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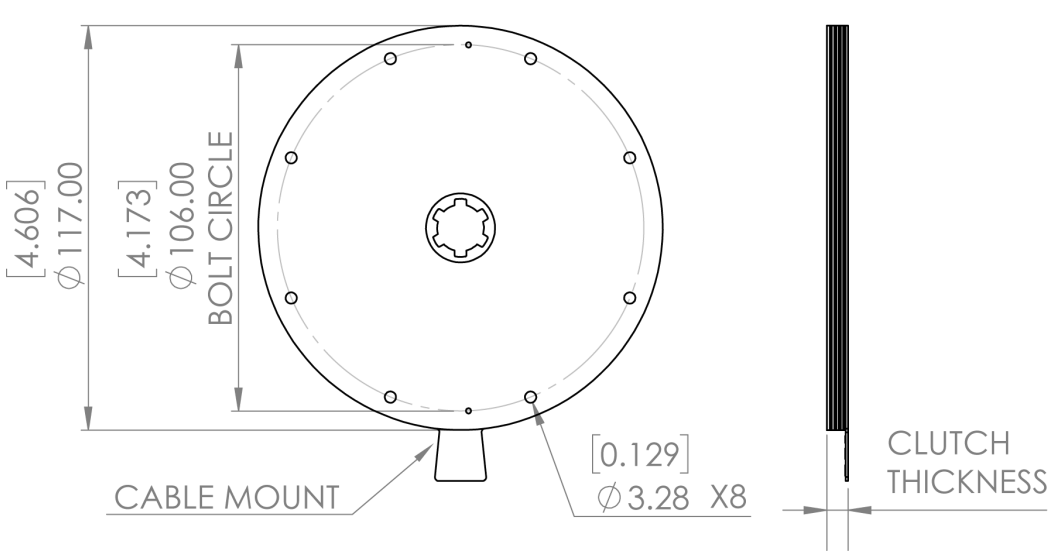
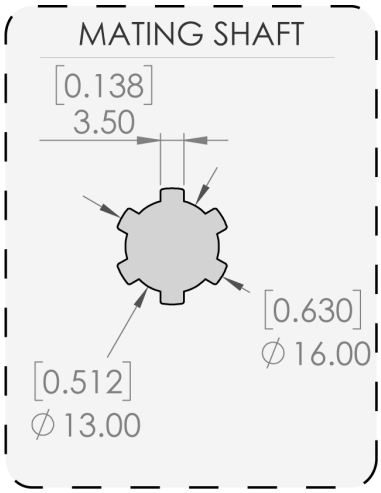
UltraSlim Rotary Evaluation Unit

Nested Disc Clutch

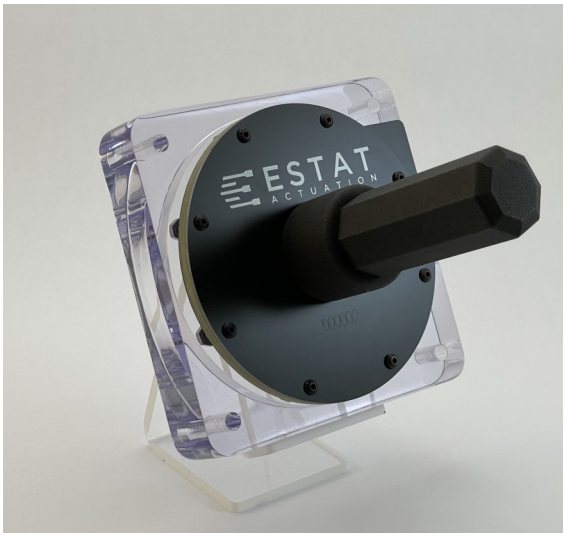
UltraSlim units provide the same holding torque as conventional options with 10x less mass, 10x less volume and 1000x less power consumption. The UltraSlim Evaluation Unit is available in a number of thicknesses to achieve different target-holding torques. All of the evaluation units are composed of clutch modules. Each clutch module adds 4 Nm of holding capacity for an additional 1.2 mm of thickness. The US-4 module is a demo unit that represents a single clutch module without any additional components. The US-12, US-24, and US-36 are full clutch units composed of multiple clutch modules and other components. Clutch units ship with a base and handle for instant evaluation after unboxing.





	Model			
Technical Specifications	**US-4 module**	**ESTAT US-12**	**ESTAT US-24**	**ESTAT US-36**
Clutch thickness—mm (inch)	0.8 (0.032)	6.2 (0.244)	9.4 (0.370)	12.8 (0.504)
Weight: clutch only—g (lb)	22 (0.049)	160 (0.35)	271 (0.60)	382 (0.842)
Rotational inertia—kg m^2 (lbm ft^2)	7.0×10^{-6} (1.6×10^{-4})	7.5×10^{-5} (1.8×10^{-3})	1.5×10^{-4} (3.6×10^{-3})	2.2×10^{-4} (5.3×10^{-3})
Max rated torque—Nm (in-lb)	4 (35.4)	12 (106.2)	24 (212.4)	36 (318.6)
Off-state friction—Nm (in-lb)	< 0.05 (0.44)	< 0.05 (0.44)	< 0.06 (0.53)	< 0.09 (0.80)
Response— msec	< 20	< 20	< 20	< 20
Power consumption (1 Hz cycling)* — **W**	< 0.002	< 0.006	< 0.012	< 0.018
Activated maintenance power — **mW** @ 400V	< 0.06	< 0.16	< 0.32	< 0.48

**Power consumption at one Hz cycling is the average power consumption experienced by the clutch when it is activated for 0.5 seconds and deactivated for 0.5 seconds in a repeating cycle.*



Device overview:

The **UltraSlim Evaluation Unit** allows users to experience our electrostatic rotary clutch within seconds of unboxing. The handle and base accessories provide simple grips for a tactile experience. Just click “engage” on the voltage driver (sold separately) to operate.

The clutch itself is extremely compact. ESTAT clutches are formed of multiple clutch modules (below) each measuring only 0.8 mm thick. Stacking multiple modules increases the torque capacity of the clutch. The quantity and diameter of these modules can be selected to fit any application.

Our clutches are 10 times lighter and 1000 times more efficient than conventional electromagnetic options.

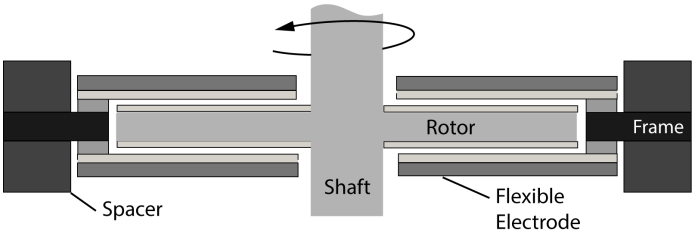
Device operation:

ESTAT clutches are load-bearing capacitors. Applying voltage across the clutch electrodes causes accumulation of positive charges on one side of the clutch and negative charges on the other. This results in adhesion between the rotor and the flexible electrodes, which locks the clutch. As capacitors, ESTAT clutches require minimal maintenance current to remain engaged (< 10 µA). The clutch disengages when the voltage potential is removed.

The inner clutch rotor interacts with a spline shaft. The outer clutch electrodes are connected to the clutch housing. Clutches can be customized to fit spline shafts, keyed shafts or other transmission elements.

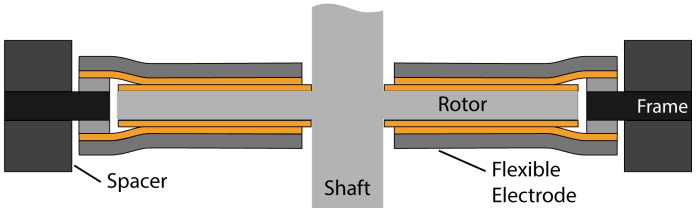
Disengaged - Power Off

Shaft and rotor are free spinning



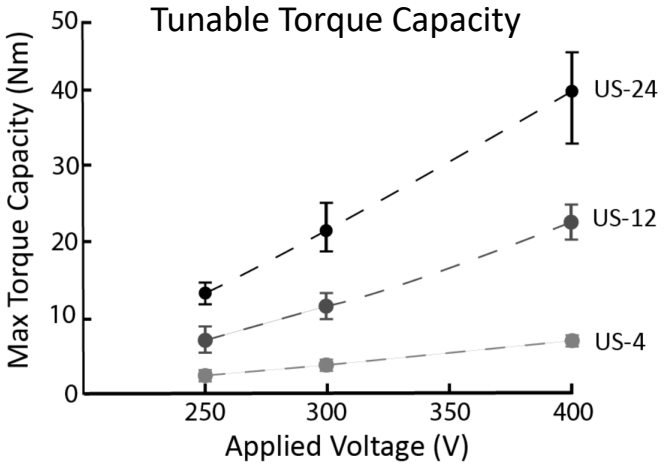
Engaged - Power On

Shaft and rotor are coupled to outer frame



Adjusting max load:

Maximum torque can be adjusted by modulating applied voltage (right bottom). This behavior can be used as a mechanical fuse to provide gear train protection or for other torque-limiting applications. If applied torque exceeds the maximum holding torque, the clutch will slip. This slip is accompanied by a drop in torque as the clutch transitions from static to kinetic friction. Try the low, medium and high voltage settings on the included voltage driver to experience this feature.



*Markers denote low, medium and high voltage driver settings

Email **info@estat.tech** for availability, questions, or to place an order.

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Note: specifications subject to change without notice.

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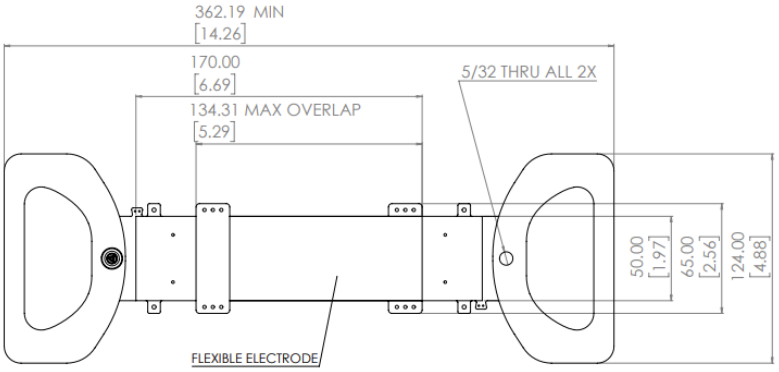
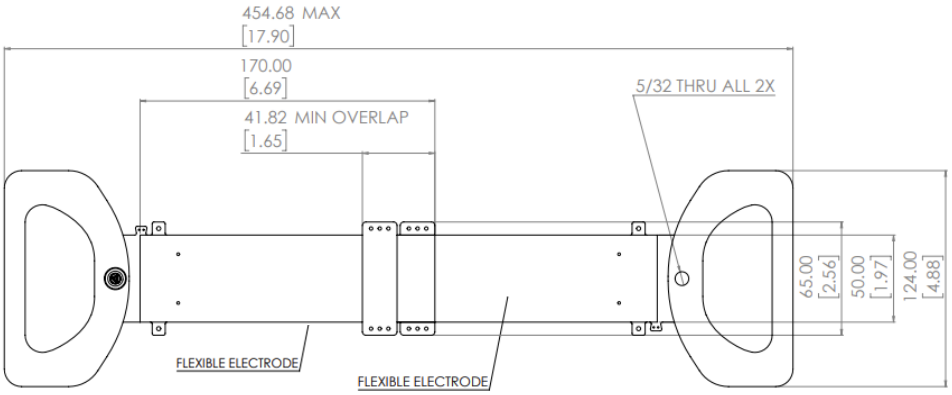
UltraSlim Linear Clutch Evaluation Unit

The Evaluation Unit includes a flexible linear clutch with handles for instant assessment after unboxing. The **UltraSlim Linear Clutch** boasts a thickness of only 1.05 mm, making it ideal for wearable robotics applications, walking robots, and general motion control in systems requiring light-weight, power-efficient actuation. For custom orders, travel length and dimensions are configurable for each application.

Collapsed



Extended



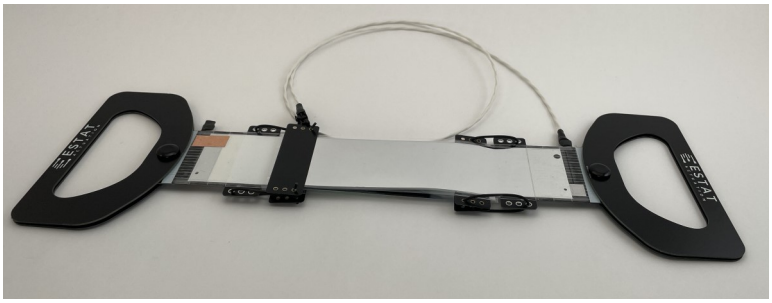
Technical Specifications	UltraThin Evaluation Unit
Reliable Holding force — N (lb)	100 (22.5)
Maximum Travel—cm (in)	8.75 (3.44)
Weight: clutch only — g (lb)	28 (0.06)
Weight: with handles — g (lb)	71 (0.16)
Power consumption with 1 Hz cycling — W @ 400 V	< 0.003
Activated maintenance power — **mW** @ 400V	< 0.08
Operating voltage range — V	250—400
Response Time* – msec	< 25
Maximum Hard Stop Load—N (lb)	350 (78.68)
Max tensioner force—N (lb)	16.0 (3.6)

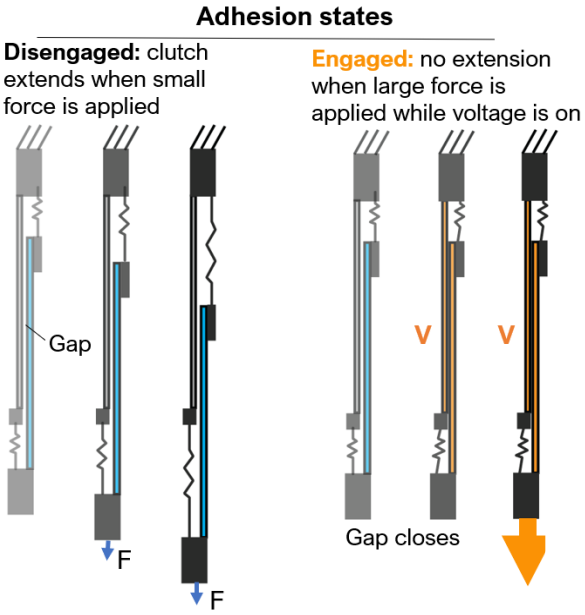
**Response time encompasses both engage and release times. Release time is measured at 400V operating voltage and released under load.*

Device overview:

The **UltraSlim Linear clutch** allows evaluation within seconds of unboxing. The handles provide simple grips for a tactile experience. Just click “engage” on the battery powered voltage driver (sold separately) to operate.

The linear evaluation clutch is extremely compact with an overall thickness of 1.05 mm. ESTAT clutches are composed of structural frames and flexible electrostatic webs. These webs are designed to be flexible and strong to support tensile loads. Multiple clutches can be stacked to increase force capacity.





Device operation:

ESTAT clutches are load-bearing capacitors. Applying voltage across the clutch webs causes accumulation of positive charges and negative charges on each side of the clutch. This results in adhesion between the clutch webs which prevents further extension of the clutch. When disengaged, the clutch is free to slide with only minimal resistance from tensioners.

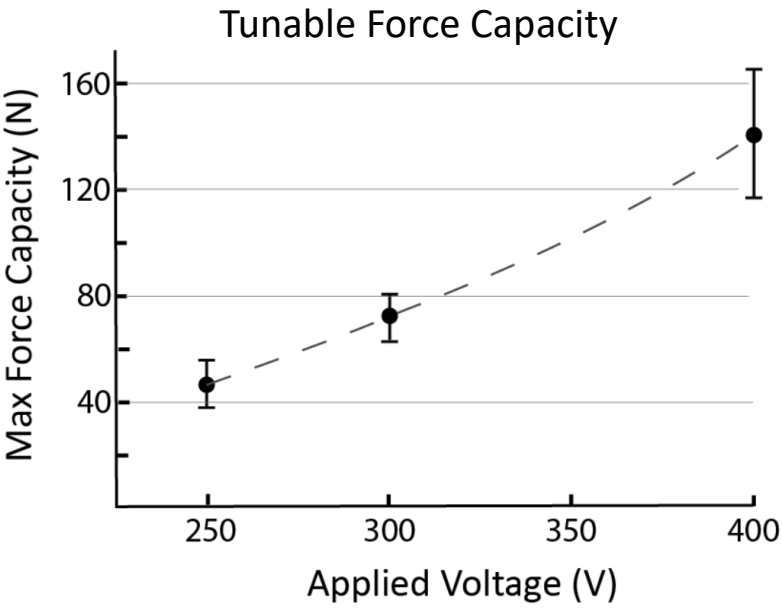
As capacitors, ESTAT clutches require minimal maintenance current to remain engaged (< 10 µA). The clutch disengages when the voltage potential is removed.

Note: The Linear Evaluation Unit is designed to support tensile loads only. For more information on linear models that also support compressive loads, contact info@estat.tech.

Adjusting max load:

Maximum force can be adjusted by modulating applied voltage (right). This behavior can be used as a mechanical fuse to provide protection for delicate components or for other force-limiting use cases. If applied force exceeds the maximum holding force, the clutch will slip. This slip is accompanied by a drop in force as the clutch transitions from static to kinetic friction. Try the low, medium and high voltage settings on the included voltage driver to experience this feature.

Operate the evaluation unit in a dry environment, free of metal filings or other debris. Contact info@estat.tech for more information on environmental sealing options.



*Markers denote low, medium and high battery-powered voltage driver settings. Intermediate voltages result in intermediate forces.

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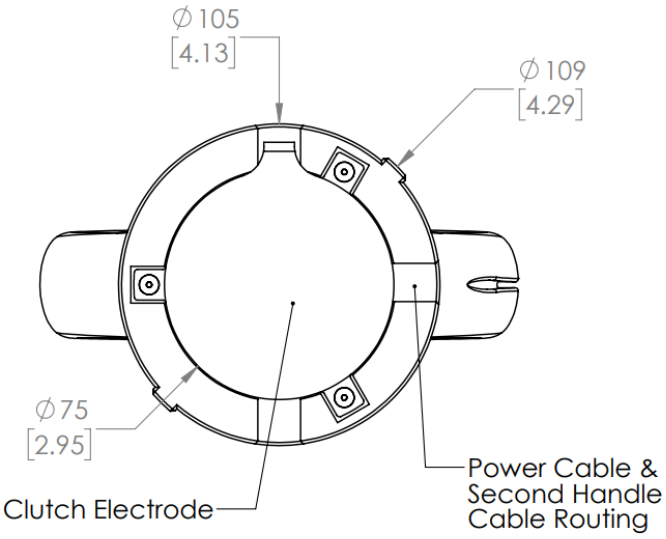
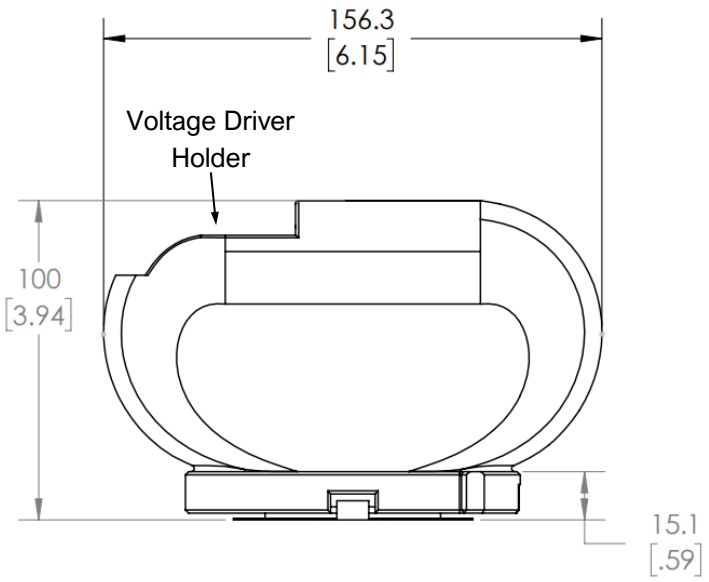
Universal Clutch Evaluation Unit

Connector with no moving parts / conductive material handler

ESTAT universal clutches are capable of supporting complex loading and can act as a connector with no moving parts. They can also function as a material handler or gripper capable of attaching to any smooth, clean, conductive material. They can even manipulate some materials with a thin insulating coating such as paint. The Universal Clutch Evaluation Unit allows users to evaluate ESTAT's surface clutch within seconds of unboxing. The essential components are ultra thin (< .125") making them suitable for any application where saving space is essential.





Technical Specifications	Universal Clutch Evaluation Unit
Max. holding force — N (lb)	100 (22.48)
Power Consumption with 1 Hz cycling — W @ 400 V Activated maintenance power — **mW** @ 400V	< 0.001 < 0.028
Maximum Operating Voltage	400V
Weight (including handles) — g (lb) Weight (both clutch halves without handles) — g (lb)	650 (1.43) 100 (.22)
Thickness (clutch half without handle) — mm (inch)	0.8 (0.032)

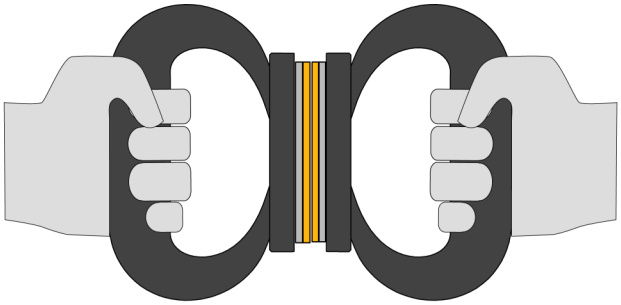
Device overview:

Universal clutches act as connectors with no moving parts and as material handlers. They are simpler, lighter, more power-efficient replacements for magnet and suction-based grippers. Universal clutches can handle all clean, smooth and flat conductive materials. This includes ferrous and non-ferrous materials, parts with holes, and even some materials with thin insulating coatings, such as anodized aluminum or painted metal.

The **Evaluation Unit** allows users to experience a **Universal Electrostatic Clutch** within seconds of unboxing. The handles allow users to feel the forces that can be supported by the universal clutch and to experiment with different types of complex loads (normal, shear, and bending). The universal clutch is exceptionally thin with essential components less than 0.8 mm thick. This makes them suitable for any application where space and weight savings are essential.

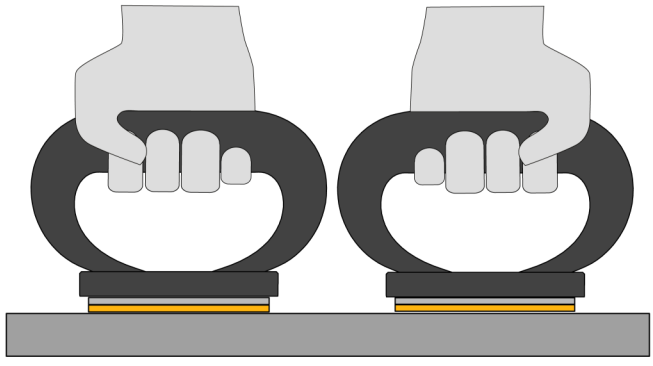
Just insert the included voltage driver and you are ready to test the surface clutch!

To use as a connector with no moving parts:



The two handles can be used against each other to simulate the use of this clutch as a lock or latch with no moving parts. Applications for this use case include fasteners, quick connections, and end-of-arm tooling.

To use as a material handler:



Place both handles down on a flat, smooth and clean conductive object such that the clutch surfaces are in complete contact with the object. Lift both handles simultaneously to lift the object. Try a number of different surface types to get a feel for how performance varies with material. Some materials to start with include: stainless steel, anodized aluminum, and brass.

Note: Performance is surface-dependent. Smoother surfaces will be most suitable for rated loads.

Sneak peek:

- Single-handle material gripping
- Multiple sizes
- Standard end-of-arm attachments

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Battery-Powered Voltage Driver

The ESTAT Battery-Powered Voltage Driver powers any ESTAT clutch product. It is easily operated while held in your hand, or while mounted to a clutch body.

The Battery-Powered Voltage Driver is programmed with three voltage outputs, generally correlating with low, medium, and high clutching force in ESTAT clutches. Toggle through the voltage settings by pressing the 'Set Voltage' button, with the voltage level indicated by the adjacent LEDs. Activate and deactivate the clutch with the 'Engage/Disengage' button. When the low battery light comes on, charge the Voltage Driver by connecting it to a USB Type-C charging port. The Battery-Powered Voltage Driver cannot be operated while charging.

Mechanical Specifications	
Dimensions —mm (inch)	65.0 x 30.0 x 16.5 (2.56 x 1.18 x 0.65)
Weight—g (oz)	34.2 (1.21)
Enclosure Material	Black ABS Plastic
Charging Connector	USB Type-C
Clutch Output Connector	Molex Nano-Fit 2-Pos. Female (Part# 105313-1102)

Electrical Specifications			
Output Voltage Accuracy	± 1.7%		
Transient Current Limit (Enabled by default)	~20 mA		
Nominal Battery Capacity	370 mAh		
Max Battery Charge Current	200 mA		
Charge Time	~2.25 h		
Control Input	Tactile Membrane Switch and Power Slide Switch		
Voltage Setting:	**Low**	**Medium**	**High**
Output Voltage	250 V	300 V	400 V
Max Continuous Output Current	2.13 mA	1.62 mA	0.369 mA
Max Continuous Output Power	533 mW	486 mW	148 mW
Output Ripple Voltage (No Load)	0.824 Vp-p	0.920 Vp-p	1.160 Vp-p
Output Ripple Voltage (10 nF Load)	0.212 Vp-p	0.246 Vp-p	0.252 Vp-p
Engage Rise Time (10 nF Load)	592 uS	708 uS	2570 uS
Disengage Fall time (10 nF Load)	366 uS	438 uS	572 uS
Battery Life while Engaged	7.0 h	6.0 h	3.5 h

WARNING: mount the Voltage Driver using a light press fit, clamp or double-sided adhesive. DO NOT DRILL INTO THE VOLTAGE DRIVER. Please contact ESTAT with questions.