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**THORLABS**

## DRV013 - JAN 21, 2020

Item # DRV013 was discontinued on JAN 21, 2020. For informational purposes, this is a copy of the website content at that time and is valid only for the stated product.

### 1" (25 MM) TRAVEL MOTORIZED ACTUATORS

- ▶ Piezo Inertia, DC Servo, or Stepper Actuators with 25 mm of Travel
- ▶ Load Capacities Up to 55 lbs (25 kg) Available
- ▶ Maximum Speeds Up to 20 mm/s Available
- ▶ Compatible with a Wide Range of Stages

**Z825B**  
25 mm Travel, DC Actuator



**Z825BV**  
Vacuum Compatible



**PIA25**  
25 mm Travel  
Piezo Inertia Actuator



**ZFS25B**  
Compact 25 mm Travel,  
Stepper Motor Actuator

## Piezo Inertia Actuator with 25 mm Travel

### OVERVIEW

#### Features

- ▶ Compact Design, 31.5 mm x 17.0 mm (W x H)
- ▶ Piezo Inertia Actuator Offers 20 nm Typical Step Size
- ▶ Manual Adjustment via Rear-Located Thumbscrew
- ▶ 125 V Maximum Operating Voltage
- ▶ Compatible with Translation Stages using 3/8"-40 Thread or 3/8" Mounting Block
- ▶ Also Available in 10 mm, 13 mm, and 50 mm Travel Versions
- ▶ Ideal for Set-and-Hold Applications that Require Relative Positioning with High Resolution
- ▶ Control Cable can be Adjusted up to 110° for Space-Constrained Applications

Thorlabs' PIA25 Piezoelectric Inertia Actuator provides high-resolution linear motion control with a long piezo-controlled translation range in a compact package. It can support loads up to 2.5 kg (5.51 lbs) and preloads up to 30 N with typical movements of 20 nm and no backlash. The step size can be adjusted up to 30% to a maximum of approximately 30 nm using the KIM101 Controller and Kinesis® software. However, due to the open-loop design, hysteresis, and application conditions, the achieved step size of the system can vary over 20%. An external feedback system will need to be used to overcome this variance.

This actuator has a Ø3/8" (9.525 mm) mounting barrel with a 3/8"-40 thread on the front of the barrel for compatibility with our wide range of translation and rotation stages. For compatibility with 1/4"-80 threaded mirror mounts see our 10 mm travel piezo inertia actuator. The actuator is self-locking when at rest and when there is no power supplied to the piezo, making the actuator ideal for set-and-hold applications that require nanometer resolution and long-term alignment stability. Manual adjustments can be made at any time, as long as the piezo is not actively translating the screw, by using the rear-located thumbscrew or with a 5/64" (2 mm) hex key.



Click for Details  
The Control Cable Can be Adjusted up to 110° for Space-Constrained Applications

Powered by a 10 mm (0.39") long discrete piezo stack, the actuator can operate at speeds of up to 3.5 mm/min. The design of the piezo motor will rotate the tip of the lead screw during translation. As shown in the image to the left, the control cable for each actuator can be rotated up to 110° for space-constrained applications.

#### Required Controller KIM101



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- Four Output Channels, Single- or Dual-Channel Operation
- Standalone Control via Top Panel or PC-Control via USB Plug and Play
- Voltage Output from 85 V to 125 V

Item #	PIA25
Travel	25 mm
Typical Step Size <sup>a</sup>	20 nm
Maximum Step Size <sup>b</sup>	<30 nm
Step Size Adjustability <sup>c</sup>	≤30%
Maximum Step Frequency <sup>d</sup>	2000 Hz
Backlash	None
Maximum Axial Preload <sup>e</sup>	25 N
Recommended Maximum Axial Load Capacity <sup>f</sup>	2.5 kg (5.51 lbs)
Velocity	2 mm/min (Typical) <3.5 mm/min (Maximum)
Drive Screw	1/4"-80 Thread, Hard PVD Coated
Motor Type	Piezoelectric Inertia
Mounting Options	Ø3/8" (9.525 mm) Barrel
	3/8"-40 Threaded Barrel
Operating Temperature	10 to 40 °C (50 to 104 °F)
Dimensions	2.81" x 1.24" x 0.67" (71.4 mm x 31.5 mm x 17.0 mm)
Cable Length	1.0 m (3.28')
Connector	SMC, Female
Compatible Controller	KIM101

- This value can vary over 20% due to component variance, change of direction, and application condition.
- This can be adjusted up to 30% in both directions using the KIM101 Controller and Kinesis Software.
- This can be Adjusted using the KIM101 Controller and Kinesis Software.
- Using the KIM101 Inertia Piezo Controller
- The axial force applied to the drive tip to achieve the specified step size. A minimum of 5 N is recommended to enhance stepping behavior.
- A higher maximum load is possible but it may adversely affect the typical step size.

For information on the design of our piezo inertia "slip-stick" motor actuators, please see the complete presentation here.

#### Required Controller

The KIM101 Controller is required to operate our PIA25 Piezo Inertia Actuator; the actuator cannot be operated using a standard piezo controller. The KIM101 has an internal sawtooth voltage signal generator capable of sending sub-millisecond pulses (steps) with controllable amplitudes from 85 V to 125 V. The driver features four channels and is capable of single- or dual-channel operation, making the controller ideal for applications involving multiple motorized actuators, such as beam steering.

For more information, please see the full web presentation.

Part Number	Description	Price	Availability
<b>PIA25</b>	<b>Piezo Inertia Actuator, 25 mm Travel, Mounting: 3/8"-40 Thread and 3/8" Barrel</b>	<b>\$550.80</b>	<b>Today</b>

## Stepper Motor Actuator with 25 mm Travel

### Features

- ▶ Non-Rotating Drive Tip
- ▶ Bi-Polar Stepper Motor Actuator: 150.5 mm (5.93") Long
- ▶ Compatible with Stages and Mounts that Accept Ø3/8" (Ø9.525 mm) Barrels
- ▶ Also Available in 6 mm and 13 mm Travel Versions

The ZST225B Actuator provides smooth, precise linear motion control in a package measuring 150.5 mm (5.93") in length. Powered by a small-diameter, dual-phase stepper motor, this actuator operates at speeds of up to 2.0 mm/s. The non-rotating drive tip reduces wear and friction and improves smoothness of motion by removing rotational contact at the tip. Mounting is via a standard Ø3/8" (Ø9.525 mm) barrel.

This actuator uses a stepper motor that provides sufficient torque for loads up to 40 N (8.99 lb). It allows very small step sizes over the entire travel range, delivering greater flexibility with low (<15 µm) backlash and fine resolution. The design incorporates a 41:1 gear reduction head which, when combined with the 49,152 microsteps per revolution offered by the KST101 stepper motor driver, gives a theoretical travel per microstep of 0.5 nm (see the *Calculations* tab for details).

Hall effect limit switches prevent the unit from being overdriven and provide homing capability with an accuracy of <5.0 µm. The ZST225B ships with 0.6 m (2 ft) of cable terminated in a 15-pin D-Type connector that is compatible with our KST101 stepper motor controller.

The ZST225B has a standard Ø3/8" (Ø9.525 mm) mounting barrel for fastening into any application compatible with our precision micrometer heads, like the PT1 Single-Axis Translation Stage or the PT3 Three-Axis Translation Stage.

### Required Controller KST101

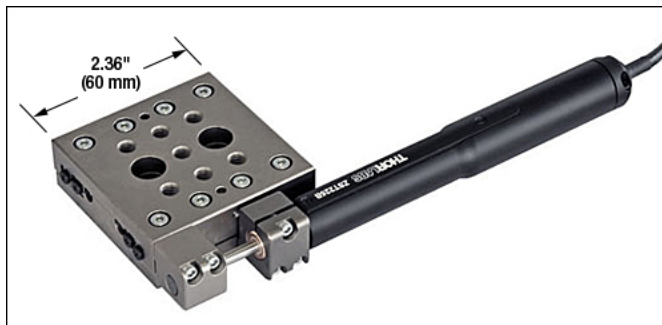
- 49,152 Microsteps per Revolution
- 15 V Output at 12 W
- Trapezoidal and 'S-Curve' Velocity Profiles



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Specification	Value
<b>Travel</b>	25 mm (0.98")
<b>Backlash<sup>a</sup></b>	<15 µm
<b>Repeatability</b>	<5.0 µm
<b>Home Location Accuracy</b>	<5.0 µm
<b>Maximum Load Capacity</b>	40 N (8.99 lb)
<b>Speed</b>	2.0 mm/s (Max)
<b>Acceleration</b>	10 mm/s <sup>2</sup> (Max)
<b>Gearbox Ratio</b>	29791:729 (Approx 41:1)
<b>Limit Switches</b>	Hall Effect Sensor
<b>Lead Screw Pitch</b>	1.0 mm
<b>Motor Type</b>	2-Phase Stepper
<b>Microsteps per Revolution of the Motor<sup>b</sup></b>	24 Full Steps, 2048 µsteps per Full Step 49,152 µsteps per Revolution
<b>Calculated Minimum Incremental Motion</b>	0.5 nm
<b>Mounting</b>	Ø3/8" (9.525 mm) Barrel
<b>Operating Temperature</b>	5 to 40 °C (41 to 104 °F)
<b>Cable Length</b>	0.6 m (2 ft)
<b>Connector</b>	HDDB15
<b>Required Controller</b>	KST101

- The user can correct for backlash errors by adjusting software settings.
- Measured using Thorlabs' previous generation TST101 T-Cube™ Stepper Motor Controller.



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An LNR25 1" travel stage shown with the manual adjuster replaced by a ZST225B actuator.

CALCULATIONS

**How to calculate the linear displacement per microstep**

Each member of the ZST200 series of motors has 24 full steps per revolution, and when driven by the KST101 drivers, there are 2048 microsteps per full step. Hence, there are 49,152 microsteps per revolution of the motor. The output shaft of the motor goes into a 40.866:1 gear head. This requires the motor to rotate 40.866 times to rotate the 1.0 mm pitch lead screw one revolution. The end result is the lead screw advances by 1.0 mm. To calculate the linear displacement of the actuator per microstep, use the following:

Linear displacement of the lead screw per microstep:

$$\text{Number of Microsteps} \times \text{Gearbox Ratio} = 49,152 \times 40.866 = 2,008,645.63$$

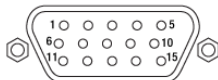
The linear displacement of the lead screw per microstep is

$$1.0 \text{ mm} / 2,008,645.63 = 0.49 \times 10^{-6} \text{ mm} = 0.5 \text{ nm}$$

PIN DIAGRAM

**Connector Pin Out**

Pin Diagram



High-Density D-Type Male 15 Pin Connector

Pin	Description	Pin	Description
1	Limit Ground	8	Reserved For Future Use
2	CCW Limit Switch	9	Reserved For Future Use
3	CW Limit Switch	10	Vcc (+5 VDC)
4	Motor Phase B-	11	Reserved For Future Use
5	Motor Phase B+	12	Reserved For Future Use
6	Motor Phase A-	13	Reserved For Future Use
7	Motor Phase A+	14	Reserved For Future Use
-	-	15	Ground



Click to Enlarge High-Density D-Type Male 15 Pin Connector

Part Number	Description	Price	Availability
ZST225B	25 mm Travel, Stepper Motorized Actuator, Ø3/8" Barrel	\$1,058.31	Today

## Compact Stepper Motor Actuator with 25 mm Travel

### Features

- ▶ Compact, Bi-Polar Stepper Motor Actuator: 88.5 mm (3.48") Long when Fully Retracted
- ▶ Manual Adjustment via Rear-Located Thumbscrew
- ▶ Non-Rotating Drive Tip
- ▶ Compatible with Stages and Mounts that Accept Ø3/8" (Ø9.525 mm) Barrels
- ▶ Also Available in 6 mm and 13 mm Travel Versions

### Required Controller KST101

- 49,152 Microsteps per Revolution
- 15 V Output at 12 W
- Trapezoidal and 'S-Curve' Velocity Profiles



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Our ZFS25B Actuator provides smooth, precise linear motion control in a sleek, compact package measuring just 88.5 mm (3.48") in length when fully retracted. This compact profile reduces the distance between the end of the actuator and optomechanical components, keeping the center of mass closer to the contact point than the ZST225B actuator described above.

Powered by a small-diameter, dual-phase stepper motor, this actuator operates at speeds of up to 2.0 mm/s. The non-rotating drive tip reduces wear and friction and improves smoothness of motion by removing rotational contact at the tip. If power is not supplied to the actuator, manual adjustment is accomplished using the rear-located thumbscrew. The actuator motor can be damaged if this thumbscrew is rotated while power is being supplied. Mounting is accomplished via a standard Ø3/8" (Ø9.525 mm) barrel.

The ZFS25B Motorized Actuator uses a stepper motor that provides sufficient torque for loads up to 40 N (8.99 lb). The actuator allows very small step sizes over the entire travel range, delivering greater flexibility with low (<15 µm) backlash and fine resolution. The design incorporates a 400:9 gear reduction head which, when combined with the 49,152 microsteps per revolution offered by the TST101 stepper motor driver, gives a theoretical travel per microstep of 0.46 nm (see the *Calculations* tab for details).

Hall effect limit switches prevent the unit from being overdriven and provide homing capability with an accuracy of <5.0 µm. The ZFS25B ships with 0.6 m (2 ft) of cable terminated in a 15-pin D-Type connector (see the *Pin Diagrams* tab) that is compatible with our KST101 stepper motor controller.

The ZFS25B has a standard Ø3/8" (Ø9.525 mm) mounting barrel for fastening into any application compatible with our precision micrometer heads, like the PT1 Single-Axis Translation Stage or the PT3 Three-Axis Translation Stage. The manual adjuster of the LNR25 stage in the photo below was replaced with a ZFS25B motorized actuator.

Specification	Value
Travel	25 mm (0.98")
Backlash <sup>a</sup>	<15 µm
Repeatability	<5.0 µm
Home Location Accuracy	<5.0 µm
Maximum Load Capacity	40 N (8.99 lb)
Speed	2.0 mm/s (Max)
Acceleration	10 mm/s <sup>2</sup> (Max)
Gearbox Ratio	400:9 (Approx 44:1)
Limit Switches	Hall Effect Sensor
Lead Screw Pitch	1.0 mm
Motor Type	2-Phase Stepper
Microsteps per Revolution of the Motor <sup>b</sup>	24 Full Steps, 2048 µsteps per Full Step 49,152 µsteps per Revolution
Calculated Minimum Incremental Motion <sup>c</sup>	0.46 nm
Mounting	Ø3/8" (9.525 mm) Barrel
Operating Temperature	5 to 40 °C (41 to 104 °F)
Dimensions (L x W x H)	88.5 mm x 35.0 mm x 19.0 mm (3.48" x 1.38" x 0.75")
Cable Length	0.6 m (2 ft)
Connector	HDDB15
Required Controller	KST101

- The user can correct for backlash errors by adjusting software settings.
- Measured using Thorlabs' previous generation TST101 T-Cube™ Stepper Motor Controller.
- See the *Calculations* tab for more information.



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The ZFS25B actuator is a component of the LNR25ZFS Translation Stage.

CALCULATIONS

**How to calculate the linear displacement per microstep**

The ZFS series of motors has 24 full steps per revolution, and when driven by the KST101 drivers, there are 2048 microsteps per full step, giving 49,152 microsteps per revolution of the motor. The output shaft of the motor goes into a 400:9 gear head. This requires the motor to rotate 44.445 times to rotate the 1.0 mm pitch lead screw one revolution. The end result is the lead screw advances by 1.0 mm.

Linear displacement of the lead screw per microstep:

$$\text{Number of Microsteps} \times \text{Gearbox Ratio} = 49,152 \times 44.445 = 2184560.64$$

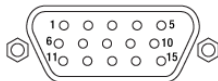
The linear displacement of the lead screw per microstep is

$$1.0 \text{ mm} / 2184560.64 = 0.46 \times 10^{-6} \text{ mm} = 0.46 \text{ nm}$$

PIN DIAGRAM

**Connector Pin Out**

Pin Diagram



High-Density D-Type Male 15 Pin Connector

Pin	Description	Pin	Description
1	Limit Ground	8	Reserved for Future Use
2	CCW Limit Switch	9	Reserved for Future Use
3	CW Limit Switch	10	Vcc (+5 VDC)
4	Motor Phase B-	11	Reserved for Future Use
5	Motor Phase B+	12	Reserved for Future Use
6	Motor Phase A-	13	Reserved for Future Use
7	Motor Phase A+	14	Reserved for Future Use
-	-	15	Ground



Click to Enlarge High-Density D-Type Male 15 Pin Connector

Part Number	Description	Price	Availability
ZFS25B	Customer Inspired! 25 mm Travel, Compact Stepper Motorized Actuator, Ø3/8" Barrel	\$1,250.92	Today

## High-Load Stepper Motor Actuator with 25 mm Travel

### Features

- ▶ 25 mm (0.98") Total Travel
- ▶ High Load Capacity
- ▶ Non-Rotating Tip
- ▶ 50 mm Travel Version Also Available

The DRV013 offers 25 mm (0.98") of travel and better than 1  $\mu\text{m}$  of bidirectional repeatability. When used with one of our stepper motor controllers, such as our Benchtop Controllers, this actuator can achieve better than 50 nm resolution and a default maximum speed of 20 mm/s.

The hybrid stepper motor, with its rotor consisting of 50 individual magnetic teeth, is ideally suited for micro-stepping applications. Aside from the obvious increase in resolution resulting from increasing the steps per revolution from 200 to 409,600, micro-stepping also ensures smoother low-speed motion by allowing the discrete 1.8° step size, which produces mechanical noise, to be reduced to much smaller steps with inherently lower resultant vibrational noise.

The DRV013 Stepper Motor drive has been equipped with a trapezoidal screw thread for a cleaner, more wear resistant operation than is available from a standard threading.

The DRV013 actuator uses a stepper motor that provides sufficient torque for large loads up to 48 lbs (22 kg). The use of a trapezoidal leadscrew in the DRV013 provides a number of benefits over the more common Acme-style thread. The benefits are improved durability, lower friction due to improved surface quality, and nearly no back-drive.

This actuator is compatible with our 2" TravelMax manual stages. To use the DRV013 with these stages, mount the motor to the side of the stage using two M4 x 40 cap screws (included).

### Recommended Controller BSC201

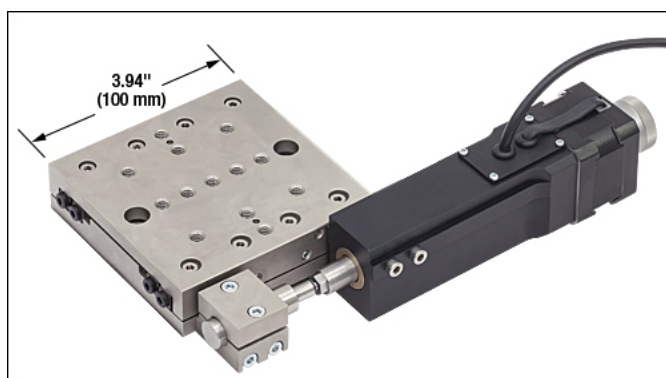
- 409,600 Microsteps per Revolution
- 48 V Output at 25 W
- Trapezoidal and 'S-Curve' Velocity Profile



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Item #	DRV013
Travel	25 mm (0.98")
Bidirectional Repeatability	<1 $\mu\text{m}$
Maximum Load Capacity	48 lbs (22 kg)
Maximum Speed (Default) <sup>a</sup>	20.0 mm/s
Full Step Angle	1.8°
Step Angle Accuracy	5%
Rated Phase Current	1 A
Phase Resistance	3.6 $\Omega$
Phase Inductance	4.6 mH
Holding Torque	23.1 N•cm
Detent Torque	1.7 N•cm
Rotor Inertia	32 g•cm <sup>2</sup>
Insulation Class	B
Limit Switches	Ceramic Tipped, Electro-Mechanical
Main Screw	1 mm Pitch, Trapezoidal
Motor Type	2-Phase Stepper
Microsteps per Revolution	409,600
Min Incremental Movement <sup>b</sup>	50.0 nm
Mounting Barrel	$\varnothing 1/2"$ (12.5 mm)
Weight (Actuator)	1.8 lbs (0.8 kg)
Compatible Controllers	BSC201, BSC202, BSC203, or MST602

- This is the maximum speed set by default when used with one of our stepper motor controllers. By adjusting settings on the controller, the maximum speed may be set to as high as 50 mm/s.
- Valid if used with a Thorlabs stepper motor controller.



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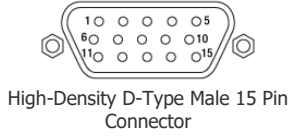
An LNR50 2" travel stage, with the manual adjuster replaced by a DRV013 actuator.



PIN DIAGRAM

Connector Pin Out

Pin Diagram



Pin	Description
1	Limit Ground/Return <sup>a</sup>
2	CCW Limit Switch
3	CW Limit Switch
4	Motor Phase B-
5	Motor Phase B+
6	Motor Phase A-
7	Motor Phase A+
8 to 14	Reserved for Future Use
15	Earth GND

- The limit switch ground wire is connected to the motor body.



Click to Enlarge High-Density D-Type Male 15 Pin Connector

CALCULATIONS

How to calculate the linear displacement per microstep

The stepper motor used in the DRV013 actuator has 200 full steps per revolution of the motor. Each full step is broken down into 128 microsteps. There are 409,600 microsteps per revolution of the motor when using the BSC201 controller. The end result is the leadscrew advances by 1.0 mm. To calculate the linear displacement of the actuator microstep, use the following:

409,600 microsteps per revolution of the lead screw

The linear displacement of the lead screw per microstep is:

$$1.0 \text{ mm} / 409,600 = 2.4 \times 10^{-6} \text{ mm}$$

To calculate the linear displacement for a full step, substitute 409,600 with 200.

Part Number	Description	Price	Availability
DRV013	25 mm Trapezoidal Stepper Motor Drive	\$1,018.27	Lead Time

## DC Servo Motor Actuators with 25 mm Travel

### OVERVIEW

#### Features

- ▶ 6 VDC Servo Actuator
- ▶ Sub-micron Resolution
- ▶ Maximum Velocity: 2.3 mm/s
- ▶ Drop In Replacement for Most 25 mm Manual Actuators
- ▶ Compatible with Stages and Mounts that Accept Ø3/8" (Ø9.525 mm) Barrels
- ▶ Limit Switches for Zero Datum and Actuator Protection
- ▶ Also Available in 6 mm and 12 mm Travel Versions

Our Z8 Series Motorized Actuators are engineered for use with optical positioning devices. They offer high resolution in a lightweight package, which makes these actuators ideally suited for demanding optical laboratory automation applications. The Z825B delivers 25 mm of travel and has been designed as a replacement for the Z725 motor.

Commercial limit switches have been added to provide overdrive protection and accurate home positioning. The motor in the Z8 provides a motion velocity of 2.3 mm/sec. The precision of the encoder (512 counts/rev) results in a minimum resolution of about 29 nm.

The Z825B has been designed specifically to replace the manual adjusters in stages and mirror mounts that have a Ø3/8" (Ø9.525 mm) barrel clamp, like the PT1 Single-Axis Translation Stage or the PT3 Three-Axis Translation Stage.

To install, remove the existing manual adjuster from the mount, and fit the replacement Z8 Actuator. The photo below shows a PT3 three-axis stage with a Z825B fitted to one of the axes.

The units are shipped with 1.6' (0.5 m) of cable. A 2.5 m (8 ft) extension cable (PAA632) is available separately.

For applications with different travel requirements, please see our 6 mm Z806 and 12 mm Z812 actuators. We also offer the Z825BV vacuum-compatible version (sold below), which is rated for use down to  $10^{-6}$  torr and is shipped with a 1.6' (0.5 m) flat ribbon cable, IDC connector, and a converter cable for use with our KDC101 controller.

The KDC101 DC Servo Controller is the required driver for the Z8 series actuators. Please note that previous generation TDC001 units will require a firmware upgrade to V1.0.10 or later, before they can be used with the Z8 series motors. An upgrade is included with the latest APT Server software, which can be downloaded [here](#).



A PT3 1" XYZ translation stage with a Z825B motorized actuator replacing the manual adjuster.

#### Required Controller KDC101

- 34,304 Microsteps per Revolution
- 15 V Output at 2.5 W
- Trapezoidal Velocity Profile



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Specification	Value
Travel Range	25 mm
Backlash	<8 $\mu\text{m}$
Bidirectional Repeatability	<1.5 $\mu\text{m}$
Home Location Accuracy	$\pm 1.0 \mu\text{m}$
Homing Repeatability	$\pm 1.0 \mu\text{m}$
Vertical Load Capacity	4.5 kg (Max)
Horizontal Load Capacity	9 kg (Max)
Vertical Load Capacity <sup>a</sup>	<4.0 kg
Horizontal Load Capacity <sup>a</sup>	<7.5 kg
Velocity <sup>b</sup>	2.6 mm/s (Max)
Acceleration	4 mm/s <sup>2</sup> (Max)
Absolute On-axis Accuracy	130 $\mu\text{m}$
Percentage Accuracy	0.52% (Max)
Phase to Phase Resistance	33.0 $\Omega$ (Max)
Phase to Phase Inductance	0.6 mH (Max)
Motor Type <sup>c</sup>	6 VDC Servo
Minimum Achievable Incremental Movement	0.05 $\mu\text{m}$
Minimum Repeatable Incremental Movement	0.2 $\mu\text{m}$
Mounting Barrel	Ø3/8" (9.525 mm)
Weight	0.134 kg

- Recommended
- The nominal motor drive voltage is 6 V. Voltages up to 12 V can be used with pulse width modulation (PWM) controlled outputs.
- At 2.6 mm/s velocity ripple and distortion of the acceleration/deceleration profile may occur. For improved control, the maximum velocity should be limited to 2.3 mm/s.

## CALCULATIONS

## How to Calculate the Linear Displacement per Encoder Count

For the Z825B, there are 512 encoder counts per revolution of the motor. The output shaft of the motor goes into a 67:1 planetary gear head. This requires the motor to rotate 67 times to rotate the 1.0 mm pitch lead screw one revolution. The end result is the lead screw advances by 1.0 mm.

The linear displacement of the actuator per encoder count is given by

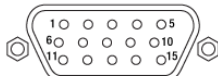
$$512 \times 67 = 34,304 \text{ encoder counts per revolution of the lead screw,}$$

whereas the linear displacement of the lead screw per encoder count is given by

$$1.0 \text{ mm} / 34,304 \text{ counts} = 2.9 \times 10^{-5} \text{ mm (29 nm).}$$

## PIN DIAGRAM

Pin Diagram



High-Density D-Type Male 15 Pin Connector

## Connector Pin Out

Pin	Description	Pin	Description
1	Ground (Limit and Vcc)	8	Reserved For Future Use
2	Forward Limit	9	Ident Resistor
3	Reverse Limit	10	Vcc (+5 VDC)
4	Reserved For Future Use	11	Encoder Channel A
5	Motor (-)	12	Reserved for Future Use
6	Reserved for Future Use	13	Encoder Channel B
7	Motor (+)	14, 15	Reserved For Future Use



Click to Enlarge  
High-Density D-Type Male 15 Pin  
Connector

Part Number	Description	Price	Availability
Z825B	25 mm Motorized Actuator with Ø3/8" Barrel (0.5 m Cable)	\$677.41	Today
PAA632	APT DC Servo Motor Cable for Z8 Motors, DE15 Male to DE15 Female, 2.5 m	\$60.06	Today

## Vacuum-Compatible DC Motor Actuator, 25 mm Travel

### Features

- ▶ 6 VDC Servo Actuator
- ▶ Sub-micron Resolution
- ▶ 2.3 mm/s Maximum Velocity
- ▶ Drop In Replacement for Most 12 mm Manual Actuators
- ▶ Compatible with Ø3/8" (Ø9.525 mm) Barrel-Fitting Stages and Mounts
- ▶ Limit Switches for Zero Datum and Actuator Protection
- ▶ Rated Down To  $10^{-6}$  Torr.
- ▶ Also Available in 6 mm and 12 mm Travel Versions

### Required Controller KDC101

- 34,304 Microsteps per Revolution
- 15 V Output at 2.5 W
- Trapezoidal Velocity Profile



Click to Enlarge

The Z825BV offers all the features and specifications of the Z825B described above, together with vacuum compatibility. These motors feature vacuum rated servo motors, a phosphorus bronze internal coupling mechanism and mounting bush, and high vacuum grease. They are rated for use down to  $10^{-6}$  Torr and are shipped with a 1.6' (0.5 m) vacuum compatible flat ribbon cable with IDC connector. This cable has a 0.05" (1.27 mm) pitch, 28 AWG stranded conductors and Fluorinated Ethylene Propylene (FEP) insulation. A converter cable for use with the KDC101 controller is also supplied, but it is not vacuum compatible and should only be used outside the chamber.

The Z825BV has been designed specifically to replace the manual adjusters in stages and mirror mounts that have a Ø3/8" (Ø9.525 mm) barrel clamp, like the PT1 Single-Axis Translation Stage or the PT3 Three-Axis Translation Stage.

To install, remove the existing manual adjuster from the mount, and fit the replacement Z8 Actuator. The photo below shows a Z825BV fitted to a custom vacuum compatible PT1 stage. For custom vacuum compatible stages, please contact Tech Support. For applications with different travel requirements, please see our 6 mm Z806V and 12 mm Z812V and Z812BV actuators.

Specifications	Value
<b>Travel Range</b>	25.0 mm
<b>Backlash</b>	<8 $\mu\text{m}$
<b>Bidirectional Repeatability</b>	<1.5 $\mu\text{m}$
<b>Home Location Accuracy</b>	<2 $\mu\text{m}$
<b>Homing Repeatability</b>	$\pm 1.0 \mu\text{m}$
<b>Vertical Load Capacity</b>	4.5 kg (Max)
<b>Horizontal Load Capacity</b>	9 kg (Max)
<b>Vertical Load Capacity<sup>a</sup></b>	<4.0 kg
<b>Horizontal Load Capacity<sup>a</sup></b>	<7.5 kg
<b>Velocity<sup>b</sup></b>	2.6 mm/s (Max)
<b>Acceleration</b>	4 mm/sec <sup>2</sup> (Max)
<b>Absolute On-axis Accuracy</b>	130 $\mu\text{m}$
<b>Percentage Accuracy</b>	0.52% (Max)
<b>Motor Coil Temperature</b>	85 °C (Max)
<b>Limit Switch Life Time</b>	>100,000 Cycles
<b>Motor Type<sup>c</sup></b>	6 VDC Servo
<b>Min Achievable Incremental Movement</b>	0.05 $\mu\text{m}$
<b>Min Repeatable Incremental Movement</b>	0.2 $\mu\text{m}$
<b>Operating Temperature Range</b>	41 to 104 °F (5 to 40 °C)
<b>Vacuum Rating</b>	$10^{-6}$ Torr
<b>Mounting Barrel</b>	Ø3/8" (9.525 mm)
<b>Weight</b>	0.134 kg

- Recommended
- At 2.6 mm/s velocity ripple and distortion of the acceleration/deceleration profile may occur. For improved control, the maximum velocity should be limited to 2.3 mm/s.
- The nominal motor drive voltage is 6 V. Voltages up to 12 V can be used with pulse width modulation (PWM) controlled outputs.



A Z825BV motorized actuator fitted to a custom vacuum-compatible PT1 stage.

The KDC101 DC Servo Controller is the required driver for the Z8 and Z6 series actuators. Please note that previous generation TDC001 units will require a firmware upgrade to V1.0.10 or later, before they can be used with the Z8 series motors. An upgrade is included with the latest APT Server software, which can be downloaded here.

## CALCULATIONS

**How to Calculate the Linear Displacement per Encoder Count**

For the Z825BV, there are 512 encoder counts per revolution of the motor. The output shaft of the motor goes into a 67:1 planetary gear head. This requires the motor to rotate 67 times to rotate the 1.0 mm pitch lead screw one revolution. The end result is the lead screw advances by 1.0 mm.

The linear displacement of the actuator per encoder count is given by

$$512 \times 67 = 34,304 \text{ encoder counts per revolution of the lead screw,}$$

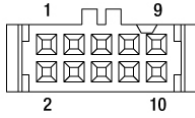
whereas the linear displacement of the lead screw per encoder count is given by

$$1.0 \text{ mm} / 34,304 \text{ counts} = 2.9 \times 10^{-5} \text{ mm (29 nm).}$$

PIN DIAGRAM

The vacuum-compatible cable integrated with the Z825BV is terminated in a Female IDC 10-Pin socket connector. A short converter cable, which adapts this female IDC socket connector to a D-Type male HD15 pin connector, is included with the Z825BV to facilitate connecting the actuator to the recommended KDC101 controller. This converter cable, whose terminating connectors are shown at right, is not vacuum compatible. Information describing the pin assignments for both the female IDC socket and Male D-Type HD connector (when it is connected to the female IDC socket connector) follows.

Pin Diagram



10 Pin Female IDC Socket Connector  
(Amphenol T812 Series, 2.54 mm Pitch)



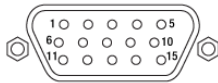
Click to Enlarge  
10 Pin Female IDC Socket Connector  
(Amphenol T812 Series, 2.54 mm Pitch)

Female IDC 10-Pin Connector Pin Out

Pin	Description	Pin	Description
1	Motor (+ve) (6 V) <sup>a</sup>	6	Motor (-ve) (6 V) <sup>a</sup>
2	Vcc (+5 V)	7	Limit Ground
3	Encoder Channel A	8	Reverse Limit
4	Encoder Channel B	9	Forward Limit
5	Ground	10	Reserved for Future Use

- The nominal motor drive voltage is 6 V. Voltages up to 12 V can be used with pulse width modulation (PWM) controlled outputs.

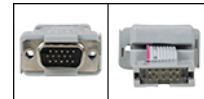
Pin Diagram



High-Density D-Type Male 15 Pin Connector

Male Hddb15 Connector Pin Out

Pin	Description	Pin	Description
1	Ground (Limit and Vcc)	8	Reserved For Future Use
2	Forward Limit	9	Ident Resistor
3	Reverse Limit	10	Vcc (+5 VDC)
4	Reserved For Future Use	11	Encoder Channel A
5	Motor (-)	12	Reserved for Future Use
6	Reserved for Future Use	13	Encoder Channel B
7	Motor (+)	14, 15	Reserved For Future Use



Click to Enlarge  
Connectors terminating the converter cable. The image on the left shows the high-density D-Type male 15-pin connector, and the image on the right shows the 10-pin female IDC socket connector.

Part Number	Description	Price	Availability
Z825BV	Vacuum-Compatible 25 mm Motorized Actuator with Ø3/8" Barrel Fitting	\$938.20	Today

**Re-greasing Kit**

## OVERVIEW

**Features**

- ▶ 1.5 cc Syringe of Apiezon 100 Grease
- ▶ Convenient, Inexpensive Package that Reduces Waste
- ▶ Prolongs Lifetime of Actuator
- ▶ Ready to Dispense
- ▶ Vacuum Compatible to  $10^{-9}$  Torr

This Apiezon grease has excellent anti-seize properties. It contains PTFE for maximum lubricity and is ideal for re-lubricating the lead screw threads of our ZST, ZFS, and Z8 series actuators described above. It is supplied in a syringe for easy application and is recommended both for general use and for vacuum applications down to  $10^{-9}$  Torr. It has an optimal working range of 10 to 30 °C (50 to 86 °F).

**Note:** It is recommended that the lead screws of the Z8, ZFS, and ZST motors are lubricated every 50,000 cycles or 6 months, whichever comes first.

Part Number	Description	Price	Availability
GKZ8	Grease Kit for Z8, ZFS, and ZST Actuators	\$15.48	Today

Visit the *1" (25 mm) Travel Motorized Actuators* page for pricing and availability information:

[https://www.thorlabs.com/newgrouppage9.cfm?objectgroup\\_id=1883](https://www.thorlabs.com/newgrouppage9.cfm?objectgroup_id=1883)