

THORLABS

ZST Series Motorized Actuator Operating Manual

Safety Precautions

* These Motorized Actuators can generate high forces. Improper handling can increase the risk of injury. Be aware that failure of the motor controller may drive the unit into a hard stop and cause damage to the unit.

* To avoid injury never put anything in the gap between the actuator and any rigid structure.

Warranty

Thorlabs warrants the ZST Series of Motorized Actuators to be free from defects in material and workmanship for a period of one year from the date of shipment. This warranty does not apply to any defects or damage resulting from misuse, abuse, or problems that may arise from improper wiring.

Caution

If the actuator encounters a hard stop while still in the middle of its range (i.e. a translation stage at the end of its travel range), the motor should be stopped as soon as possible to prevent damage to the gear head or motor and to keep the unit from overheating. When storing these units, be sure to fully retract the lead screw to protect the threads from damage. Improper connection of the motor will result in permanent damage. All power supplied to the motor should be turned off before altering any connections to the motor. Check all connections before supplying power to the motor. Under some operating conditions the housing of the motor will reach temperatures in excess of 55°C. Use caution when coming in contact with the actuator after prolonged use.

Table of Contents:

1.	Overview	3
2.	Model Specifications	4
2.1.	ZST6 Motorized Actuator Specifications	4
2.2.	ZST13 Motorized Actuator Specifications	4
2.3.	ZST25 Motorized Actuator Specifications	5
	How do I calculate the linear displacement per micro step?	5
2.4.	Mechanical Drawings	6
2.5.	Cable Assembly Drawing	6
2.6.	Wiring Diagrams.....	7
	Interface connector	7
	D-sub Pin Assignments.....	7
2.7.	Description of Connections.....	8
	Interface Connector.....	8
	Motor Specifications.....	8
2.8.	Recommended Motor Controller	8

1. Overview

Thorlabs Inc. has developed this series of high-resolution motorized actuators for use in high precision applications. From drop-in replacements to custom mounts, these motorized actuators will satisfy even the most demanding requirements. Three different travel lengths are offered in two mounting versions depending on the application.

The ZST series Motorized Actuators utilize a current limited 2 phase bi-polar stepper motor. A 76:1 gear reduction is used to multiply both the torque and resolution of the actuator while maintaining the compact package. These actuators provide very small movements over the entire travel range, allowing greater flexibility combined with fine resolution. Mechanical limit switches¹ protect the actuator from damage due to overdriving. Unlike most small actuators, Thorlabs utilizes internal limit switches to prevent overdriving.

The ZST series Motorized Actuators are light, compact and extremely durable. They are ideal for use in mirror mounts, translation stages, microscopes, OEM applications and a wide variety of other components that require higher precision than most standard drive mechanisms allow. These actuators are especially convenient for compact laboratory setups that are difficult to adjust by hand. With sub-micron minimum incremental movement, the ZST series actuators are suitable for most high precision applications.

¹ *Note: The limit switches are wired to be normally open.*

2. Model Specifications²

2.1. ZST6 Motorized Actuator Specifications

Item #	ZST6	ZST6B
Motor Type	6 mm motorized micrometer	
Travel Range	6 mm	
Gear Reduction	76:1	
Lead Screw Pitch	0.5 mm	
Limit Switches	Electromechanical	
Motor Type	2 Phase Stepper	
Backlash (with Preload)	<8 μm	
Axial Load Capacity	12 lbs (6.8 kg)	
Speed Range (at max. comm. rate)	0 – 500 $\mu\text{m/s}$	
Minimum Incremental Motion	$\cong 0.05 \mu\text{m}$	
Max Load Vertical	8 lbs (3.6 kg)	
Max Load Horizontal	15 lbs (6.8 kg)	
Holding Torque (w/ Nom Current in Both Phases)	65 oz. x in.	
Calculated Resolution	274 nm	
Repeatability	<8 μm	
Feedback	None	

2.2. ZST13 Motorized Actuator Specifications

Item #	ZST13	ZST13B
Motor Type	13mm motorized micrometer	
Travel Range	13 mm	
Gear Reduction	76:1	
Lead Screw Pitch	0.5 mm	
Limit Switches	Electromechanical	
Motor Type	2 Phase Stepper	
Backlash (with Preload)	<8 μm	
Axial Load Capacity	15 lbs (6.8 kg)	
Speed Range (at max. comm. rate)	0 – 500 $\mu\text{m/s}$	
Minimum Incremental Motion	$\cong 0.05 \mu\text{m}$	
Max Load Vertical	8 lbs (3.6 kg)	
Max Load Horizontal	15 lbs (6.8 kg)	
Holding Torque (w/ Nom Current in Both Phases)	65 oz. x in.	
Calculated Resolution	274 nm	
Repeatability	<8 μm	
Feedback	None	

² When used with Thorlabs' TST001 Controller.

2.3. ZST25 Motorized Actuator Specifications

Item #	ZST25	ZST25B
Motor Type	25 mm motorized micrometer	
Travel Range	25 mm	
Gear Reduction	76:1	
Lead Screw Pitch	0.5 mm	
Limit Switches	Electromechanical	
Motor Type	2 Phase Stepper	
Backlash (with Preload)	<8 μ m	
Axial Load Capacity	15 lbs (6.8 kg)	
Speed Range (at max. comm. rate)	0 – 500 μ m/s	
Minimum Incremental Motion	\cong 0.05 μ m	
Max Load Vertical	8 lbs (3.6 kg)	
Max Load Horizontal	15 lbs (6.8 kg)	
Holding Torque (w/ Nom Current in Both Phases)	65 oz. x in.	
Calculated Resolution	274 nm	
Repeatability	<8 μ m	
Feedback	None	

How do I calculate the linear displacement per micro step?

The stepper motor used in the ZST series actuators has 24 full steps (15° increments) per revolution of the motor. Each full step is broken down into 128 microsteps. There are 3072 microsteps per revolution of the motor when using the TST001. The output shaft of the motor goes into a 76:1 planetary gear head. This gear head requires the motor to rotate 76 full revolutions to rotate the 0.5 mm pitch lead screw one revolution. The end result is the leadscrew advances by 0.5 mm. To calculate the linear displacement of the actuator microstep, use the following:

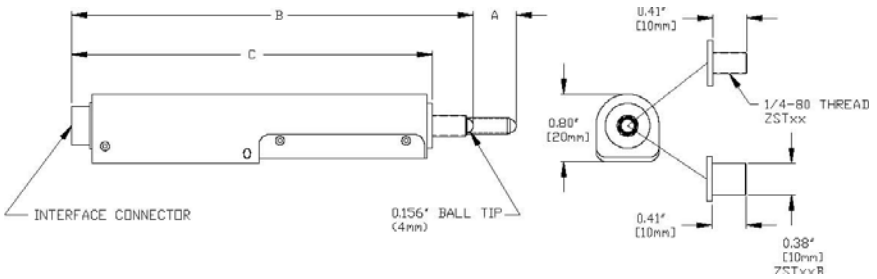
$$3072 \times 76 = 233472 \text{ microsteps per revolution of the lead screw}$$

The linear displacement of the lead screw per microstep is:

$$0.5 \text{ mm} / 233472 = 2.14 \times 10^{-6} \text{ mm}$$

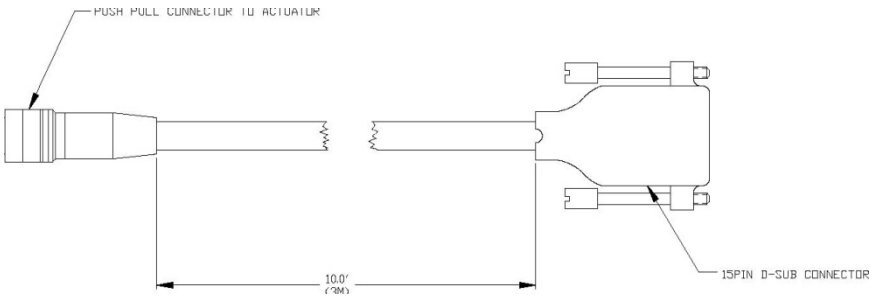
To calculate the linear displacement for a full step, substitute 233,472 with 1,824.

2.4. Mechanical Drawings

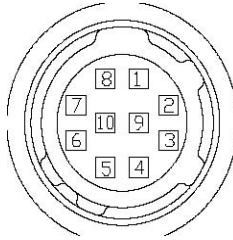


Item #	A	B	C
ZST6	0.25" (6 mm)	4.65 (118 mm)	3.78" (96 mm)
ZST13	0.52" (13 mm)	4.77" (121 mm)	4.29" (109 mm)
ZST25	1.00" (25 mm)	5.95" (151 mm)	5.29" (134 mm)

2.5. Cable Assembly Drawing



2.6. Wiring Diagrams



Interface connector

Pin	Description	Pin	Description
1	Reserved	6	Forward Limit
2	Phase A+	7	Reverse Limit
3	Phase A-	8	Limit Ground
4	Phase B+	9	Reserved
5	Phase B-	10	Reserved

D-sub Pin Assignments

Pin	Description	Pin	Description
1	Ground	9	Ident In
2	CCW Limit Switch	10	For Future Use
3	CW Limit Switch	11	For Future Use
4	Phase B -ve	12	For Future Use
5	Phase B +ve	13	For Future Use
6	Phase A -ve	14	For Future Use
7	Phase A +ve	15	For Future Use
8	For Future Use		

2.7. Description of Connections

Interface Connector

Spec	Value
Manufacturer	Hirose Electric
Manufacturer P/N	HR10A-10R-10SC
Interface cable	ZST-CAB1
Phase A+	See Motor Specifications
Phase A-	See Motor Specifications
Phase B+	See Motor Specifications
Phase B-	See Motor Specifications
Forward Limit	The forward limit prevents over driving of the actuator at its full extension. No resistor is supplied in the actuator. A pull-up resistor may be necessary to function with a non Thorlabs inc. controller. This limit switch is wired to be normally open.
Reverse Limit	The reverse limit prevents over driving of the actuator at full retraction. No resistor is supplied in the actuator. A pull-up resistor may be necessary to function with a non Thorlabs Inc. controller. This limit switch is wired to be normally open.
Limit Ground	This is a common ground for both the forward and reverse limit switches.

Motor Specifications

Spec	Value
Motor	2 Phase stepper Operation
Mode	Current Mode
Phase Inductance	5.5 mH
Phase Resistance	12.5 ohms @ 20 °C
Nominal Current Per Phase	3.5 V/k steps/s
Full Step Angle	15°
Max Winding Temp	130 °C
Max Power	1.5 W

2.8. Recommended Motor Controller

Thorlabs inc. T-cube controllers are recommended for this product. The use of these controllers ensures optimal performance. All above performance specifications are guaranteed only with use of Thorlabs inc. controllers and drivers.

Supplier	Model#
Thorlabs	TST001