

RSB-E Series User's Manual

High speed motorized rotary stages with built in motor encoders and optional brakes



Disclaimer

Zaber's products are not intended for use in any critical medical, aviation, or military applications or situations where a product's use or failure could cause personal injury, death, or damage to property. Zaber disclaims any warranty of fitness for a particular purpose. The user of this product agrees to [Zaber's general terms and conditions of sale](#).

Precautions

Zaber's autodetect peripheral axes are designed to be used effortlessly with Zaber's line of autodetect controllers. The RSB-E includes onboard memory that allows Zaber's controllers to autodetect the model and set reasonable parameters. See the [Protocol Manual](#) for more information on how to modify the settings. Damage to the axis may result if the settings are not correct. To use your Zaber peripheral with a third-party controller, review the motor, sensor, and encoder specifications and pin-outs carefully.

Zaber's rotary motion control devices are precision instruments and must be handled with care. In particular, moving parts must be treated with care. Avoid torque loads in excess of the rated maximum torque load, impact, dust and other contaminants and damage to the drive system. These will reduce the performance of the device below stated specifications.

⚠ Caution: The motor in this device can exceed 60° C during normal operation and become hot enough to cause burns. Take precautions to prevent contact with the motor.

⚠ Dynamic Stops: The power-off brake is intended to prevent damage and maintain the position of a static load in the event of a power loss. Precautions should be taken to avoid dynamic braking when possible, as this may reduce brake lifetime.

💡 Dust Generation: Brake pads may generate small amounts of dust particulate over their lifetime of use.

Conventions used throughout this document

- Fixed width type indicates communication to and from a device. The `␣` symbol indicates a carriage return, which can be achieved by pressing enter when using a terminal program.
- An [ASCII command](#) followed by (T:xx) indicates a legacy T-Series [Binary Protocol](#) command that achieves the same result. For example, `move abs 10000 (T:20:10000)` shows that a move abs ASCII command can also be achieved with Binary command number 20.

Not all ASCII commands have an equivalent Binary counterpart.

Device Overview

AutoDetect

Your RSB-E peripheral is equipped with AutoDetect, a feature that allows a Zaber controller to automatically configure its settings for the peripheral when it is connected.

💡 Important: The controller should always be powered down before disconnecting or connecting your RSB-E peripheral.

To connect the peripheral to a controller:

- Power off the controller.
- Connect the RSB-E peripheral.
- Power on the controller.
- The controller will activate the peripheral shortly after it is powered on.

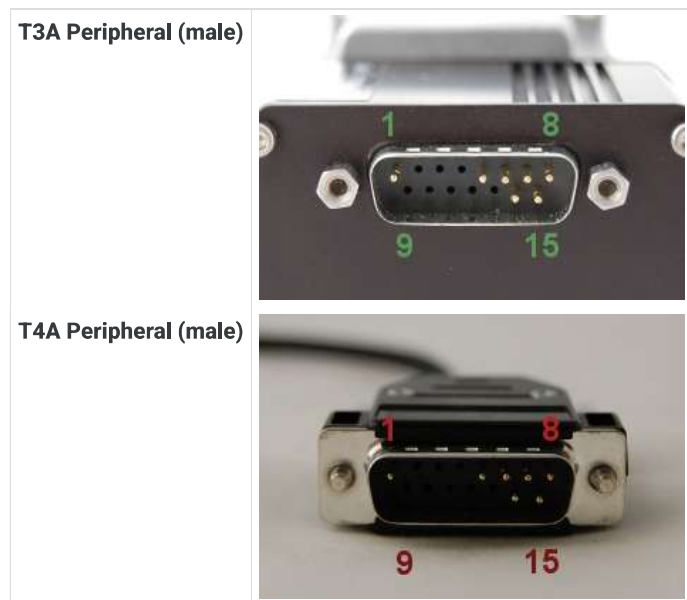
Controller Compatibility: X-MCC (revision 2+) with firmware (FW 7.34+) is required for the operation of devices with a power-off brake. See the Zaber controller user manual for more details on peripheral activation and control.

Connectors

Recommended controller(s) for your RSB-E peripheral are provided in the product specifications. Zaber's controllers and peripherals are designed for ease of use when used together. Optimal settings for each peripheral are automatically detected by Zaber's controllers when the device is connected.

For reference, the pinout for the peripheral cable connectors is shown below:

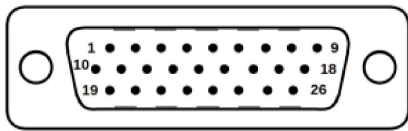
Pinout for D-sub 15 Connectors (peripherals) without brakes



Pin #	Function
1	+5V for Limits & Encoder
2	AutoDetect Data
3	<i>reserved</i>
4	Away Sensor
5	Home Sensor
6	Ground
7	Motor B1
8	Motor A1
9	AutoDetect Clock
10	Encoder A
11	Encoder B
12	Encoder Index
13	Ground
14	Motor B2
15	Motor A2

Not all pins are used for all models

Pinout for D-sub 26 Connectors (peripherals) for Brake-Equipped Products



Male High Density D-sub26 Connector
Motor and Sensor Interface

Pin	Description	Pin	Description
1	AutoDetect Clock	14	Single-ended Encoder Index
2	AutoDetect Data	15	+5V
3	N.C.	16	Ground
4	N.C.	17	Brake-
5	Home Limit Sensor	18	Motor B1 (<i>N.C. for T12A devices</i>)
6	N.C.	19	N.C.
7	Ground	20	N.C.
8	Motor A2 (<i>N.C. for T12A devices</i>)	21	N.C.
9	Motor A1 (<i>N.C. for T12A devices</i>)	22	Encoder A
10	N.C.	23	Encoder B
11	N.C.	24	N.C.
12	N.C.	25	Brake+
13	N.C.	26	Motor B2 (<i>N.C. for T12A devices</i>)

NOTE: All hall sensor signals (for limits or motor phase) are open collector and require a pull-up on the controller.

NOTE: All single-ended encoder inputs are non-isolated 5V TTL lines.

Alternate Controllers

The RSB-E can be controlled by any 2-phase stepper motor controller with limit sensor and appropriate encoder and brake input. **We do not recommend using your own controller unless you are familiar with how to control a stepper motor with hall sensor limit switches, encoders, and power-off brakes.** Improper use can result in excessive heat generated by the device, potentially causing harm to operators or damage to the system. Damage to the device due to incorrect wiring is not covered by warranty.

Motors & Encoders

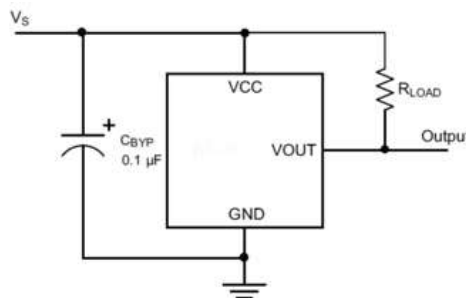
For motor and encoder information see the [RSB-E product page](#)

Limit Sensors

Hall effect sensors are used in the RSB-E as home sensors. The Hall sensors used are part number A1120LLHLT-T made by Allegro. [Click here for data sheet](#). Your controller should be configured so the stage stops immediately (quick deceleration) when the sensors are triggered.

- PCB wire colour code:
 - 5 Vdc input - red
 - Home signal - yellow
 - Away signal - white
 - Ground - black

The Hall sensor has an open-collector output. The default output is high impedance when the Hall sensor is not active. When the sensor detects a magnet, the Hall sensor pulls the output low to ground.

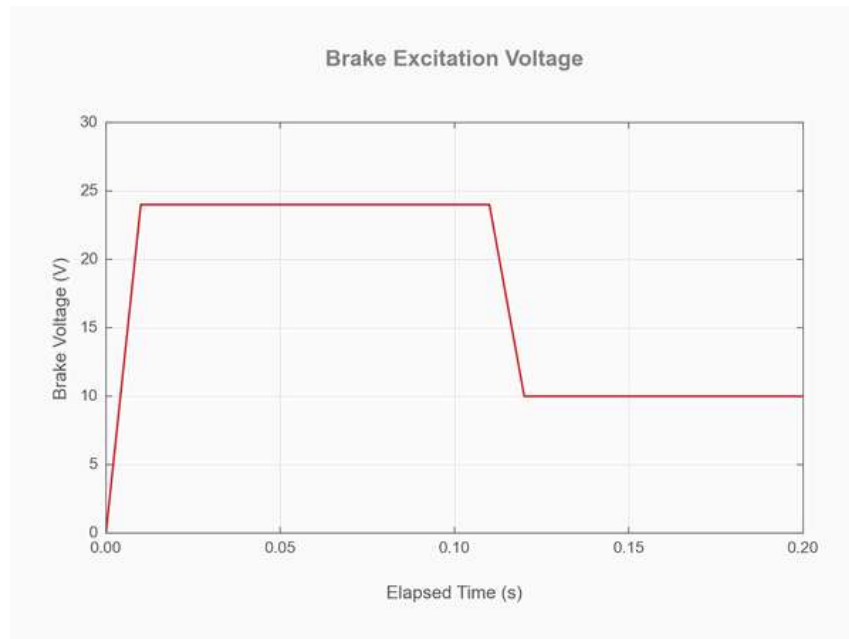


If you are not using a Zaber controller, ensure that your controller has a pull-up resistor on the output line of each Hall sensor as shown in the diagram. The bypass capacitor is optional, but may help to eliminate false triggering in noisy environments. The typical value for the pull-up resistor (R_{LOAD}) is 10 k Ω and for the bypass capacitor is 0.1 μ F to 1 μ F. The larger the capacitance, the better the noise filtering but the slower the response time.

Power-off Brake

It is necessary to follow the recommended values for excitation and hold voltages:

- The initial excitation voltage of 24 V should be applied for at least 100 ms to ensure the power-off brake is opened.
- A hold voltage of 10 V can then be applied to reduce excess heating of the brake.
- When open, the brake will consume ~2 watts to remain open.



Installation

Mounting

You can mount Zaber's rotary stages by using the M6 or 1/4"x20 mounting holes on the bottom flange of the stage. All of Zaber's rotary stages are compatible with 25 mm spaced mounting grids. There are also M6 threaded holes on the sides of the stages which are available for mounting purposes. See the [RSB-E web page](#) for dimensions, technical specifications and other details.

Trajectory Control and Behaviour

This section describes the behaviour of the axis trajectory when a movement command is issued.

Software Position Limits

The travel range of the axis is limited by the Minimum Position and Maximum Position settings. The factory settings for the axis are configured to match the physical travel range. If a customized range is desired, it can be changed by configuring the [limit.min \(T:106\)](#) and [limit.max \(T:44\)](#) settings to appropriate values. For the Current Position, query [pos \(T:60\)](#).

Minimum Position

When the Current Position is less than the Minimum Position value, the axis cannot move in the negative direction (towards the motor).

Maximum Position

When the Current Position is greater than the Maximum Position value, the axis cannot move in the positive direction (away from the motor).

Movement Speed

The movement speed of the axis depends on axis status and various speed settings. If the axis has not been initialized by the [home \(T:1\)](#) command or by moving towards the home end of the axis, movement speed will be constrained to fail-safe values. The home status of the axis can be determined by reading the [limit.home.triggered \(T:53:103\)](#) setting.

Movement speed of the axis is specified below:

[move vel \(T:22\)](#)

The axis will move at the specified speed regardless of home status.

Knob movement in Velocity Mode

The axis will move at the specified speed regardless of home status.

The speed is specified by the [knob.speedprofile \(T:112\)](#) and [knob.maxspeed \(T:111\)](#) settings.

Other movement commands - when the axis has not been homed

The axis will move at the slower of the [maxspeed \(T:42\)](#) and [limit.approach.maxspeed \(T:41\)](#) settings.

Other movement commands - when the axis has been homed

The axis will move at the speed specified by the [maxspeed \(T:42\)](#) setting.

Power-Off Brake Control

Described below are the recommended procedures for operating a brake-equipped device:

Dynamic Brake Engagement - For Position Holding After Faults

The power-off brake opens by default when the system is powered up. The brake will close if the device stalls, is displaced while stationary, the driver is disabled, or the power is interrupted. Repeated dynamic stopping may reduce the lifetime of the brake. We strongly recommend avoiding dynamic braking when possible.

Stationary Brake Engagement - For Position Holding

The power-off brake opens by default when the system is powered up. To change the brake state, use `brake.mode`.

The order of operations to set a retaining position should follow:

- Open the brake by setting `brake.mode` to 1.
- Allow 100 ms for the brake to open.
- Move the positioner.
- Close the brake by setting `brake.mode` to 0.
- Allow 100 ms for the brake to close.

If accuracy is required, the [`driver.current.hold`](#) (T:39) should remain on to prevent slight shifts in the device position.

Stationary Brake Engagement - For Reducing Motor Heat

The power-off brake opens by default when the system is powered up. To change the brake state, use `brake.mode`. To reduce heat generated in the motor, use the driver disable command in between moves.

The order of operations to maintain a vertical position, and disabling the driver to reduce heat, should follow:

- Set the hold current to the appropriate value based on load (see [defaults](#) on website).
- Move the positioner to the intended location.
- Send the [`driver.disable`](#) command. The brake will automatically close.
- When ready to move again, send the [`driver.enable`](#) command. The brake will open.
- Move the positioner as normal

Turning off the hold current will cause a small displacement of the positioner.

Manual Device Movement

Manual Device movement requires disabling the encoder displacement detection to prevent engagement of the power-off brake. The order of operations for manual movement should follow:

- Remove any load from the positioner.
- Disable closed-loop control by setting `clloop.enable` to 0.
- Set the hold current to 0.
- Move the positioner manually by hand. For screw driven linear devices, turning the lead screw can assist in achieving smaller increments during manual movement.

Warranty and Repair

For Zaber's policies on warranty and repair, please refer to the [Ordering Policies](#).

Standard products

Standard products are any part numbers that do not contain the suffix ENG followed by a 4 digit number. Most, but not all, standard products are listed for sale on our website. All standard Zaber products are backed by a one-month satisfaction guarantee. If you are not satisfied with your purchase, we will refund your payment minus any shipping charges. Goods must be in brand new saleable condition with no marks. Zaber products are guaranteed for one year. During this period Zaber will repair any products with faults due to manufacturing defects, free of charge.

Custom products

Custom products are any part numbers containing the suffix ENG followed by a 4 digit number. Each of these products has been designed for a custom application for a particular customer. Custom products are guaranteed for one year, unless explicitly stated otherwise. During this period Zaber will repair any products with faults due to manufacturing defects, free of charge.

How to return products

Customers with devices in need of return or repair should contact Zaber to obtain an RMA form which must be filled out and sent back to us to receive an RMA number. The RMA form contains instructions for packing and returning the device. The specified RMA number must be included on the shipment to ensure timely processing.

Email Updates

If you would like to receive our periodic email newsletter including product updates and promotions.

Contact Information

Contact Zaber Technologies Inc by any of the following methods:

Phone	1-604-569-3780 (direct) 1-888-276-8033 (toll free in North America)
Fax	1-604-648-8033
Mail	#2 - 605 West Kent Ave. N., Vancouver, British Columbia, Canada, V6P 6T7
Web	www.zaber.com
Email	Please visit our website for up to date email contact information.

The original instructions for this product are available at <https://www.zaber.com/manuals/RSB-E>.

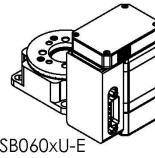
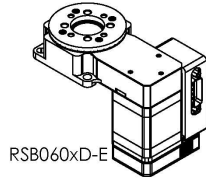
Appendix A: Default Settings

Please see [the Zaber Support Page](#) for default settings for this device.

Product Drawings

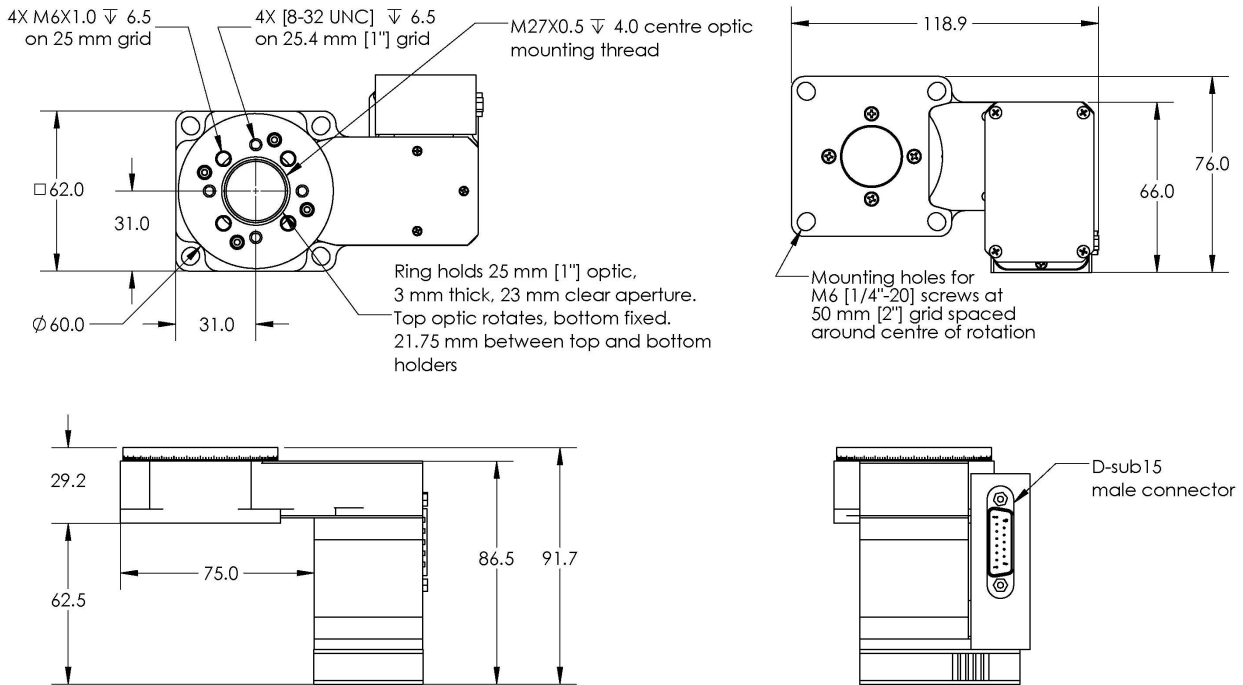
ZABER

RSB060-E Rotation Stage
dimensions in mm



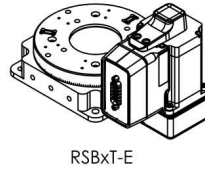
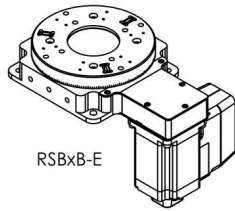
RSB060xD-E shown below

*See product page for complete list of available models at www.zaber.com



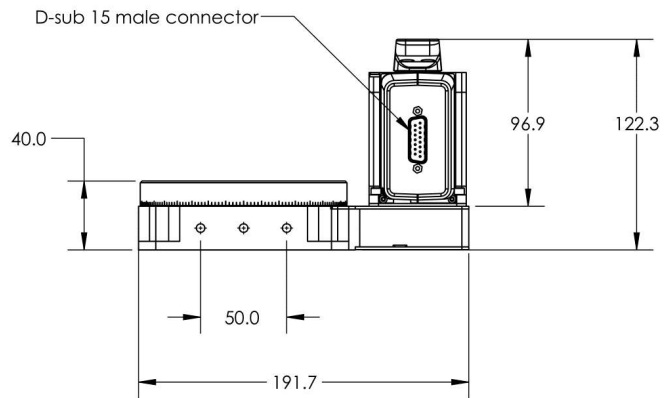
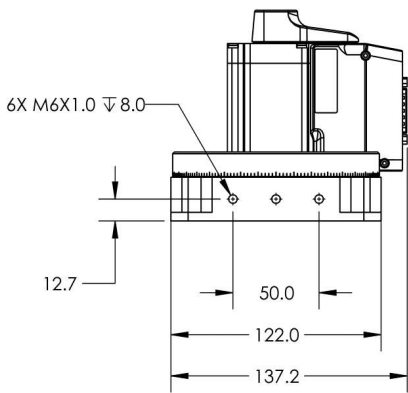
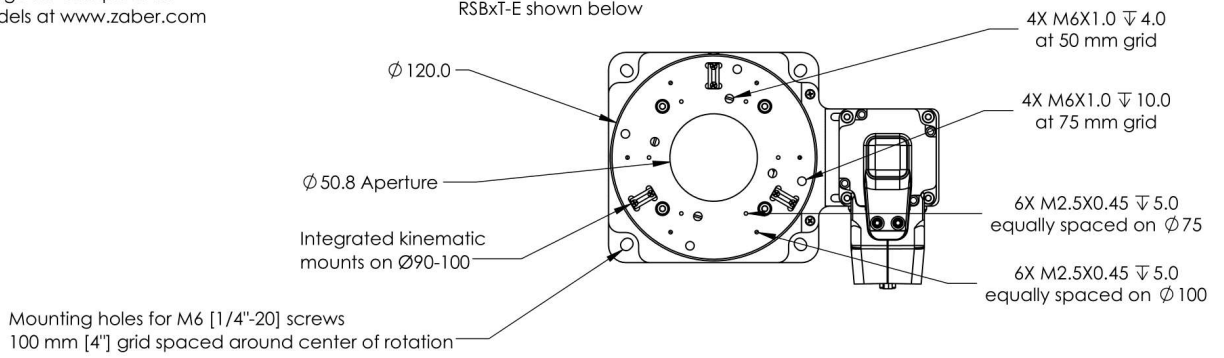
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RSB-E Rotation Stage
dimensions in mm



*See product page for complete list of available models at www.zaber.com

RSBxT-E shown below

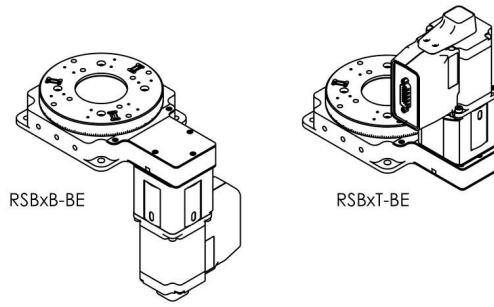


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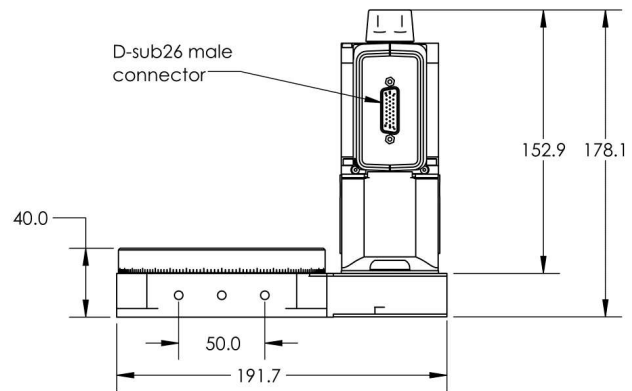
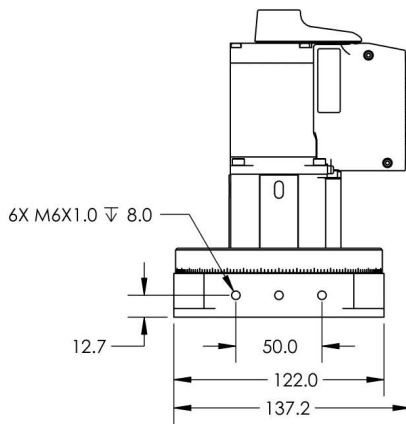
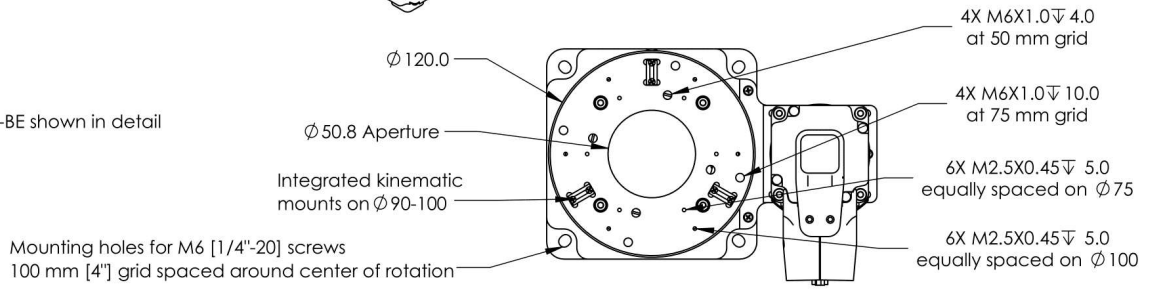
RSB-BE Rotation Stage

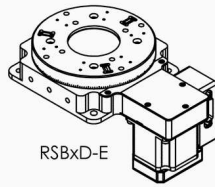
dimensions in mm

*See product page for complete list of available models at www.zaber.com

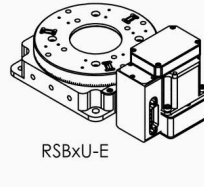


RSBxT-BE shown in detail





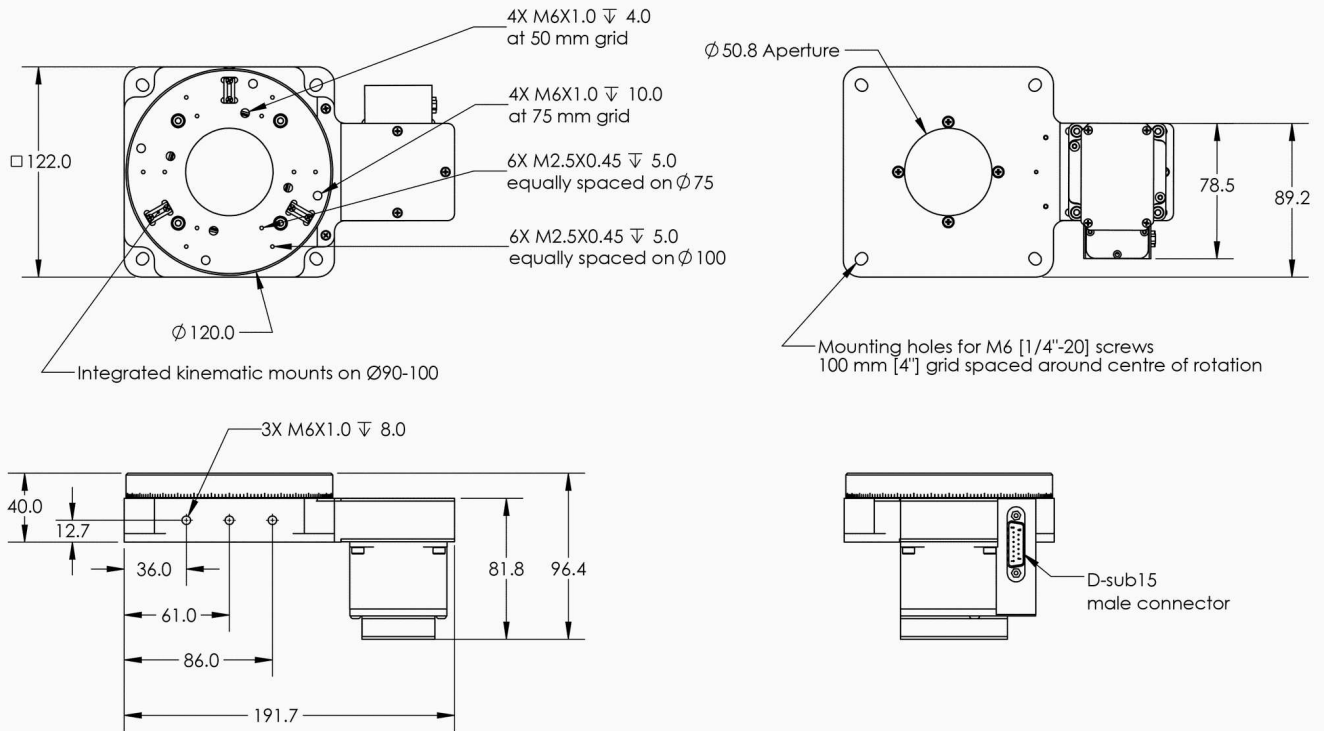
RSBxD-E



RSBxU-E

*See product page for complete list of available models at www.zaber.com

RSBxD-E shown below



DWG 1187 R01

Specifications

Specification	Value	Alternate Unit
Microstep Size (Default Resolution)	0.005625°	98.173 μ rad
Built-in Controller	No	
Recommended Controller	X-MCC (48 V) Recommended	
AutoDetect	Yes	
Range	360°	
Repeatability	< 0.001°	< 0.017 mrad
Minimum Speed	0.003434°/s	59.934 μ rad/s
Speed Resolution	0.003434°/s	59.934 μ rad/s
Encoder Type	Rotary quadrature encoder	
Angular Motion Per Motor Rev	72°	
Motor Type	Stepper (2 phase)	
Default Resolution	1/64 of a step	
Mechanical Drive System	Synchronous belt	
Limit or Home Sensing	Magnetic home sensor	
CE Compliant	Yes	
Vacuum Compatible	No	

Comparison

Part Number	Accuracy (unidirectional)	Backlash	Maximum Speed	Encoder Resolution
RSB060AD-E01T3A	0.2° (3.490000 mrad)	< 0.1° (< 1.745 mrad)	7200°/s (1200 rpm)	500 CPR (2000 states/rev)
RSB060AU-E01T3A	0.2° (3.490000 mrad)	< 0.1° (< 1.745 mrad)	7200°/s (1200 rpm)	500 CPR (2000 states/rev)
RSB120AB-E08T3A	0.28° (4.886000 mrad)	< 0.25° (< 4.362 mrad)	5400°/s (900 rpm)	400 CPR (1600 states/rev)
RSB120AB-BE08T10A	0.28° (4.886000 mrad)	< 0.25° (< 4.362 mrad)	3600°/s (600 rpm)	400 CPR (1600 states/rev)
RSB120AD-E01T3A	0.28° (4.886000 mrad)	< 0.25° (< 4.362 mrad)	3000°/s (500 rpm)	500 CPR (2000 states/rev)
RSB120AT-E08T3A	0.28° (4.886000 mrad)	< 0.25° (< 4.362 mrad)	5400°/s (900 rpm)	400 CPR (1600 states/rev)
RSB120AT-BE08T10A	0.28° (4.886000 mrad)	< 0.25° (< 4.362 mrad)	3600°/s (600 rpm)	400 CPR (1600 states/rev)
RSB120AU-E01T3A	0.28° (4.886000 mrad)	< 0.25° (< 4.362 mrad)	3000°/s (500 rpm)	500 CPR (2000 states/rev)

Part Number	Maximum Continuous Torque	Maximum Brake Torque	Maximum Centered Load	Maximum Moment (Transverse)
RSB060AD-E01T3A	230 N·cm (325.7 oz·in)		200 N (44.9 lb)	410 N·cm (580.6 oz·in)
RSB060AU-E01T3A	230 N·cm (325.7 oz·in)		200 N (44.9 lb)	410 N·cm (580.6 oz·in)
RSB120AB-E08T3A	750 N·cm (1062.1 oz·in)		500 N (112.1 lb)	2000 N·cm (2832.2 oz·in)
RSB120AB-BE08T10A	750 N·cm (1062.1 oz·in)	750 N·cm (1062.1 oz·in)	500 N (112.1 lb)	2000 N·cm (2832.2 oz·in)
RSB120AD-E01T3A	250 N·cm (354.0 oz·in)		500 N (112.1 lb)	2000 N·cm (2832.2 oz·in)
RSB120AT-E08T3A	750 N·cm (1062.1 oz·in)		500 N (112.1 lb)	2000 N·cm (2832.2 oz·in)
RSB120AT-BE08T10A	750 N·cm (1062.1 oz·in)	750 N·cm (1062.1 oz·in)	500 N (112.1 lb)	2000 N·cm (2832.2 oz·in)
RSB120AU-E01T3A	250 N·cm (354.0 oz·in)		500 N (112.1 lb)	2000 N·cm (2832.2 oz·in)

Part Number	Stage Top Dimension	Radial Error Motion	Axial Error Motion	Tilt Error Motion
RSB060AD-E01T3A	60 mm (2.362")	+/- 4 µm (+/- 0.000157")	< 4 µm (< 0.000157")	+/- 0.0033° (+/- 57.60 µrad)
RSB060AU-E01T3A	60 mm (2.362")	+/- 4 µm (+/- 0.000157")	< 4 µm (< 0.000157")	+/- 0.0033° (+/- 57.60 µrad)
RSB120AB-E08T3A	120 mm (4.724")	+/- 3 µm (+/- 0.000118")	< 3 µm (< 0.000118")	+/- 0.0014° (+/- 24.43 µrad)
RSB120AB-BE08T10A	120 mm (4.724")	+/- 3 µm (+/- 0.000118")	< 3 µm (< 0.000118")	+/- 0.0014° (+/- 24.43 µrad)
RSB120AD-E01T3A	120 mm (4.724")	+/- 3 µm (+/- 0.000118")	< 3 µm (< 0.000118")	+/- 0.0014° (+/- 24.43 µrad)
RSB120AT-E08T3A	120 mm (4.724")	+/- 3 µm (+/- 0.000118")	< 3 µm (< 0.000118")	+/- 0.0014° (+/- 24.43 µrad)
RSB120AT-BE08T10A	120 mm (4.724")	+/- 3 µm (+/- 0.000118")	< 3 µm (< 0.000118")	+/- 0.0014° (+/- 24.43 µrad)

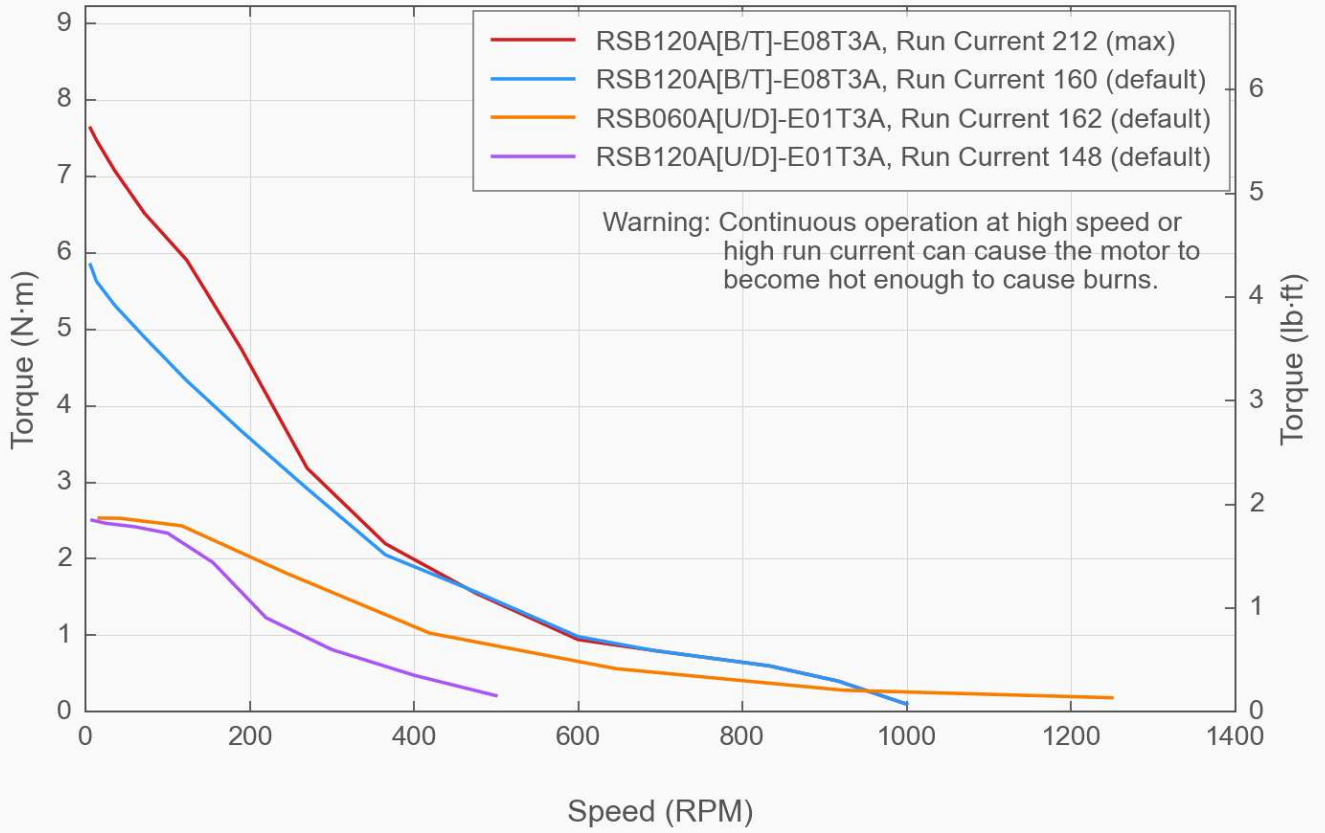
Part Number	Stage Top Dimension	Radial Error Motion	Axial Error Motion	Tilt Error Motion
RSB120AU-E01T3A	120 mm (4.724")	+/- 3 μ m (+/- 0.000118")	< 3 μ m (< 0.000118")	+/- 0.0014° (+/- 24.43 μ rad)

Part Number	Bearing Plane Offset	Motor Rated Current	Motor Winding Resistance	Inductance
RSB060AD-E01T3A	16.37 mm (0.644")	2300 mA/phase	1 ohms/phase	2.2 mH/phase
RSB060AU-E01T3A	16.37 mm (0.644")	2300 mA/phase	1 ohms/phase	2.2 mH/phase
RSB120AB-E08T3A	20 mm (0.787")	3000 mA/phase	0.53 ohms/phase	2 mH/phase
RSB120AB-BE08T10A	20 mm (0.787")	3000 mA/phase	0.53 ohms/phase	2 mH/phase
RSB120AD-E01T3A	20 mm (0.787")	2100 mA/phase	2.9 ohms/phase	7.2 mH/phase
RSB120AT-E08T3A	20 mm (0.787")	3000 mA/phase	0.53 ohms/phase	2 mH/phase
RSB120AT-BE08T10A	20 mm (0.787")	3000 mA/phase	0.53 ohms/phase	2 mH/phase
RSB120AU-E01T3A	20 mm (0.787")	2100 mA/phase	2.9 ohms/phase	7.2 mH/phase

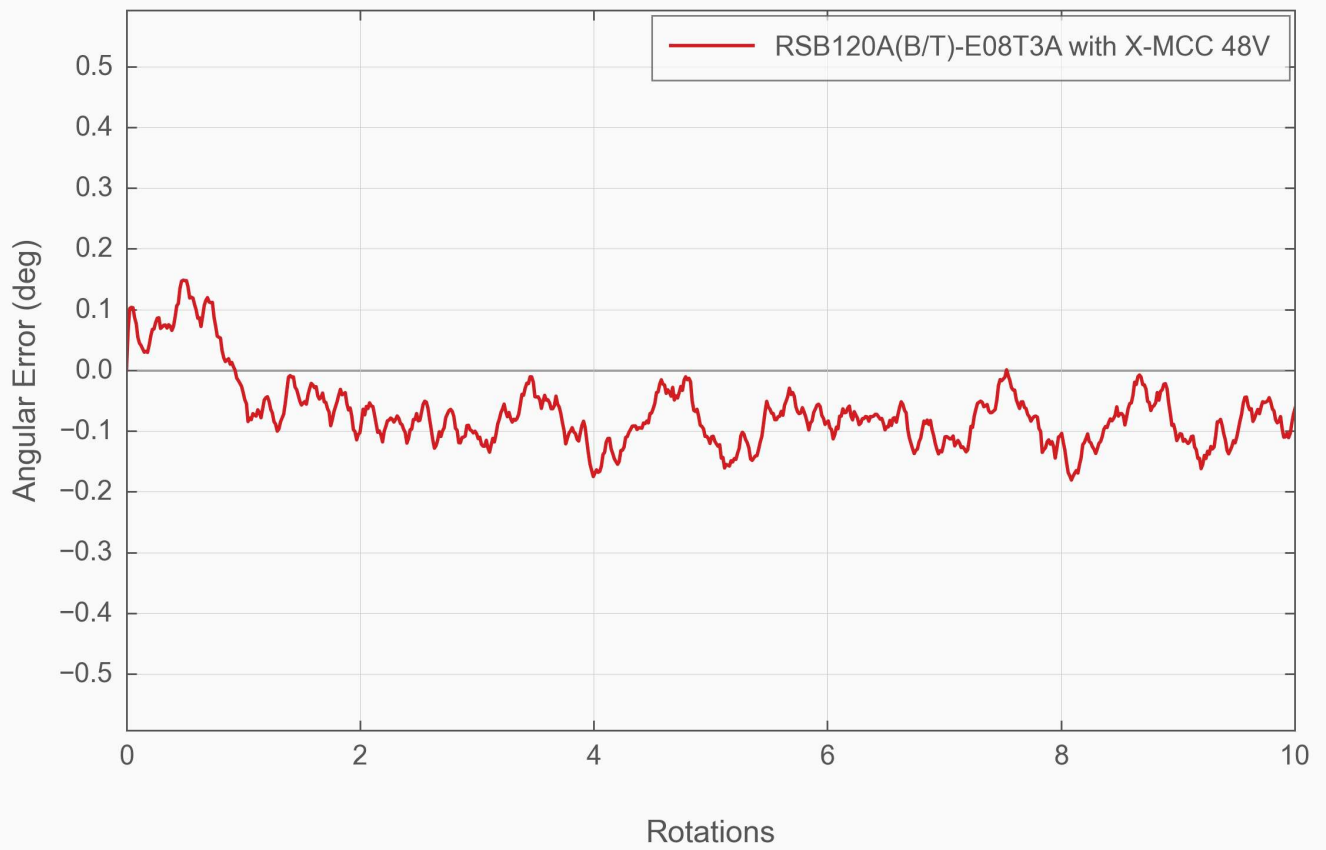
Part Number	Motor Connection	Mounting Interface	Weight
RSB060AD-E01T3A	D-sub 15	M6 and #8-32 threaded holes	0.84 kg (1.852 lb)
RSB060AU-E01T3A	D-sub 15	M6 and #8-32 threaded holes	0.84 kg (1.852 lb)
RSB120AB-E08T3A	D-sub 15	Kinematic with M2.5 and M6 threaded holes	2.1 kg (4.630 lb)
RSB120AB-BE08T10A	D-sub 26	Kinematic with M2.5 and M6 threaded holes	2.726 kg (6.010 lb)
RSB120AD-E01T3A	D-sub 15	Kinematic with M2.5 and M6 threaded holes	2.10 kg (4.630 lb)
RSB120AT-E08T3A	D-sub 15	Kinematic with M2.5 and M6 threaded holes	2.1 kg (4.630 lb)
RSB120AT-BE08T10A	D-sub 26	Kinematic with M2.5 and M6 threaded holes	2.726 kg (6.010 lb)
RSB120AU-E01T3A	D-sub 15	Kinematic with M2.5 and M6 threaded holes	2.10 kg (4.630 lb)

Torque Speed Performance

with X-MCCx 48V

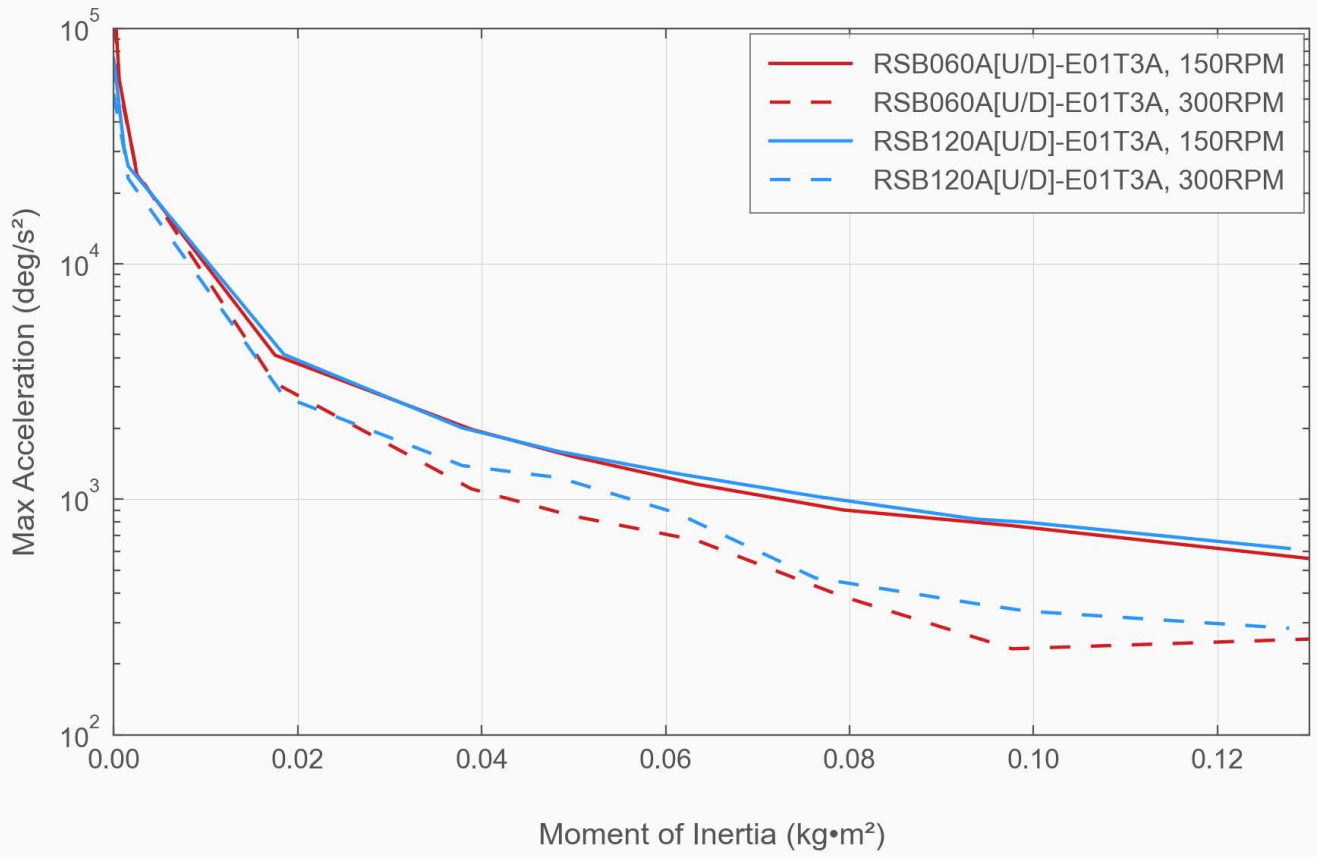


Typical Accuracy



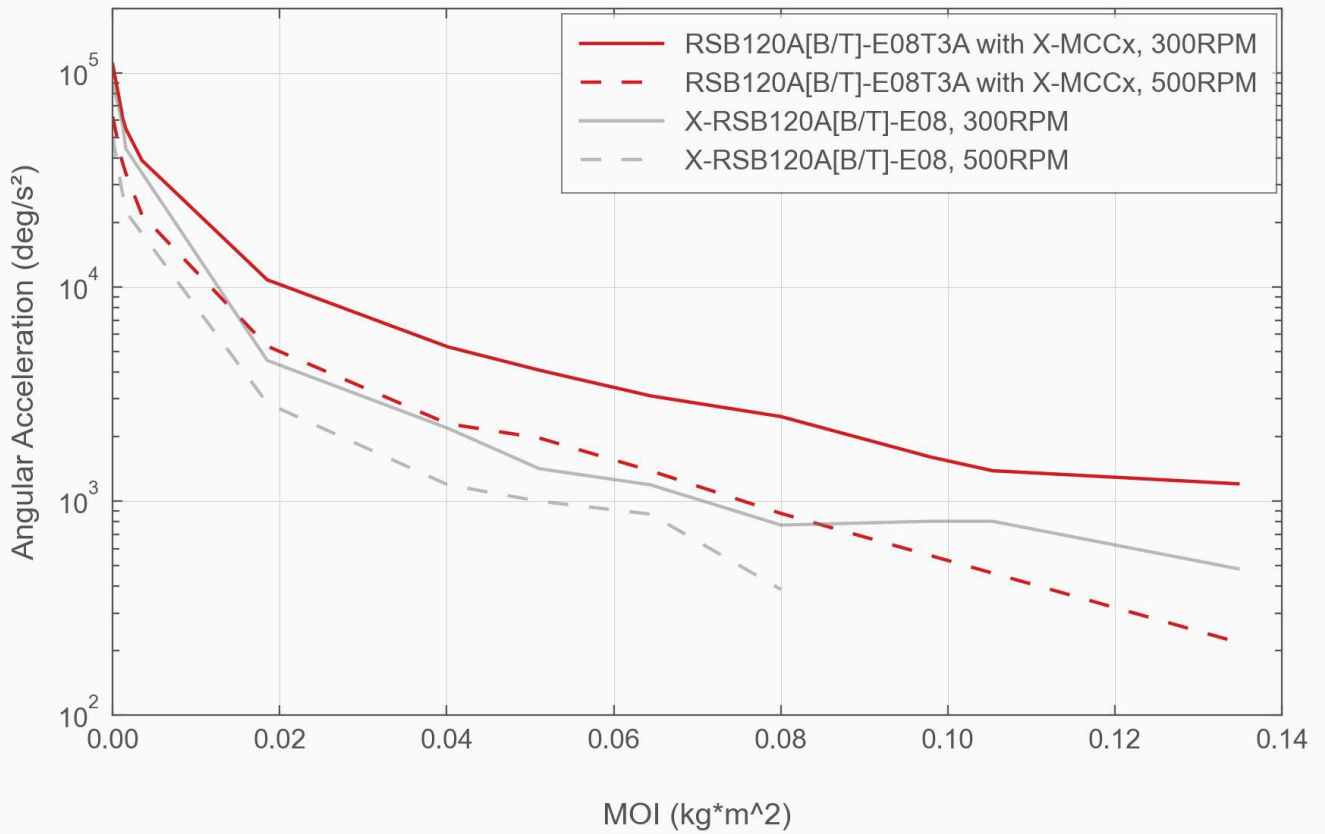
Angular Acceleration

with X-MCCx - 48V, Default Run Current



Angular Acceleration

48V, Run Current 212 (max)



Product Change Notices

Click [here](#) to view the current product change notices and subscribe to future change notifications.