PPS-50 Series

Precision Positioning Stage
Reference Manual
(Piezo and Linear Motor Versions)

micronix USA
PRECISION MOTION SOLUTIONS

PPS-50

Piezo/Linear Motor
Precision Positioning Stage

Reference Manual

Rev 1.2

MICRONIX USA, LLC
Tel: 949-480-0538
Fax: 949-480-0538
Email: info@micronixusa.com
http://micronixusa.com

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1. Introduction

1.1 Product Description

The precision **piezo motor stage** PPS-50 allows nano-positioning of high loads. The PPS-50 is fully integrated with our patented multi-phase piezo motor and an optional high-resolution encoder or absolute encoder.

The **linear motor stage** PPS-50 allows nano-positioning at high speeds. The PPS-50 is fully integrated with a high-resolution absolute encoder (up to 25 nm resolution).

Both PPS-50 configurations are built using anti-creep crossed roller bearings assure high stiffness. The PPS-50 is available with external Nanodrive controller, and any PPS-50 configuration can be combined with our rotary and gonio stages for ultimate motion flexibility.

Product Specifications	Motor Type	PPS-50-X1XXX	PPS-50-X2XXX	PPS-50-X3XXX	PPS-50-X4XXX
Travel	All	26 mm	50 mm	75 mm	100 mm
Max Speed	Piezo Motor	10 mm/s (MMC-110), 5 mm/s (NanoDrive) 2 mm/s (MMC-100)			
Max Speed	Linear Motor	> 300 mm/s (NanoDrive)			
Digital Encoder Resolution	Piezo Motor	1nm			
Absolute Encoder Resolution	All	25 nm			
Max Load (Vertical)	All	20 N			

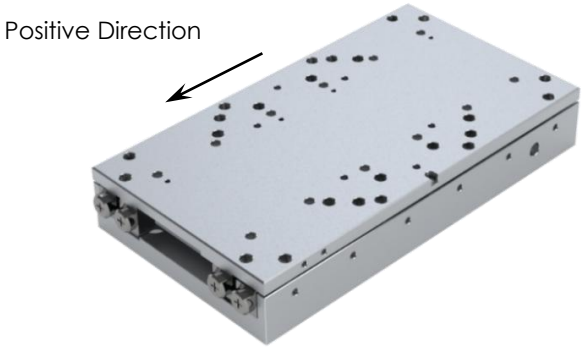


Figure 1-A. PPS-50 Linear / Piezo Motor

1.2 Recommended Controllers

The following controllers are available from MICRONIX USA:

- NanoDrive – Compatible with all motors
- MMC-110 – Compatible with Piezo motor only, all encoders
- MMC-100 - Compatible with 2 Phase Piezo motor and digital encoder only

1.3 Technical Data and Ordering Information

Detailed specifications and ordering information can be found on the PPS-50 product page on the MICRONIX USA website.

2. Preparing to Install the PPS-50 Stage

2.1 Installation Preparation

When mounting the stage, it is important to consider the flatness of the mounting surface, as the stage will conform to the shape of that surface. The stage's performance and structural integrity are impacted by the mounting flatness. It is required to have a mounting surface with flatness less than the overall specified flatness on the product datasheet.

The stage is calibrated and guaranteed to be within specification at 20°C ± 5°C unless otherwise specified. Be sure to use the stage under the following conditions:

- Mount to a clean surface which is free of debris, burrs or dings with a flatness to be less than the flatness of the base as specified on the product datasheet.
- An indoor atmosphere free of corrosive gases, excessive dust, and condensation.
- Temperature range of 5-40°C.
- Relative humidity between 20-80%.
- Locate away from water, heat, and electrical noise.

WARNING: Powerful magnets are installed in linear motor configurations. Keep magnetic hardware away when installing the stage.

2.2 Package Contents

If the product is damaged or there are missing components, contact MICRONIX USA immediately. Do not discard product packaging in case of return shipment.

Package Should Contain:

- PPS-50 Linear Stage
- Reference Manual
- Any other previously agreed upon components such as a controller.

3. Installing the PPS-50 Stage

Refer to Section 3.1.1 for general mounting, 3.1.2 for XY Mounting. Additional brackets and screws may be required for custom applications, see Section 5 for stacking configuration examples.

Important: Mounting the PPS-50 requires M3 low profile socket head cap screws or screws with a maximum head height of 2 mm. Use non-magnetic materials for linear motor versions.

Recommended mounting screw:

- 92855A304, M3 Low Profile Socket Head Cap Screw (McMaster-Carr)

Note: *Stages assembled in factory do not require disassembly for base mounting.*

3.1 PPS-50 Installation

3.1.1 *General Mounting*

A recommended general mounting pattern sample can be found in Section 4.2.

1. Align the stage to the mounting surface using at least two M1.5 x 4 mm dowel pins.
2. Move the carriage to access the mounting holes. Secure the stage to the mounting surface using at least four M3 low profile socket head cap screws at 0.5 Nm recommended torque.

Important: It is possible to move the carriage of the linear and piezo motor configurations manually without damaging the stage. However, the encoder scale is installed under the moving carriage. **Do not handle the stage with bare hands to avoid contaminating the scale located under the bearing rail or under the moving carriage.**

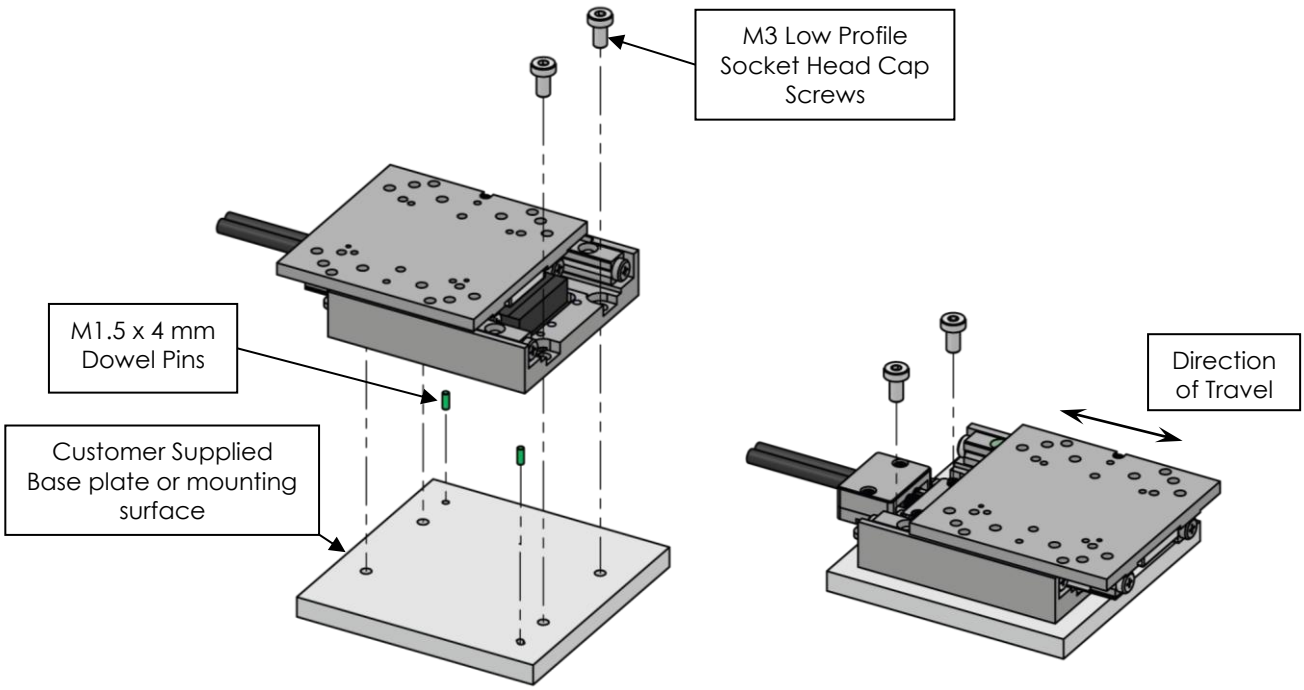


Figure 3-A. PPS-50 General Mounting Installation

3.1.2 *X-Y Mounting*

It is possible to mount the 26 mm length base versions directly onto any length bottom axis carriage without the use of an adapter bracket. However, longer base versions will require the use of an adapter bracket (P/N: 431687) for X-Y configurations.

3.1.2.1 X-Y Mounting, 26 mm Travel Configurations

1. Install the bottom stage to the mounting surface as shown in Section 3.1.1.
2. Align and secure the top stage to the bottom stage using four M3 x 5 mm low profile socket head cap screws at 0.5 Nm recommended torque.

   Note: Do not use screws longer than specified to avoid damage to the bearings.

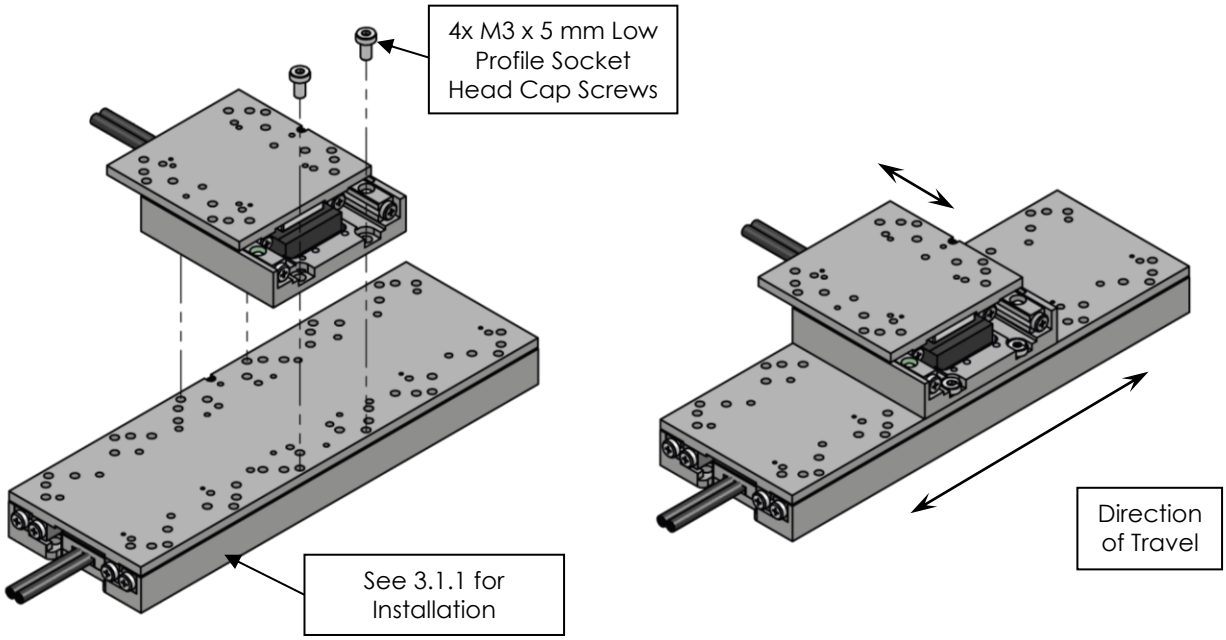


Figure 3-B. PPS-50 XY Mounting Installation, 26mm Configuration

3.1.2.2 X-Y Mounting, 50mm, 75mm, 150mm Travel Configurations

1. Install the bottom stage to the mounting surface as shown in Section 3.1.1.
2. Align the adapter bracket (PN: 431687) to the carriage using at least two M1.5 x 5 mm dowel pins and secure using four M3 x 4 mm low profile socket head cap screws at 0.5 Nm recommended torque.

   Note: Do not use screws longer than specified to avoid damage to the bearings.
3. Align the stage onto the adapter bracket using two M1.5 x 5 mm dowel pins. Move the carriage to access the mounting holes and secure the using four M3 x 6 mm low profile socket head cap screws at 0.5 Nm recommended torque.

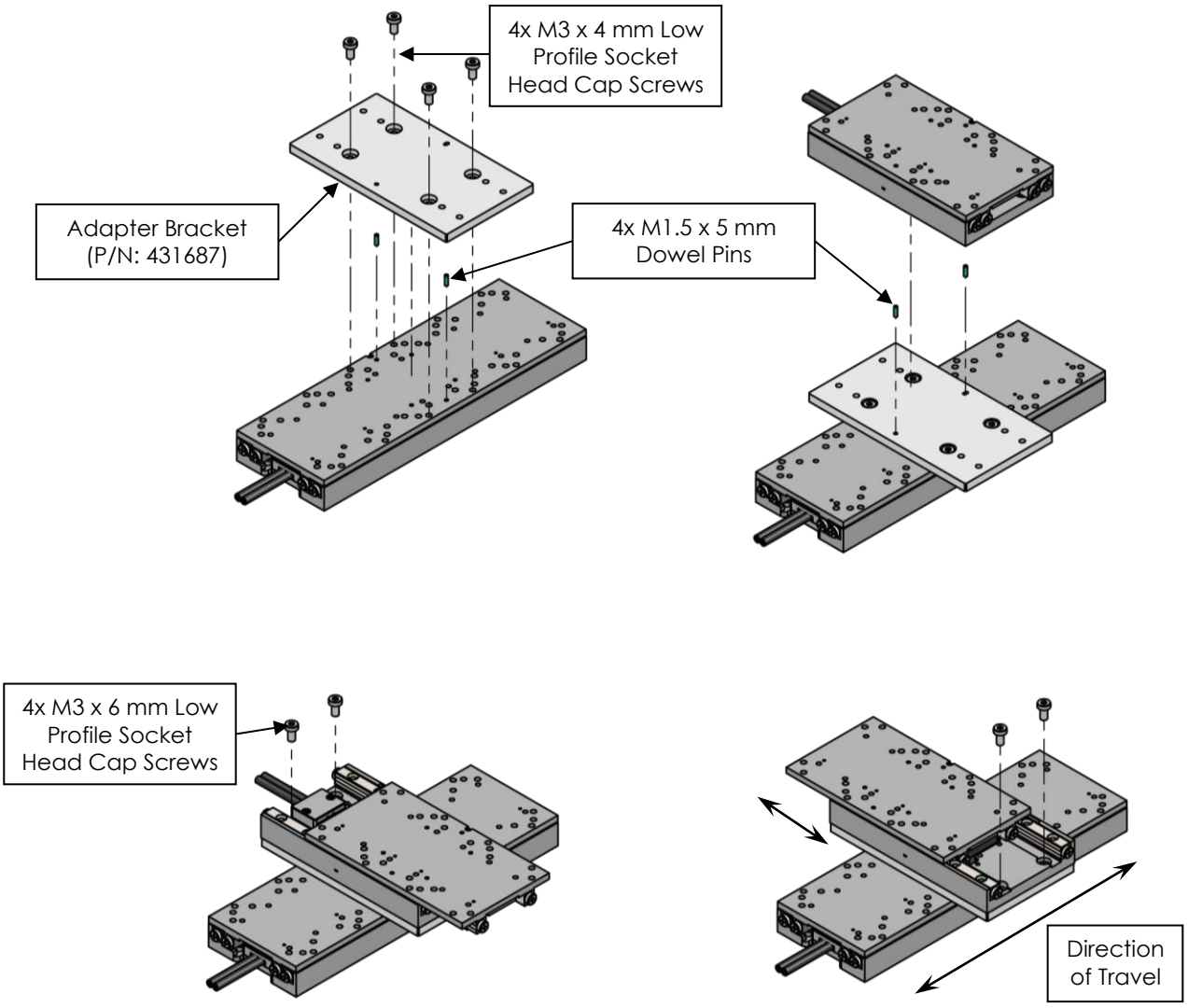
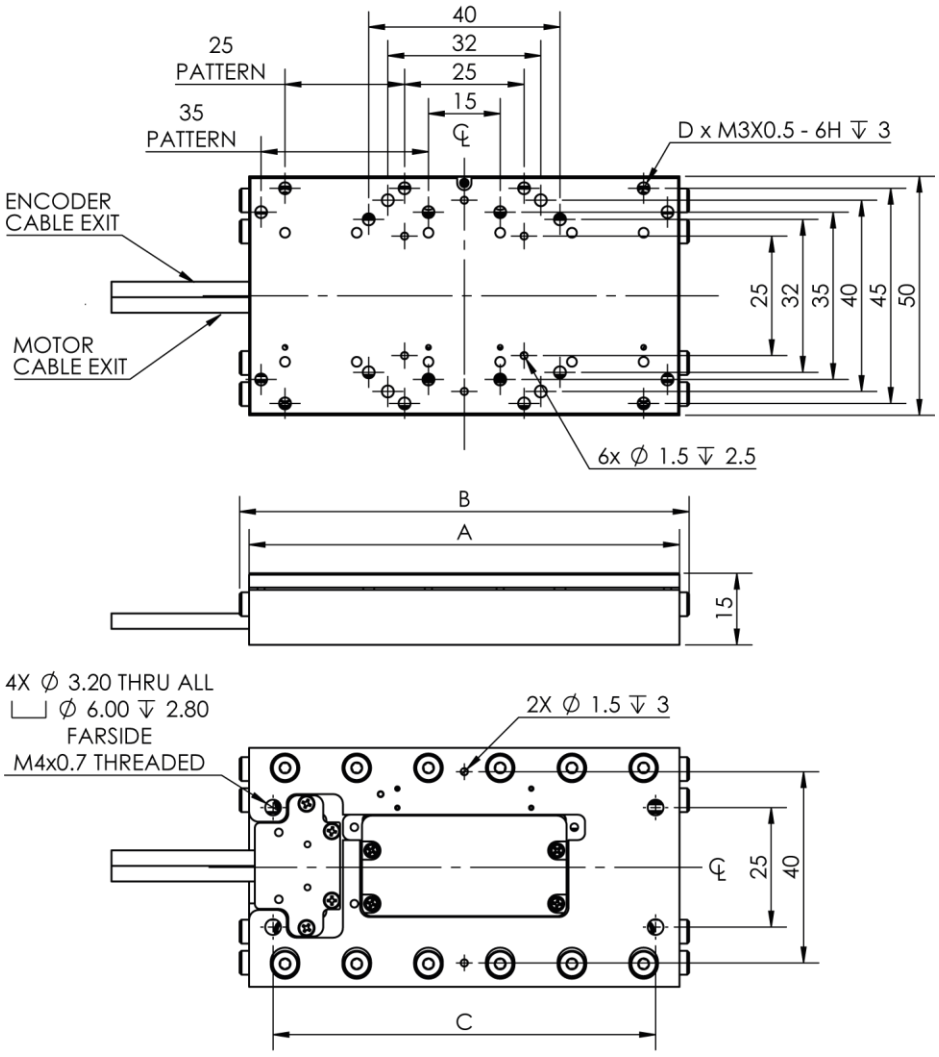


Figure 3-C. PPS-50 XY Mounting Installation, Longer Configurations

4. Dimensions

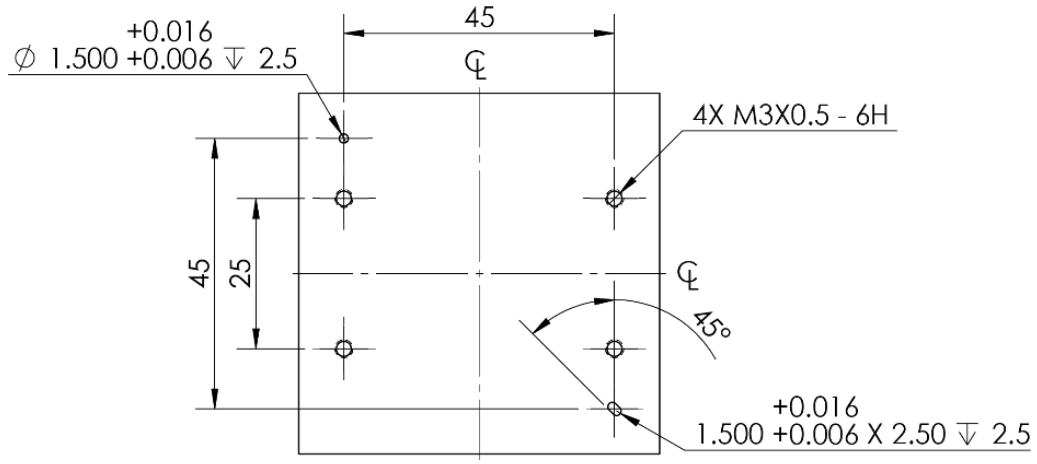
4.1 PPS-50 Piezo/Linear Dimensions



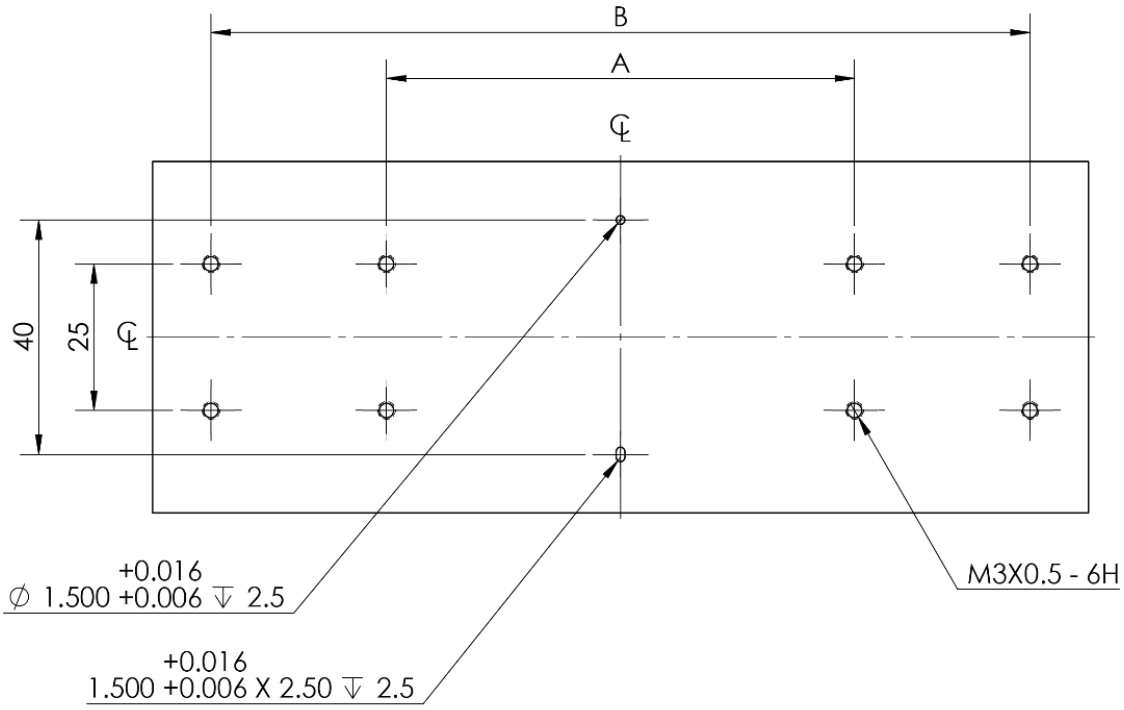
TRAVEL	A	B	C	D
26	50	50	45	16
50	90	94	80	24
75	120	124	60	24
100	150	154	80	48

4.2 Recommended General Mounting Pattern

4.2.1 26 mm Travel Configuration



4.2.2 50 mm, 75 mm, and 150 mm Travel Configurations

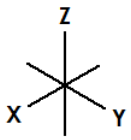


TRAVEL	A	B
50	N/A	80
75	60	110
100	80	140

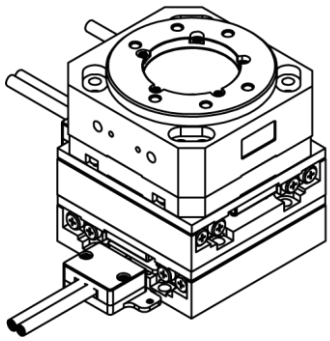
5. Stacking Configurations

5.1 Configuration Examples (additional configurations available upon request)

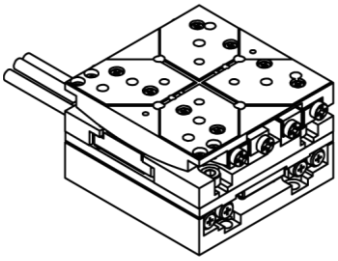
- Additional configurations available upon request
- Note: Stacking compatibility for all motor configurations.
- Images are positioned according to:



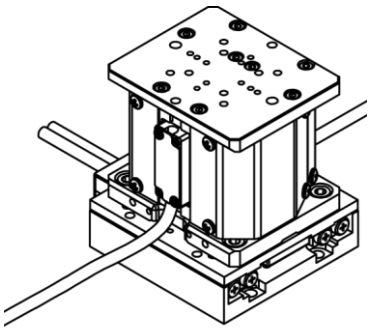
No Adapters



X-θ 26mmx360°
[with PR-50 Rotational Stage]

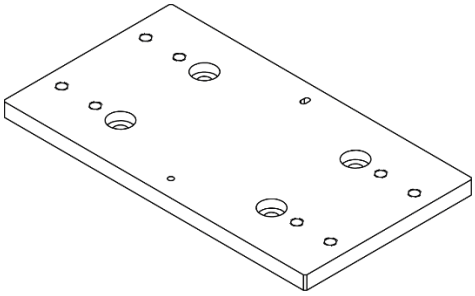


X-θ 26mmx10°
[with PG-50 Gonio Stage]



X-Z 26x10 mm
[with ES-50 Elevation Stage]

5.2 Accessories

431687 XY-Bracket Adapter Plate

Used to adapt 50 mm, 75 mm, and 150 mm length versions of the PPS-50 to an XY configuration. For longer XY-Bracket Adapter Plates, contact MICRONIX USA.

6. Connecting the PPS-50 Stage

Connecting the PPS-50 stage only requires that the Dsub-9 pin male motor cable is connected to a compatible MMC controller. No other cables or components are required.

Please contact Micronix USA for Wiring Diagrams and Pinouts.

6.1 Vacuum Environments

6.1.1 *Handling and Preparation*

When preparing the stage for vacuum environments, take the necessary precautions, such as wearing latex gloves, clean room, clothing, etc. Avoid any contaminants. Maximum bake-out temperature is 100°C. MICRONIX USA optionally supplies the stage with vacuum compatible connectors, see chart below.

Connector Description	Connector Material	Contacts	Backshell
High Vacuum Glass- filled Dyiathilate D-Subminiature	DAP	T2 Female Crimps, Gold Pins (Accuglass P/N: 111652)	Nickle-plated Zinc Backshell Strain Relief
Ultra High Vacuum D-Subminiature	PEEK	T1 Female Crimps, Gold Pins (Accuglass P/N: 100180)	PEEK UHV Strain Relief

Environment	Open Loop	Closed Loop
High Vacuum (10^{-6} mbar)	9 Pin Female DAP	15 Pin Female DAP
Ultra-High Vacuum (10^{-9} mbar)	9 Pin Female PEEK	15 Pin Female PEEK

Connecting an open loop PPS-50 stage in a vacuum chamber requires the use of a feed-through connector at the vacuum chamber wall.

Please contact Micronix USA for Wiring Diagrams and Pinouts.

The vacuum compatible PPS-50 will be supplied with wiring for a straight through feed-through, not a cross over gender changer. MICRONIX USA supplies test connectors that simulate the vacuum feed-through to allow for functionality testing prior to installation in a vacuum chamber, see Appendix A.4 for feedthrough pins.

Note: Linear motor versions are not available for ultra-high vacuum environments.

7. Supplementary Information

7.1 Maintenance & Handling

- The PPS-50 series of modular linear stages utilizes a maintenance free design. Do not modify the stage or perform any maintenance unless specifically instructed to do so by MICRONIX USA personnel. If the stage is not performing up to the original specifications, please contact MICRONIX USA.
- The PPS-50 piezo stage is a precision mechanical device and should be handled with care. Do not drop or mishandle the stage.
- Do not touch the bearing slide with bare hands to avoid contaminating the motor friction surface.
- Do not touch the underside of the bearing to avoid contaminating or damaging the encoder scale.
- Do not de-rail the bearing as this will affect stage performance if re-installation is attempted. Please contact MICRONIX USA if this occurs.
- Follow the *Installation Preparation* requirements and use proper cable management to ensure a clean and safe operating environment.

7.2 Units and Conversions

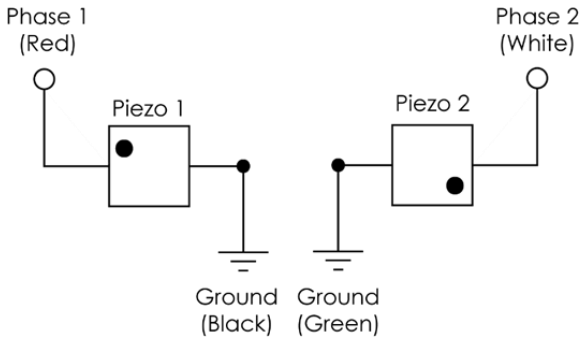
All measurements in this document are in the metric system of units.

Metric Unit	English Unit
1 millimeter	0.0394 inches
1 micron	0.0000394 inches
1 Newton	0.2248 lbs
1 Newton-meter	8.85 in-lbs

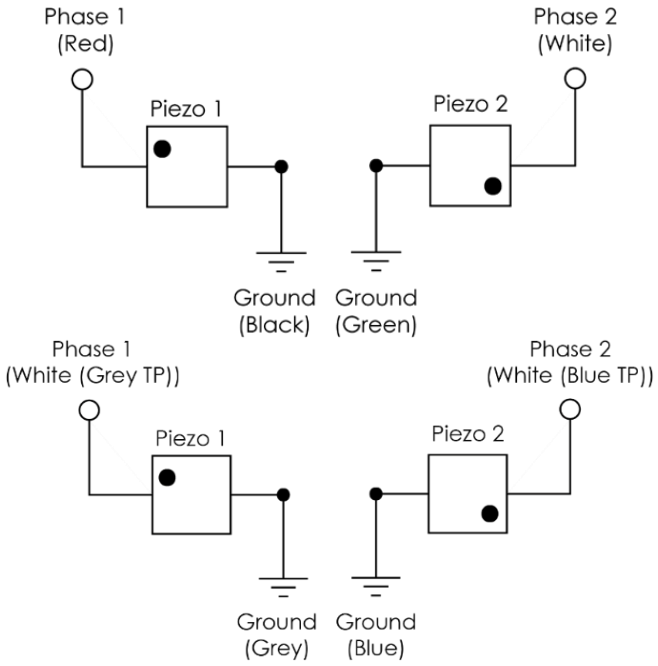
A. Appendix

A.1 Piezo Motor Operating and Electrical Specifications

A.1.1 2 Phase Piezo Motor Wiring Diagram



A.1.2 4 Phase Piezo Motor Wiring Diagrams

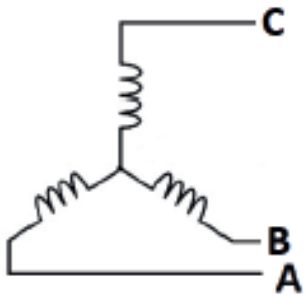


A.1.3 Piezo Operating and Electrical Specifications

Voltage	60V maximum
Capacitance	150nf ±15%

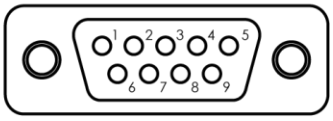
A.2 BLDC Motor Operating and Electrical Specifications

Motor Winding Diagram:
3-Phase Wye Configuration

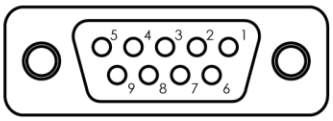


Linear Motor Type	Brushless DC (Ironless)
Winding Type	Wye
Continuous Force	2 N
Continuous Current	1.72 A_{rms}
Peak Force	5 N
Peak Current	4.31 A_{rms}
Force Constant (K_f)	1.16 N / A_{rms}
Back EMF (K_e)	1.0 V-sec/m
Resistance (Line-to-Line) 25°C	2.8 Ohms
Inductance (Line-to-Line)	0.25 mH
Magnetic Pitch (N-N)	12.49mm

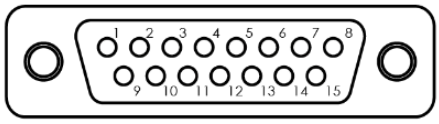
A.3 Dsub Connector Pinout



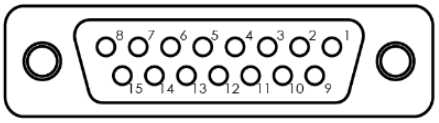
Male Dsub9 Connector (Dsub9M) - Front View



Female Dsub9 Connector (Dsub9F) - Front View



Male Dsub15 Connector (Dsub-15M) - Front View

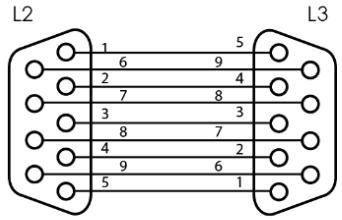


Female Dsub15 Connector (Dsub-15F) - Front View

A.4 Vacuum Feedthrough Pinout

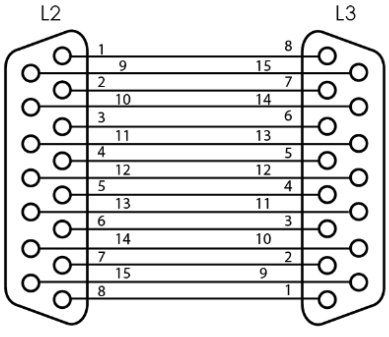
Recommended feedthrough pinout based on off the shelf feedthroughs.

Straight Through 9-Pin Feed-through



Male DB9 **Male DB9**

Straight Through 15-Pin Feed-through



Male DB15 **Male DB15**

A.5 Using the Digital Encoder

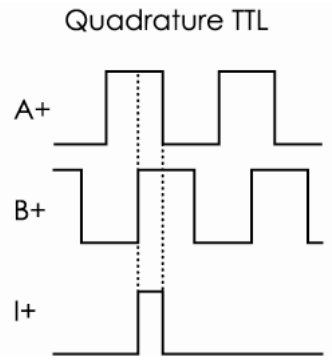
A.5.1 Encoder Overview

The PPS-70 with Digital Encoder must be paired with an appropriate controller. The PPS-70 with a digital encoder will be supplied with a 9-pin connector that incorporates these encoder signals.

A.5.2 Operating and Electrical Specifications

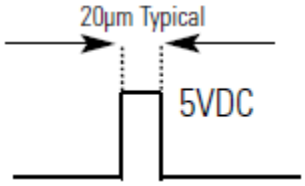
Power Supply	5VDC ±10% @ < 35mA (No outputs terminated) @ < 85mA (A, B, I, and both limits terminated); 50mA at the sensor

A.5.2.1 Output Signals



***Note:** The index pulse may be aligned with A- or B- at some interpolation values.

A.5.2.2 Index Window



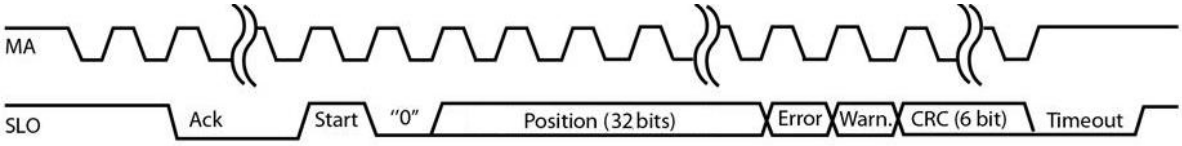
A.5.3 Resolution

Digital encoder with an MMC controller has an achievable resolution of 1nm.

A.6 Using an Absolute Encoder

A.6.1 Encoder Overview

The Micronix absolute encoder operates using standard BiSS C-mode (continuous) interface, transmitting 32-bits of position data on each request. The controller will clock position acquisitions via the MA signal. The SLO signal will transmit position data from the encoder.

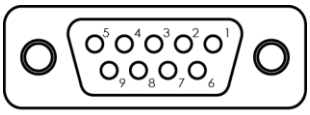


A.6.2 Operating and Electrical Specifications

Power Supply	5VDC ±10% (< 30mA for sensor)

A.6.2.1 Absolute Encoder Pinout

Pin DE9S	Description
1	SLO+ / DATA+
2	MA+ / CLK+
3	SLI+
4	Ground
5	+5V
6	SLO- / DATA-
7	MA- / CLK-
8	SLI-
9	Not In Use



Dsub9F - Front View
9 Pin Female Connector

A.6.2.2 Absolute Encoder Setup

Absolute Encoder BiSS-C	
Absolute Resolution	32 Bits
Encoder BiSS Frequency	5 MHz
Encoder BiSS CRC Polynomial	0
Position Integer Type	Unsigned
Number of Status Bits	0
Error Bits Mask	0
CRC Error Suppression	None
Data Alignment	Left Justified

A.6.3 Resolution

Absolute encoder with an MMC controller has an achievable resolution of <25nm.