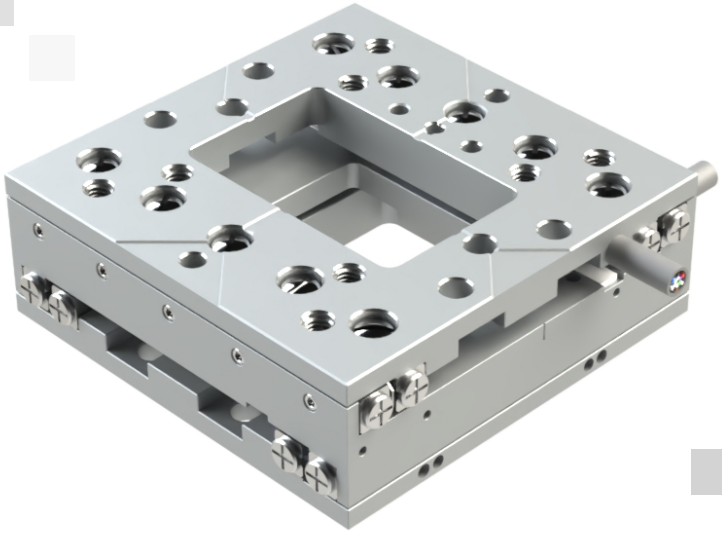
PPX-50 Series



Precision Piezo XY Stage

Reference Manual

(Open and Closed Loop Versions)

micronix USA
PRECISION MOTION SOLUTIONS

PPX-50

Piezo XY Stage
Reference Manual

Rev 3.1

MICRONIX USA, LLC
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http://micronixusa.com

Table of Contents

1. Introduction

1.1 Product Description

The PPX-50 is a low profile, long travel, integrated XY stage with an open aperture and a height of only 17.5 mm. Crossed roller bearings guarantee smooth and stable motion for loads up to 30 N. It utilizes a multi-phase piezo motor and is available in open loop or with a linear encoder with a closed-loop resolution of 2 nm. Versions capable of operation in vacuum (down to 10^{-9} mbar) are available.

Product Specifications	Open Loop	Analog Encoder	Digital Encoder
Travel	28 x 28 mm		
Minimum open aperture	9.5 x 9.5 mm		
Maximum open aperture	19 x 19 mm		
Max Speed (MMC-100)	2 mm/s		
Max Speed (MMC-110)	10 mm/s		
Resolution	1 nm	10 nm	2 nm
Max Load (Vertical)	30 N		

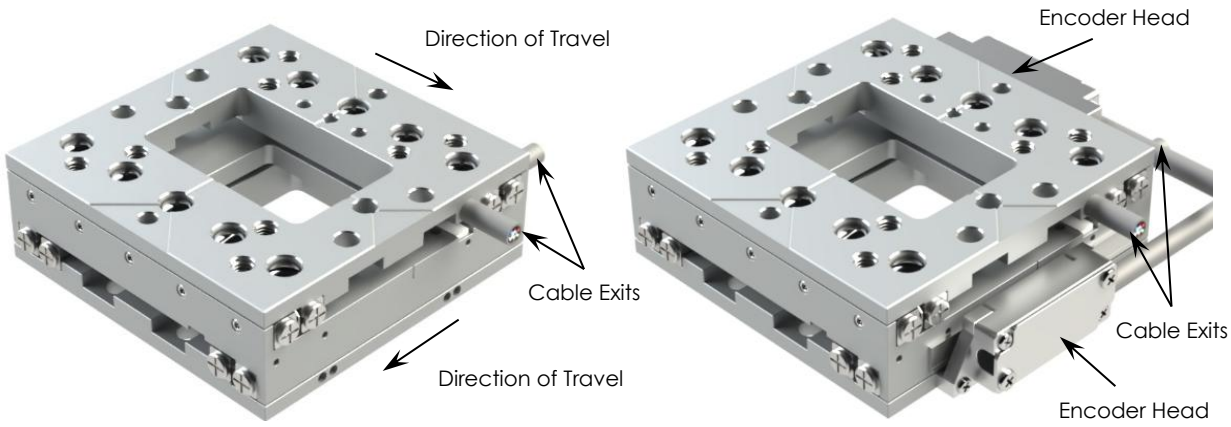


Figure 1-A. PPX-50, Open Loop Version (left), Closed Loop Version (right)

1.2 Recommended Controllers

The following compatible controllers are available from MICRONIX USA:

Controller	Piezo Motor	Analog Encoder	Digital Encoder
MMC-100	✓	✓	✓
MMC-110	✓	✓	✓
NanoDrive	✓		✓
MMX-120	✓	✓	✓

CAUTION: Ensure the controller is compatible with the stage's motor and feedback signals and that connector types match before connecting. Improper connections or incompatibility may cause damage to the stage or controller.

1.3 Technical Data and Ordering Information

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

2. Preparing to Install the PPX-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.

The stage specification is tested at a temperature of 20°C ± 5°C unless otherwise specified. Ensure the following conditions are met before operating the stage:

- Mounting surface is clean and free of debris, burrs or dings.
- Recommended mounting surface flatness is less than 25 µm for optimal performance.
- Indoor atmosphere is free of corrosive gases, excessive dust, and condensation.
- Operating temperature range of 5-40°C.
- Relative humidity between 20-80%.
- The stage is located away from water, heat, and electrical noise.

2.2 Product Handling

- The PPX-50 is a precision mechanical device and should be handled with care. Do not drop or mishandle the stage.
- Do not touch the scale or ceramic track, as this will contaminate and jeopardize the performance of the stage.
- Use proper cable management to ensure a clean and safe operating environment.
- Properly connect the stage to the controller before powering on the controller. Failure to do so can result in damage to the stage.
- Allow for easy access to the stage in case of servicing.

NOTE: Piezo stages use friction-based motion with ceramic components that are sensitive to oils. Wear powder-free nitrile gloves when handling the stage to avoid contamination.

NOTE: It is possible to gently move the carriage manually without damaging the stage.

WARNING: Keep hands clear of all moving parts while the stage is in motion to avoid personal injury.

2.3 Package Contents

The package contains all necessary components for the PPX-50 stage setup. 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 Contents:

- PPX-50 XY Stage
- Reference Manual
- Any additional components specified in the order, such as a controller

3. Installing the PPX-50 Stage

Additional brackets and screws may be required for custom applications. See Section 5 for stacking configuration examples.

NOTE: It is possible to gently move the carriage manually without damaging the stage.

3.1 PPX-50 Installation

3.1.1 General Mounting Option 1

1. Move the bottom carriage to access the mounting holes. Align and secure the stage to the mounting surface using two M3 Socket Head Cap Screws at 0.5 Nm recommended torque.

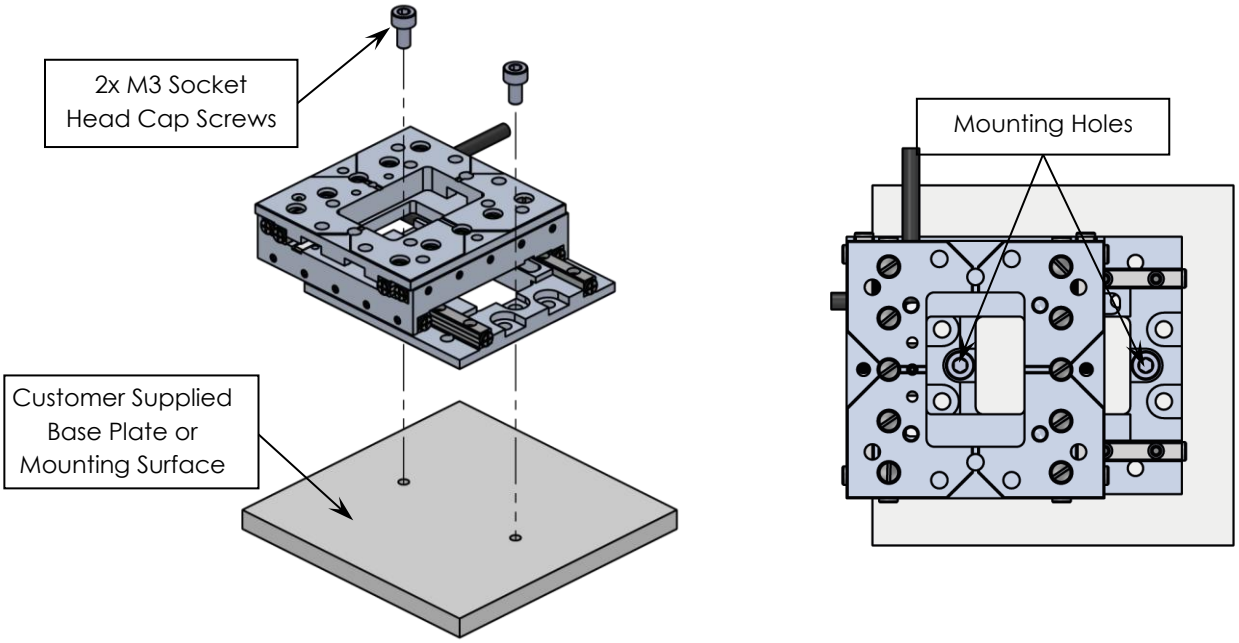
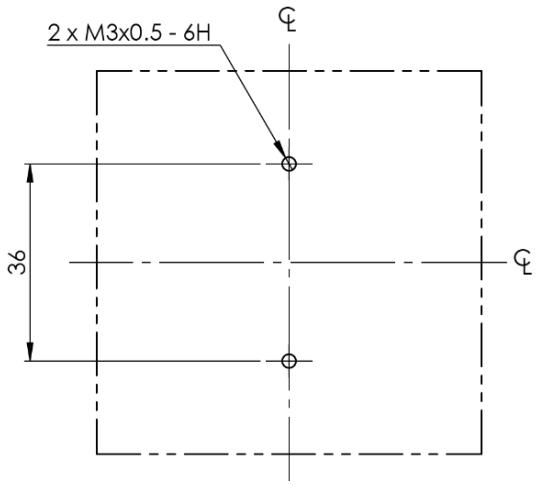


Figure 3-A. PPX-50 Installation Option 1

3.1.1.1 Option 1 Mounting Pattern



3.1.2 General Mounting Option 2

1. Move the bottom carriage to access the mounting holes. Align and secure the stage to the mounting surface using four M3 Socket Head Cap Screws at 0.5 Nm recommended torque.

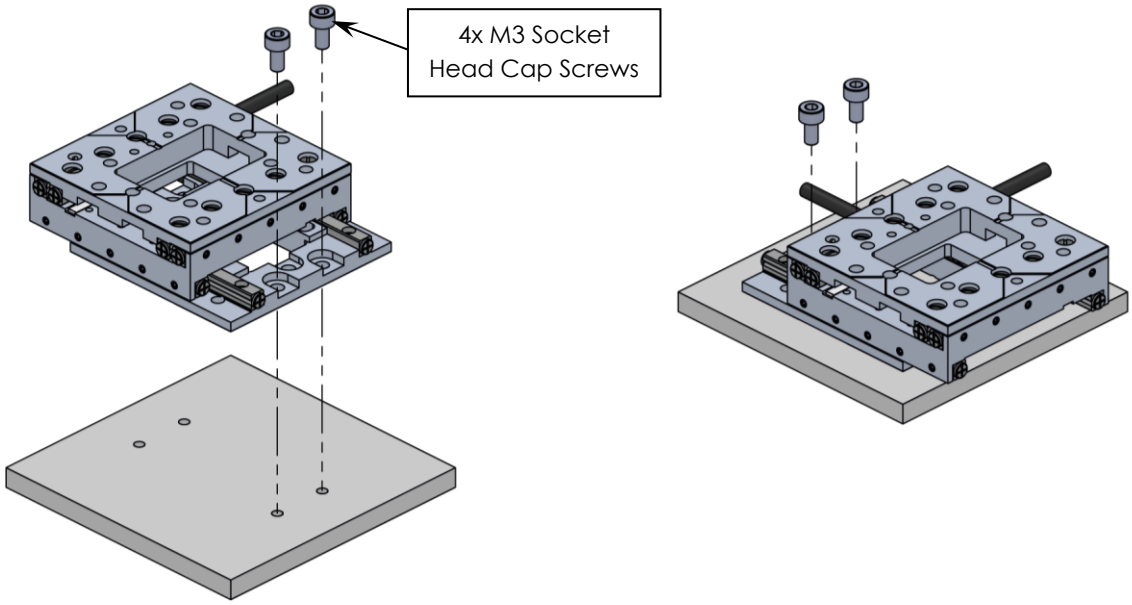
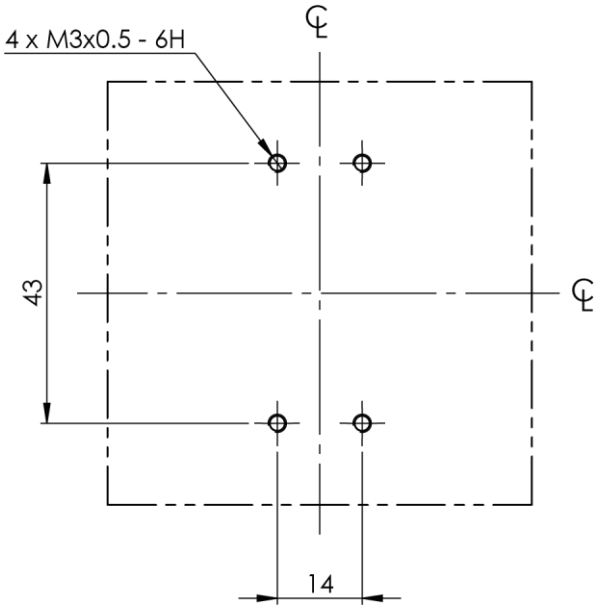


Figure 3-B. PPX-50 Installation Option 2

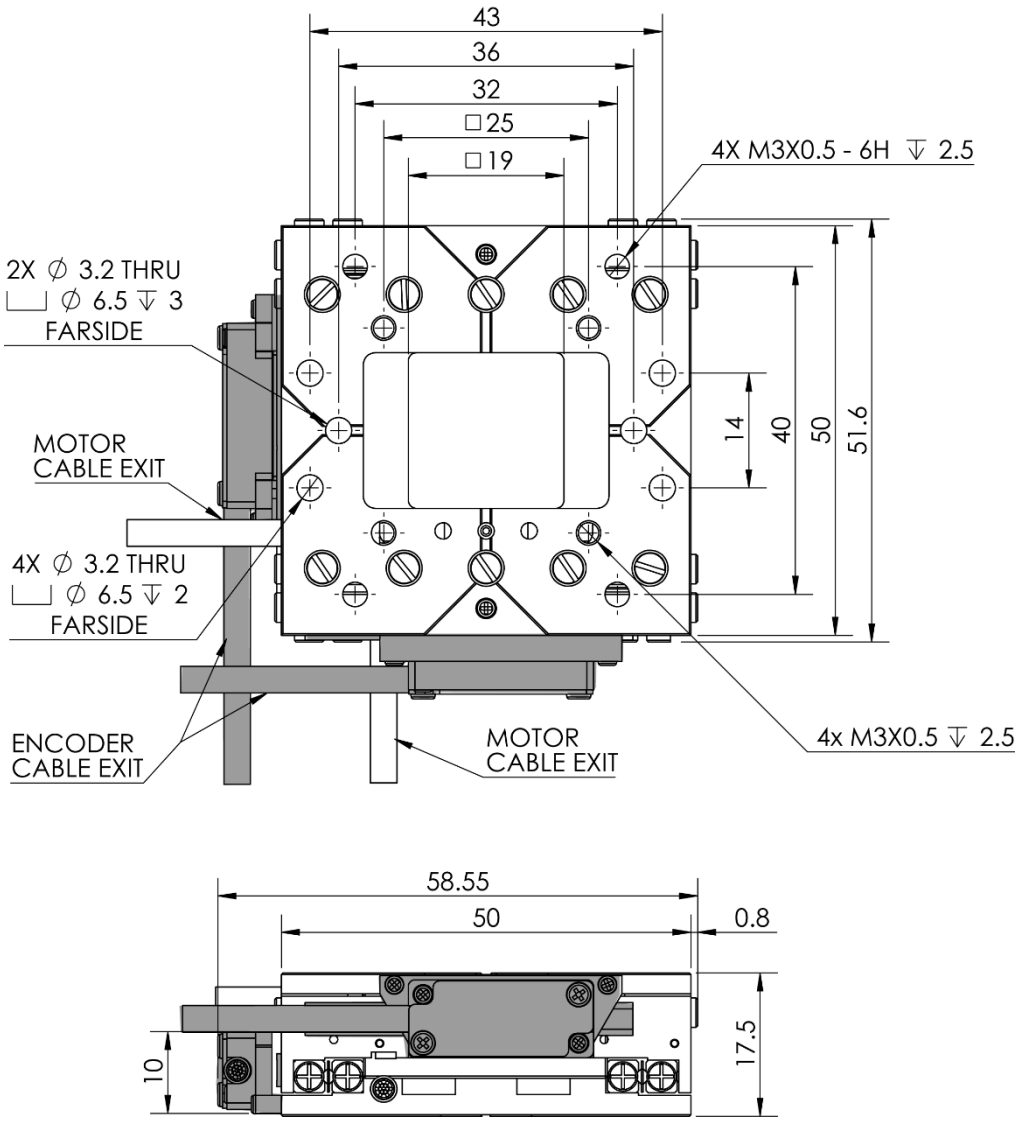
3.1.2.1 Option 2 Mounting Pattern



4. Dimensions

4.1 PPX-50 Standard Dimensions

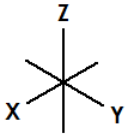
Grey parts are for closed loop versions only.



Dimensions in millimeters

5. Stacking Configuration

- Additional configurations are available upon request.
- Images are positioned according to:



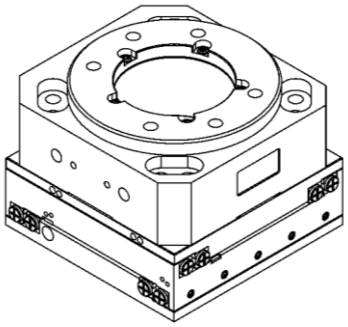
5.1 PPX-50 Interface with Other MICRONIX Stages (Examples)

The PPX-50 can be mounted directly onto a range of MICRONIX stages, enabling flexible multi-axis configurations. Below are examples of stages that support direct mounting without the need for an adapter bracket.

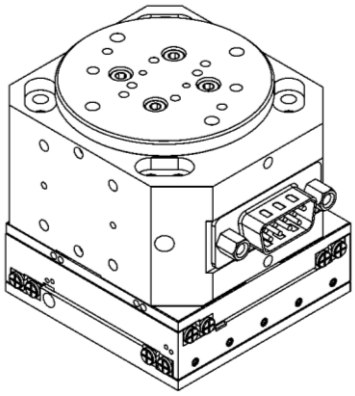
If an adapter is required, contact MICRONIX USA for assistance.

5.1.1 PPX-50 + PR-50, XY Translation + Rotation

PR-50 and PR-50SM can mount directly on PPX-50 for 360° with up to 28mm XY travel.



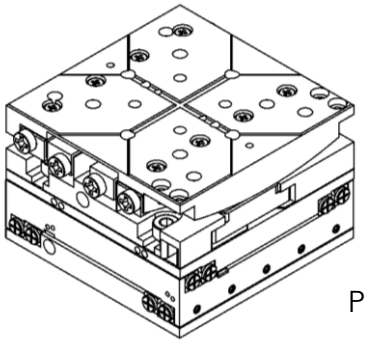
PPX-50 & PR-50



PPX-50 & PR-50SM

5.1.2 PPX-50 + PG-50, XY Translation + Goniometer

The PG-50 can mount directly on PPX-50 for angular ±5° with up to 28mm XY travel.



PPX-50 & PG-50

6. Connecting the PPX-50 Stage (MMC Controller)

For all setups, 2-axis controllers are needed per stage. For MMC systems, controllers may be stacked or standalone units depending on the application.

6.1 Atmospheric Environments

For controller information refer to the appropriate MMC controller manual.

6.1.1 Open Loop, Atmospheric Wiring Diagram

Connecting the PPX-50 in an open loop only requires that the D-sub 9 pin motor cables be connected to a compatible controller. For details regarding the pinout see Appendix Section A.2.1.

Cable Descriptions:

A. Motor Cable (Male D-sub 9 Pin, 1.5m PVC Black Cable)

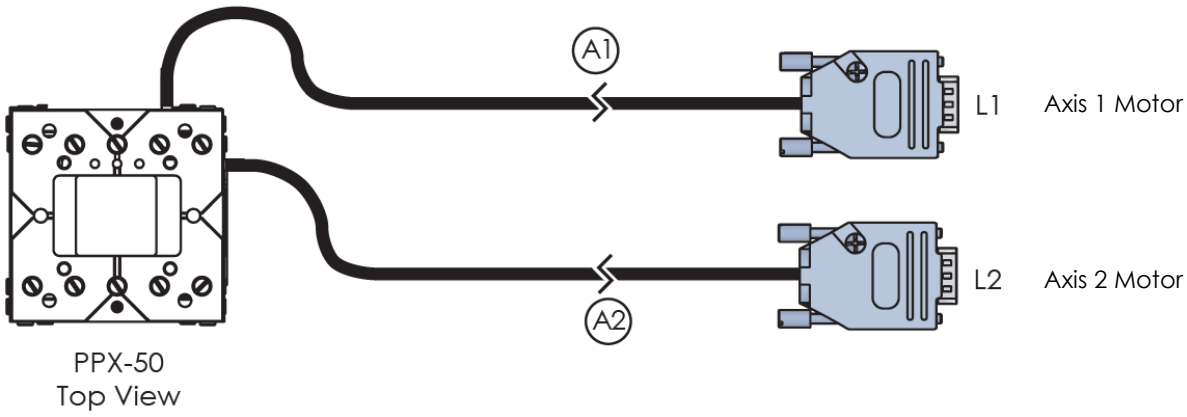


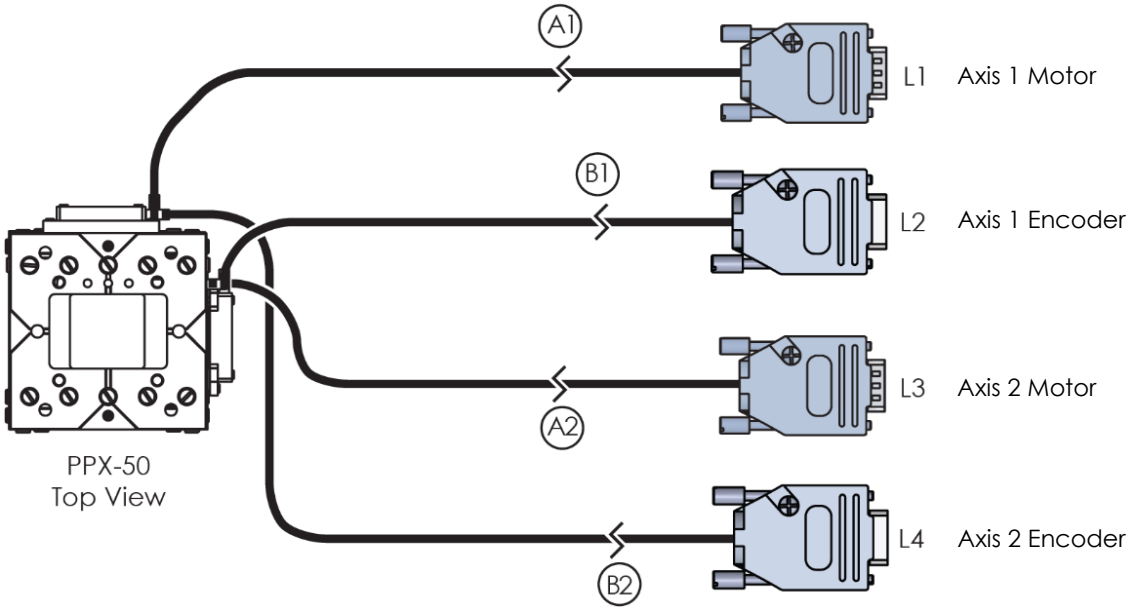
Figure 6-A. PPX-50, Open Loop, Atmospheric Wiring Diagram

6.1.2 Closed Loop (Encoder), Atmospheric Wiring Diagram

See Appendix Section A.2.2 and A.2.3 for analog and digital pinouts respectively.

Cable Descriptions:

A. Motor Cable (Male D-sub 9 Pin, 1.5m PVC Black Cable)
B. Encoder Cable (Female D-sub 9 Pin, 1.5m PVC Black Cable)



**For digital encoders, the interpolator is internal to connector*

Figure 6-B. PPX-50, Closed Loop, Atmospheric Wiring Diagram

6.2 *Vacuum Environments*

6.2.1 Handling and Preparation

When handling stages configured for vacuum use, take the necessary precautions, such as wearing powder-free nitrile gloves, clean room garments, etc. to avoid any contaminants. Maximum bake-out temperature is 100°C. As standard, the stage is supplied with non-vacuum-compatible connectors. MICRONIX USA optionally offers this stage supplied with vacuum-rated connectors installed, see chart below.

Connector Description	Connector Material	Contacts	Backshell
High Vacuum Glass- filled Diallyl Phthalate D-Subminiature	DAP	T2 Female Crimps, Gold Pins (Accuglass P/N: 111652)	Nickel-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 the PPX-50 in a vacuum chamber requires the use of a feedthrough connector at the vacuum chamber wall. For final application, the customer is responsible for providing their own feedthrough connection.

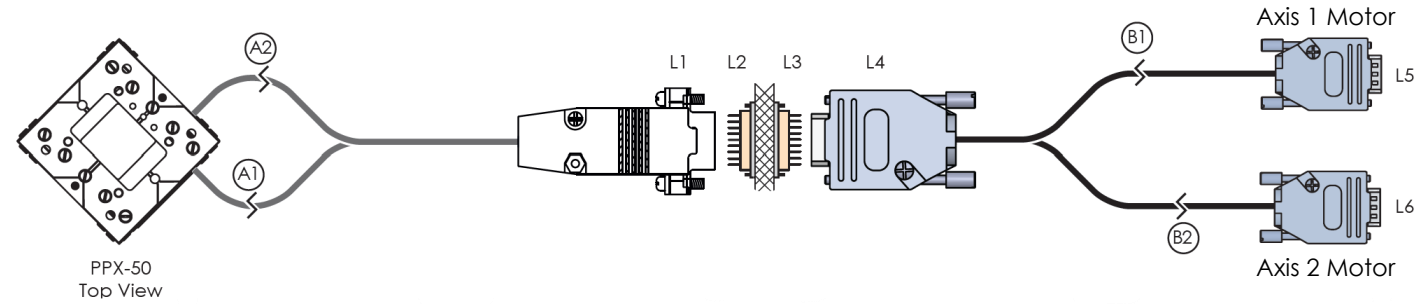
The vacuum compatible PPX-50 will be supplied with wiring for a straight through feedthrough, not a cross over gender changer. MICRONIX USA supplies test connectors that simulate the vacuum feedthrough, to allow for functionality testing prior to installation in a vacuum chamber. See Appendix Section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

6.2.2 Open Loop, Vacuum Wiring Diagram

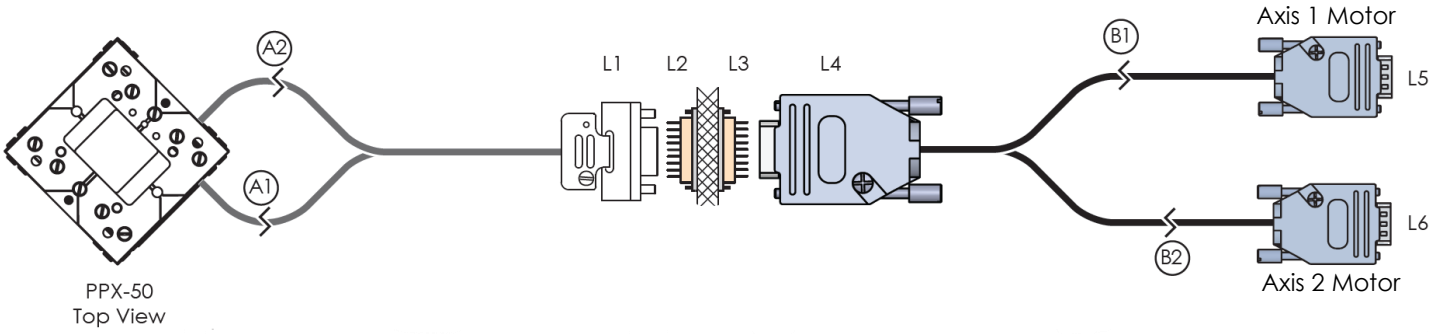
See Appendix Section A.2.4 for pinout information.

Cable Descriptions:

A. Vacuum Motor Cable (Female D-sub 9 Pin PEEK or DAP, 1.5m Silver Braided Cable)
B. Atmospheric Motor Breakout Cable (Female D-sub 9 Pin to Male D-sub 9 Pin, 1.5m PVC Black Cable)



HV Connector



UHV Connector

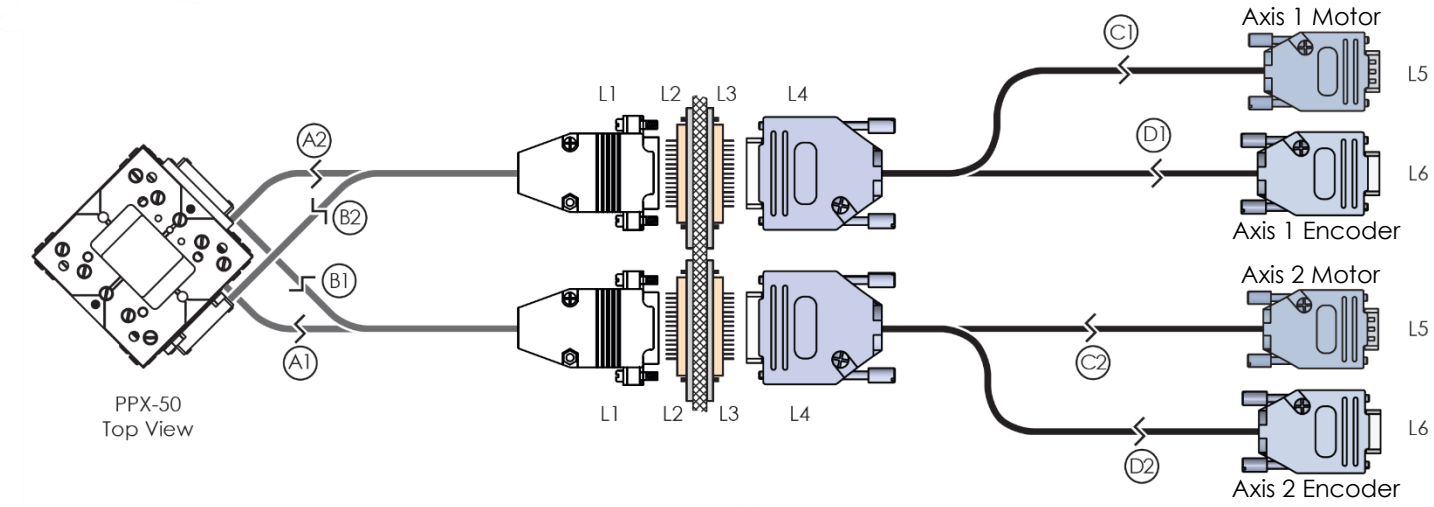
Figure 6-C. PPX-50, Open Loop, Vacuum Wiring Diagram

6.2.3 Closed Loop (Encoder), Vacuum Wiring Diagram

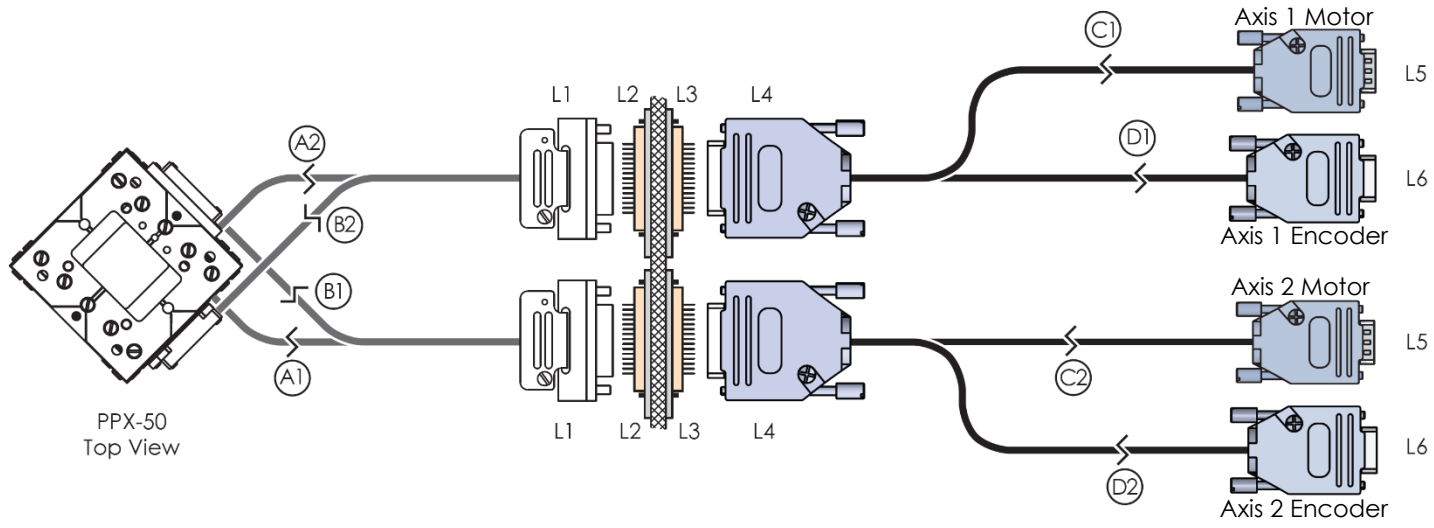
See Appendix Section A.2.5 and A.2.6 for analog and digital pinouts respectively.

Cable Descriptions:

A. Vacuum Encoder Cable (Female D-sub 15 Pin PEEK Connector, 1.5m Silver Braided Cable)
B. Vacuum Motor Cable (Female D-sub 15 Pin PEEK Connector, 1.5m Silver Braided Cable)
C. Atmospheric Motor Breakout Cable (Female D-sub 15 Pin to Male D-sub 9 Pin, 1.5m PVC Black Cable)
D. Atmospheric Encoder Breakout Cable (Female D-sub 15 Pin to Female D-sub 9 Pin, 1.5m PVC Black Cable)



HV Connector



UHV Connector

**For digital encoders, the interpolator is internal to connector*

Figure 6-D. PPX-50, Closed Loop, Vacuum Wiring Diagram

7. Supplementary Information

7.1 Maintenance

The PPX-50 series XY stage 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.

7.2 Units and Conventions

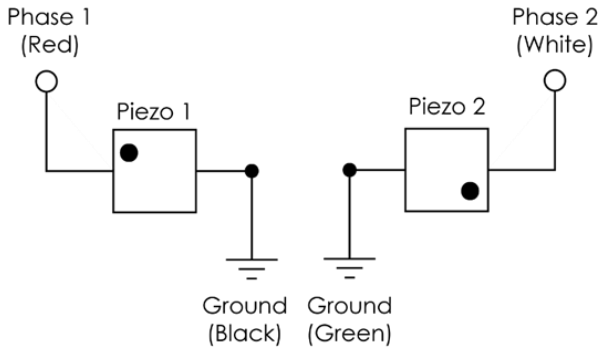
All measurements in this document are in the metric system of units.

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 Electrical Specifications

A.1.1 2 Phase Piezo Motor Wiring Diagram



A.1.2 Piezo Motor Specifications

Voltage	60V maximum
Capacitance	150nF ±15%

A.2 Wiring Pinouts

A.2.1 Piezo Motor, Atmospheric, Open Loop Pinout

See Figure 6-A

Pinout for PPX-50-11000 — Cable A1 & A2 D-sub 9M

	Description	Color	L1
Motor 1&2	Motor Phase 1	Red	1
	Motor Phase 2	White (Green TP)	2
	Motor Ground	Black/Green	5
	Shield	-	Casing

A.2.2 Piezo Motor, Atmospheric, Closed Loop, Analog Pinout

See Figure 6-B.

Pinout for PPX-50-11200 — Cable A1 & A2 D-sub 9M

	Description	Color	L1
Motor 1&2	Motor Phase 1	Red	1
	Motor Phase 2	White (Green TP)	2
	Motor Ground	Black/Green	5
	Shield	-	Casing

Cable B1 & B2 D-sub 9F

	Description	Color	L2
Encoder 1&2	Cos +	Brown	1
	Sin +	Blue	2
	Index+	Violet	3
	GND	Grey	4
	+5V	White (Grey TP)	5
	Cos -	White (Brown TP)	6
	Sin -	White (Blue TP)	7
	Index-	White (Violet TP)	8
	Shield	-	Casing

A.2.3 Piezo Motor, Atmospheric, Closed Loop, Digital Pinout

See Figure 6-B.

Pinout for PPX-50-11300

Cable A1 & A2
D-sub 9M

	Description	Color	L1
Motor 1&2	Motor Phase 1	Red	1
	Motor Phase 2	White (Green TP)	2
	Motor Ground	Black/Green	5
	Shield	-	Casing

Cable B1 & B2
D-sub 9F

	Description	Color	L2
Encoder 1&2	A +	Brown	1
	B +	Blue	2
	Index+	Violet	3
	GND	Grey	4
	+5V	White (Grey TP)	5
	A -	White (Brown TP)	6
	B -	White (Blue TP)	7
	Index-	White (Violet TP)	8
	Shield	-	Casing

A.2.4 Piezo Motor, Vacuum, Open Loop Pinout

Figure 6-C.

Pinout for PPX-50-11006/11009

			Cable A1 & A2 D-sub 9F	Feedthrough D-sub 9M			Cable B1 & B2 D-sub 9F	D-sub 9M	D-sub 9M
	Description	Color	L1	L2	L3	Color	L4	L5	L6
Motor 1	Motor 1 Phase 1	Red	1	1	5	Red	5	1	-
	Motor 1 Phase 2	White (Green TP)	2	2	4	White (Green TP)	4	2	-
	Motor 1 Ground	Black/Green	6	6	9	Black/Green	9	5	-
	Shield	-	7	7	8	-	8	Casing	-
Motor 2	Motor 2 Phase 1	Red	5	5	1	Red	1	-	1
	Motor 2 Phase 2	White (Green TP)	4	4	2	White (Green TP)	2	-	2
	Motor 2 Ground	Black/Green	9	9	6	Black/Green	6	-	5
	Shield	-	8	8	7	-	7	-	Casing

A.2.5 Piezo Motor, Vacuum, Closed Loop, Analog Pinout

See Figure 6-D.

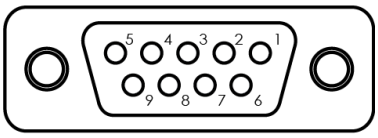
	Pinout for PPX-50-11206/9		Cable A&B D-sub 15F	Feedthrough D-sub 15M			Cable C&D D-sub 15F	Cable C&D D-sub 9M	Cable C&D D-sub 9F
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L5**	**L6**
Motor 1&2	Motor Phase 1	Red	1	1	8	Red	8	1	-
	Motor Phase 2	White (Green TP)	2	2	4	White (Green TP)	7	2	-
	Motor GND	Black/Green	9	9	15	Black/Green	15	5	-
	Shield	-	10	10	14	-	14	Casing	-
Encoder 1&2	GND	Grey	8	8	1	Grey	1	-	4
	Cos +	Brown	7	7	2	Brown	2	-	1
	+5V	White (Grey TP)	6	6	3	White (Grey TP)	3	-	5
	Cos-	White (Brown TP)	5	5	4	White (Brown TP)	4	-	6
	Sin+	Blue	4	4	5	Blue	5	-	2
	Sin-	White (Blue TP)	12	12	12	White (Blue TP)	12	-	7
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	-	8
	Index+	Violet	14	14	10	Violet	10	-	3
	Shield	-	15	15	9	-	9	-	Casing

A.2.6 Piezo Motor, Vacuum, Closed Loop, Digital Pinout

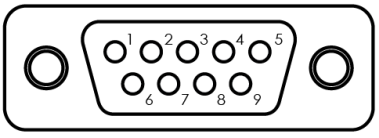
See Figure 6-D.

	Pinout for PPX-50-11306/9		Cable A&B D-sub 15F	Feedthrough D-sub 15M			Cable C&D D-sub 15F	Cable C&D D-sub 9M	Cable C&D D-sub 9F
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L5**	**L6**
Motor 1&2	Motor Phase 1	Red	1	1	8	Red	8	1	-
	Motor Phase 2	White (Green TP)	2	2	4	White (Green TP)	7	2	-
	Motor GND	Black/Green	9	9	15	Black/Green	15	5	-
	Shield	-	10	10	14	-	14	Casing	-
Encoder 1&2	Encoder GND	Grey	8	8	1	Grey	1	-	4
	A+	Brown	7	7	2	Brown	2	-	1
	+5V	White (Grey TP)	6	6	3	White (Grey TP)	3	-	5
	A-	White (Brown TP)	5	5	4	White (Brown TP)	4	-	6
	B+	Blue	4	4	5	Blue	5	-	2
	B-	White (Blue TP)	12	12	12	White (Blue TP)	12	-	7
	Index -	White (Violet TP)	13	13	11	White (Violet TP)	11	-	8
	Index +	Violet	14	14	10	Violet	10	-	3
	Shield	-	15	15	9	-	9	-	Casing

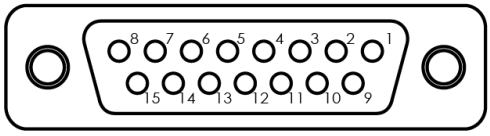
A.3 Standard D-sub Connector Pinout



Dsub9F - Front View
9 Pin Female Connector



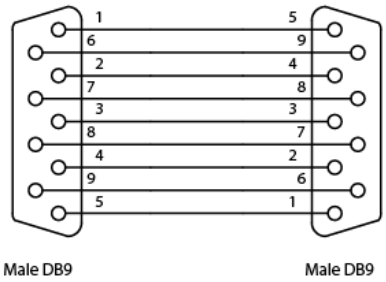
Dsub9M - Front View
9 Pin Male Connector

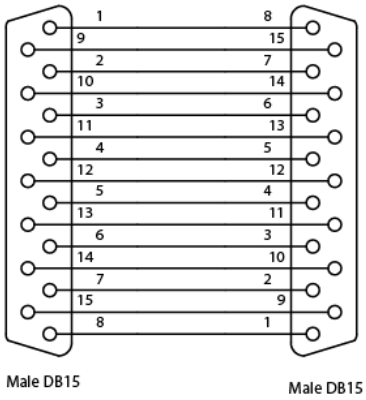


Dsub15F - Front View
15 Pin Female Connector

A.4 Vacuum Feedthrough Pinout

Recommended feedthrough pinout based on off the shelf feedthroughs.





A.5 Using an Analog Encoder

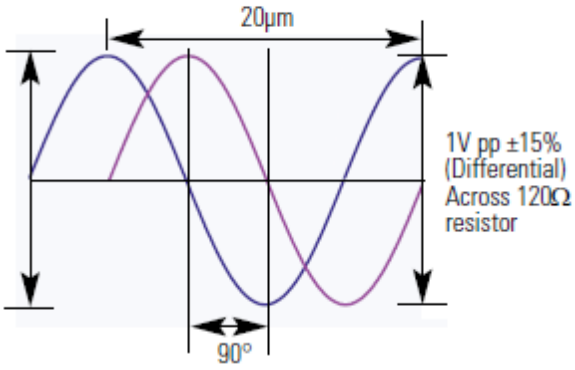
A.5.1 Encoder Overview

A PPX-50 with analog encoder will need to be paired with an appropriate controller that supports 1 Vpp sine/cosine encoders such as the MMC-100 and MMC-110. The PPX-50 with an analog encoder will be supplied with a D-sub 9 pin connector that incorporates these encoder signals.

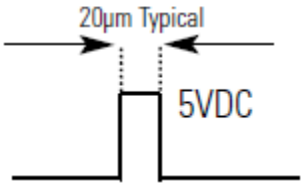
A.5.2 Operating and Electrical Specifications

Power Supply	5VDC ±5% @ 330mA (60mA for sensor)

A.5.3 Analog Output (Pins 1,2,6, and 7)



A.5.4 Index Window (Pin 3)



A.5.5 Resolution

All closed loop stages are supplied with 20 µm scales. The interpolation is done in the MMC-100/MMC-110 to the resolution as specified in the order. With an analog encoder, the MMC-100/MMC-110 has an achievable resolution of 10 nm.

A.6 Using the Digital Encoder

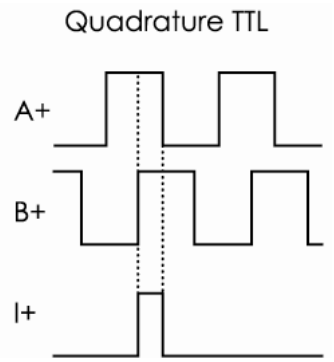
A.6.1 Encoder Overview

The PPX-50 with the digital encoder must be paired with an appropriate controller. The PPX-50 with a digital encoder will be supplied with a 9-pin connector that incorporates these encoder signals.

A.6.2 Operating and Electrical Specifications

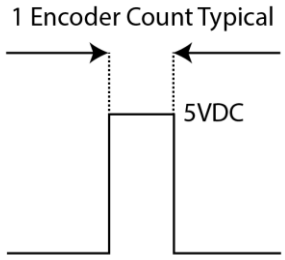
Power Supply	5VDC ±10% @ < 35mA (No outputs terminated) @ < 85mA (A, B, I, and both limits terminated); 50mA at the sensor

A.6.3 Output Signals



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

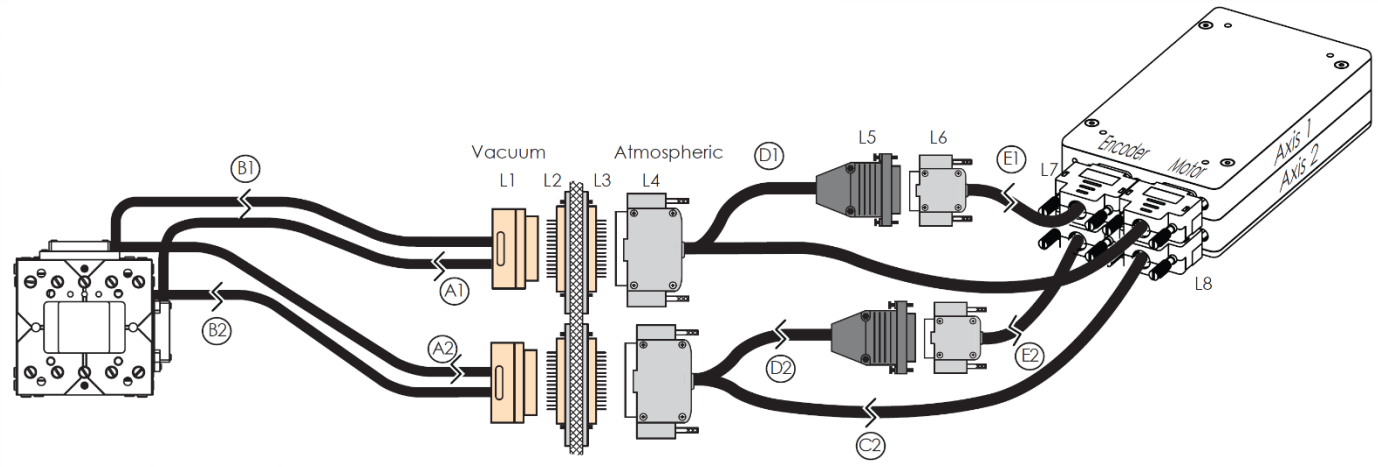
A.6.4 Index Window



A.6.5 Resolution

All closed loop stages are supplied with 20µm scales. The digital encoder module interpolates to a higher resolution as specified in the order. With a digital encoder an MMC controller has an achievable resolution of 2nm.

A.7 Legacy – Closed Loop, Digital Encoder, Vacuum Wiring Diagram



PPX-50, Piezo Motor, Closed Loop, Vacuum Wiring Diagram, Digital Encoder

Pinout for Axis 1 Cables A1, B1, C1, D1

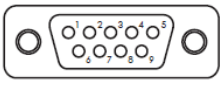
	Description:	Color	L1	L2	L3	Color	L4	L8
Motor B1 & C1	Phase 1	Red	1	1	8	Red	8	1
	Phase 2	White (Green TP)	2	2	7	White (Green TP)	7	2
	Ground	Black/Green	9	9	15	Black/Green	15	5
	Shield	-	10	10	14	-	14	Casing
Encoder A1 & D1	GND	Grey	8	8	1	Grey	1	
	Cos+	Brown	7	7	2	Brown	2	
	+5V	White (Grey TP)	6	6	3	White (Grey TP)	3	
	Cos-	White (Brown TP)	5	5	4	White (Brown TP)	4	
	Sin+	Blue	4	4	5	Blue	5	
	Sin-	White (Blue TP)	12	12	12	White (Blue TP)	12	
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	
	Index+	Violet	14	14	10	Violet	10	
	Shield	-	15	15	9	-	9	

Pinout for Axis 2 Cables A2, B2, C2 D2

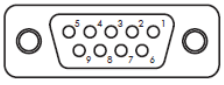
	Description:	Vac Color	L1	L2	L3	L4	L4	L8
Motor B2 & C2	Phase 1	White (Grey TP)	1	1	8	Red	8	1
	Phase 2	White (Blue TP)	2	2	7	White (Green TP)	7	2
	Ground	Grey/Blue	9	9	15	Black/Green	15	5
	Shield	-	10	10	14	-	14	Casing
Encoder A2 & D2	GND	Grey	8	8	1	Grey	1	
	Cos+	Brown	7	7	2	Brown	2	
	+5V	White (Grey TP)	6	6	3	White (Grey TP)	3	
	Cos-	White (Brown TP)	5	5	4	White (Brown TP)	4	
	Sin+	Blue	4	4	5	Blue	5	
	Sin-	White (Blue TP)	12	12	12	White (Blue TP)	12	
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	
	Index+	Violet	14	14	10	Violet	10	
	Shield	-	15	15	9	-	9	

Pinout for Cable E1 & E2

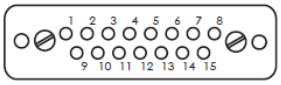
	Description:	L5	Color	L6	L7
E	Ground	2	Grey	2	4
	Index -	4	White (Violet)	4	8
	B -	5	White (Blue)	5	7
	A -	6	White (Brown)	6	6
	+5VDC	7	White (Grey)	7	5
	Index +	12	Violet	12	3
	B +	13	Blue	13	2
	A +	14	Brown	14	1
	Shield	Casing	-	Casing	Casing



Female Dsub9 Connector - Rear View



Male Dsub9 Connector - Rear View



Female PEEK Dsub15 Connector - Rear View