

LRM-E Series User's Manual

Miniature, steel motorized linear stages with built-in motor encoders



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 LRM 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 motion control devices are precision instruments and must be handled with care. In particular, moving parts must be treated with care. Avoid axial loads in excess of the rated thrust load, axial and radial impact, dust and other contaminants and damage to the lead screw thread. These will reduce the performance of the device below stated specifications. Lubrication should be limited to what's described in the procedures below; grease or oil should not be applied to any other surfaces, including the lead screw.

Care for Ground Steel Surfaces

The LRM base and carriage are constructed from steel alloys specifically chosen for their dimensional stability, wear resistance and hardness. These parts are not made from stainless steel. As such, a small amount of care is necessary to maintain the ground mounting surfaces on the base and carriage.

The bare steel surfaces on LRM stages are treated with [Boeshield T9](#) corrosion protection before shipping. In our testing, this coating has proven very effective in preventing corrosion. We recommend re-applying as needed to maintain corrosion resistance. To prevent contamination of the linear bearings, spray the Boeshield onto a clean rag and wipe onto the carriage top and stage base. WD40 is an effective alternative if Boeshield is not available.



Wipe a thin layer of Boeshield on the carriage mounting surfaces periodically to ensure continued corrosion resistance.



Do the same for the base mounting surfaces.

Lubrication of Linear Guide

Many factors affect the lifetime of the grease and bearings including duty cycle, environment, travel length, stage orientation, and loading configuration. As a general guideline for usage in a clean office environment, the recommended re-lubrication interval is 250 km with an inspection after every 1500 hours of continuous operation. Inspection should be done by wiping a bearing rail with a clean, lint-free wipe and

ensuring that there is clean, wetted grease present.

Harsh environment, short travel, vertically oriented, and high duty cycle applications require more frequent re-lubrication and inspection. Contact an Applications Engineer to discuss your application for more specific recommendations.

Short travel can cause an insufficient distribution of lubricant amongst the rolling elements of the bearing system. For recirculating bearing guide types, short travel is equal to or less than the length of the carriage. For crossed-roller bearing guide types, short travel is equal to or less than twice the spacing of the rolling elements (typically 5-6 mm). If your application is considered short travel, it is recommended to occasionally drive the stage throughout its full travel range to maintain an even lubrication film over the entire guide surface. More frequent re-lubrication and inspection may be required in these applications.

Contact [Zaber support](#) for [relubrication kit SG133](#). We recommend using Shell Gadus S2 V220 2 or similar lithium thickened petroleum grease.

We recommend injecting 0.1 cm³ (1 mL) of grease into the two grease ports shown. These grease ports are located on end of the carriage facing away from the motor (see pictures below). Simply remove the set screw plugs using a 1.5 mm hex key and inject about 0.1 cm³ of grease into each port. Cycle the stage through its travel several times and wipe off any excess grease from the rails. If the grease ports shown are inaccessible, there are two alternate ports at the opposite end of the carriage that can be used instead.

All guides come pre-lubricated and are ready to go out of the box.

This grease is only intended for lubricating the ball bearing guide. It is not suitable for use on the lead screw or any other locations on the stage.



LRM linear guide lubrication ports



Re-lubricating LRM linear guide

Noise Emissions

The A-weighted emission sound pressure level (SPL) of this device does not exceed 70 dB(A) during intended use.

Conventions used throughout this document

- Fixed width type indicates communication to and from a device. The μ 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 LRM 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 LRM peripheral.

To connect the peripheral to a controller:

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

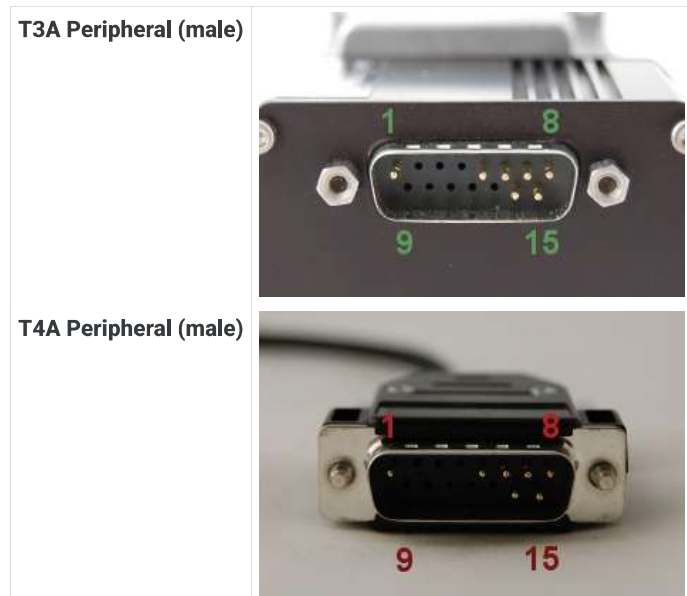
See the Zaber controller user manual for more details on peripheral activation and control.

Connectors

Recommended controller(s) for your LRM 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)



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

Alternate Controllers

The LRM can be controlled by any 2-phase stepper motor controller with limit sensor and appropriate encoder input. **We do not recommend using your own controller unless you are familiar with how to control a stepper motor with encoders and hall sensor limit switches.** Damage to the device due to incorrect wiring is not covered by warranty.

Motors & Encoders

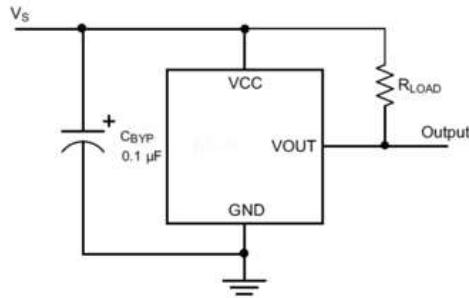
For motor and encoder information see the [LRM product page](#)

Limit Sensors

Hall effect sensors are used in the LRM 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.

Installation

Physical Installation

LRM stages can be mounted horizontally or vertically without additional hardware.

Low profile M6 (supplied) or 1/4-20 fasteners must be used. Additional fasteners can be purchased from [McMaster-Carr](#), [Fastenal](#), or other fastener suppliers.



Low profile M6 or 1/4-20 mounting screws must be used.

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.

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/LRM>.

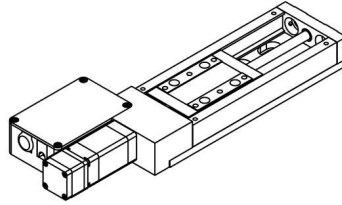
Appendix A: Default Settings

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

Product Drawing

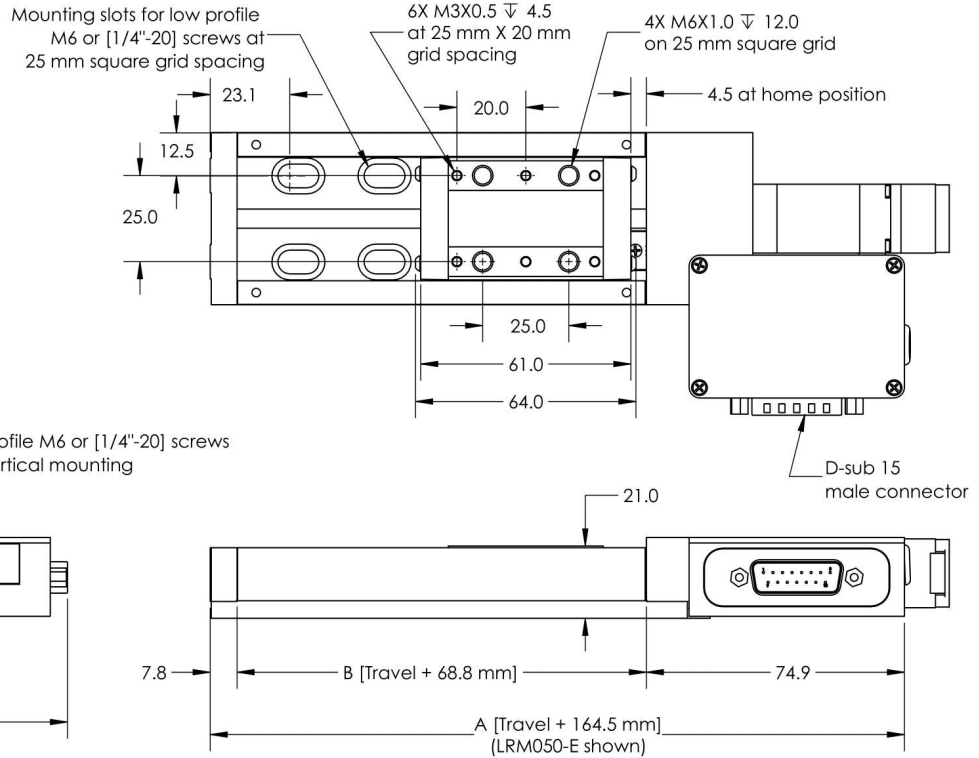
ZABER

LRM-E Motorized Linear Stage
dimensions in mm



Model Number*	Travel	A	B
LRM025-E	25.0	189.5	93.8
LRM050-E	50.0	214.5	118.8
LRM100-E	100.0	264.5	168.8
LRM150-E	150.0	314.5	218.8
LRM200-E	200.0	364.5	268.8

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



DWG 1466 R01D

Specifications

Specification	Value	Alternate Unit
Built-in Controller	No	
Recommended Controller	X-MCC (48 V) Recommended	
AutoDetect	Yes	
Repeatability	< 4 μm	< 0.000157"
Encoder Resolution	200 CPR	800 states/rev
Encoder Type	Rotary quadrature encoder	
Maximum Continuous Thrust	25 N	5.6 lb
Maximum Centered Load	500 N	112.1 lb
Maximum Moment (Pitch)	6 N·m	4.4 ft·lb
Maximum Moment (Roll)	15 N·m	11.1 ft·lb
Maximum Moment (Yaw)	6 N·m	4.4 ft·lb
Vertical Runout	< 8 μm	< 0.000315"
Horizontal Runout	< 12 μm	< 0.000472"
Pitch	0.02°	0.349 mrad
Roll	0.02°	0.349 mrad
Yaw	0.02°	0.349 mrad
Stiffness in Pitch	550 N·m/°	32 $\mu\text{rad/N}\cdot\text{m}$

Specification	Value	Alternate Unit
Stiffness in Roll	550 N·m/°	32 µrad/N·m
Stiffness in Yaw	550 N·m/°	32 µrad/N·m
Motor Steps Per Rev	200	
Motor Type	Stepper (2 phase)	
Motor Rated Current	600 mA/phase	
Motor Winding Resistance	6.5 ohms/phase	
Inductance	3.5 mH/phase	
Motor Rated Power	6.9 Watts	
Motor Connection	D-sub 15	
Motor Rotor Inertia	2.9 g·cm ²	
Default Resolution	1/64 of a step	
Motor Frame Size	NEMA 08	
Guide Type	Recirculating ball bearing	
Mechanical Drive System	Precision lead screw	
Limit or Home Sensing	Magnetic hall sensor	
Axes of Motion	1	
Mounting Interface	M3 and M6 threaded holes	
Stage Parallelism	< 10 µm	< 0.000394"
Operating Temperature Range	0 to 50 °C	
CE Compliant	Yes	
Vacuum Compatible	No	

Comparison

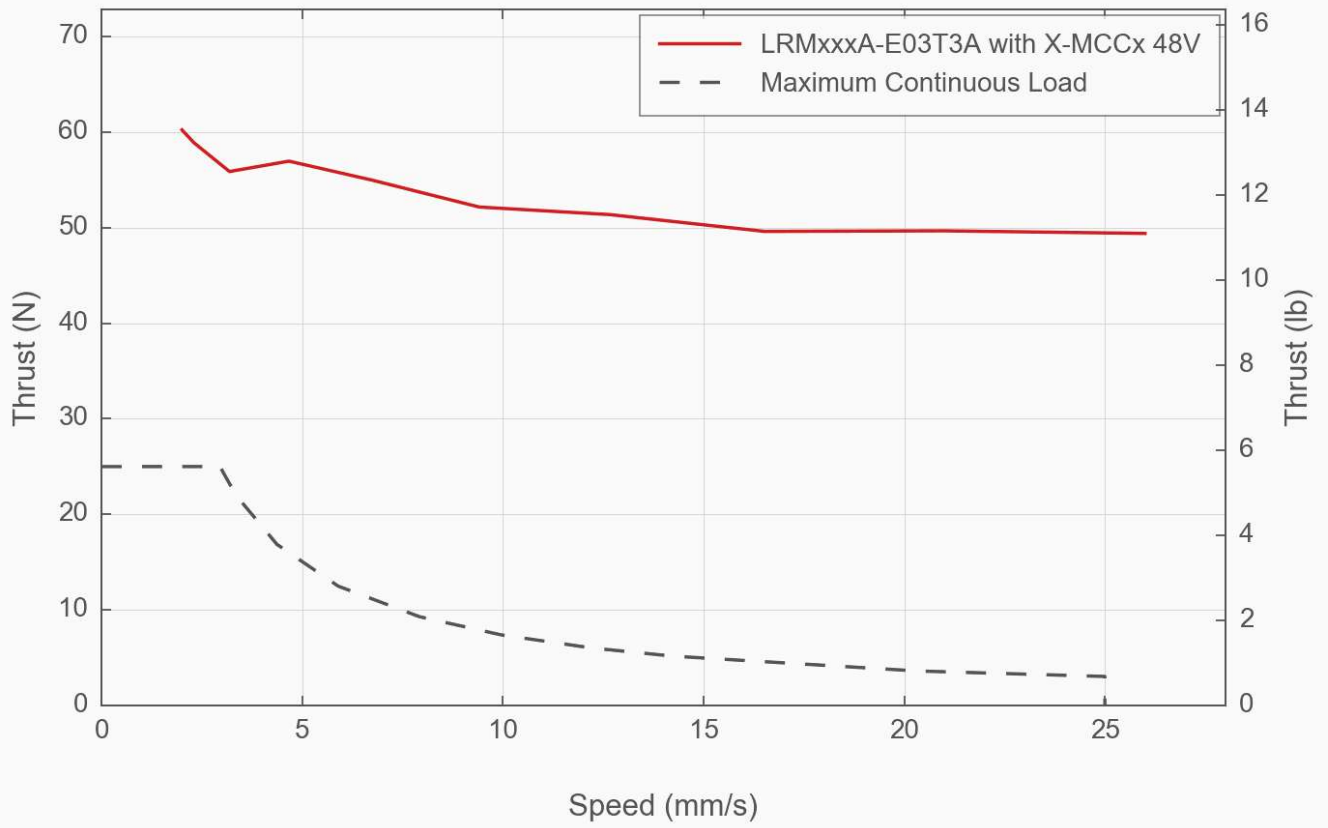
Part Number	Microstep Size (Default Resolution)	Travel Range	Accuracy (unidirectional)	Backlash
LRM025A-E03T3A	0.047625 µm	25 mm (0.984")	8 µm (0.000315")	< 5 µm (< 0.000197")
LRM025B-E03T3A	0.1905 µm	25 mm (0.984")	8 µm (0.000315")	< 12 µm (< 0.000472")
LRM050A-E03T3A	0.047625 µm	50 mm (1.969")	15 µm (0.000591")	< 5 µm (< 0.000197")
LRM050B-E03T3A	0.1905 µm	50 mm (1.969")	15 µm (0.000591")	< 12 µm (< 0.000472")
LRM100A-E03T3A	0.047625 µm	100 mm (3.937")	30 µm (0.001181")	< 5 µm (< 0.000197")
LRM100B-E03T3A	0.1905 µm	100 mm (3.937")	30 µm (0.001181")	< 12 µm (< 0.000472")
LRM150A-E03T3A	0.047625 µm	150 mm (5.905")	45 µm (0.001772")	< 5 µm (< 0.000197")
LRM150B-E03T3A	0.1905 µm	150 mm (5.905")	45 µm (0.001772")	< 12 µm (< 0.000472")
LRM200A-E03T3A	0.047625 µm	200 mm (7.874")	60 µm (0.002362")	< 5 µm (< 0.000197")
LRM200B-E03T3A	0.1905 µm	200 mm (7.874")	60 µm (0.002362")	< 12 µm (< 0.000472")

Part Number	Maximum Speed	Minimum Speed	Speed Resolution	Peak Thrust
LRM025A-E03T3A	25 mm/s (0.984"/s)	0.000029 mm/s (0.000001"/s)	0.000029 mm/s (0.000001"/s)	50 N (11.2 lb)
LRM025B-E03T3A	100 mm/s (3.937"/s)	0.000116 mm/s (0.000005"/s)	0.000116 mm/s (0.000005"/s)	25 N (5.6 lb)
LRM050A-E03T3A	25 mm/s (0.984"/s)	0.000029 mm/s (0.000001"/s)	0.000029 mm/s (0.000001"/s)	50 N (11.2 lb)
LRM050B-E03T3A	100 mm/s (3.937"/s)	0.000116 mm/s (0.000005"/s)	0.000116 mm/s (0.000005"/s)	25 N (5.6 lb)

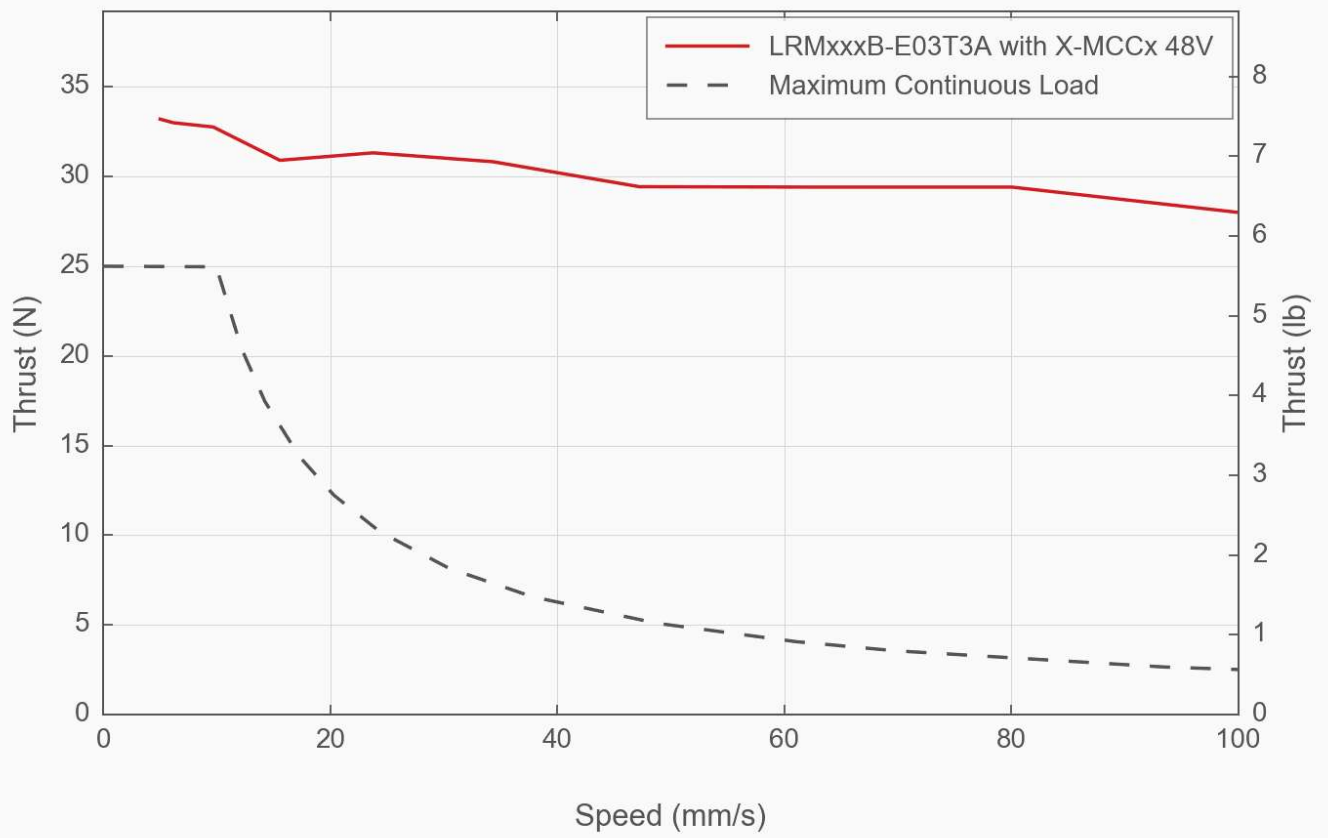
Part Number	Maximum Speed	Minimum Speed	Speed Resolution	Peak Thrust
LRM100A-E03T3A	25 mm/s (0.984"/s)	0.000029 mm/s (0.000001"/s)	0.000029 mm/s (0.000001"/s)	50 N (11.2 lb)
LRM100B-E03T3A	100 mm/s (3.937"/s)	0.000116 mm/s (0.000005"/s)	0.000116 mm/s (0.000005"/s)	25 N (5.6 lb)
LRM150A-E03T3A	25 mm/s (0.984"/s)	0.000029 mm/s (0.000001"/s)	0.000029 mm/s (0.000001"/s)	50 N (11.2 lb)
LRM150B-E03T3A	100 mm/s (3.937"/s)	0.000116 mm/s (0.000005"/s)	0.000116 mm/s (0.000005"/s)	25 N (5.6 lb)
LRM200A-E03T3A	25 mm/s (0.984"/s)	0.000029 mm/s (0.000001"/s)	0.000029 mm/s (0.000001"/s)	50 N (11.2 lb)
LRM200B-E03T3A	100 mm/s (3.937"/s)	0.000116 mm/s (0.000005"/s)	0.000116 mm/s (0.000005"/s)	25 N (5.6 lb)

Part Number	Linear Motion Per Motor Rev	Weight
LRM025A-E03T3A	0.6096 mm (0.024")	0.73 kg (1.609 lb)
LRM025B-E03T3A	2.4384 mm (0.096")	0.73 kg (1.609 lb)
LRM050A-E03T3A	0.6096 mm (0.024")	0.81 kg (1.786 lb)
LRM050B-E03T3A	2.4384 mm (0.096")	0.81 kg (1.786 lb)
LRM100A-E03T3A	0.6096 mm (0.024")	0.97 kg (2.138 lb)
LRM100B-E03T3A	2.4384 mm (0.096")	0.97 kg (2.138 lb)
LRM150A-E03T3A	0.6096 mm (0.024")	1.13 kg (2.491 lb)
LRM150B-E03T3A	2.4384 mm (0.096")	1.13 kg (2.491 lb)
LRM200A-E03T3A	0.6096 mm (0.024")	1.31 kg (2.888 lb)
LRM200B-E03T3A	2.4384 mm (0.096")	1.31 kg (2.888 lb)

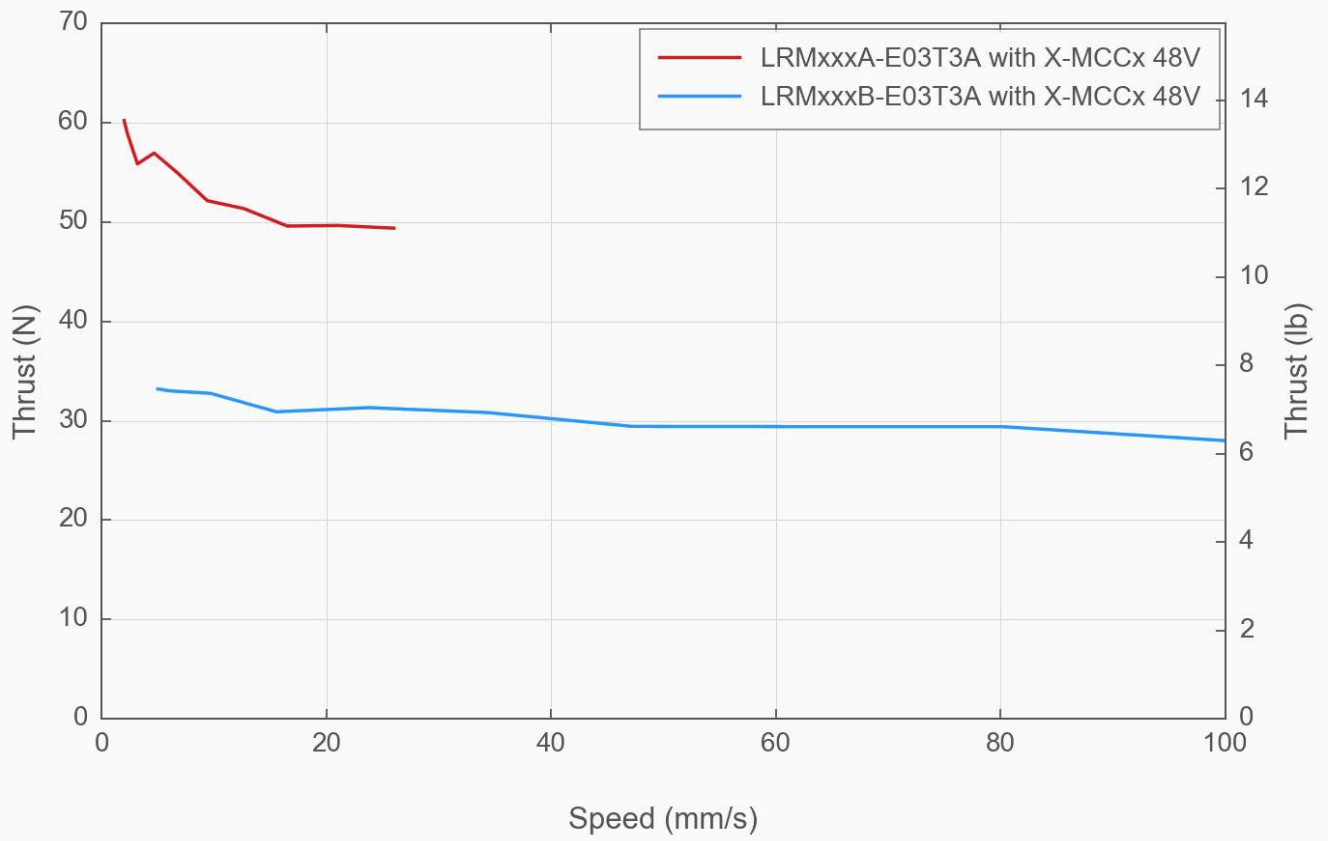
Thrust Speed Performance



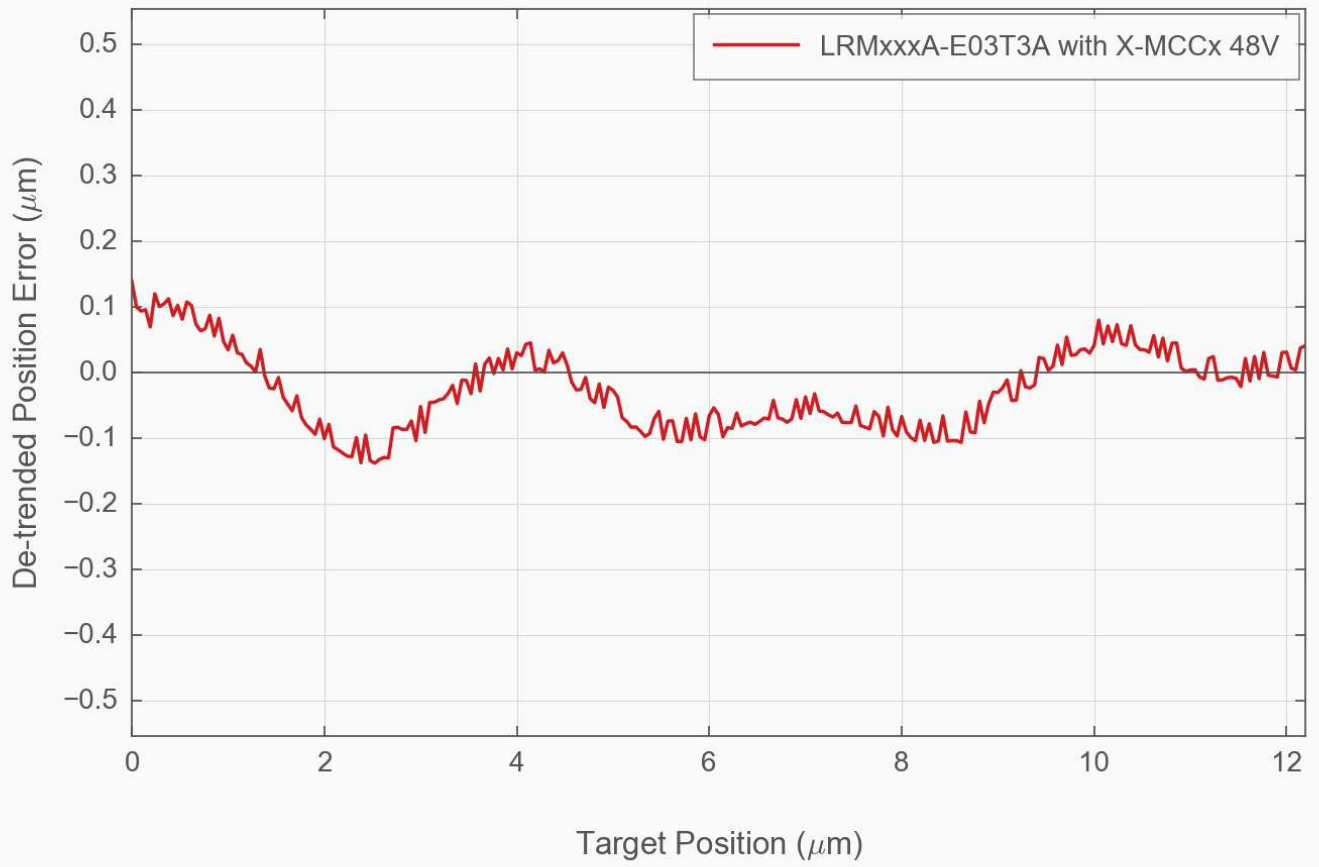
Thrust Speed Performance



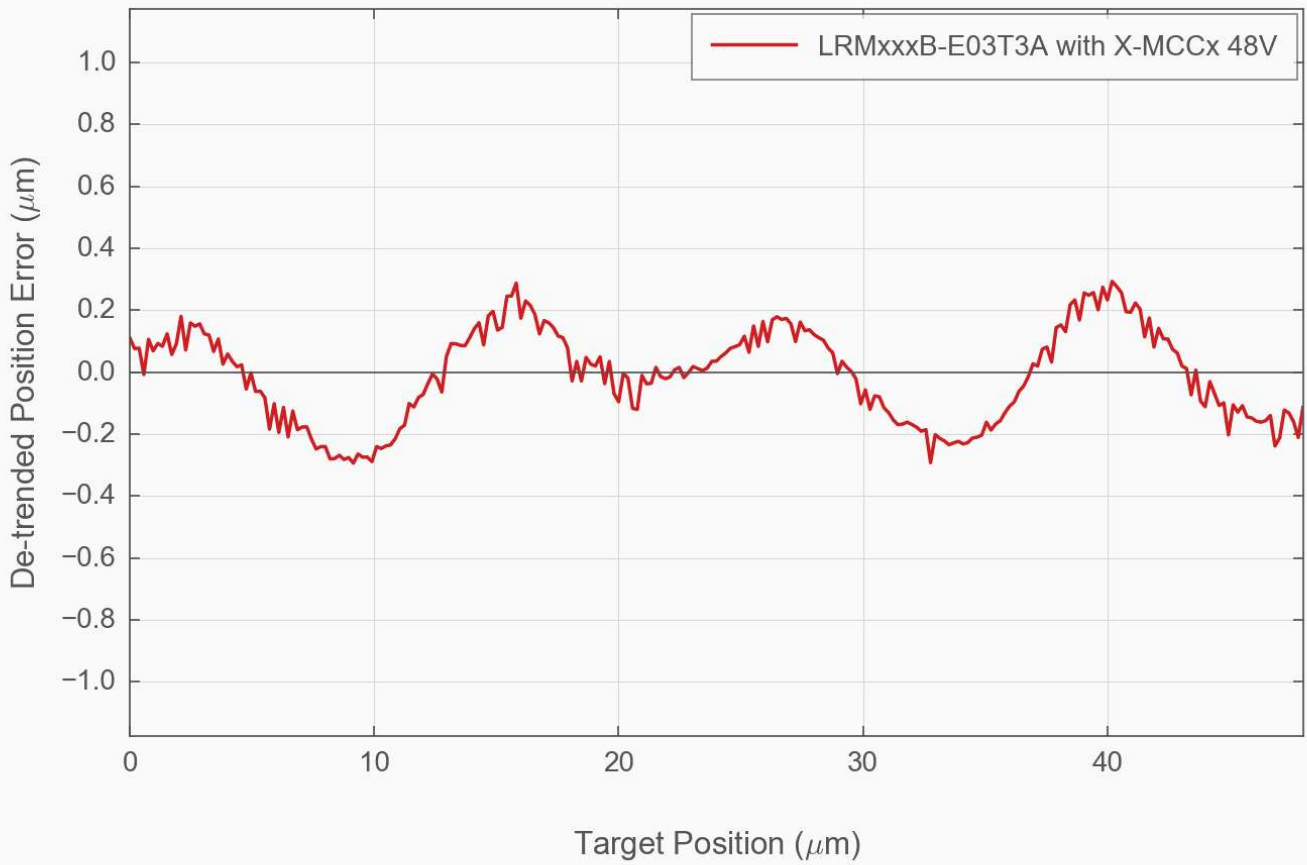
Thrust Speed Performance



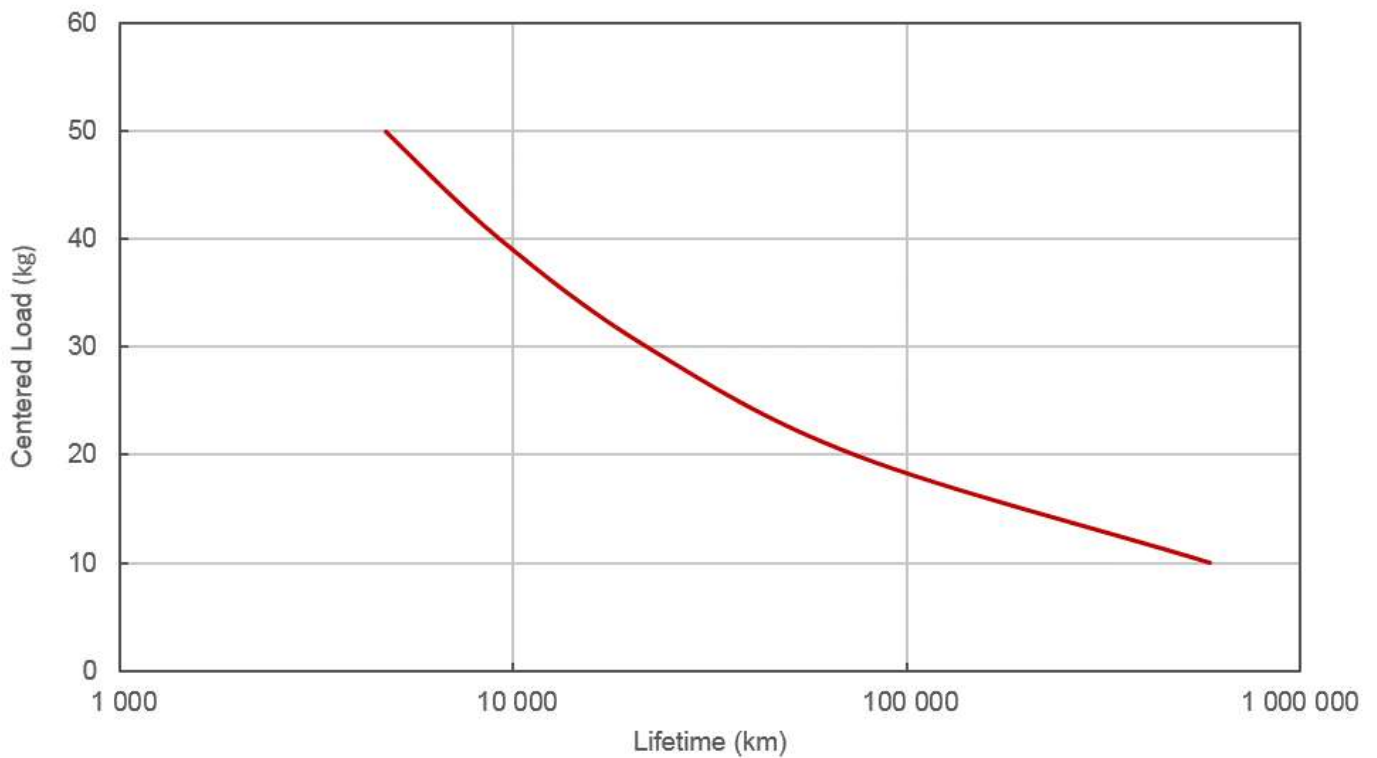
Typical Microstepping Accuracy



Typical Microstepping Accuracy



LRM Linear Bearing Lifetime



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