more compact actuation hardware in a competitive product.

Despite their ubiquity, actuation components have seen relatively little innovation in recent decades. Meanwhile, limitations of conventional brakes, clutches, and torque limiters have persistently led to lower system performance and higher costs. Traditional hardware gives no room for error. However, innovations in electroadhesive technology are changing the design landscape, offering never-before-seen levels of compactness, lightweighting, and energy efficiency.



The ESTAT Rotary Clutch/Brake is perfect for robotics, safety, and motion control applications.

ESTAT Actuation: Redefining What's Possible with Groundbreaking Actuation Hardware

ESTAT is revolutionizing how designers and OEMs perceive actuators. It's goodbye to decades of circular design, frustration, and operational risks as ESTAT technology overcomes long-standing limitations in actuators while supercharging innovation, reducing total cost of ownership -- and introducing new avenues for growth and competitive advantage. Traditional actuators severely limit robotic designs. Actuation hardware has not kept up with the rapid evolution of other enabling technologies, like computer vision, sensors, and artificial intelligence.

So, teams designing next-generation robotics and automation systems commonly find themselves thinking:

- *"My battery life is too short. I need better efficiency."*
- *"My system is too big and slow. How can I make it smaller and lighter?"*
- *"My actuators are overheating and shutting down the robot."*
- *"My actuators are too expensive."*
- *"My actuators are constantly breaking."*
- *"I can't find anything that's high torque and backdrivable."*



Clutches and brakes less than 1mm thick.



Conventional actuators have critical drawbacks. Those offering high torque and high power (e.g., hydraulics and pneumatics) are loud and heavy. BLDC motors and integrated servo motors offer high power density and versatility but are prohibitively expensive for many applications and are quick to overheat. Gearboxes present difficult tradeoffs such as speed vs. torque and cost vs. efficiency. Finally, conventional clutches and brakes – usually electromagnetic – are too heavy, bulky, and power-hungry. Until now, roboticists and motion control designers have been forced to accept these limitations.

ESTAT Actuation addresses these shortcomings head-on — by providing the thinnest, lightest, and most power-efficient clutch, brake, and torque limiter hard-

ware ever built. ESTAT actuator hardware empowers engineers and roboticists to design systems that have long been out of reach.



Comparing Common Technologies

ACTUATOR TECHNOLOGY

❗ POOR

✅ GOOD

⚠️ INTERMEDIATE OR APPLICATION-DEPENDENT

FEATURE	Hydraulic	Pneumatic	BLDC Motor	Integrated Servo Motor	High-Ratio Gears	Low-Ratio Gears	Electromagnetic Clutches & Brakes	ESTAT Clutches & Brakes
High Force / Torque	✅	✅	⚠️	⚠️	✅	⚠️	✅	✅
High Power	✅	✅	⚠️	⚠️	⚠️	⚠️	✅	✅
Power Density	⚠️	⚠️	✅	✅	⚠️	⚠️	❗	✅
Weight	❗	❗	⚠️	⚠️	⚠️	⚠️	⚠️	✅
Noise	❗	❗	✅	✅	✅	✅	✅	✅
Holding Efficiency	⚠️	⚠️	❗	❗	⚠️	❗	❗	✅
Affordability	✅	✅	❗	❗	⚠️	⚠️	⚠️	✅
Reflected Inertia	⚠️	⚠️	✅	✅	❗	⚠️	✅	✅
Heat Generation	⚠️	⚠️	❗	❗	⚠️	⚠️	❗	✅
Compact	❗	❗	✅	⚠️	⚠️	⚠️	⚠️	✅
Modular	❗	❗	❗	❗	❗	❗	❗	✅
Tunable	⚠️	⚠️	✅	✅	⚠️	⚠️	❗	✅

ESTAT's products operate via electrostatic adhesion, like an "electric glue" that causes two surfaces to stick when voltage is applied and release when voltage is removed.

Leveraging this fundamentally different core technology means our clutches and brakes can be *10x lighter, 10x more compact, and 1000x more efficient than conventional options for equal or better performance.*

With these advantages, ESTAT hardware breaks the mold — going where traditional actuators cannot and powering a new wave of robotics innovation.



10X lighter, 10x more compact, 1000x less power consumption, and almost zero resistive heating.

Custom designs are available to match your needs.

ESTAT Solutions: Features and Benefits

- **Reduce weight and inertia.** Optimizing weight at each degree of freedom has cascading positive effects across a robotic system. Using ESTAT products instead of bulky conventional hardware to meet your torque-limiting or power-off safety requirements leads to higher operating speeds and payload capacities.
- **Consume less energy.** Counterintuitively, adding a highly efficient clutch or brake to a motorized joint can reduce motor requirements. The clutch shares the load with the motor, allowing designers to use smaller motors. Plus, when the robot is stationary, the clutch can support the entire load, meaning the motor consumes no power.
- **Generate less heat.** Consuming almost no power means that ESTAT hardware does not heat itself up. Consequently, your system can experience fewer thermal shut-offs and be safer for human interaction.
- **Engineer creatively.** ESTAT clutches and brakes, being fully modular, are ideal for an accelerated design cycle. Intuitive and cost-effective ESTAT voltage drivers also make it easy to use our hardware right out of the box.
- **Dial in your performance.** ESTAT clutches and brakes are highly tunable; raise the voltage to transmit more torque and lower the voltage to transmit less. It's that simple.
- **Do more with less space.** Paper-thin and flexible, ESTAT products fit virtually anywhere and can quickly scale to your specifications.
- **Save money.** Conventional actuation hardware is prone to breaking. One shock load is enough to shatter an expensive gearbox, whether it's a robot falling over, being dropped, or being accidentally over-torqued. Now, your team has to shoulder the replacement and repair costs, console a frustrated customer, and delay other priorities. All of these increase the total cost of ownership. Instead, lower TCO (and preserve your customers' patience) by protecting your drivetrain with ESTAT's electrically controllable torque limiters.
- **Supercharge your team's innovation.** In a world of intense competition, truly innovative technologies are few and far between. You have to fight for every slight improvement. ESTAT can help you and your team move beyond incrementalism. Our game-changing actuation technology will help your engineering teams approach design with a fresh perspective.
- **Partner for growth.** With our lightweight and compact design, ESTAT Actuation's electroadhesive clutches and brakes enable manufacturers to create sleek and agile robotic systems that outperform traditional hardware. By partnering with ESTAT, robotics manufacturers and automation providers can differentiate their products, achieve a competitive edge, and position themselves as leaders in the industry.
- **Move quickly.** ESTAT excels at prototyping, delivering high-quality hardware in weeks, not months, enabling you to be more agile and responsive to your own customers.

ESTAT Technology Advantages

Robotics, automation, and motion control systems have been stuck with the same conventional actuator components for decades, leading teams to focus on improving their solution through software or sensor changes instead. However, this approach can only take a robotic solution as far as the hardware performance limits and cost limits will allow. ESTAT's leap forward in actuator technology now offers the opportunity to achieve a dramatic competitive advantage in hardware for both existing and new products. Fortunately, with a focused internal team and the right partner, you can ensure your products' continuing success and margins as we set the new industry standard for robot and motion control capabilities.



Contact us today to order your prototype for testing in your actuator system.

Who Benefits?

- Exoskeleton and prosthetics designers
- Automation and machinery OEMs
- Cutting-edge robot designers
- Motor, gearbox, and motion control OEMs

Markets and Applications

- Medical and Life Science
- Automation and Robotics
- Military applications
- Semiconductor
- Automotive
- Aerospace
- Motion Control

Contact us today for a quote and technical discussion on how our technology can take your design to the next level!



ESTAT Actuation

91 43rd St. Suite 260 | Pittsburgh, PA 15201
(412) 212-3103 | info@estat.tech | www.estat.tech
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