

ROTARY CLUTCH SELECTION GUIDE

ULTRA EFFICIENT

ULTRA SLIM



DESIGN

THE IMPOSSIBLE



ESTAT

ACTUATION

10x LIGHTER
10x MORE COMPACT
1000x MORE EFFICIENT

The world's most efficient and compact robotic clutches and brakes.

ESTAT products are 10 times lighter, 10 times more compact, and 1000 times more efficient than conventional options.

Whether you need small quantities for evaluation or are ready to scale, ESTAT's rapid production processes and team of contract manufacturers ensure our clutches and brakes are ready when you are.

YOUR SPACE, WEIGHT AND ENERGY PROBLEMS
SOLVED.

Want a braked motor, but can't fit a brake?

ESTAT clutches are exceptionally thin
(as small as 0.8 mm)

Want a brake, but can't afford the power costs?

Regardless of size or torque capacity, all of ESTAT's products operate on an energy budget less than .75 watts in the most strenuous cases .

Need a large thru-bore?

ESTAT clutches can accommodate.

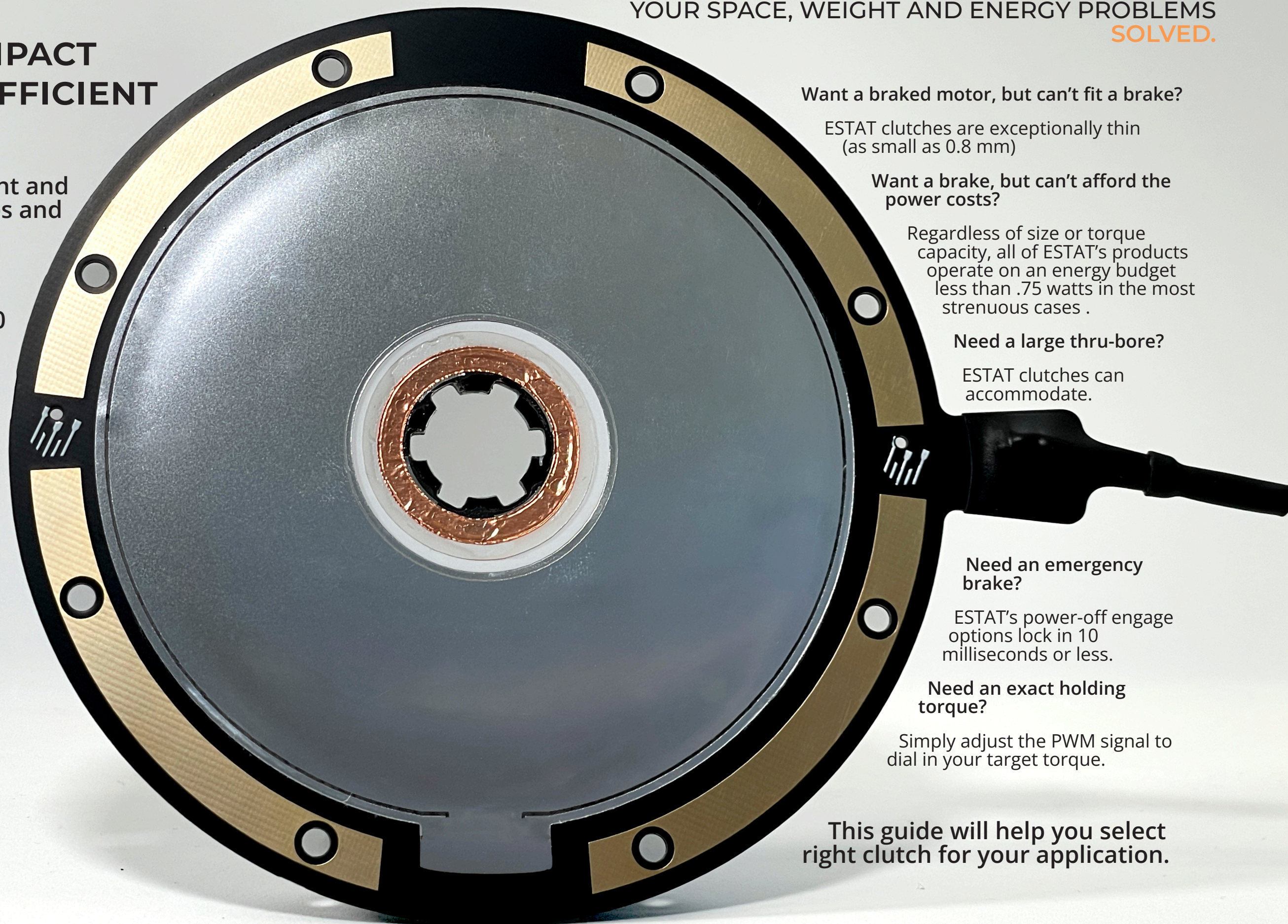
Need an emergency brake?

ESTAT's power-off engage options lock in 10 milliseconds or less.

Need an exact holding torque?

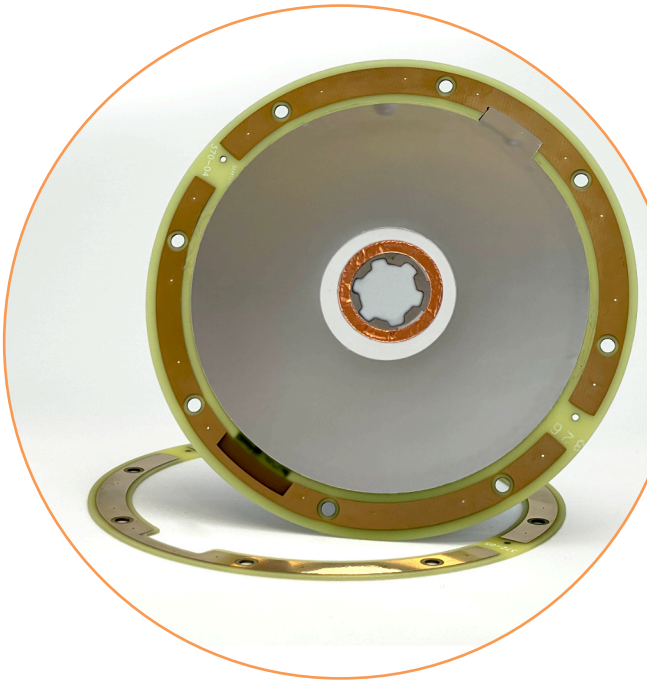
Simply adjust the PWM signal to dial in your target torque.

This guide will help you select right clutch for your application.



OUR ROTARY CLUTCHES

Series F - Our Framed Clutches are designed for ease of use. These clutches are designed to bolt into place onto motors or onto the high torque output of gearboxes. We take care of the housing and shaft adapters.

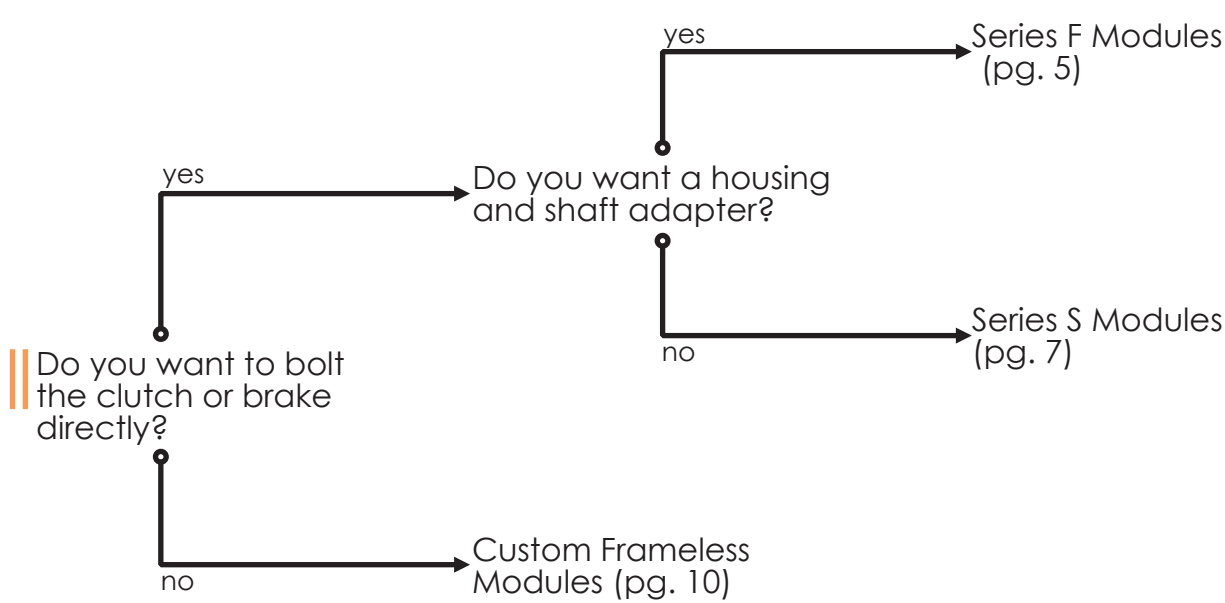


Series S - Our Slim Clutch modules are designed for compact robotic assemblies. Think of these clutches as small components in your greater design. We supply the clutch components that fit your housing and shaft.



Custom Frameless clutches - Designed for ultra-compact robotic assemblies. Similar to frameless motors, these clutches are designed to be clamped, glued, or held by splines as specified by the customer. These offer the greatest torque density.

PICK WHAT'S BEST FOR YOU

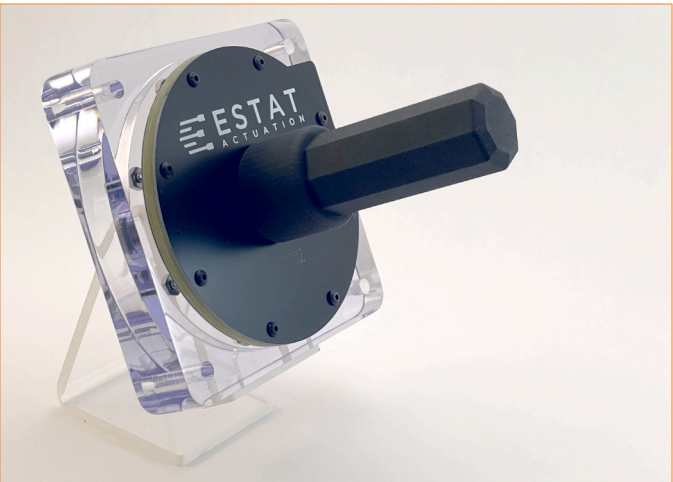


Wanna take it for a spin?

Evaluation units

Don't know what you need, but want to try something out? Our evaluation units allow you to experience our electrostatic rotary clutches within seconds of unboxing.

The handle and base accessories provide simple grips for a tactile experience. Our rechargeable manually controlled voltage drivers allow for immediate testing without the hassle of mounting and wiring.



SERIES F - FRAMED CLUTCHES



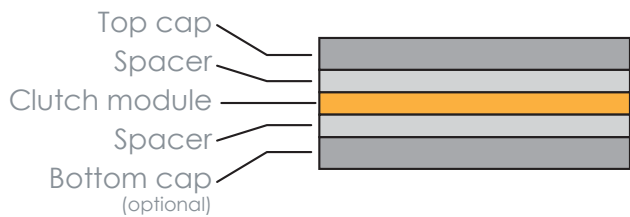
A ready-made solution designed to bolt effortlessly into place on the output of an existing motor or gearbox.

Tech Tip: Unlike conventional clutches, ESTAT clutches are made of repeating clutch modules. These clutch modules are most commonly 0.8 mm thick.

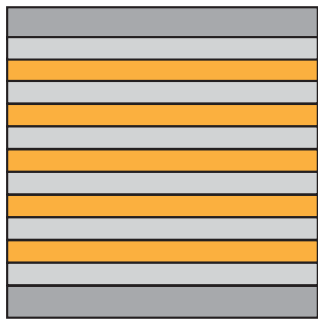
For each frame size, the number of modules determines the rated torque. Two modules produce twice the torque of a single module. Three modules produce three times the torque, and so on. In other words, torque increases linearly with the number of modules.

The minimum of the configurable torque range represents the maximum torque supported by a single module. The high end of the configurable torque range is set by the torque limits of the shaft or bolted connections.

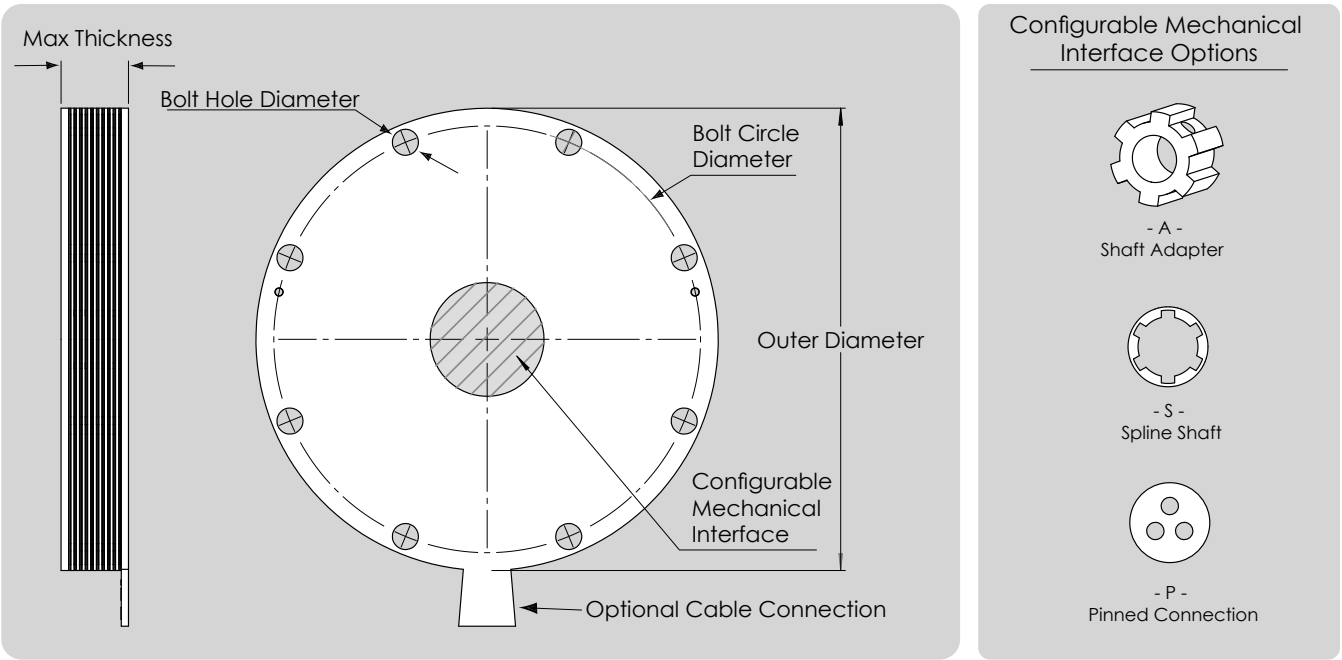
Each module and required spacer increases the thickness of the clutch by 1.6 mm.



Add modules to reach desired torque capacity



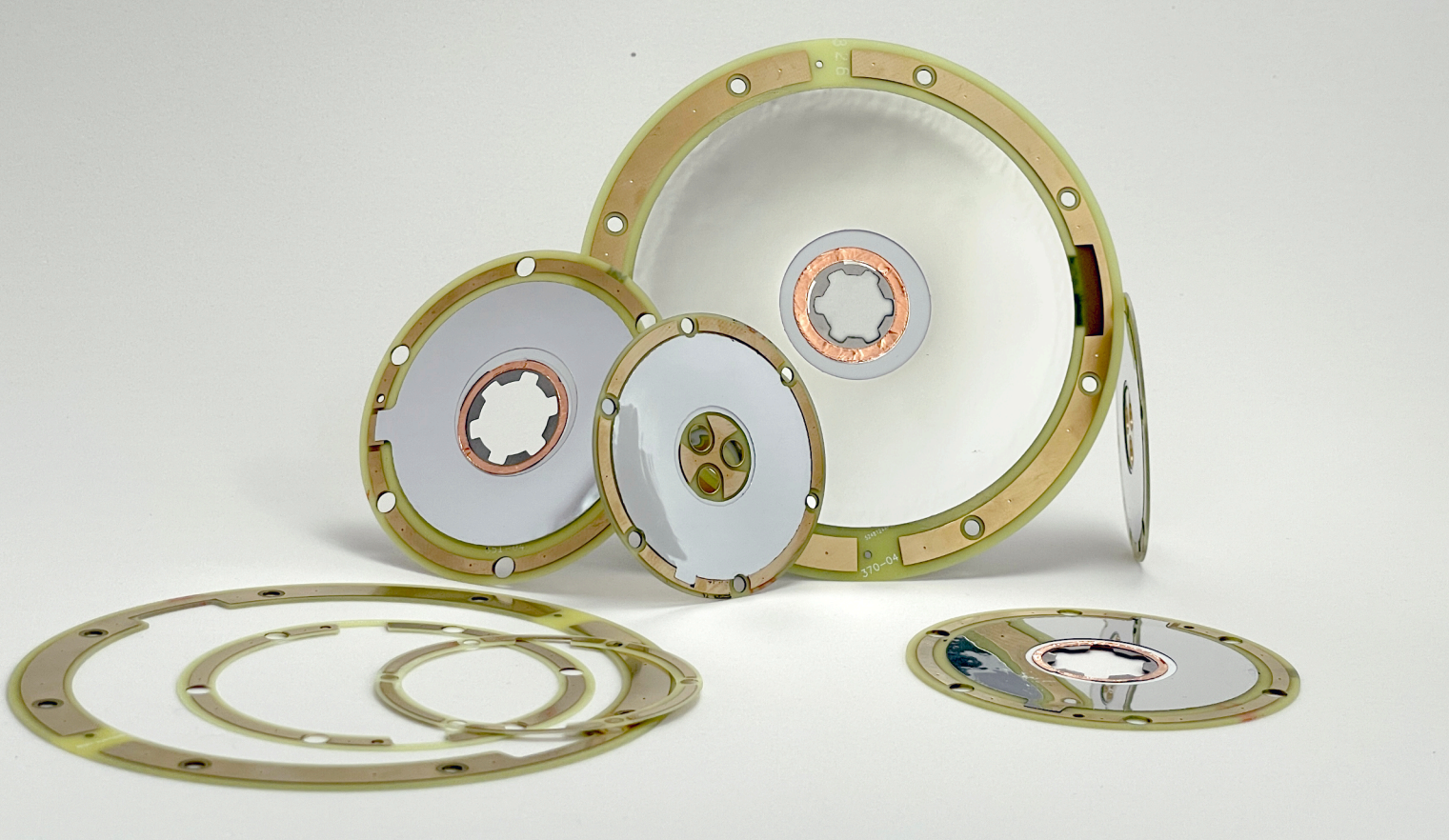
SERIES F - DIMENSIONAL VIEW



SERIES F - SPECIFICATIONS															
		058		067		073		098		117		120		133	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Exact Outer Diameter	mm	58		66.8		73		97.5		117		120.1		132.7	
Bolt Circle Diameter	mm	52.8		62		66		90		106		112		125.7	
Number of Bolts	#	6		8		6		8		8		8		8	
Bolt Hole Diameter	mm	3.2		2		4.4		5.5		3.3		6.6		5.5	
Thickness	mm	4.8	38.8	4.8	23	4.8	42.0	4.8	19.8	4.8	19.8	4.8	23	4.8	11.9
	in	0.19	1.53	0.19	0.91	0.19	1.65	0.19	0.78	0.19	0.78	0.19	0.91	0.19	0.47
Torque	Nm	0.37	8	0.9	10	0.8	20	3.1	30	4	40	6.2	77	11.2	50
	lb-in	3	71	8	89	7	177	27	266	35	354	55	682	99	442
Clutch Modules	#	1	22	1	12	1	24	1	10	1	10	1	12	1	5

LARGE THROUGH-BORE SPECIFICATIONS							
		108T		120T		177T	
		Min	Max	Min	Max	Min	Max
Exact Outer Diameter	mm	108		119.9		176.9	
Bolt Circle Diameter	mm	100		108		165	
Number of Bolts	#	6		8		8	
Bolt Hole Diameter	mm	4.5		3.8		8.4	
Through-Bore Size	mm	113		115		200	
Thickness	mm	5.6	42.0	5.6	42.0	5.6	35.6
	in	0.22	1.65	0.22	1.65	0.22	1.4
Torque	Nm	2.8	67	4.3	100	20.2	400
	lb-in	25	593	38	885	179	3540
Clutch Modules	#	1	24	1	24	1	20

SERIES S - SLIM CLUTCH MODULES



These ultra-slim clutch components provide the thinnest solution that can be bolted into place. ESTAT provides the clutch components, you bolt it into your housing. These clutches are perfect for high end robotic applications where space comes at a premium.

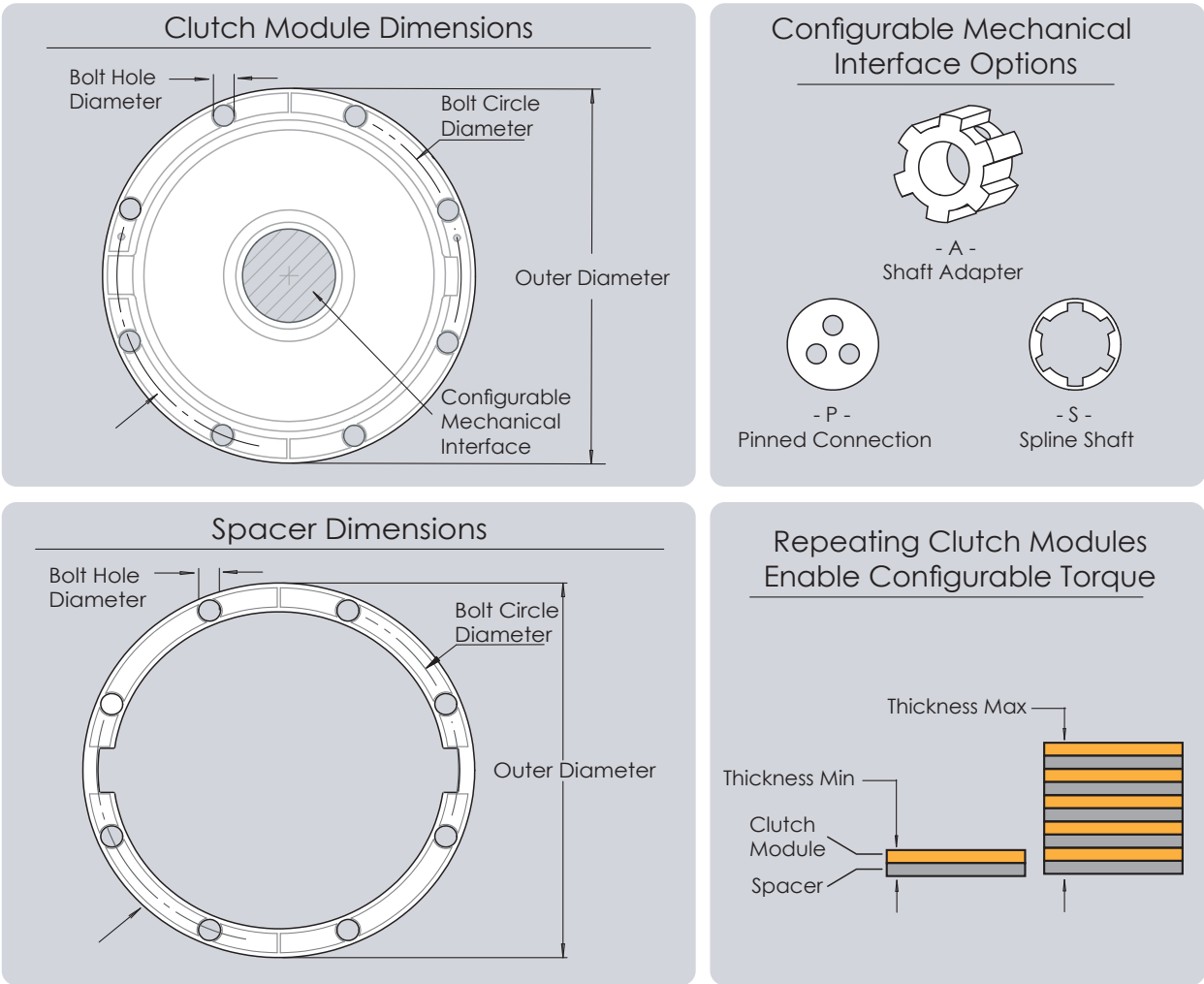
Tech Tips:

- 1) Unlike conventional clutches, ESTAT clutches are made of repeating clutch modules. These clutch modules are most commonly .8 mm thick and must be separated by clutch spacers. For each frame size, the number of modules determines the rated torque. Two modules produce twice the torque of a single module. Three modules produce three times the torque, etc. The minimum of the configurable torque range represents the torque produced by a single module. The high end of the configurable torque range is set by the torque limits of the shaft or bolted connections.

Each module increases the thickness of the clutch by 1.6 mm.

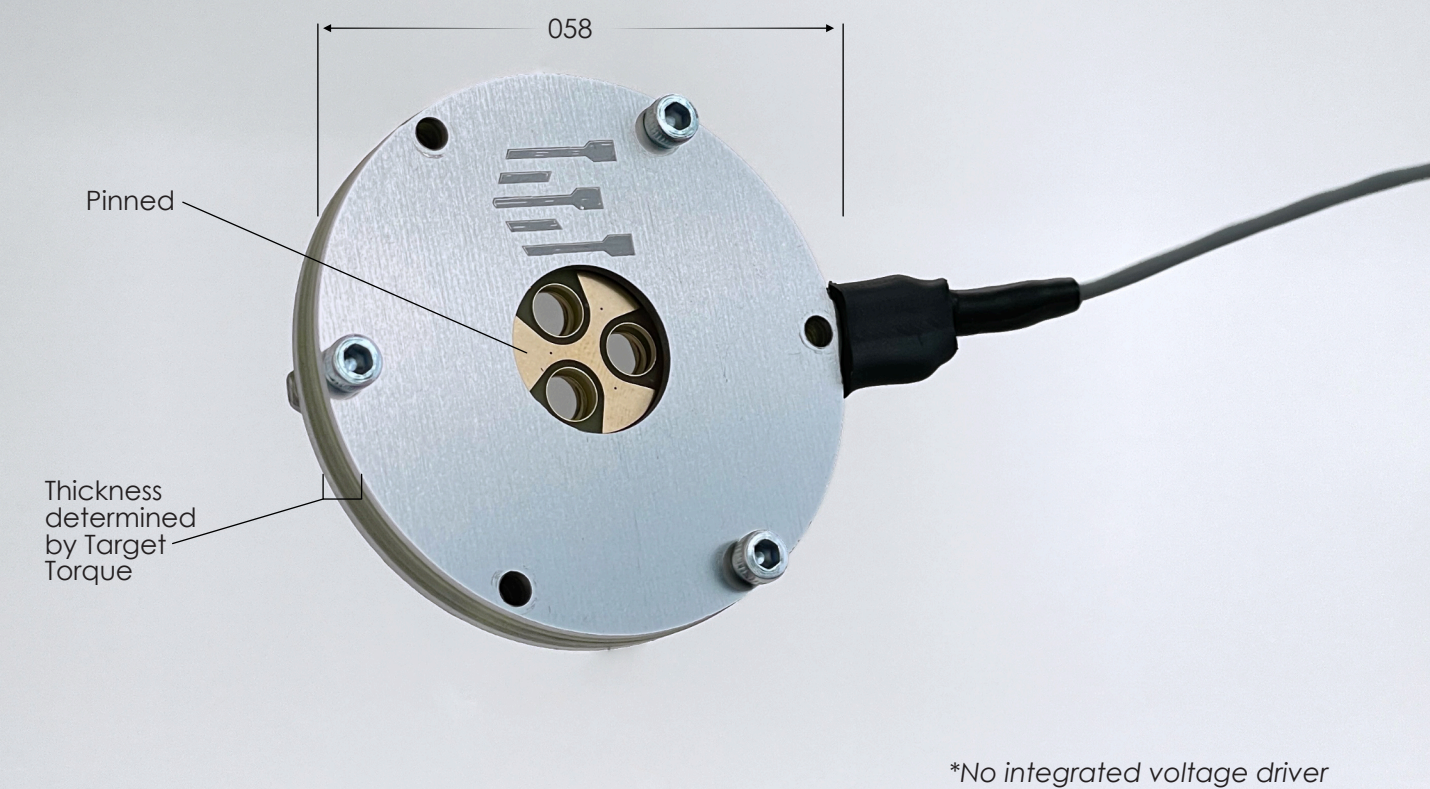
- 2) Only one module requires an electrical connection. Each additional module receives its power from the adjacent clutch module

SERIES S DIMENSIONAL VIEW



Series S - Specifications															
		058		067		073		098		117		120		133	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Exact Outer Diameter	mm	58		66.8		73		97.5		117		120.1		132.7	
Bolt Circle Diameter	mm	52.8		62		66		90		106		112		125.7	
Number of Bolts	#	6		8		6		8		8		8		8	
Bolt Hole Diameter	mm	3.2		2		4.4		5.5		3.3		6.6		5.5	
Thickness	mm	1.6	37.0	1.6	21.4	1.6	40.3	1.6	16.6	1.6	18.2	1.6	20	1.6	10.3
	in	0.06	1.46	0.06	0.84	0.06	1.59	0.06	0.65	0.06	0.72	0.06	0.79	0.06	0.41
Torque	Nm	0.37	8	0.9	10	0.8	20	3.5	30	4	40	6.8	77	11.4	50
	lb-in	3	71	8	88	7	177	31	265	35	354	60	682	101	443
Clutch Modules	#	1	26	1	12	1	25	1	9	1	10	1	12	1	5

LARGE THROUGH-BORE SPECIFICATIONS							
		108T		120T		177T	
		Min	Max	Min	Max	Min	Max
Exact Outer Diameter	mm	108		119.9		176.9	
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Through-Bore Size	mm	113		115		200	
Thickness	mm	5.6	40.3	5.6	40.3	5.6	34.0
	in	0.22	1.59	0.22	1.59	0.22	1.34
Torque	Nm	2.8	67	4.3	100	20.2	400
	lb-in	25	593	38	885	179	3540
Clutch Modules	#	1	24	1	24	1	20



Nomenclature **Series** - Frame - Torque -Interface - Lead - Driver - POE - IP rating
Above Example **F-058-4.2-P-B-N-NO-30**
**No integrated voltage driver*

Clutch Series

- F - Framed (bolt-on assembly)⁺
- S - Slim (bolt-in clutch modules)

Frame Size

- measurement in millimeters

Target Torque

- measurement in Newton meters in increments of minimum torque, ranging from min to max.

Mechanical Interface

- P - pinned⁺
- S - spline shaft
- A - adapter - for connecting standard shaft sizes to ESTAT clutches. (Note: use of an adapter slightly reduces torque capability.)
- K - keyed shaft⁺
- S - set screw for round or D shaft
- C - custom request (Note: large mechanical interfaces reduce torque capability.)

Lead Option

- S - solder pads on top face
- B - bare leads⁺
- C - connector for interfacing directly with ESTAT's standard voltage drivers

Voltage Driver

- I - integrated to reduce cabling and eliminate high-voltage leads
- N - non-integrated (most compact option)⁺

Power-Off Engage (Emergency Brake)

- PO - power-off engage⁺
- NO - no power-off engage

Ingress Protection (IP rating)*

- numerical rating per IP code
**Only available for F Series clutches.*
Baseline outer diameter and thickness assume IP-30. These measures are subject to change when more rigorous ingress protection is required.
⁺ Indicates the most common selection



LOOKING FOR THE **MOST COMPACT** SOLUTION?

ESTAT offers frameless clutches on a custom-order basis.

Similar to frameless motors, our custom frameless clutches are the most compact method for integrating an electroadhesive clutch.

Frameless clutches include separate rotor and frame components that are each mounted separately into the greater device assembly.

Methods for mounting include:

- | | |
|-----------------|----------------------------------|
| • Press fit | • Barrel clamp |
| • Adhesive bond | • Splined or toothed connections |
| • Axial clamp | |

ESTAT's frameless clutches have the greatest torque density of our clutch options. Eliminating bolts from the assembly frees up space on the clutch's outer diameter, allowing a greater area of clutch interface. This small difference pays large dividends as clutch torque scales with radius cubed. A few extra millimeters can result in surprisingly large torque boosts!

Not seeing what you need?

If you need to make and break a connection in a controllable way, we can help: our electroadhesives are paper-thin and can fit almost anywhere.

Here are ways we have helped customers:

- Add an emergency brake to an existing application
- Provide a tunable mechanical fuse for emergency breakaways
- Retrofit a brake to an existing joint to improve rigidity
- Cut down on heat generation by replacing motors for joint locking

ESTAT’s standard offerings are available on short lead times.

We are a lean startup that can move with agility to provide clutches for engineering evaluation on short lead times (4-12 weeks). We are supported by verified contract manufacturers so we are ready to scale when you are.

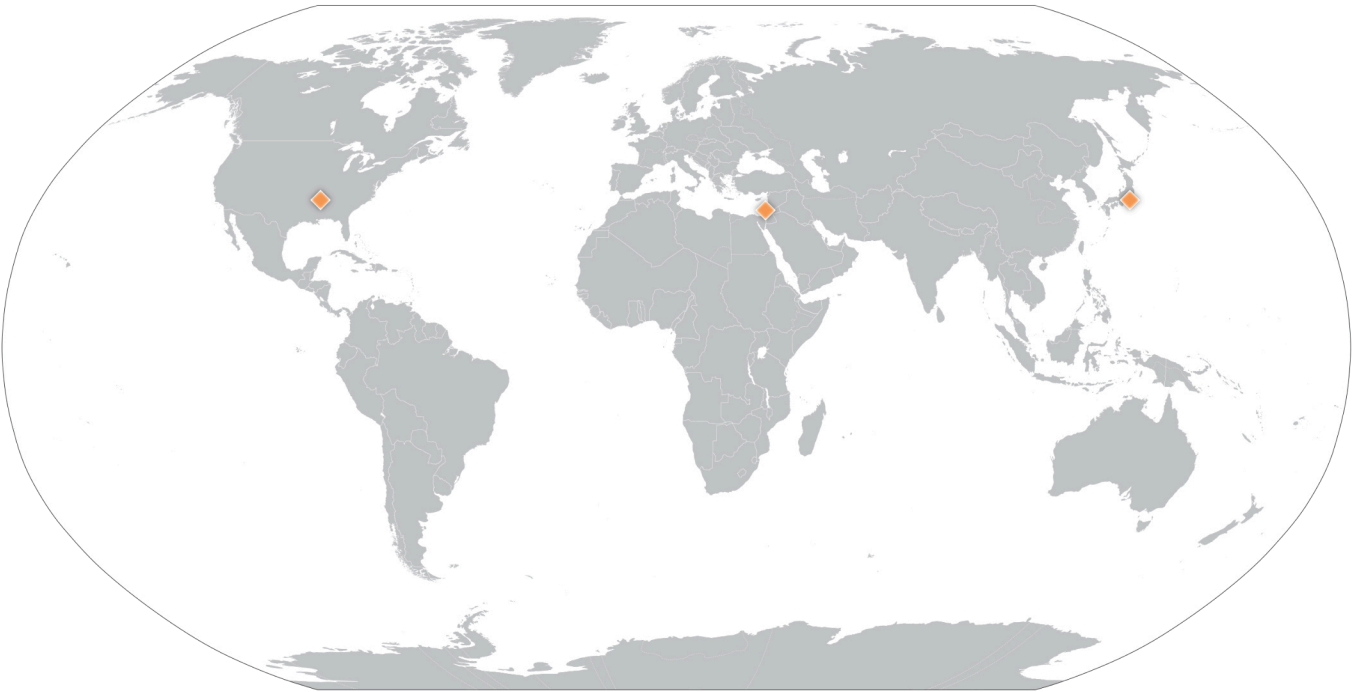
Our sales representatives in the following regions offer hands-on demos and support:

- Israel

Japan

United States

 - Ohio
 - Kentucky
 - Tennessee
 - Maryland
 - D.C.
- Delaware
 - W. Virginia
 - Virginia
 - North Carolina
 - South Carolina
 - Georgia
 - Florida
 - Alabama
 - Mississippi



Ask about our latest offerings

- Tunable break away clutches** - Clutches with exact holding force
- Cylindrical clutches** - Tube shaped clutches with wall thickness of less than 1 mm
- Emergency brakes** - Clutches with added power-off engage functionality
- Linear clutches** - Paper-thin clutches with peel and stick assembly for linear applications



Our clutches and brakes require an ESTAT voltage driver to operate.

Simply connect the voltage driver to input power (4.5-24.5 volts) and lock and unlock the clutch using a digital logic signal (high is engaged, low is disengaged).

Unlike most braking hardware, ESTAT’s electrostatic clutches feature a selectable max holding torque. This feature, reusable mechanical fuse.

The **Isolated Voltage Driver with Digital Control** is the key to fully leveraging this powerful feature. A simple PWM input gives the user direct, precise, and continuous control over the max holding torque produced by their ESTAT braking hardware.

- Key Features**
- Tunable:** with direct control over the PWM input signal duty cycle, you can dial in the precise torque the ESTAT brake or clutch will support before slip.
 - Convenient Control:** easy to use and highly efficient, this Driver interfaces directly with your control circuit.
 - Versatile:** the Isolated Voltage Driver with Digital Control allows quick, intuitive control of any ESTAT clutch.
 - Compact:** just 27.2 g (approx. 1 oz.) and compact enough to fit in the palm of your hand. The Isolated Voltage Driver provides powerful control anywhere.
 - Synchronous control** of multiple clutch or brake devices connected in parallel using a single voltage driver.
 - Independent control** of multiple devices using a single voltage driver is available upon request.

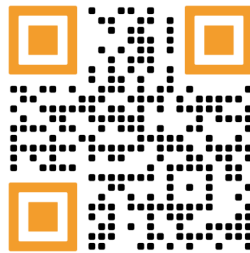


For more information, visit our [website](#):



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A C T U A T I O N

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