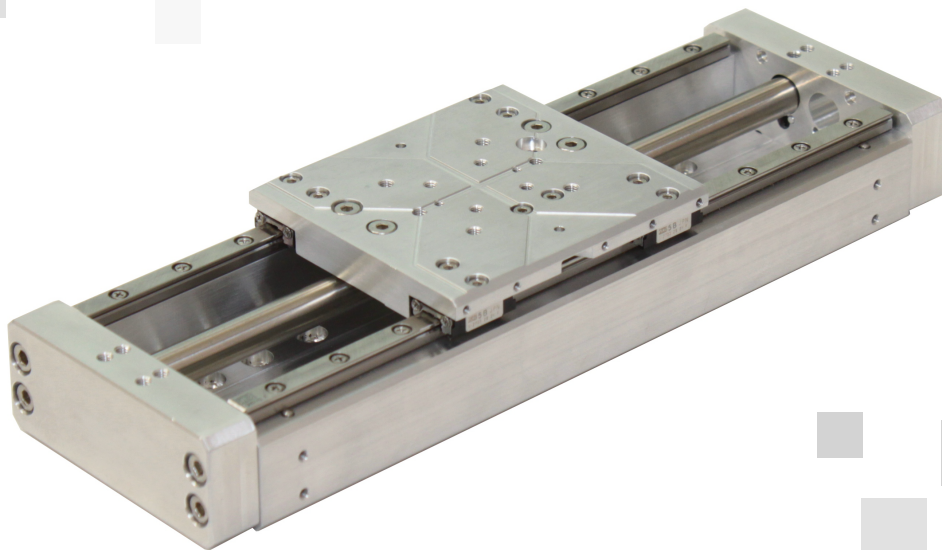


PPS-60

Series



Precision Positioner Stage Reference Manual (Open and Closed Loop Versions)

PPS-60

Precision Positioner Stage

Reference Manual

Rev 1.08

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<http://micronixusa.com>

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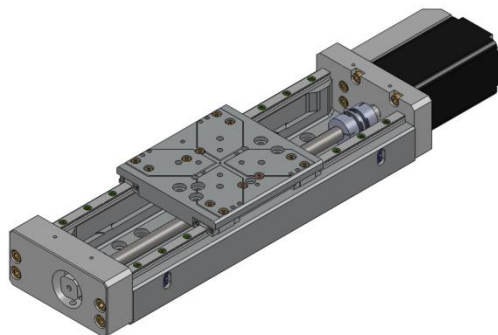
1. Introduction

1.1 Product Description

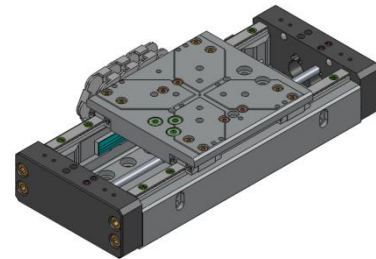
The PPS-60 is a high-precision, long travel linear stage which incorporates stepper, piezo, or linear motors into the same form factor. Precision ball bearings assure high stiffness and guiding accuracy for loads up to 150N (horizontal orientation). The PPS-60 is available in standard travel lengths of up to 300mm, and an optional linear encoder provides nanometer resolution and repeatability. Vacuum and Ultra High Vacuum (10^{-9} mbar) versions are available. Longer travel and covered versions are available upon request.

Features:

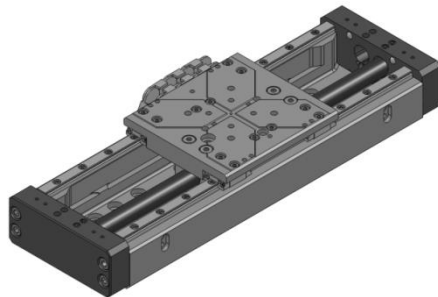
- Travel ranges of 25mm, 50mm, 100mm, 200mm, and 300mm (longer travel available upon request)
- Load capacity up to 15kg (Piezo and Stepper Motor), up to 5kg (Linear Motor)
- Optional linear encoder



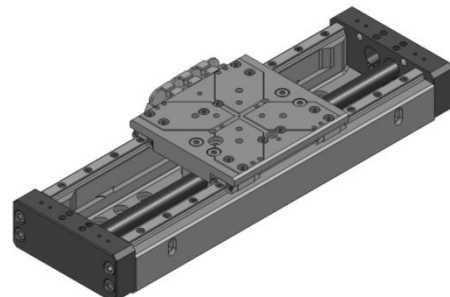
PPS-60 100mm with External Stepper Motor option
(Shown in center position)



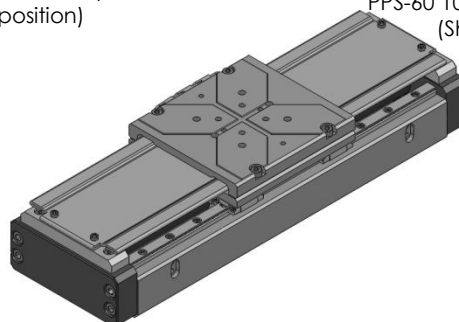
PPS-60 50mm with Internal Stepper Motor option
(Shown in center position)



PPS-60 100mm with Piezo Motor option
(Shown in center position)



PPS-60 100mm with Linear Motor option
(Shown in center position)



Covered Versions Available Upon Request

1.2 Recommended Controllers

The following controllers are available from MICRONIX USA:

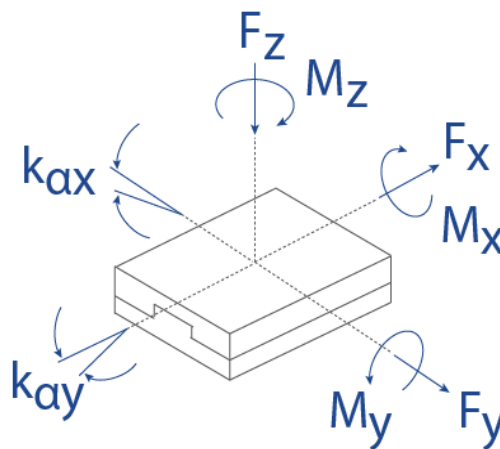
- MMC-110 – Piezo

1.3 Technical Data

Motor option	PM-003				SM-001/SM-004				LM-002		
Speed, max. [mm/sec]	5 (MMC-110)				5 (†15)				100		
Encoder option	Open Loop	Analog (1 V _{pp})	Digital (RS-422)	Digital Low Cost (RS-422)	Open Loop	Analog (1 V _{pp})	Digital (RS-422)	Digital Low Cost (RS-422)	Analog (1 V _{pp})	Digital (RS-422)	Digital Low Cost (RS-422)
Resolution, typical [μm]	0.001	0.01	0.002	0.5	0.1	0.1	0.05	0.5	0.01	0.01	0.5
Repeatability, bi-directional [μm]	-	± 0.5	± 0.1	± 1	± 4	± 0.2	± 0.2	± 1	± 0.1	± 0.1	± 1
Repeatability, uni-directional [μm]	-	0.5	0.1	1	0.2	0.2	0.2	1	0.1	0.1	1

† -achievable with external stepper motor

1.4 Load Characteristics



Load Characteristics	F _x [N]	F _y [N]	F _z [N]	M _x [Nm]	M _y [Nm]	M _z [Nm]	k _{ax} [μrad/Nm]	k _{ay} [μrad/Nm]
PM-003	5	100	150	10	10	10	100	100
SM-001 (internal)	5	100	150	10	10	10	100	100
SM-004 (external)	10	100	150	10	10	10	100	100
LM-002	5 Peak	100	50	10	10	10	100	100

2. Model configurations

2.1 PPS-60 Order Numbers

Order No.	PPS-60-				
Piezo Motor PM-003.....	1				
Stepper Motor, SM-001*.....	2				
Linear Motor, LM-002**.....	3				
Stepper Motor, SM-004*.....	4				
25mm Travel.....	1				
50mm Travel.....	2				
100mm Travel.....	3				
200mm Travel.....	4				
300mm Travel.....	5				
None (Open Loop).....	0				
Analog (1V _{pp}).....	2				
Digital (RS-422).....	3				
Digital low cost, 0.5 μm †.....	4				
None ‡.....	0				
Mechanical.....	1				
Atmospheric.....	0				
High Vacuum, 10 ⁻⁶ mbar.....	6				
Ultra-High Vacuum, 10 ⁻⁹ mbar †.....	9				

*SM-001 internal standard installation on stages with 50mm or less travel.
 SM-004 external standard installation on stages with 100mm or greater travel.

**Linear motor is not available with open loop or in ultra- high vacuum environments.

† Only available with Piezo motor option or externally mounted UHV stepper motor.

‡ Not available in vacuum environments.

‡ Only available with Piezo and Linear motor.

Contact MICRONIX USA for custom applications and stacking configurations.

3. Preparing to Install the PPS-60

3.1 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. A surface that is not flat can adversely affect the performance and structural integrity of the stage.

The stage is calibrated and guaranteed to be within specification at $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$, unless otherwise specified. The operating conditions of the stage are as follows:

- Mount to a clean and flat surface which is free of debris, burrs, and dings
- An indoor atmosphere free of corrosive gases, excessive dust, and condensation
- Temperature range of 0-40°C
- Relative humidity between 20-80%
- Locate away from water, heat, and electrical noise

3.2 Package Contents

If 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-60 Linear Stage
- Reference Manual
- Any other previously agreed upon components such as a controller

4. Installing the PPS-60

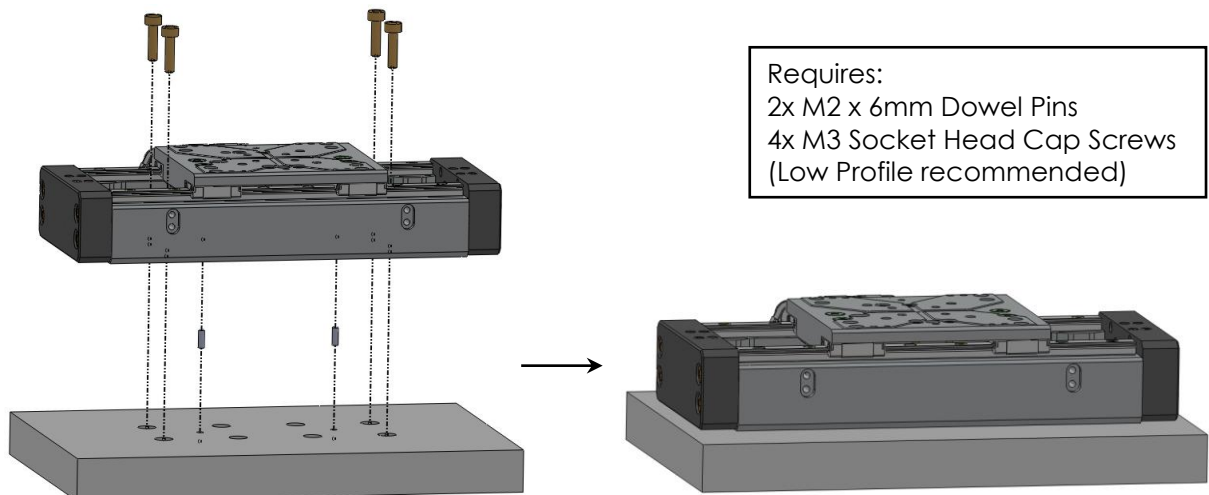
Mounting patterns require M3, M4, or 4-40 socket head cap screws or pan head machine screws for mounting, as well as M2 x 6mm dowel pins for precision alignment. Additional brackets and screws may be required for custom applications.

4.1 PPS-60 Installation

4.1.1 General Mounting

For general mounting configurations, mount the base to the mounting surface using the thru holes. Move the carriage to access base mounting pattern. Note that the 25mm version can only be mounted using the M4 Bottom Mount method. (Please note, it is possible to move the carriage of the linear and piezo motor configurations manually without damaging the stage, however, for *stepper versions the motor must be driven by a controller to reposition the carriage.)

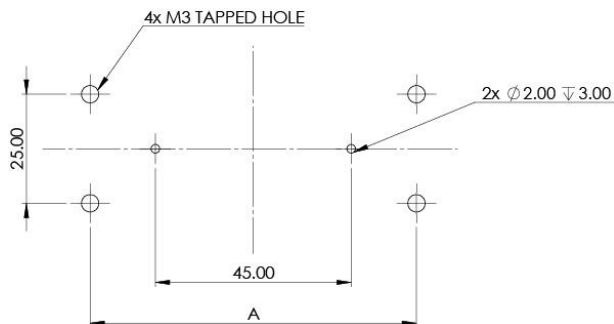
4.1.1.1 Metric Mounting: M3 Top Mount



1. Move carriage via controller*, if necessary, to access four mounting holes. Insert Pins and M3 SHCS as shown.

Metric M3 Top Mount Mounting Pattern

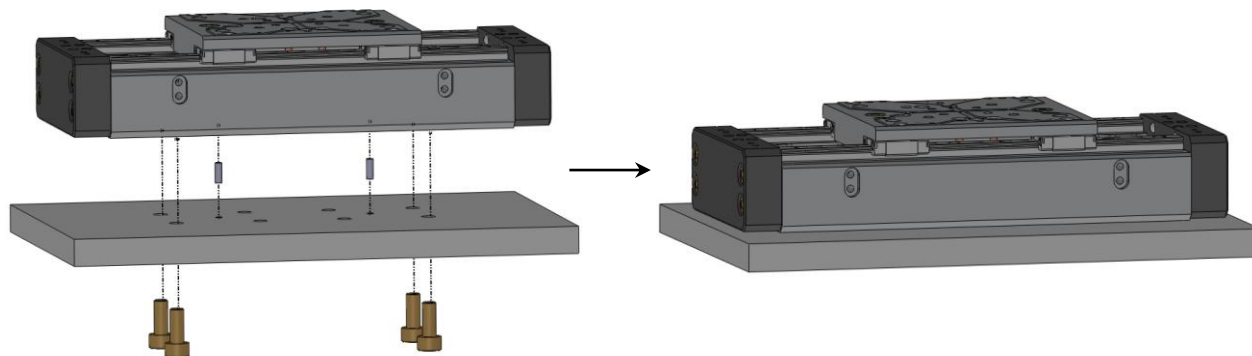
◆For internal motor configurations: Mounting screws must be flush with base surface.



Travel	A [mm]
25mm	75
50mm	75
100mm	125
200mm	225
300mm	325

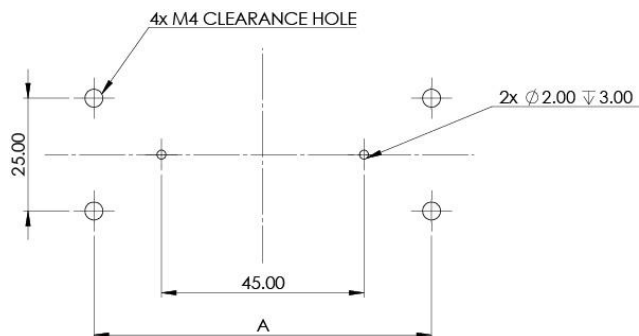
4.1.1.2 Metric Mounting: M4 Bottom Mount

Requires:
 2 x M2 x 6mm Dowel Pins
 4 x M4 Socket Head Cap Screws



Insert Pins and M4 SHCS as shown.

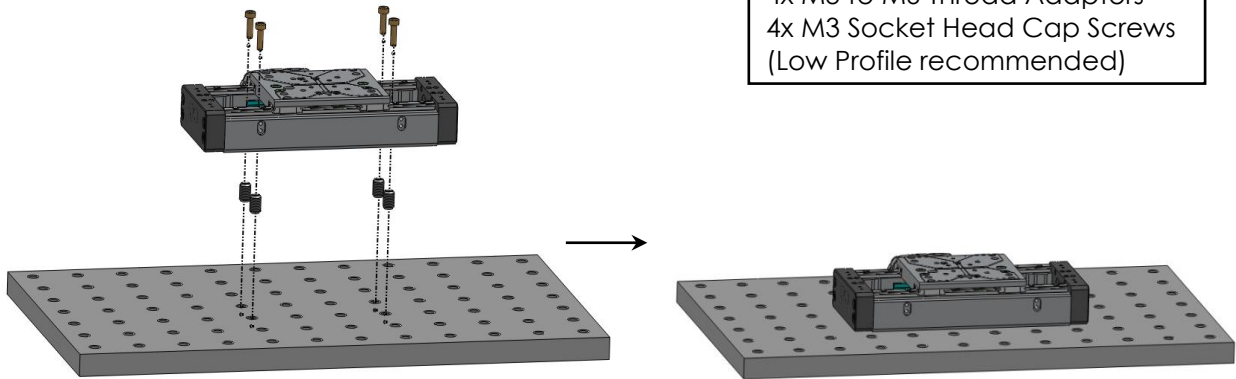
Metric M4 Bottom Mount Mounting Pattern



Travel	A [mm]
25mm	75
50mm	75
100mm	125
200mm	225
300mm	325

4.1.1.3 Mounting to Metric Optical Table (25mm x 25mm spacing)

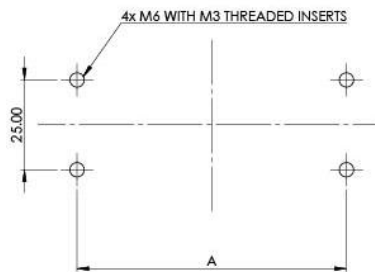
Requires:
 2x M2 x 6mm Dowel Pins
 4x M3 to M6 Thread Adapters
 4x M3 Socket Head Cap Screws
 (Low Profile recommended)



1. Move carriage via controller*, if necessary, to access four mounting holes. Insert Thread Adapters and M3 SHCS as shown.

Metric Optical Table Mounting Pattern

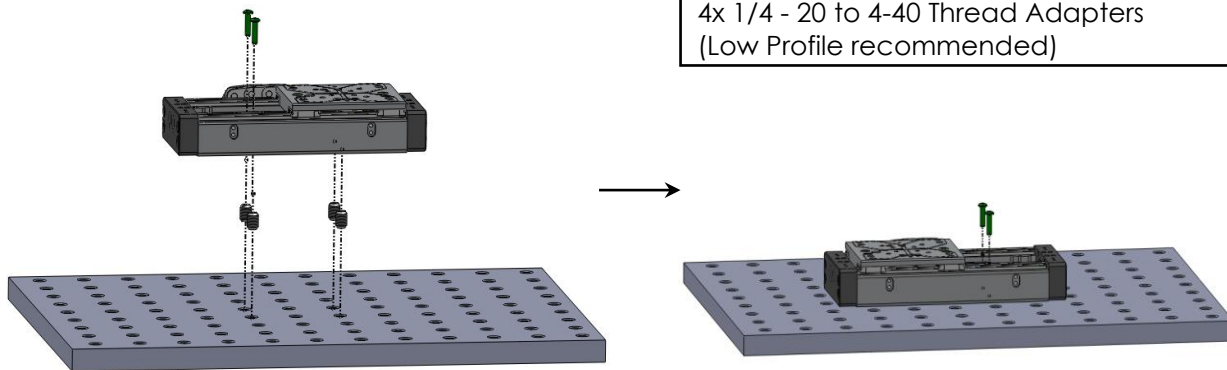
- ◆Assuming 25mm optical table hole spacing.
- ◆Check manufacturing tolerances of the optical table for precision fit.
- ◆For internal motor configurations: Mounting screws must be flush with base surface.



Travel	A [mm]
25mm	75
50mm	75
100mm	125
200mm	225
300mm	325

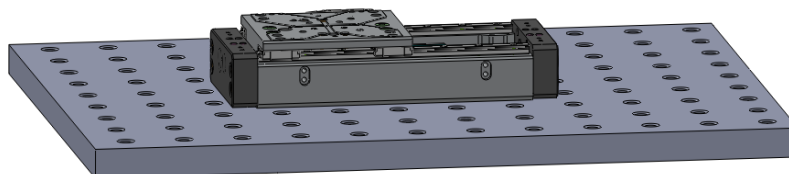
4.1.1.4 Mounting to Imperial Optical Table (1" x 1" spacing)

Requires:
 2 x M2 x 6mm Dowel Pins
 4 x 4-40 Pan Head Machine Screws
 4x 1/4 - 20 to 4-40 Thread Adapters
 (Low Profile recommended)



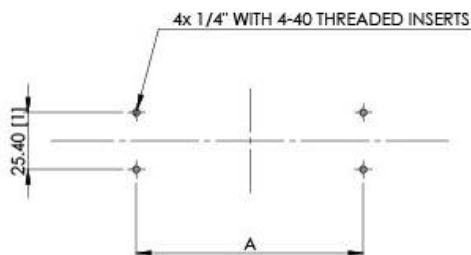
1. Move carriage via controller*, if necessary, to access two mounting holes. Insert Thread Adapters and 4-40 Pan Head Machine Screws as shown.

2. Move carriage via controller*, if necessary, to access remaining two mounting holes. Insert 4-40 Pan Head Machine Screws as shown.



Imperial Base Mounting Pattern

- ◆Assuming 25.40mm [1 inch] optical table hole spacing.
- ◆Check manufacturing tolerances of the optical table for precision fit.
- ◆For internal motor configurations: Mounting screws must be flush with base surface.



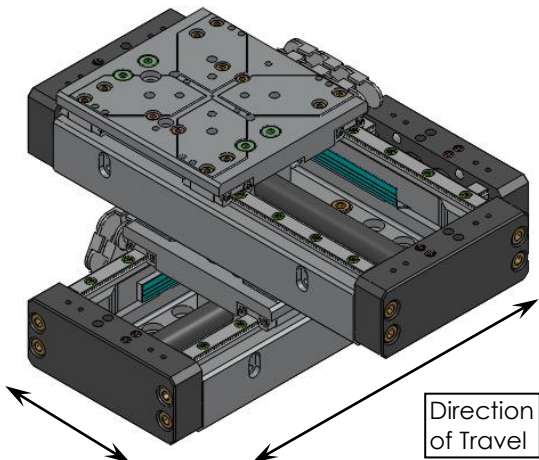
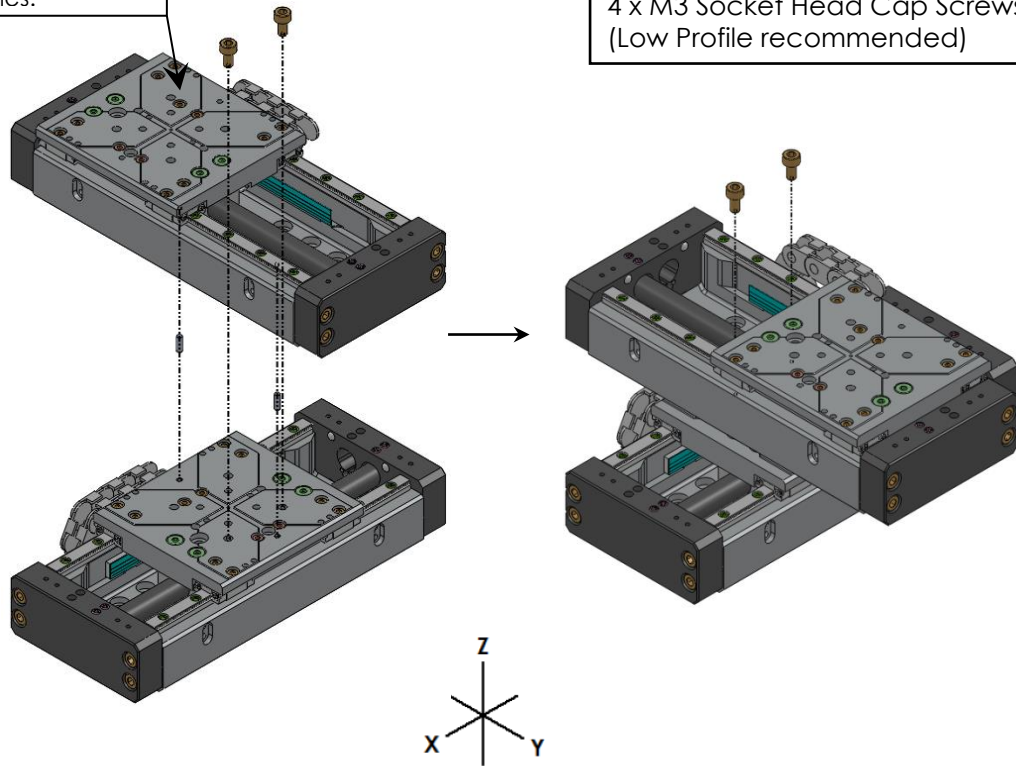
Travel	A mm [in]
25mm	50.8 [2]
50mm	50.8 [2]
100mm	101.6 [4]
200mm	203.2 [8]
300mm	304.8 [12]

4.1.2 X-Y Mounting

For additional mounting configurations see Section 7: Stacking Configurations. Note that the 25mm version shall be factory mounted. (Additionally, please note that it is possible to move the carriage of the linear and piezo motor configurations manually without damaging the stage, however, for stepper versions the motor must be driven by a controller to reposition the carriage.) For internal motor configurations: Mounting screws must be flush with base surface.

Move carriage via the controller*, if necessary, to access mounting holes.

Requires:
 2 x M2 x 6mm Dowel Pins
 4 x M3 Socket Head Cap Screws
 (Low Profile recommended)



5. Connecting the PPS-60

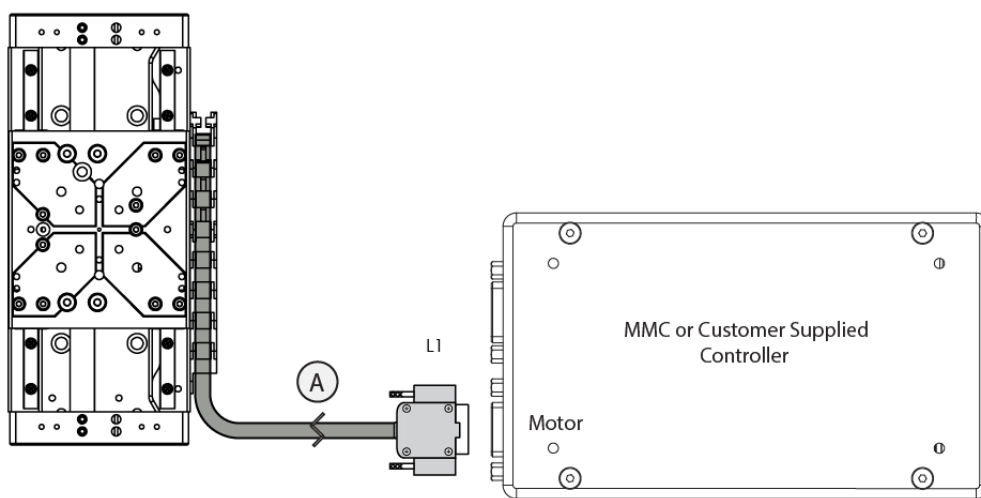
5.1 Atmospheric Environments

For controller information refer to the appropriate MMC controller manual.

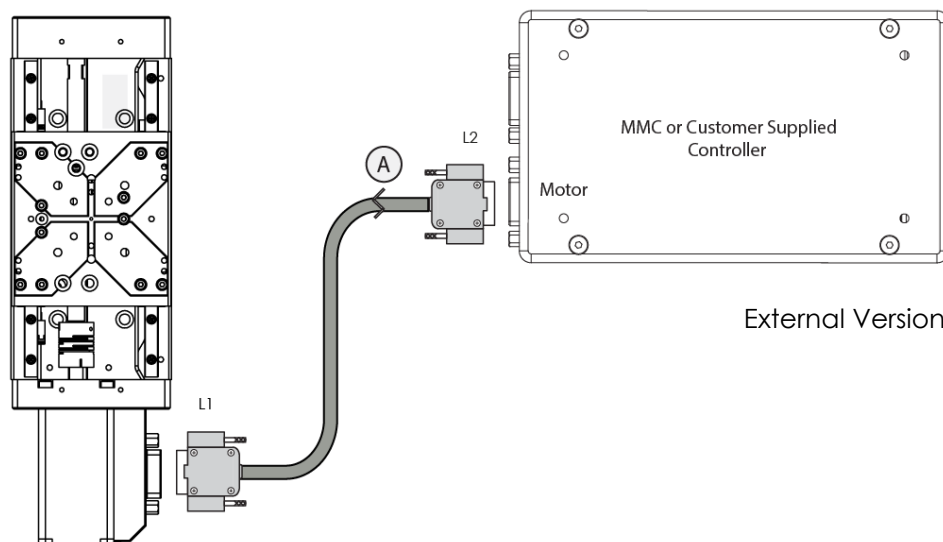
Wiring diagrams are consistent for all piezo, stepper, and linear motor assemblies.

5.1.1 Open Loop Installation & Wiring Diagram

Connecting the PPS-60 in an open loop configuration only requires that the D-sub 9 Pin Motor Cable be connected to a compatible controller. No other cables or components are required. Please note, open loop configurations are only available for stepper or piezo motor versions (See Appendix A.1 or A.3 for pinout configurations).



Internal Piezo and Stepper Versions

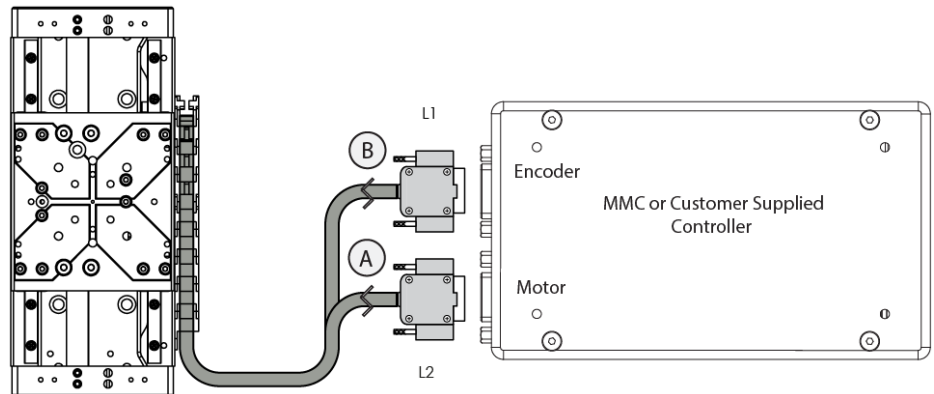


External Version

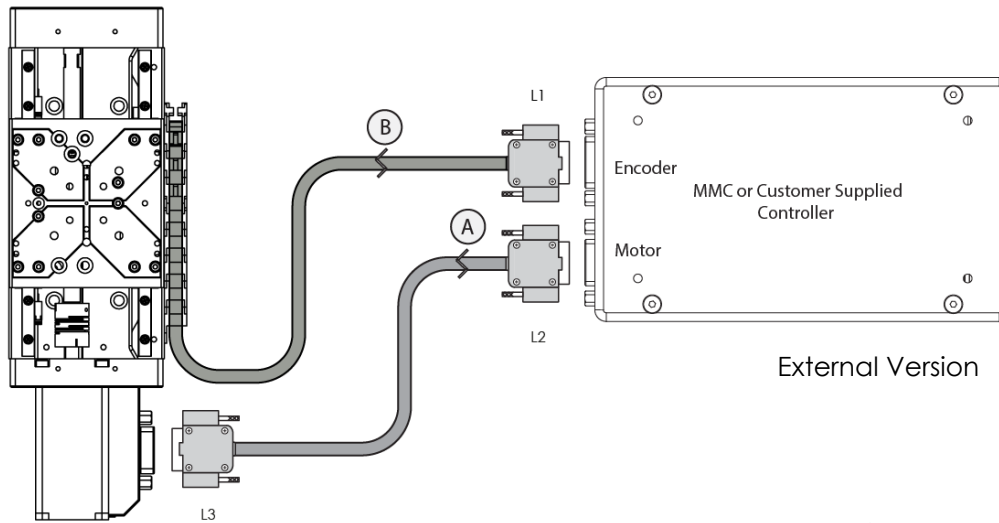
5.1.2 Closed Loop/Encoder Installation & Wiring Diagram

Using the PPS-60 stage with an encoder requires a closed loop compatible controller that recognizes the proper type of encoder feedback. Connect the stage as shown below.

5.1.2.1 Analog or Low-Cost Digital Encoder Wiring Diagram

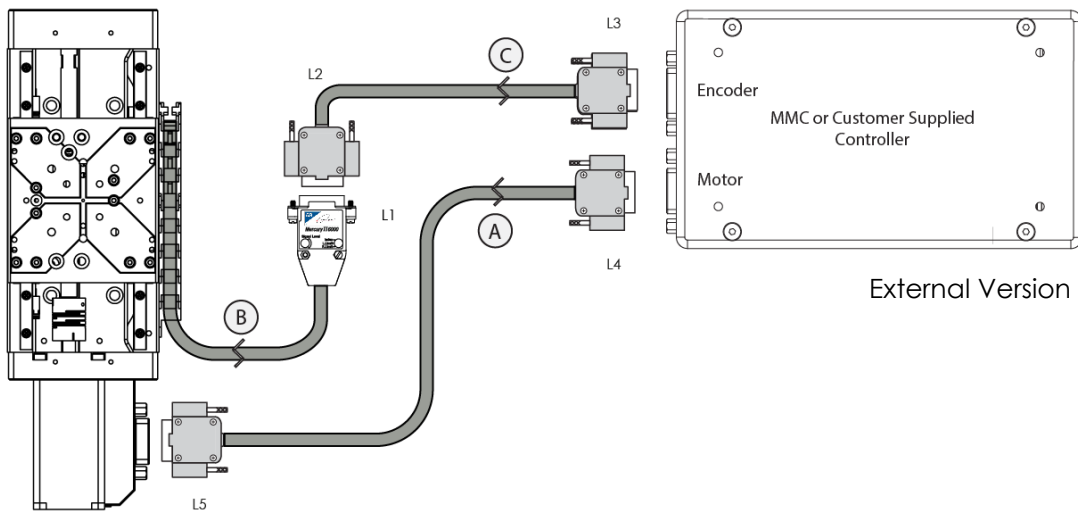
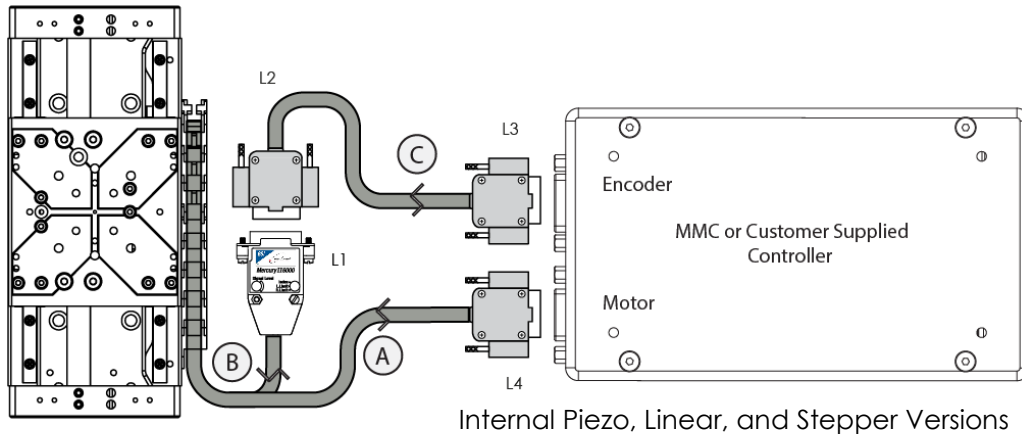


Internal Piezo, Linear, and Stepper Versions



External Version

5.1.2.2 MII 6000 Digital Encoder Wiring Diagram



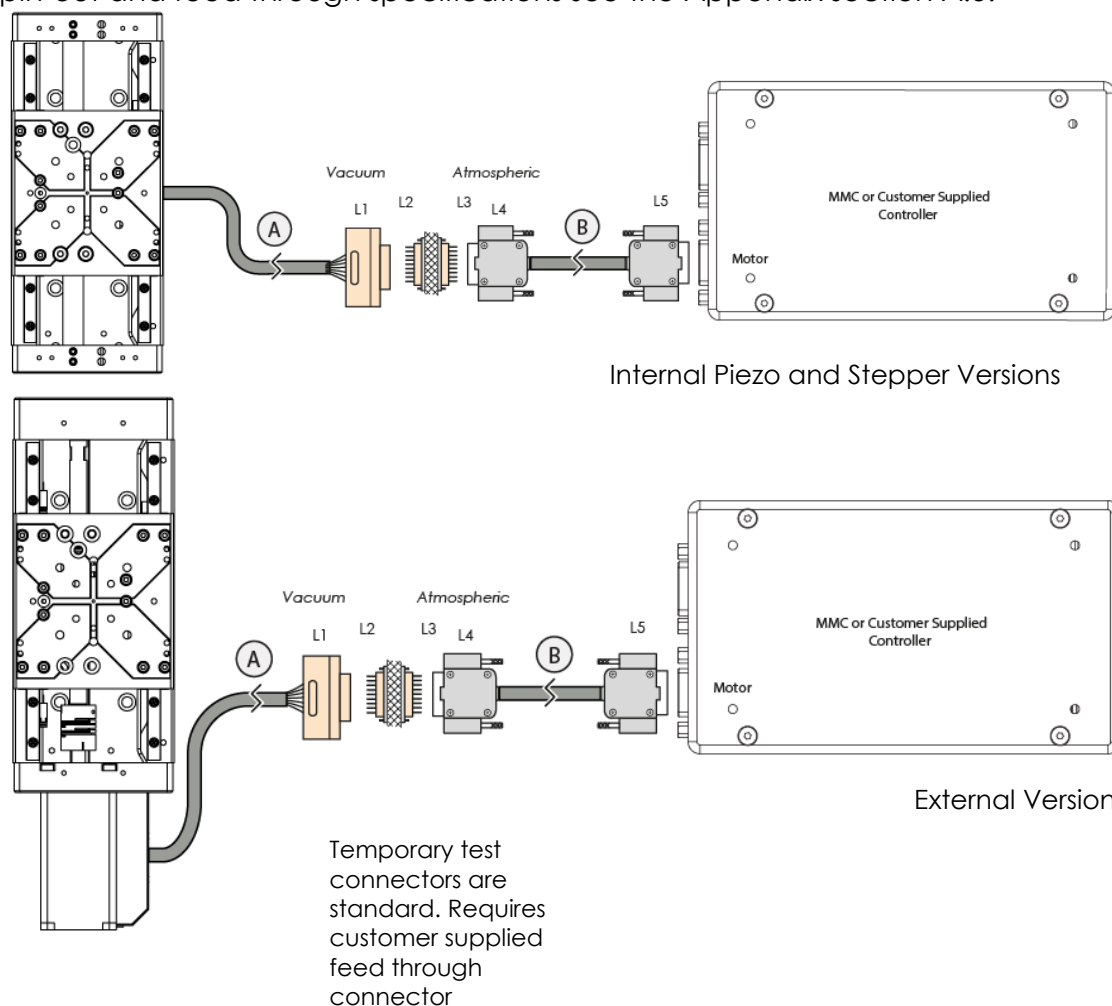
5.1 Vacuum Environments

5.1.1 Handling and Preparation

When preparing the stage for vacuum environments, take the necessary precautions (such as wearing gloves, clean room, clothing, etc.) when handling the stage as to avoid any contaminants. Maximum Bake-out temperature is 100°C. MICRONIX USA can supply the stage with vacuum compatible connectors: 9-pin female PEEK connector for open loop, 15-Pin female PEEK connector for closed loop with analog encoder, 25-pin female PEEK connector for closed loop with MII 6000 digital encoder.

5.1.2 Open loop Installation & Wiring Diagram

Connecting an open loop PPS-60 in a vacuum chamber requires the use of a feed through connector at the vacuum chamber wall. The vacuum compatible PPS-60 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. Note: Linear motor versions and low-cost digital encoder versions are not available for vacuum environments. For details regarding the pin-out and feed through specifications see the Appendix section A.5.

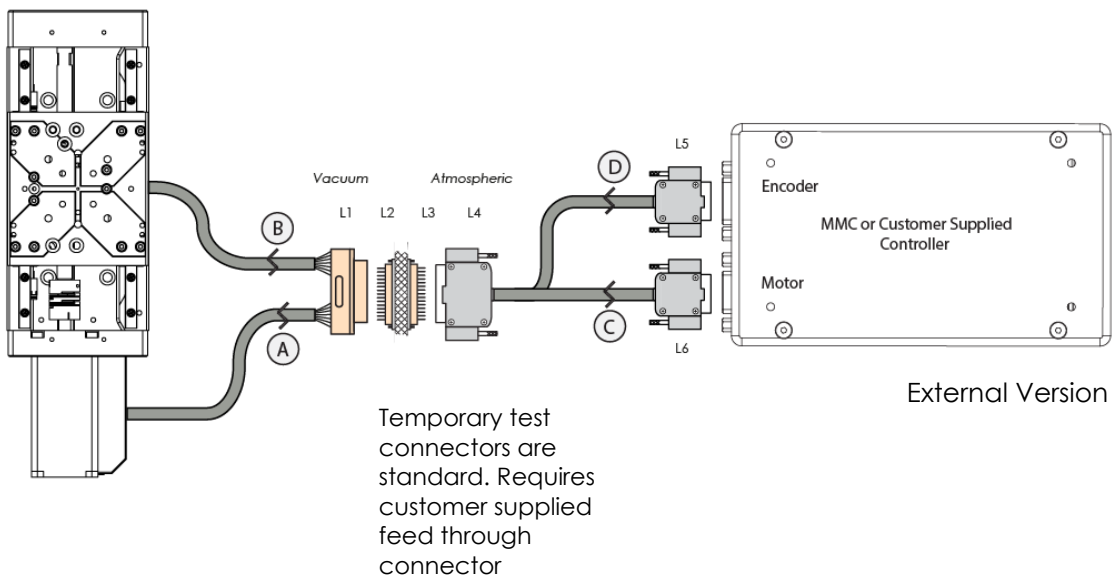
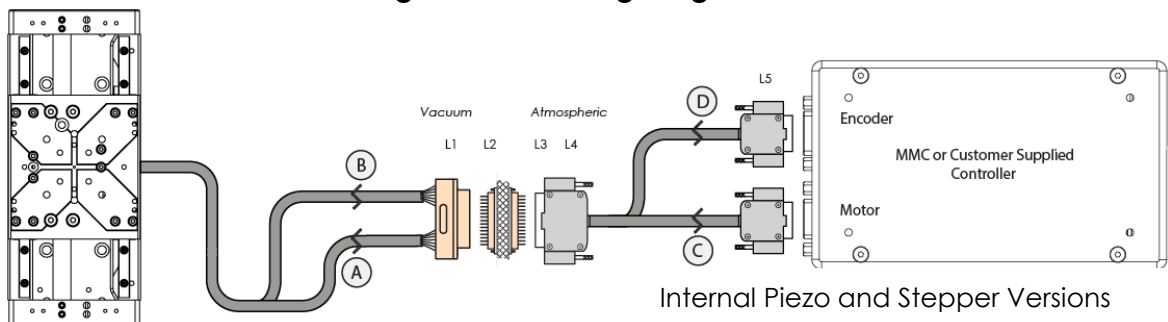


5.1.3 Closed Loop/Encoder Installation & Wiring Diagram

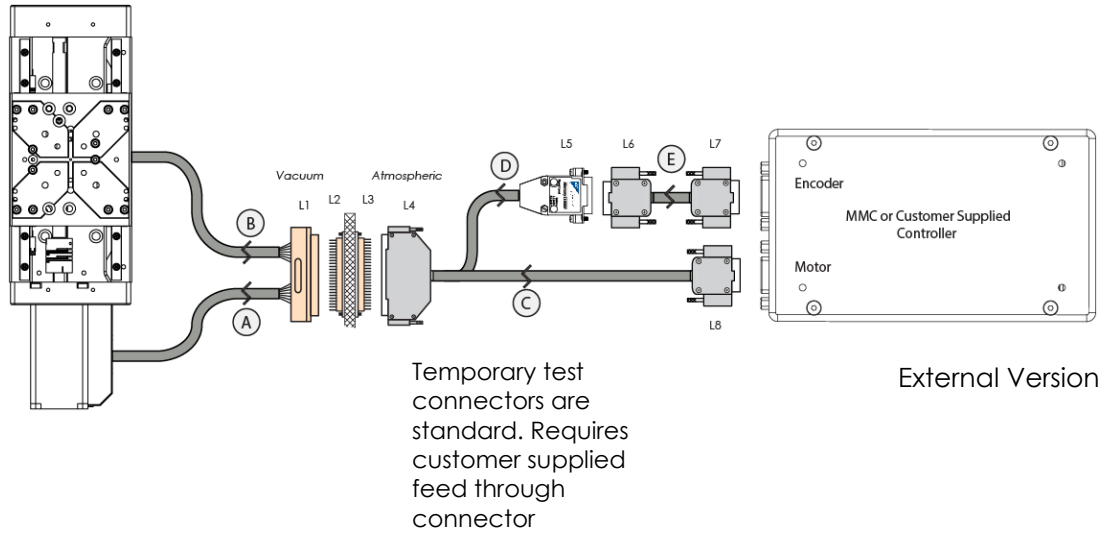
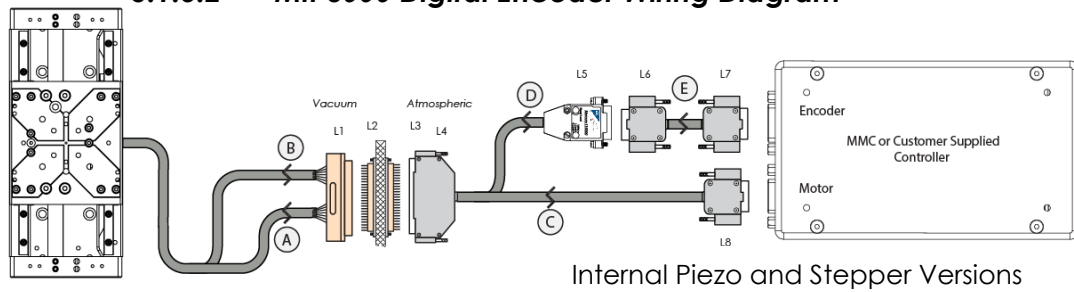
Closed loop installation of the PPS-60 stage in vacuum environments requires an intermediate feed through connector at the vacuum chamber wall that can accommodate both the motor cable, and the encoder cable.

The vacuum compatible PPS-60 will be supplied with wiring for a straight through feed through, not a cross over gender bender. MICRONIX USA supplies test connectors that simulate the vacuum feed through to allow for functionality testing prior to installation in a vacuum chamber. For details regarding the pin-out and feed through specifications see the Appendix sections A.6.7, A.7.5.

5.1.3.1 Analog Encoder Wiring Diagram

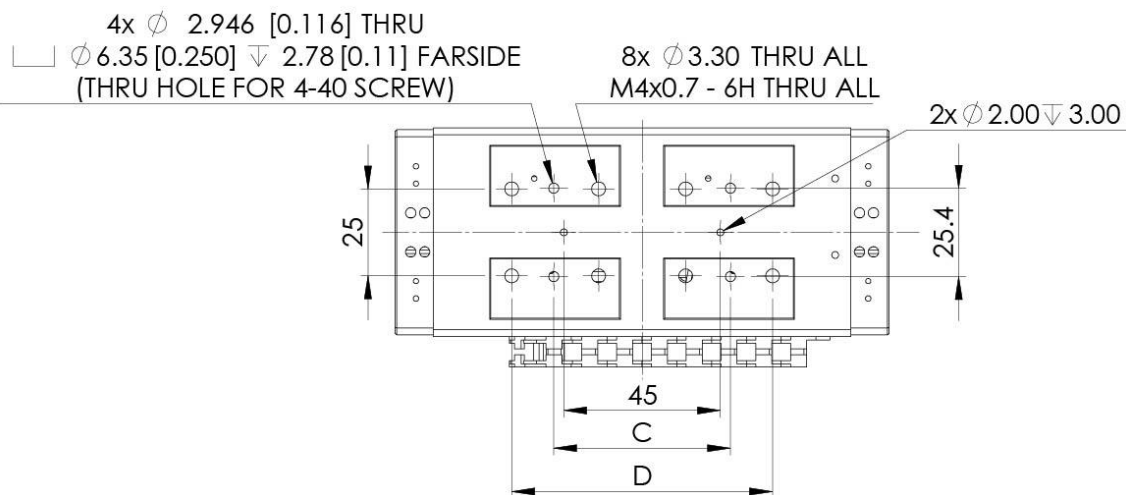
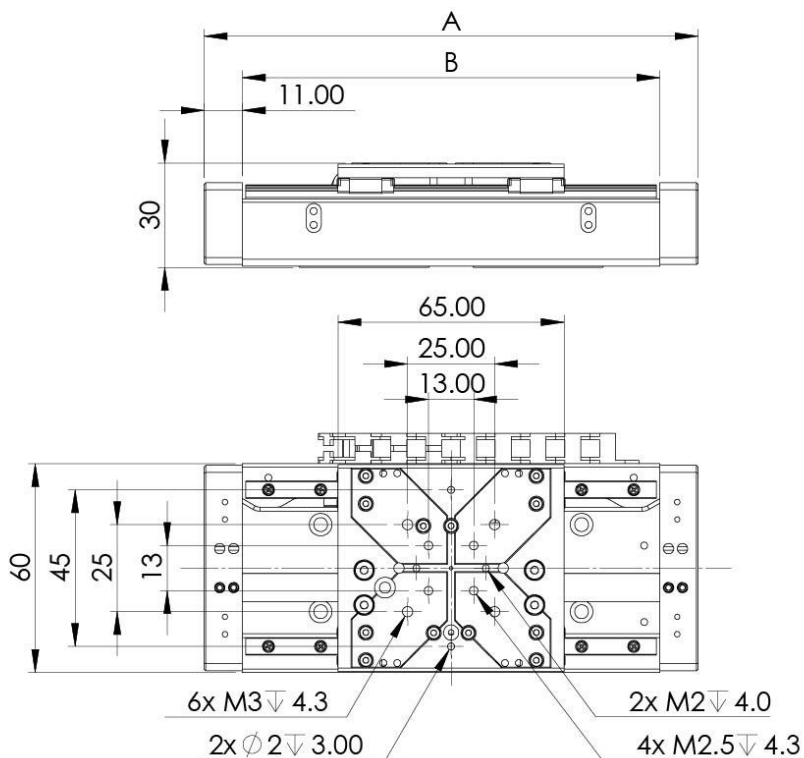


5.1.3.2 MII 6000 Digital Encoder Wiring Diagram



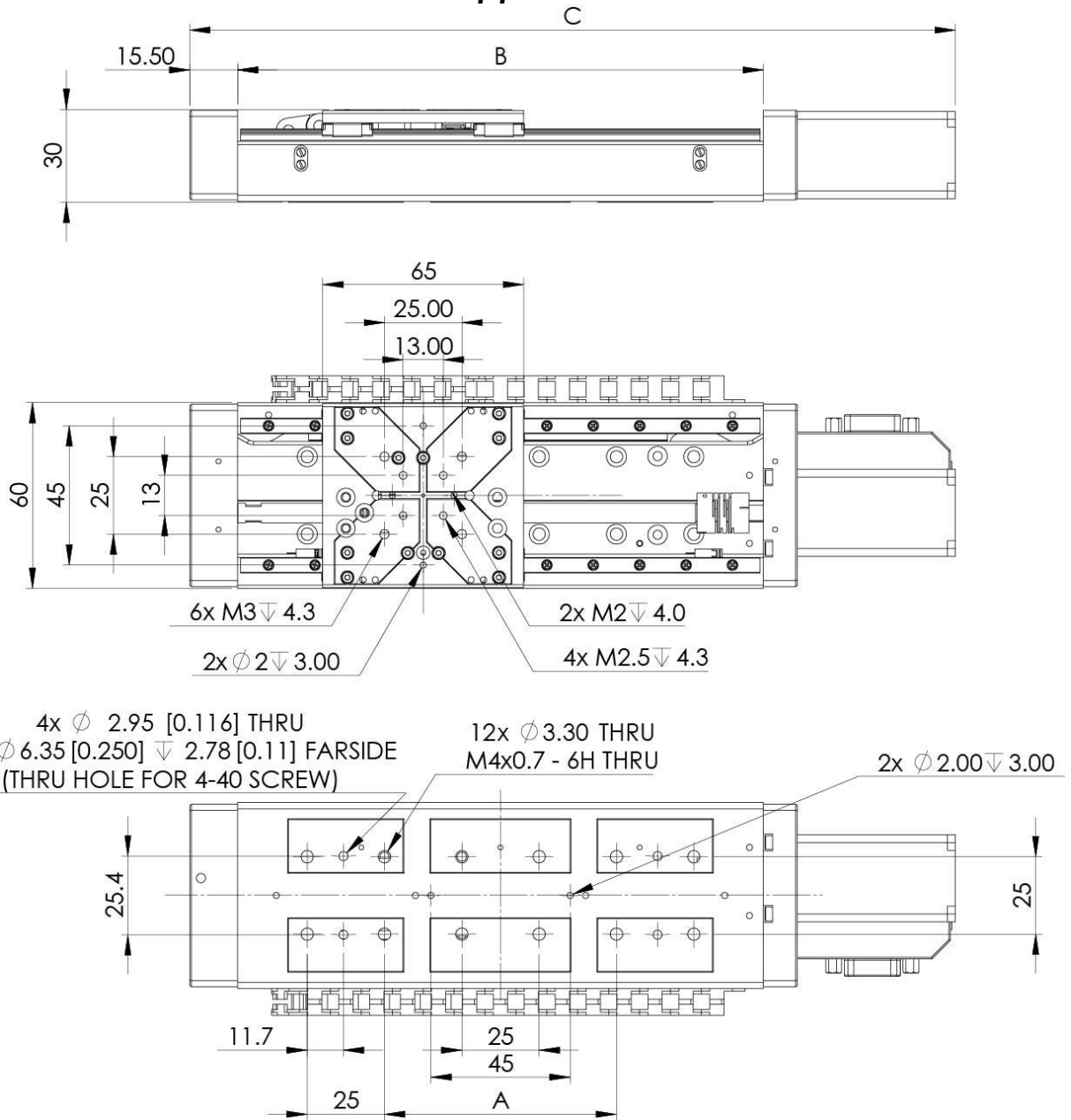
6. Dimensions

6.1 PPS-60 Internal Motor Versions



Travel [mm]	A [mm]	B [mm]	C [mm]	D [mm]
25	117	95	50.8	75
50	142	120	50.8	75
100	192	170	101.6	125
200	292	270	203.2	225
300	392	370	304.8	325

6.2 PPS-60 External Stepper Motor Versions

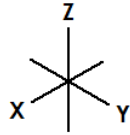


Travel [mm]	A [mm]	B [mm]	C [mm]
100	75	170	247.6
200	175	270	347.6
300	275	370	447.6

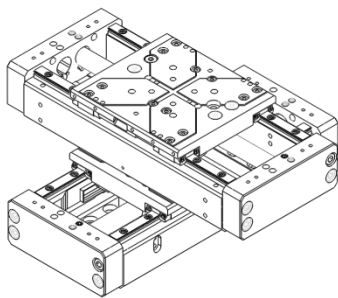
7. Stacking Configurations

7.1 Configuration Examples

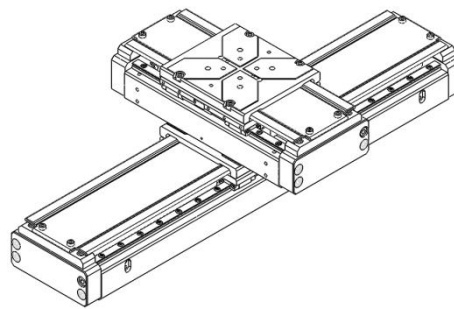
- Additional configurations available upon request
- Note: Stacking compatibility for all motor configurations.
- Positioning according to:



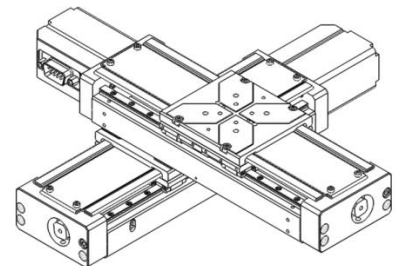
No Adapters



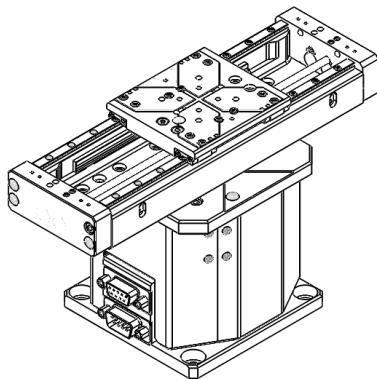
X-Y 50x50mm



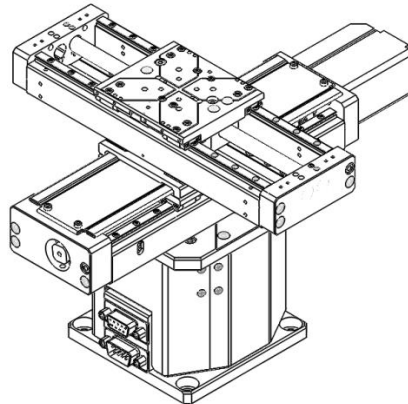
X-Y 200x50mm



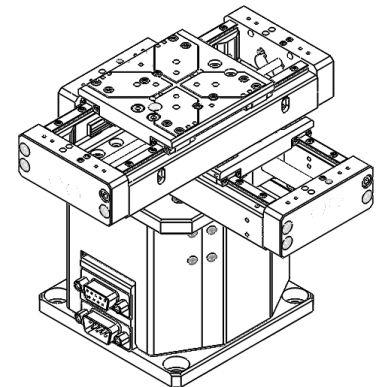
X-Y Off-Center 100x100mm



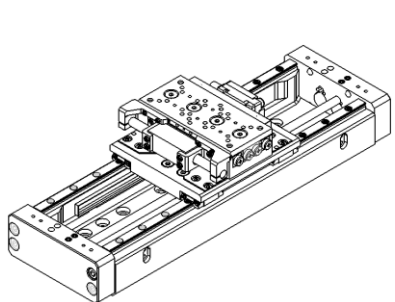
X-Z 100x35mm
[with PZS-90 Elevation Stage]



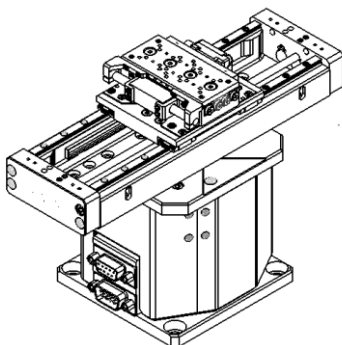
X-Y-Z 100x100x35mm
[with PZS-90 Elevation Stage]



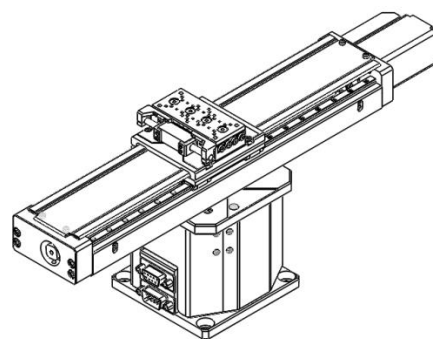
X-Y-Z Off-Center
50x50x35mm
[with PZS-90 Elevation Stage]



X-Y 100x26mm
[with PPS-28 Linear Stage]

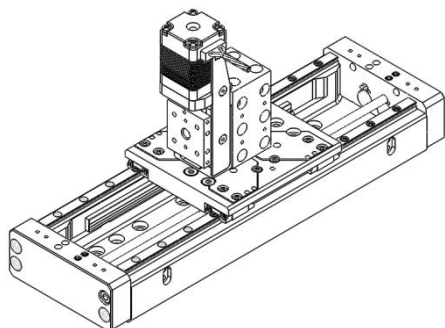


X-Y-Z 100x26x35mm
[with PPS-28 Linear Stage
& PZS-90 Elevation Stage]

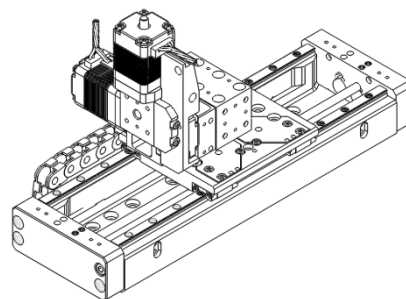


X-Y-Z 200x26x35mm
[with PPS-28 Linear Stage
& PZS-90 Elevation Stage]

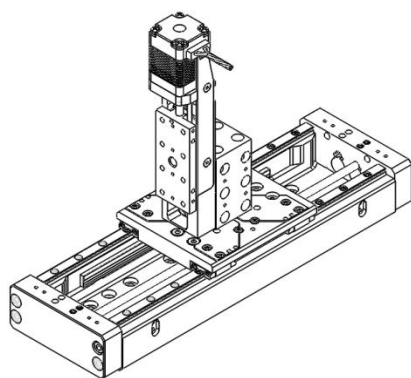
Using: Adapter Block (P/N 430141) & VT-21 Linear Stages



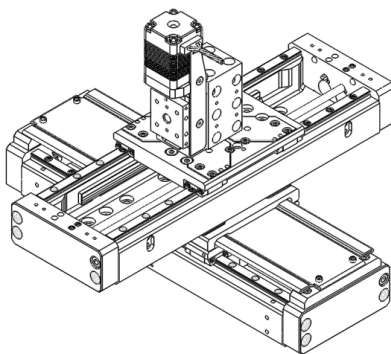
X-Z 100x10mm



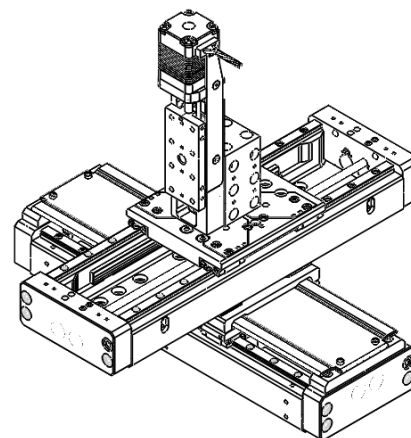
X-Y-Z 100x10x10mm



X-Z 100x26mm

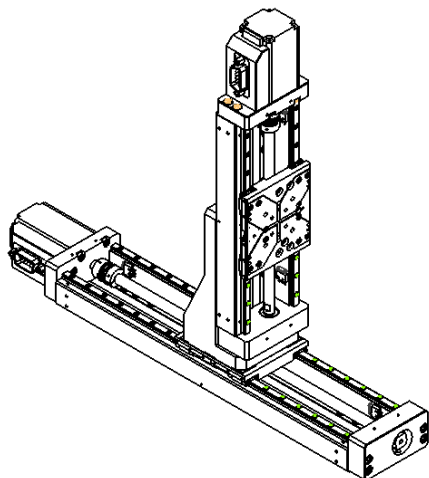


X-Y-Z 100x100x10mm

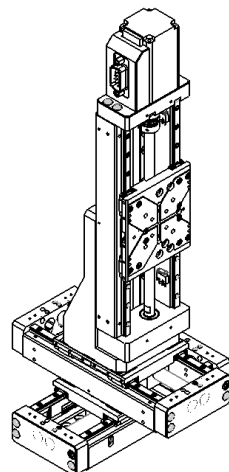


X-Y-Z 100x100x26mm

Using: Z Bracket (P/N 430613)

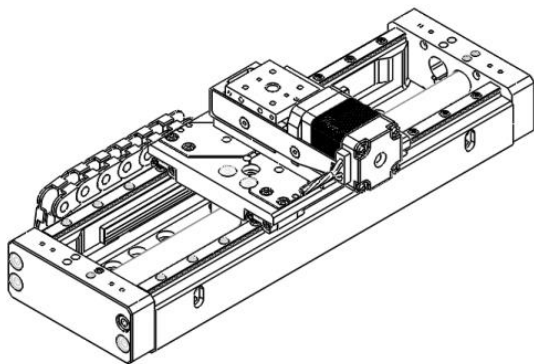


X-Y 200x100mm

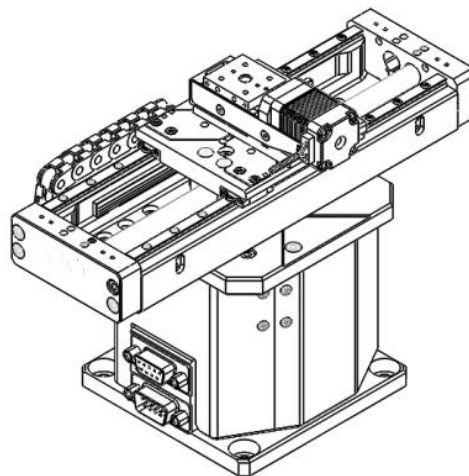


X-Y-Z 50x50x100mm

Using: XY Bracket (P/N 430169) & VT-21 Linear Stages



X-Y 100x10mm



X-Y-Z 100x10x35mm
[with PZS-90 Elevation Stage]

8. Supplementary Information

8.1 Maintenance

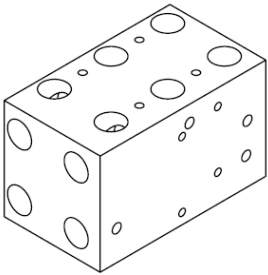
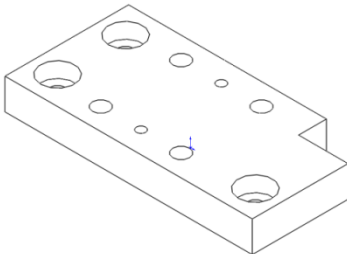
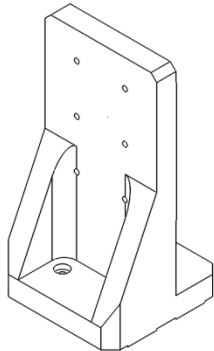
- The PPS-60 series of Linear stages utilizes a maintenance free design. Do not modify the stage or perform any maintenance unless specifically instructed to do so by MICRONIX USA personal. If the stage is not performing up to the original specifications, please contact MICRONIX USA.
- The PPS-60 Linear Piezo stage is a precision mechanical device and should be handled with care. Do not drop or mishandle the stage.
- Do not touch the bearings, as this will contaminate the lubrication and jeopardize the longevity of the stage.
- Follow the *Installation Preparation* requirements and use proper cable management to ensure a clean and safe operating environment.

8.2 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.

8.3 Accessories

430141-B Adapter Block VT-21	430104-B Adapter Plate XY Side VT-21	430613 Z Bracket PPS-60
		
Used to adapt the VT-21 series to the PPS-60 series of linear stages for XY and XZ mounting configurations.	Used to adapt the VT-21 series to the PPS-60 series of linear stages for XY mounting configurations.	Used to adapt the PPS-60 series to a perpendicular assembly for XZ mounting configurations.

A. Appendix

A.1 Stepper Motor

A.1.1 Standard Atmospheric DB-9 Male Motor Connector

Pin	Function	Wire Color	
		External Stepper SM-003	Int. Stepper SM-001
1	Motor A+	Red	Green
2	Motor A-	Blue	Green & White
3	Motor B+	Green	Red & White
4	Motor B-	Black	Red
5	Limit Switch GND	Brown	Brown
6	Limit Switch+	White	Violet
7	Limit Switch-	Violet	White
8	N/C	N/C	N/C
9	N/C	N/C	N/C

** White motor wire may be changed to green or blue in the future*

- ◆ For vacuum prepared wiring, blue may be substituted for green/white, and black for red/white.

A.1.2 Stepper Motor Specifications

External Stepper Motor		Internal Stepper Motor	
Motor Type	2 Phase Bipolar	Motor Type	2 Phase Bipolar
Phase Current	1.3 A Max	Phase Current	0.24 A Max
Step Angle	1.8°	Step Angle	1.8°
Steps	200	Steps	200
Coil-Resistance	1.9 Ohms	Coil-Resistance	20.4 Ohms
Coil-Inductance	1.7 mH	Coil-Inductance	5 mH
Pitch	1 mm/rev	Pitch	0.5 mm/rev
Resolution/Full step	5 μm	Resolution/Full step	2.5 μm

A.2 Linear Motor

A.2.1 Standard Atmospheric DB-9 Male Motor Connector

Linear Motor		
Pin	Function	Wire Color
1	A	Red
2	B	Black
3	C	White*
4	N/C	N/C
5	Limit Switch GND	Brown
6	Limit Switch+	White
7	Limit Switch-	Violet
8	N/C	N/C
9	N/C	N/C

A.2.2 Linear Motor Specifications

Linear Motor

Continuous Force	2.7 N
Continuous Current	0.8 Arms
Acceleration Force	10.8 N
Acceleration Current	3.4 Arms
Force Constant (K_f)	3.2 N/Arms
Back EMF (K_e)	1.1 V/m/s
Resistance 25°C	6.8 Ohms
Inductance	1.0 mH
Electric Time Constant	0.147ms
Rated Voltage (AC)	240 V
Fundamental Motor Constant (K_m)	1.23 $N\sqrt{W}$
Magnetic Pitch (North-North)	30mm

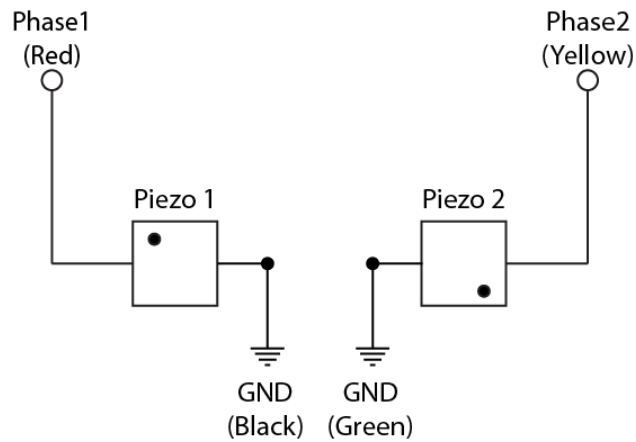
A.3 Piezo Motor

A.3.1 Standard Atmospheric DB-9 Male Motor Connector

Piezo Motor		
Pin	Function	Wire Color
1	Phase 1	Red
2	Phase 2	Yellow
3	N/C	N/C
4	N/C	N/C
5	Ground	Black Green
6	Limit Switch+	White
7	Limit Switch-	Violet
8	N/C	N/C
9	Limit Switch GND	Brown

A.3.2 2 Phase Piezo Motor

Wiring Connections



A.4 Limit Switches

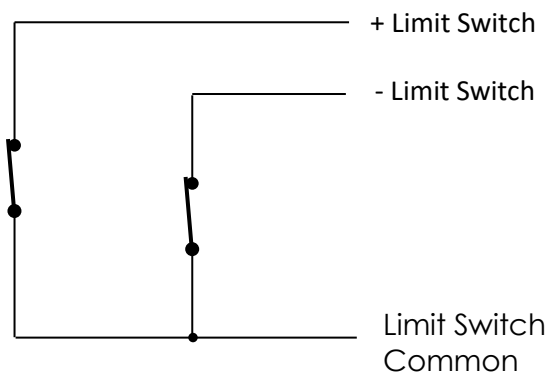
The limit switches are normally closed (when not activated) and should be connected to a compatible controller that recognizes these settings. A hard stop is designed into the PPS-60 body which will prevent the carriage from running away should the limit switches fail.

The mechanical limit switches are factory calibrated to ensure advertised travel length and cannot be adjusted by the customer. Optical limit switches can be factory adjusted to custom, specific travel lengths. For custom travel lengths, please contact MICRONIX USA.

A.4.1.1 Mechanical Limit Switches

Contact Rating	100 mA @ 30 V
Contact Type	Normally Closed
Operating Temperature	-25 to +70 °C

A.4.1.2 Limit Switch Schematic

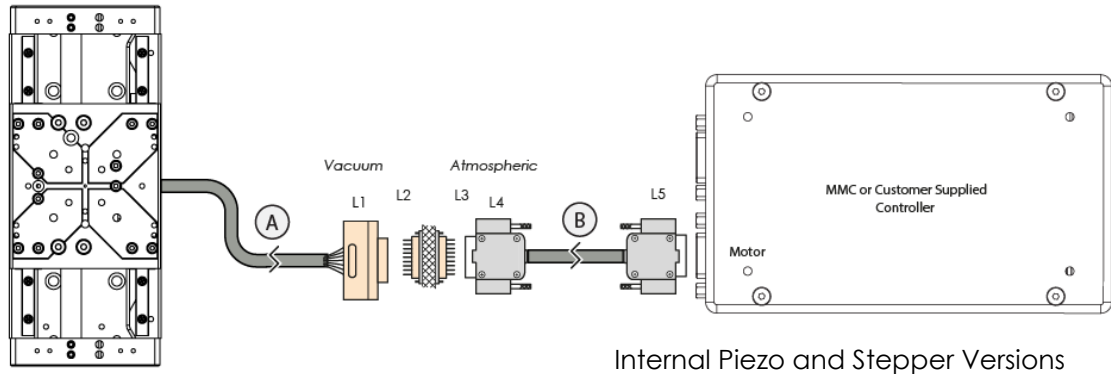


A.5 Open Loop Vacuum Wiring Diagram

Standard Cable Descriptions:

- A. PPS-60 Motor Cable - Vacuum Side (Female Dsub 9 Pin Peek Connector)
- B. Atmospheric Motor Connector (Female Dsub 9 Pin to Male Dsub 9 Pin)

Wiring Diagram:



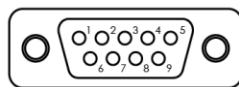
Piezo Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L5
Phase 1	Red	5	5	1	1	1
Phase 2	Yellow	4	4	2	2	2
Limit Switch -	Violet	8	8	7	7	7
Motor Ground	Green&Blk	1	1	5	5	5
Limit Ground	Brown	7	7	8	8	8
Limit Switch+	White	9	9	6	6	6

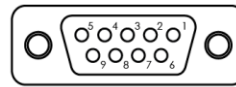


Internal Stepper Motor Connector Pinout

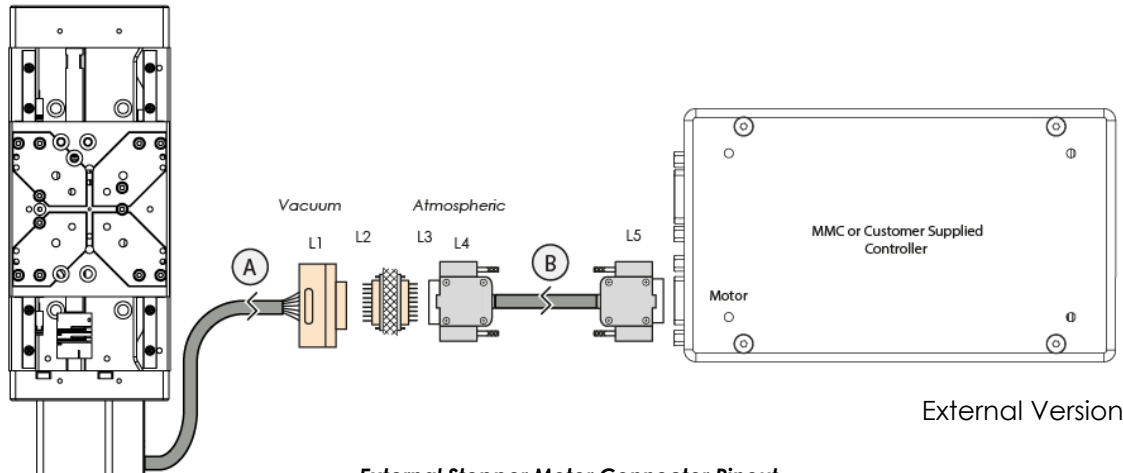
Description	Color	L1	L2	L3	L4	L5
Motor Phase A+	Green	5	5	1	1 (Green)	1
Motor Phase A-	Green & White	4	4	2	2 (White - Green TP)	2
Motor Phase B+	Red & White	3	3	3	3 (Black)	3
Motor Phase B-	Red	2	2	4	4 (Red)	4
Limit Ground	Brown	1	1	5	5 (Brown)	5
Limit Switch +	Violet	9	9	6	6 (Violet)	6
Limit Switch-	White	8	8	7	7 (White - Violet TP)	7
Shield	-	6	6	9	9 (Shield)	Casing



Female Dsub9 Connector - Rear View



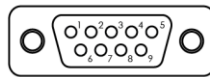
Male Dsub9 Connector - Rear View



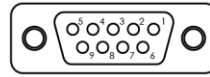
External Stepper Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L5
Motor Phase A+	Red	5	5	1	1 (Red)	1
Motor Phase B+	Green	3	3	3	3 (Green)	3
Limit Switch +	White	9	9	6	6 (White - Violet TP)	6
Motor Phase A-	Blue	4	4	2	2 (Black)	2
Motor Phase B-	Black	2	2	4	4 (White - Green TP)	4
Limit Switch-	Violet	8	8	7	7 (Violet)	7
Limit Ground	Brown	1	1	5	5 (Brown)	5
Shield	-	6	6	9	9 (Shield)	Casing

-Motor

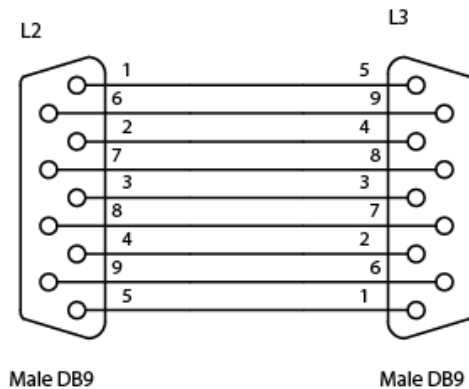


Female Dsub9 Connector - Rear View



Male Dsub9 Connector - Rear View

A.5.1 Straight Through 9-Pin Feed Through



A.6 Using an Analog Encoder

A.6.1 Analog Encoder Overview

A PPS-60 with Analog encoder will need to be paired with an appropriate controller. MMC controllers have an Analog option. The PPS-60 vacuum configurations with an internal analog encoder will be supplied with a 15-pin vacuum connector that incorporates both motor and encoder signals, along with an atmospheric cable splitting the signals into separate 9-pin connectors (motor connector and encoder connector).

A.6.2 Encoder Pin-out

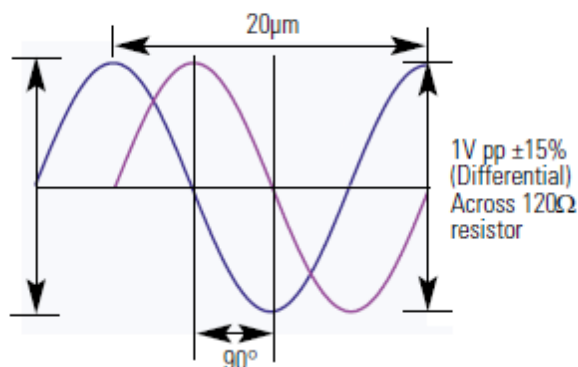
Pin	Wire Color	Description
1	Brown	Cos+
2	Yellow	Sin+
3	Violet	Index +
4	Black	Ground
5	Red	+5V
6	Orange	Cos-
7	Green	Sin-
8	Blue	Index -
9	Not in Use	Not in Use

A.6.3 Operating and Electrical Specifications

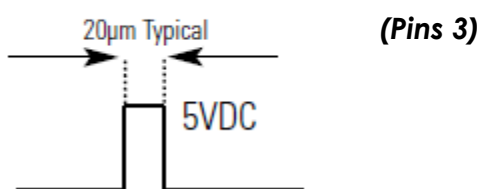
Power Supply	5VDC \pm 5% @ 330mA (60mA for sensor)
Operating Temperature	0 to 70°C
Humidity	10 - 90% RH non-condensing

A.6.4

Analog Output (Pins 1,2,6, and 7)



A.6.5 Index Window



A.6.6 Resolution

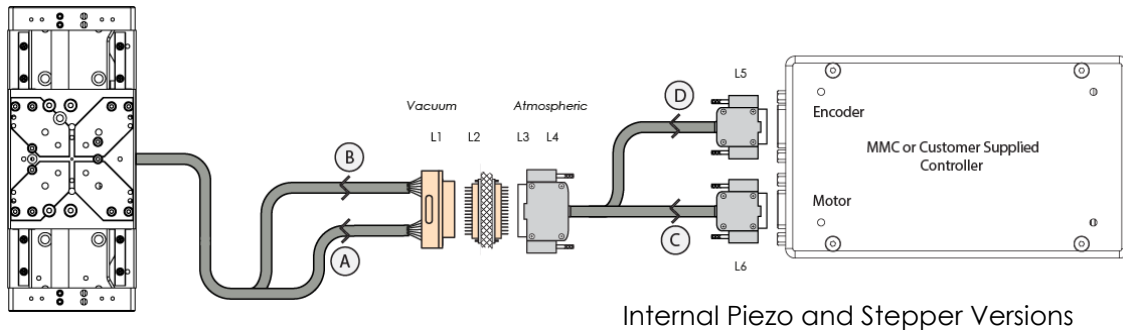
All closed loop stages are supplied with 20µm scales. The interpolation is done in an MMC controller to a higher resolution as specified in the order. With an analog encoder the MMC controller has an achievable resolution of 10nm.

A.6.7 Analog Encoder Wiring Diagram

Standard Cable Descriptions:

- A. PPS-60 Motor Cable - Vacuum Side > (Female Dsub 15 Pin Peek Connector)
- B. PPS-60 Encoder Cable - Vacuum Side >
- C. Atmospheric Motor Connector (Female Dsub 15 Pin to Male Dsub 9 Pin)
- D. Atmospheric Encoder Module (Female Dsub 15 Pin to Female Dsub 9 Pin)

Wiring Diagram:

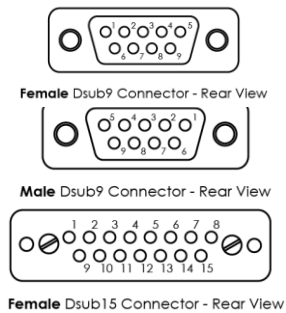
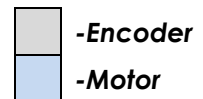


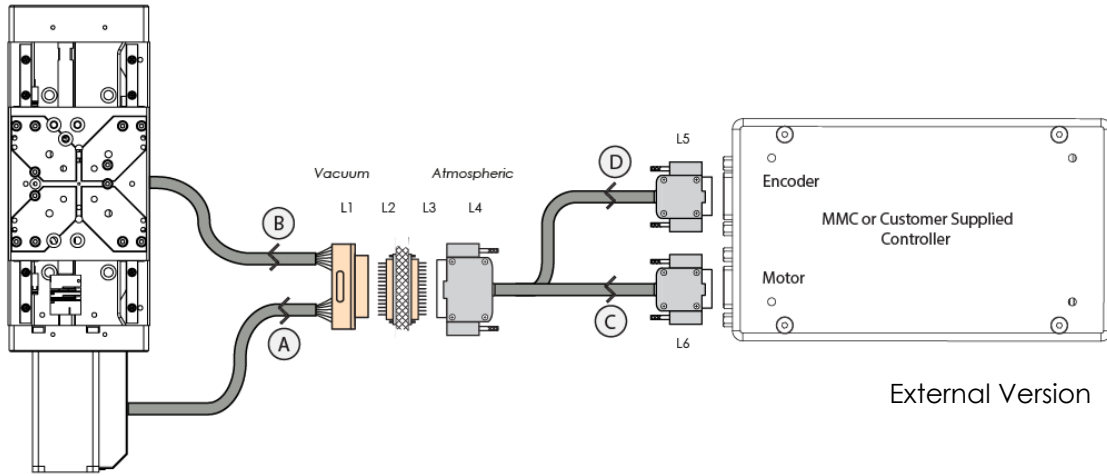
Piezo Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L5	L6
Phase 1	Red	1	1	8	8 (Red)		1
Phase 2	Yellow	2	2	7	7 (White - Green TP)		2
Enc Shield	Shield	4	4	5	5 (Shield)	Casing	
+5V	Red	5	5	4	4 (Red)	5	
Index+	Violet	6	6	3	3 (Violet)	3	
Cos+	Brown	7	7	2	2 (Brown)	1	
Sin-	Green	8	8	1	1 (White - Yellow TP)	7	
Motor Ground	Green&Blk	9	9	15	15 (Green & Black)		5
Enc Ground	Black	12	12	12	12 (Black)	4	
Index-	Blue	13	13	11	11 (White - Violet TP)	8	
Cos-	Orange	14	14	10	10 (White - Brown TP)	6	
Sin+	Yellow	15	15	9	9 (Yellow)	2	
Shield		10		14	14 Shield		Housing

Internal Stepper Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L5	L6
Motor Phase A+	Green	1	1	8	8 (Brwn & Brwn Whi TP)		1
Motor Phase B+	Red & White	2	2	7	7 (Violet & Violet Whi TP)		3
Limit Switch +	Violet	3	3	6	6 (Blue)		6
Enc Shield	Shield	4	4	5	5 (Shield)	Casing	
+5V	Red	5	5	4	4 (Red)	5	
Index+	Violet	6	6	3	3 (Violet)	3	
Cos+	Brown	7	7	2	2 (Brown)	1	
Sin-	Green	8	8	1	1 (White - Yellow TP)	7	
Motor Phase A-	Green & White	9	9	15	15 (Grn & Grn Whi TP)		2
Motor Phase B-	Red	10	10	14	14 (Yellow & Yellow Whi TP)		4
Limit Switch-	White	11	11	13	13 (White - Blue TP)		7
Ground	Brown Black	12	12	12	12 (Black/Black)	4	5
Index-	Blue	13	13	11	11 (White - Violet TP)	8	
Cos-	Orange	14	14	10	10 (White - Brown TP)	6	
Sin+	Yellow	15	15	9	9 (Yellow)	2	

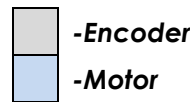
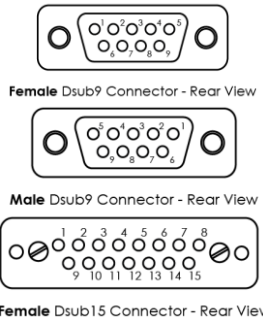




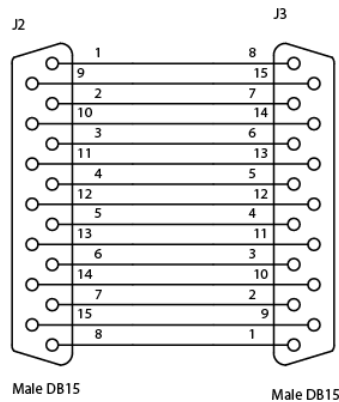
External Version

External Stepper Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L5	L6
Motor Phase A+	Red	1	1	8	8 (Brwn & Brwn Wht TP)		1
Motor Phase B+	Green	2	2	7	7 (Violet & Violet Wht TP)		3
Limit Switch +	White	3	3	6	6 (Blue)		6
Enc Shield	Shield	4	4	5	5 (Shield)	Casing	
+5V	Red	5	5	4	4 (Red)	5	
Index+	Violet	6	6	3	3 (Violet)	3	
Cos+	Brown	7	7	2	2 (Brown)	1	
Sin-	Green	8	8	1	1 (White - Yellow TP)	7	
Motor Phase A-	Blue	9	9	15	15 (Grn & Grn Wht TP)		2
Motor Phase B-	Black	10	10	14	14 (Yellow & Yellow Wht TP)		4
Limit Switch-	Violet	11	11	13	13 (White - Blue TP)		7
Ground	Brown Black	12	12	12	12 (Black/Black)	4	5
Index-	Blue	13	13	11	11 (White - Violet TP)	8	
Cos-	Orange	14	14	10	10 (White - Brown TP)	6	
Sin+	Yellow	15	15	9	9 (Yellow)	2	



A.6.8 Straight Through 15-Pin Feed Through



A.7 Using the Digital Encoder Module

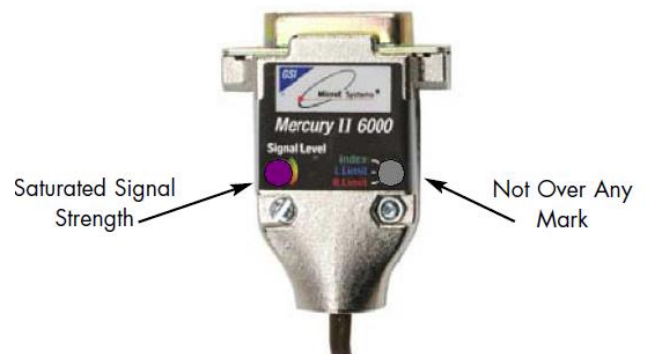
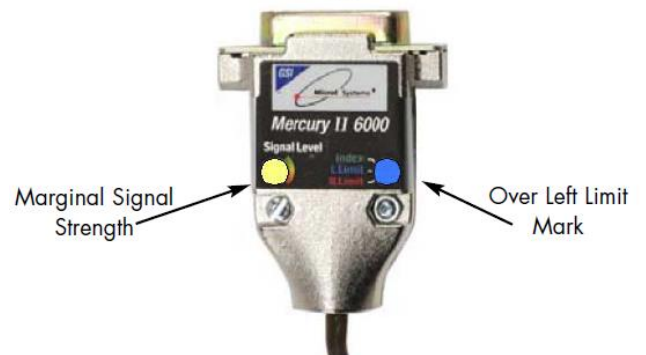
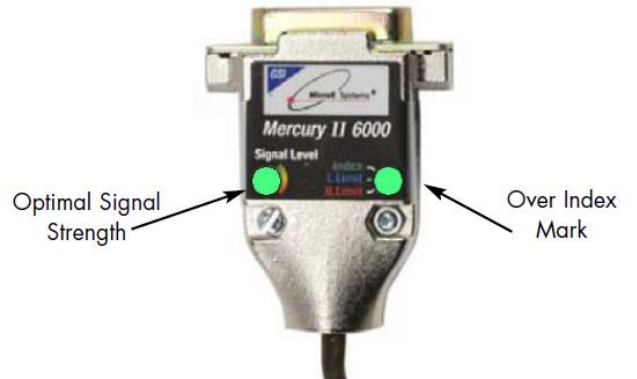
When using the digital external encoder configuration, the Encoder Module should display two green LED's indicating a power source and proper encoder alignment. A Red or Yellow Signal Level LED indicates misalignment of the Encoder Head, if this occurs contact MICRONIX USA. Do not adjust the Encoder Head or scale. For more information refer to MicroE Systems Mercury Encoders.

A.7.1 Encoder Module Pin-out

Pin	Description	Pin	Description
1	*Right Limit+	9	Ground
2	Ground	10	*Left Limit+
3	*Right Limit-	11	*Left Limit-
4	Index-	12	Index+
5	B-	13	B+
6	A-	14	A+
7	+5V	15	(not used)
8	+5V		

*-Limits must be specified at the time of order and calibrated at the factory.
 Note: Tri-state alarm: A and B are tri-stated if the encoder signal becomes too low for reliable operation.

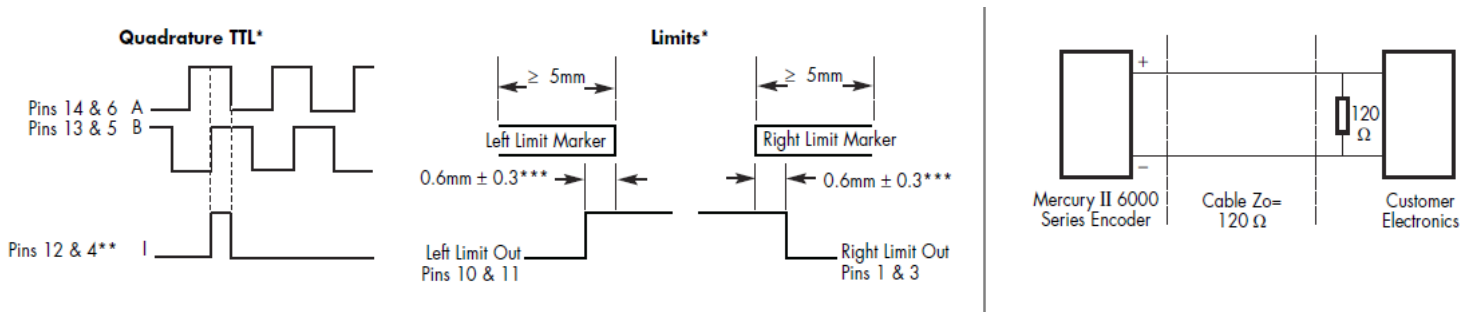
Normal Operation



A.7.2 Operating and Electrical Specifications

Power Supply	5VDC \pm 5% @ 140mA (No outputs terminated) @ 180mA (A, B, I, and both limits terminated); 50mA at the sensor
Operating Temperature	0 to 70°C
Humidity	10 - 90% RH non-condensing

A.7.3 Output Signals & Signal Termination for A quad B, Index and limits



*Output signals are differential. Inverse signals are not shown for clarity.

**Note: At some interpolations values the index pulse may be aligned with other states of A or B than the ones shown.

***Above are with reference to the sensor's optical centerline

A.7.4 Resolution

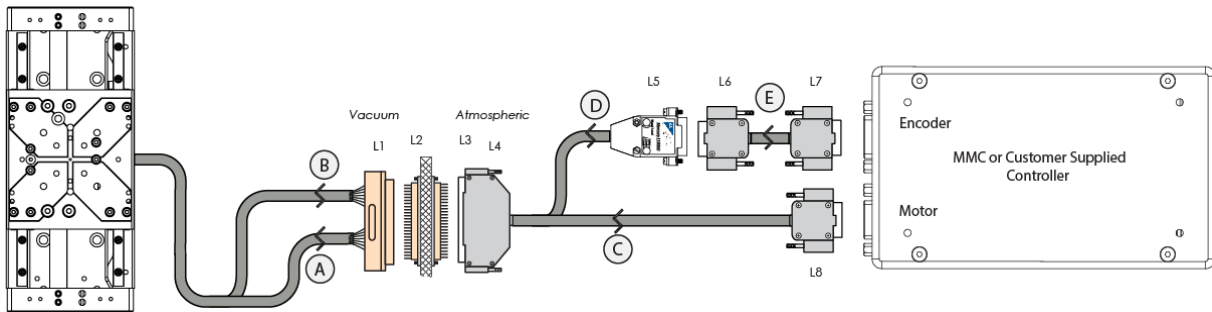
All closed loop stages are supplied with 20 μm scales. The digital encoder module interpolates to a higher resolution as specified in the order. With a digital encoder an MMC controller has an achievable resolution of 2nm.

A.7.5 MII 6000 Digital Wiring Diagram

Standard Cable Descriptions:

- A. PPS-60 Motor Cable - Vacuum Side > (Female Dsub 25 Pin Peek Connector)
- B. PPS-60 Encoder Cable - Vacuum Side
- C. Atmospheric Motor Cable (Female Dsub 25 Pin to Male Dsub 9 Pin)
- D. Atmospheric Encoder Module Cable (Female Dsub 25 Pin to MII 6000 Interpolator Module)
- E. Encoder Module Adapter Cable (Female Dsub 15 to Female Dsub 9 Pin)

Wiring Diagram:



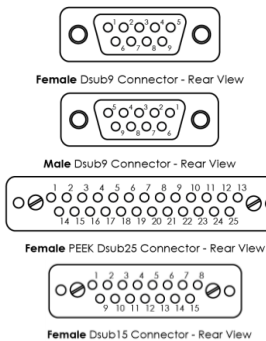
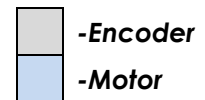
Internal Piezo and Stepper Versions

Piezo Motor Connector Pinout

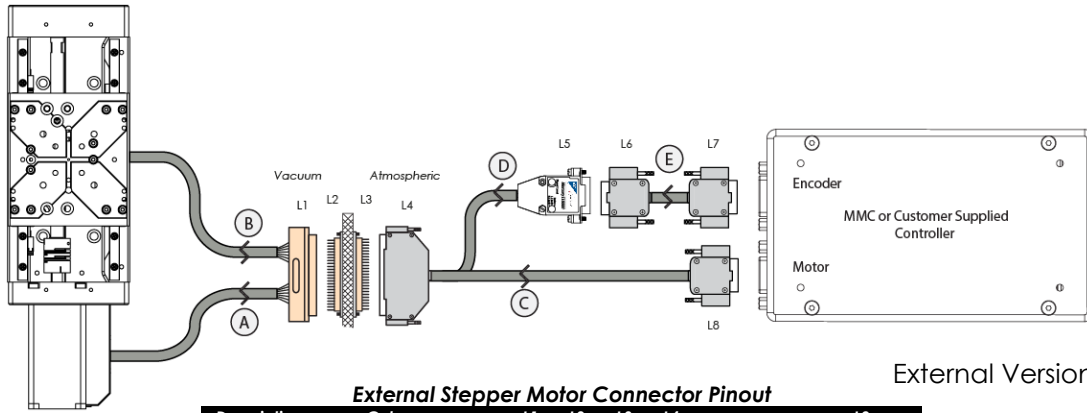
Description	Color	L1	L2	L3	L4	L8
Phase 1	Red	1	1	13	13 (Red)	1
Phase 2	Yellow	2	2	12	12 (White - Green TP)	2
Ground	Green&Blk	14	14	25	25 (Green&Blk)	5
Shield	Shield	15	15	24	24 (Shield)	Casing
+5VDC	Red	4	4	10	10 (Red)	
GND	Black	17	17	22	22 (Black)	
DCLK-	Gray	5	5	9	9 (Gray)	
DCLK+	White - Gray TP	18	18	21	21 (White - Gray TP)	
MISO-	Violet	6	6	8	8 (Violet)	
MISO+	White - Violet TP	19	19	20	20 (White - Violet TP)	
MOSI-	Blue	7	7	7	7 (Blue)	
MOSI+	White - Blue TP	20	20	19	19 (White - Blue TP)	
nSS-	Green	8	8	6	6 (Green)	
nSS+	White - Green TP	21	21	18	18 (White - Green TP)	
CLK-	Brown	9	9	5	5 (Brown)	
CLK+	White - Brown TP	22	22	17	17 (White - Brown TP)	
Shield	Shield	16	16	23	N/C	

Internal Stepper Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L8
Motor Phase A+	Green	1	1	13	13 (Green)	1
Ground	Brown	14	14	25	25 (Brown)	5
Motor Phase A-	Green & White	2	2	12	12 (White - Green TP)	2
Limit Switch +	Violet	15	15	24	24 (Violet)	6
Motor Phase B+	Red & White	3	3	11	11 (Black)	3
Limit Switch -	White	16	16	23	23 (White - Violet TP)	7
Motor Phase B-	Red	4	4	10	10 (Red)	4
Shield	-	5	5	9	9 (Shield)	Casing
+5VDC	Red	8	8	6	6 (Red)	
GND	Black	20	20	19	19 (Black)	
DCLK-	Gray	9	9	5	5 (Gray)	
DCLK+	White - Gray TP	21	21	18	18 (White - Gray TP)	
MISO-	Violet	10	10	4	4 (Violet)	
MISO+	White - Violet TP	22	22	17	17 (White - Violet TP)	
MOSI-	Blue	11	11	3	3 (Blue)	
MOSI+	White - Blue TP	23	23	16	16 (White - Blue TP)	
nSS-	Green	12	12	2	2 (Green)	
nSS+	White - Green TP	24	24	15	15 (White - Green TP)	
CLK-	Brown	13	13	1	1 (Brown)	
CLK+	White - Brown TP	25	25	14	14 (White - Brown TP)	
Shield	-	7	7	7	7 (Shield)	



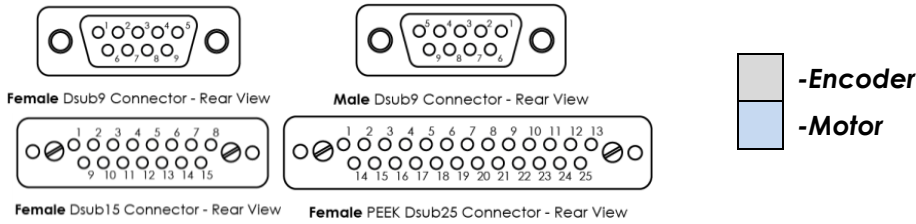
◆ Note: For the pinout of cable E, refer to the appropriate MMC manual.



External Version

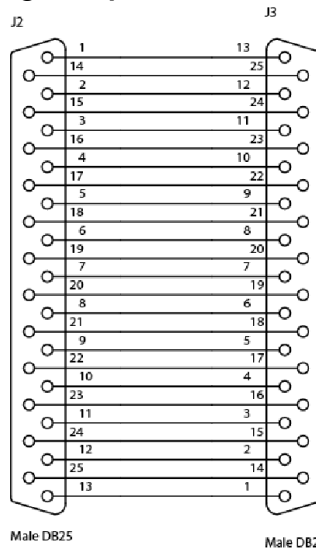
External Stepper Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L8
Motor Phase A+	Red	1	1	13	13 (Red)	1
Ground	Brown	14	14	25	25 (Brown)	5
Motor Phase A-	Blue	2	2	12	12 (Blue)	2
Limit Switch +	White	15	15	24	24 (White - Violet TP)	6
Motor Phase B+	Green	3	3	11	11 (Green)	3
Limit Switch -	Violet	16	16	23	23 (Violet)	7
Motor Phase B-	Black	4	4	10	10 (Black)	4
Shield	-	5	5	9	9 (Shield)	Casing
+5VDC	Red	8	8	6	6 (Red)	
GND	Black	20	20	19	19 (Black)	
DCLK-	Gray	9	9	5	5 (Gray)	
DCLK+	White - Gray TP	21	21	18	18 (White - Gray TP)	
MISO-	Violet	10	10	4	4 (Violet)	
MISO+	White - Violet TP	22	22	17	17 (White - Violet TP)	
MOSI-	Blue	11	11	3	3 (Blue)	
MOSI+	White - Blue TP	23	23	16	16 (White - Blue TP)	
nSS-	Green	12	12	2	2 (Green)	
nSS+	White - Green TP	24	24	15	15 (White - Green TP)	
CLK-	Brown	13	13	1	1 (Brown)	
CLK+	White - Brown TP	25	25	14	14 (White - Brown TP)	
Shield	-	7	7	7	7 (Shield)	



◆ Note: For the pinout of cable E, refer to the appropriate MMC manual.

A.7.6 Straight Through 25-pin Feed Through



A.8 Using a Micro Tape (Low Cost) Digital Encoder

A.8.1 Micro Tape Encoder Overview

The tri-color status LED in the sensor shows system status at all times.

Green = power is on, alignment is good. Blink off when passing over index.

Yellow = alignment not optimal, but encoder counting integrity is still good.

Red = alignment poor, discontinue use and realign sensor to scale.



Technical Specifications

Resolution	Linear: 0.5 μm
Linearity	Tape Scale: $\leq \pm 8\mu\text{m}/\text{m}$
Outputs	A-quad-B, Bidirectional Optical Index Pulse
Scales	Linear Tape
Grating Pitch	20 μm
Maximum Speed	7200mm/s

A.8.2 Encoder Pin-out

Pin	Function	Wire Color
1	A+	Brown
2	B+	Grey
3	Index +	Violet
4	Ground	Black
5	+5V	Red
6	A-	Orange
7	B-	White
8	Index -	Blue
9	Not In Use	Not in Use

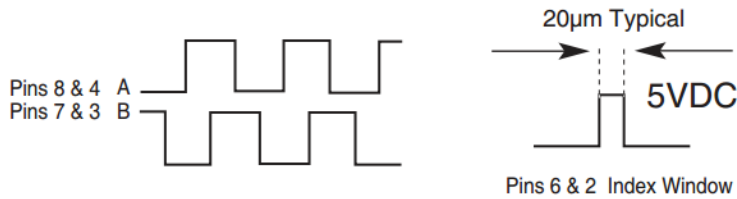
A.8.3 Operating and Electrical Specifications

Power Supply	5VDC \pm 5% @ 95mA (40mA for sensor)
Operating Temperature	0 to 70°C
Storage	-20 to 85°C
Humidity	10 - 90% RH non-condensing

A.8.4

Output Signals

Quadrature and Index



Alarm

