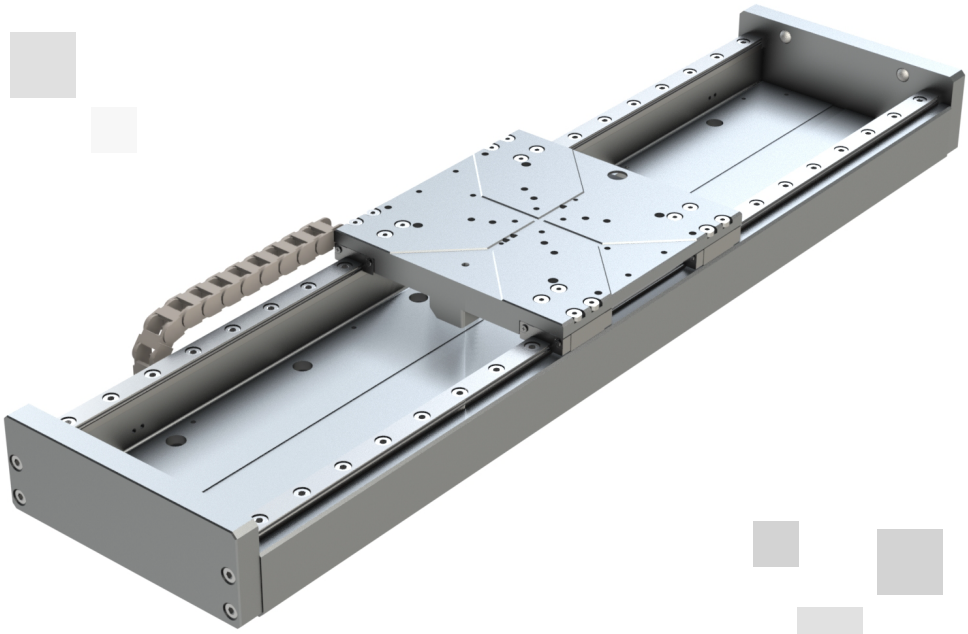
PPS-110 Series



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

micronix USA
PRECISION MOTION SOLUTIONS

PPS-110

Precision Positioner Stage

Reference Manual

Rev 2.1

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Table of Contents

1. Introduction

1.1 Product Description

The PPS-110 is a high-precision, long travel linear stage. It is available with piezo motor, linear motor, or stepper motor with ball screw drives. Steel recirculating ball bearings allow for smooth motion, and high guiding accuracy for loads up to 25 kg. Closed loop encoder resolution of 2 nm is achievable with a high precision digital encoder for piezo motor version.

Features:

- Travel ranges of 1000 mm
- Load capacity up to 25 kg
- Closed loop encoder resolution of 2 nm (Piezo motor)
- Closed loop encoder resolution of 50 nm (Stepper motor)
- Closed loop encoder resolution of 10 nm (Linear motor)

Figure 1. PPS-110 300mm Travel with Piezo Motor option

Figure 2. PPS-110 300mm Travel with Stepper Motor Option

Figure 3. PPS-110 300mm Travel with Linear Motor Option

1.2 Recommended Controllers

The following controllers are available from MICRONIX USA:

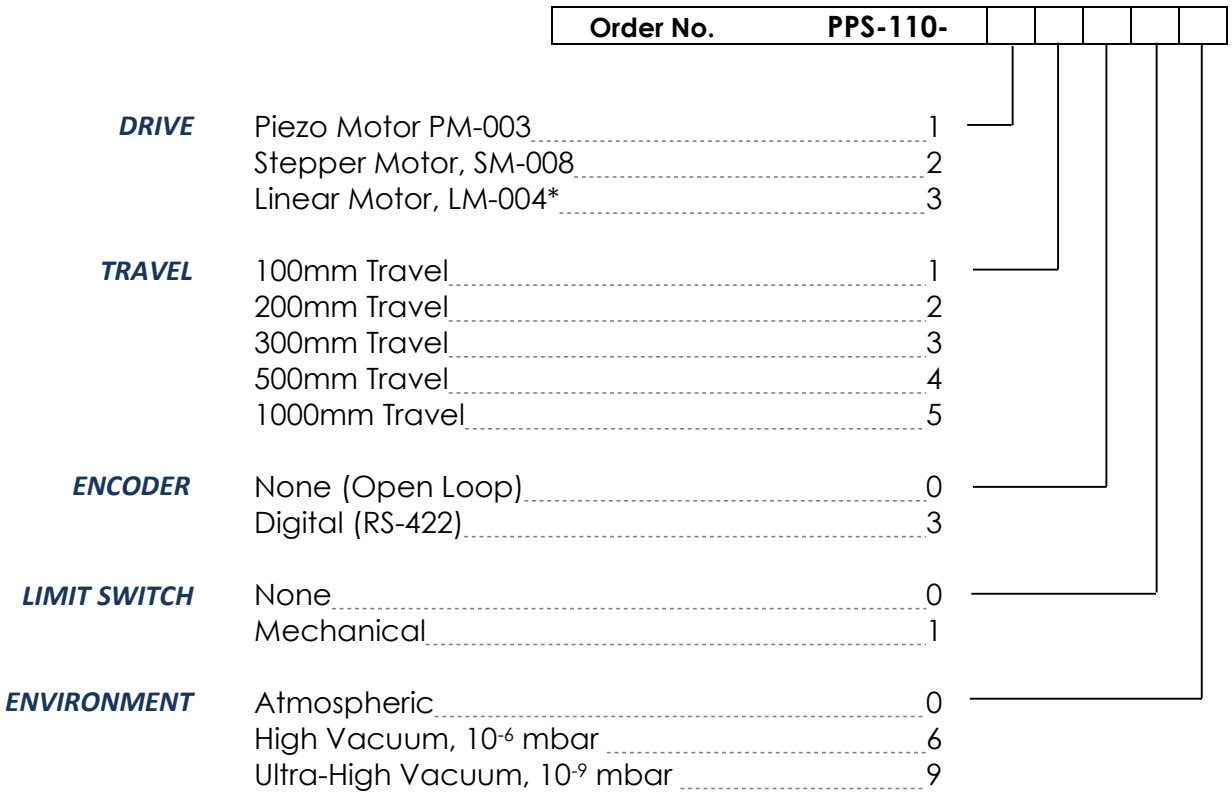
Stage Motor Type	Compatible Controller
Piezo (PM-003)	MMC-100 MMC-110 NanoDrive-1xxxx
Stepper (SM-008)	MMC-200 NanoDrive-2xxxx
Linear/BLDC (LM-004)	NanoDrive-3xxxx

1.3 Technical Data

See Datasheet

2. Model configurations

2.1 PPS-110 Order Numbers



Linear motor is only available with encoder feedback and atmospheric environment
Contact MICRONIX USA for custom applications and stacking configurations.

3. Preparing to Install the PPS-110

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 mounting surface. A surface that is not flat can adversely affect the performance and structural integrity of the stage. It is required to have a mounting surface with flatness less than the overall specified flatness of the base.

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 and flat 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 stage 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.

3.2 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-110 Linear Stage
- Reference Manual
- Any other previously agreed upon components such as a controller

4. Installing the PPS-110

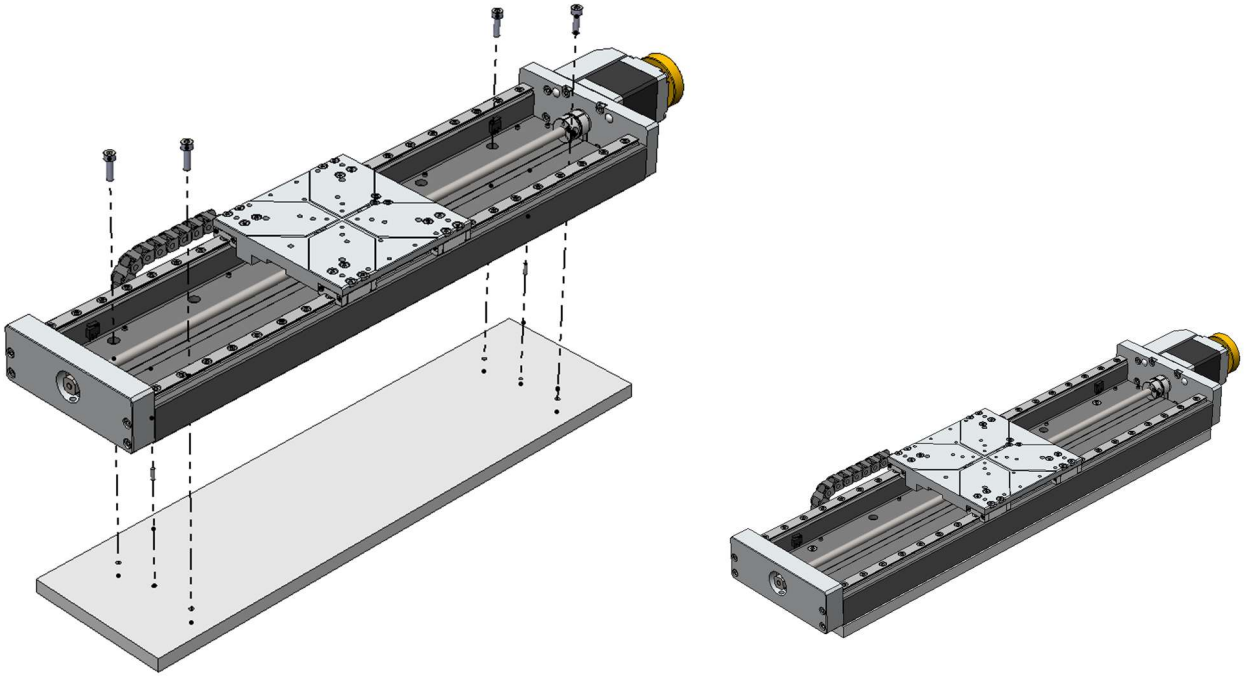
All configurations of the PPS-110 share the same mounting patterns, see Section 4.1.1 for general mounting, 4.1.2, for Bottom Mounting and 4.1.3 for XY Mounting. Additional brackets and screws may be required for custom applications, see Section 6 for stacking configuration examples.

4.1 PPS-110 Installation

4.1.1 *General Mounting*

Mount any configuration of PPS-110 using at least two M2.5 dowel pin holes for alignment and M4 socket head cap screws to secure the stage. It is recommended to torque the screws to 0.35Nm. Move the carriage to access the base mounting pattern. *(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*). See 4.1.1.1 for general mounting pattern.

Requires:
2x M2.5 x 6mm Dowel Pins
4x M4 Socket Head Cap Screws
(Low Profile recommended)

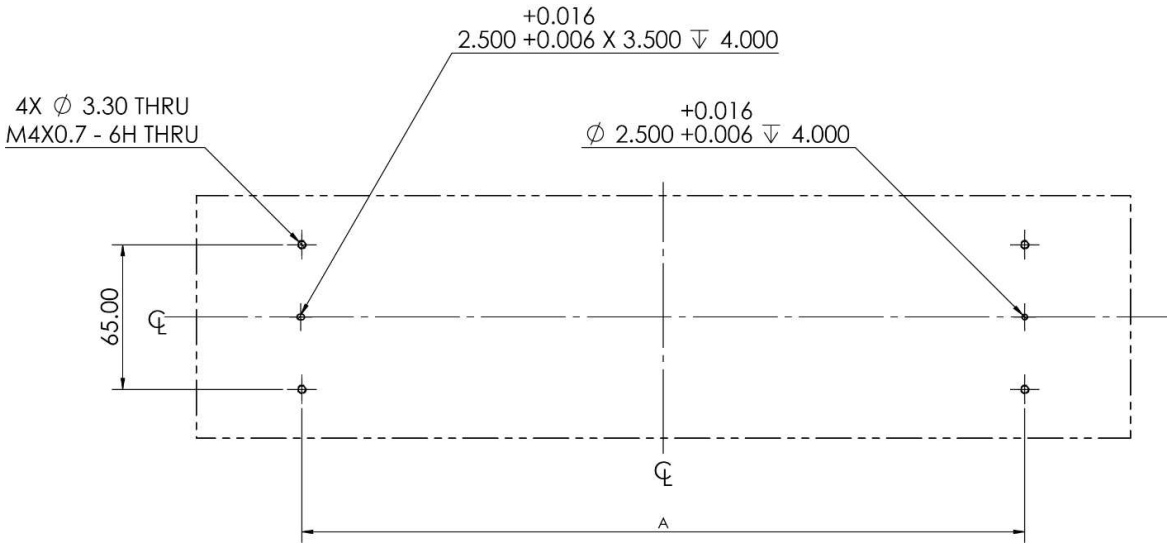


- ***For Linear motor configurations: Mounting screws must be flush with base surface.***

Figure 4 PPS-110 General Installation

4.1.1.1 General Mounting Pattern

It is recommended to use a pin-slot hole pattern to use the dowel pin holes on the base for alignment.



Travel	A *[mm]*
100mm	*195*
200mm	*195*
300mm	*325*
500mm	*585*
1000mm	*1105*

*For 1000mm travel version, use at least 8 screws to fix the mounting plate.

4.1.2 *Bottom Mounting*

Mount any configuration of PPS-110 using at least two M2.5 dowel pin holes for alignment and M5 screws to secure the stage. It is recommended to torque the screws to 0.5Nm. See recommended pattern in section 4.1.2.1.

Requires:
2 x M2.5 x 6mm Dowel Pins
4 x M5 Socket Head Cap Screws

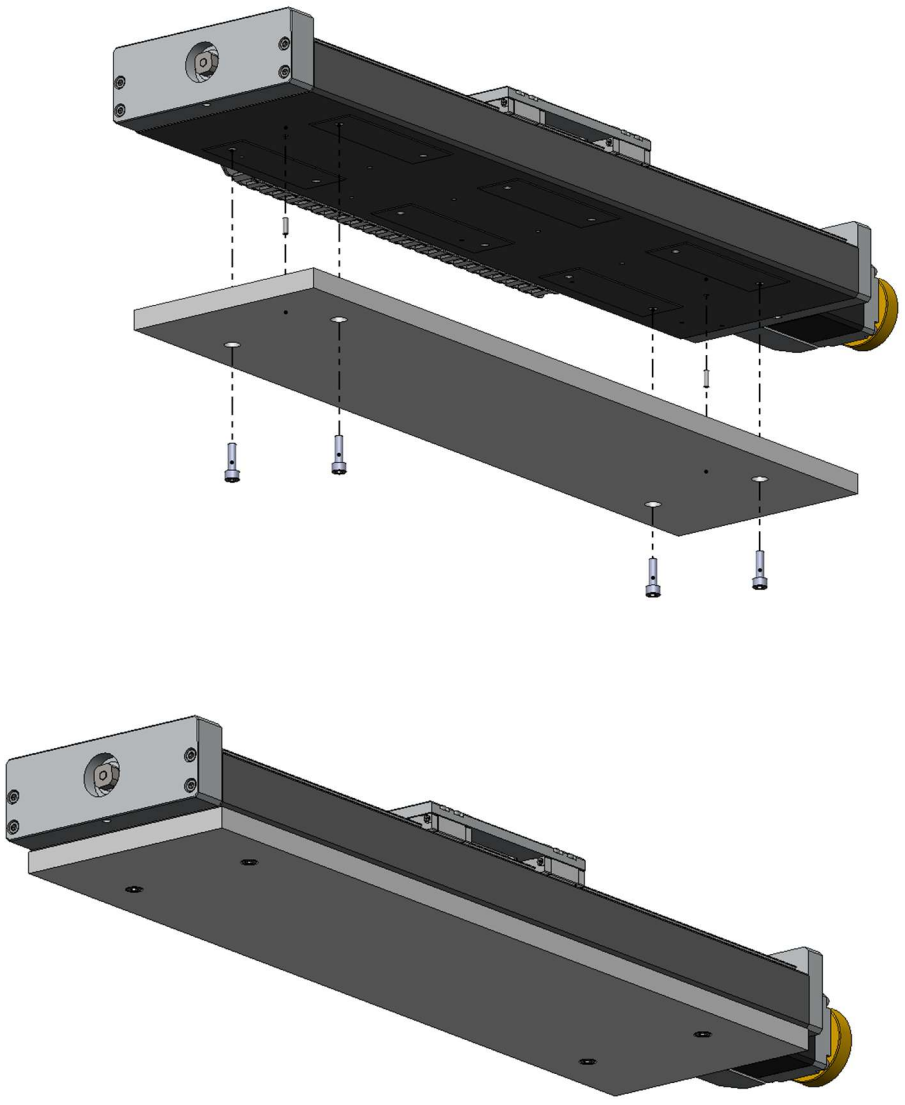
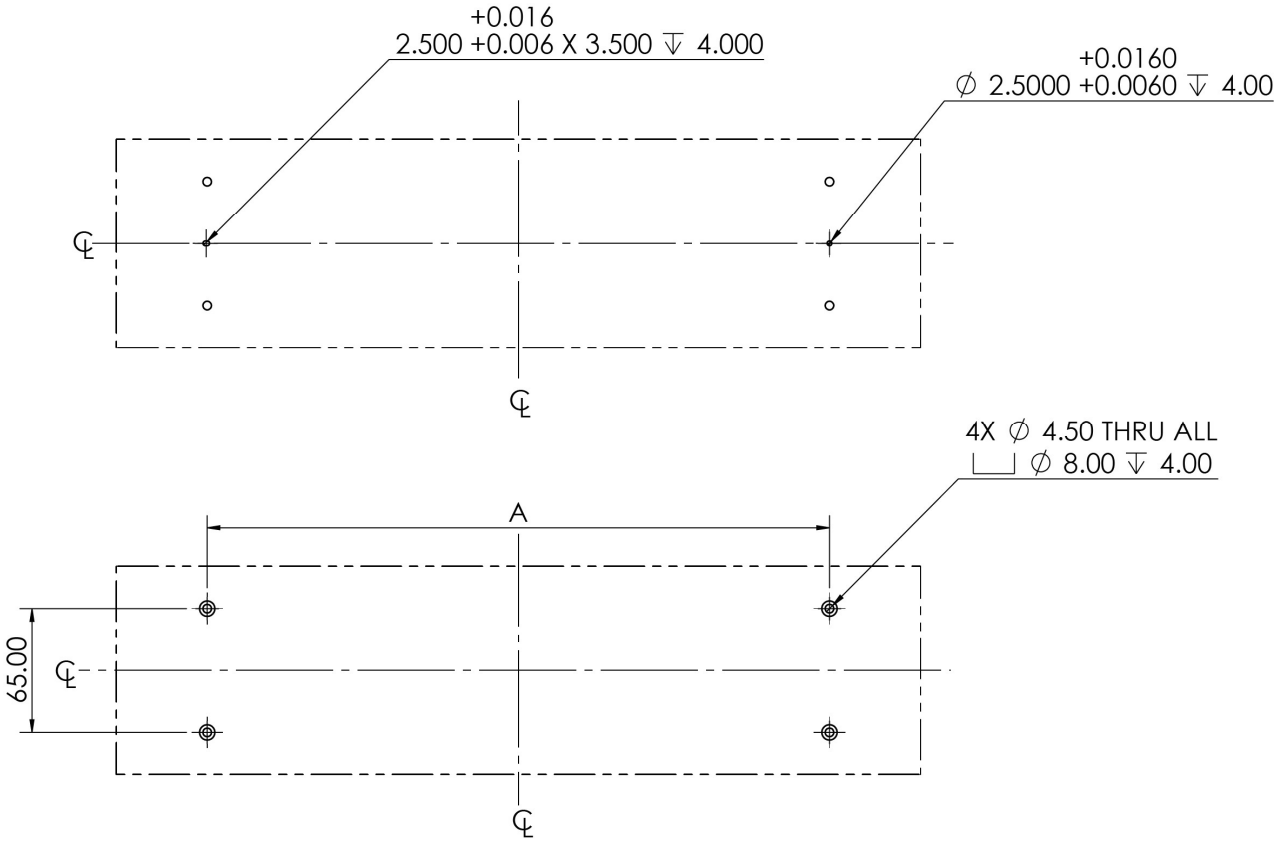


Figure 5. PPS-110 Bottom Mounting

4.1.2.1 General Mounting Pattern for Bottom Mounting

It is recommended to use a pin-slot hole pattern to use the dowel pin holes on the base for alignment.



Travel	*A [mm]*
100mm	*195*
200mm	*195*
300mm	*325*
500mm	*585*
1000mm	*1105*

*For 1000mm travel version, use at least 8 screws to secure the stage

4.1.3 *X-Y Mounting*

For general mounting of the PPS-110 bottom axis use the mounting methods from sections 4.1.1or 4.1.2.
To mount the top axis in XY, align the base to the carriage using at least two M2.5 dowel pins for alignment. Secure the top base to the carriage using M4x0.7x10mm socket head cap screw. Torque screws to 0.6Nm (recommended torque).
(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 additional mounting configurations see Section 6: Stacking Configurations.

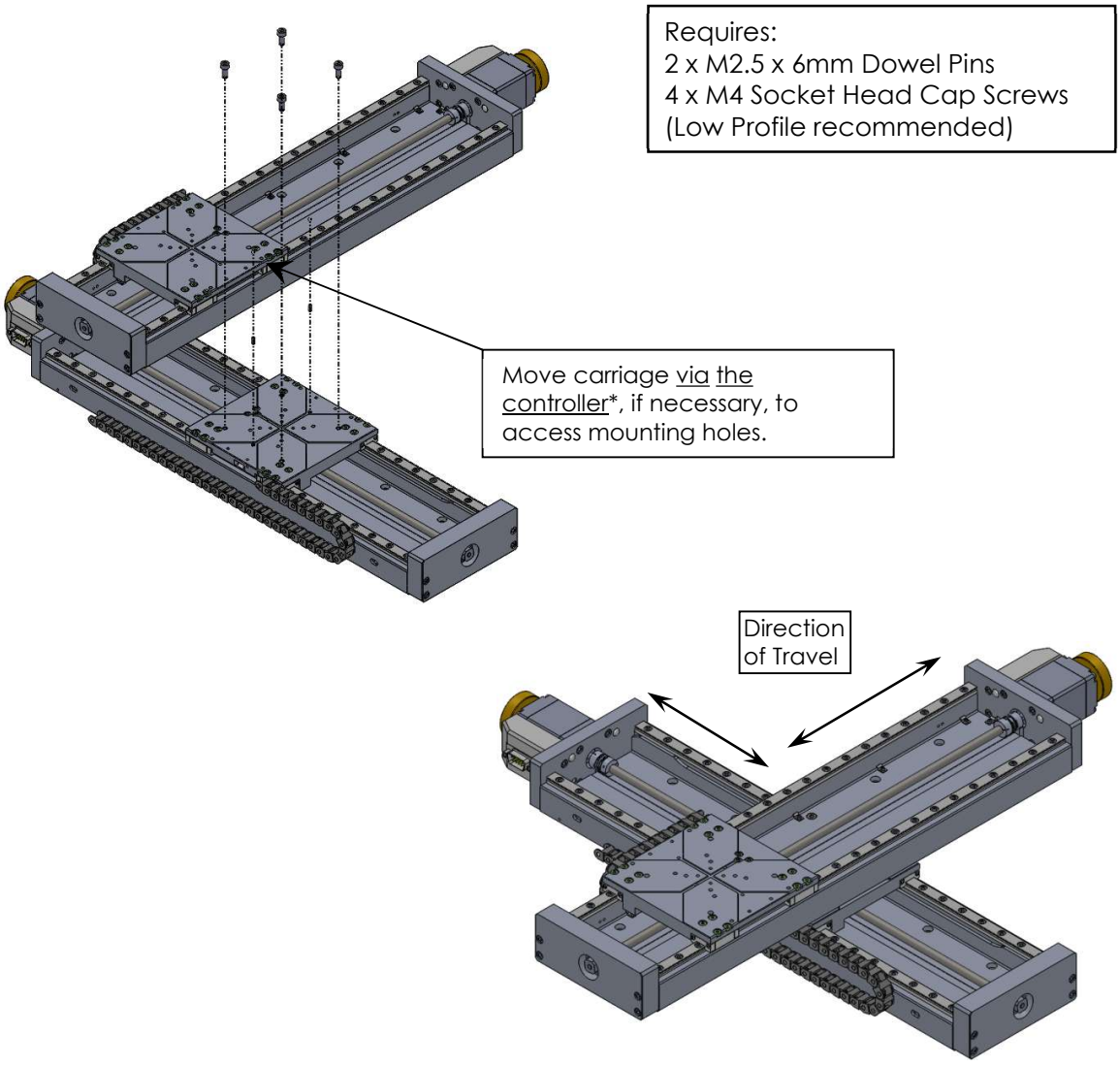
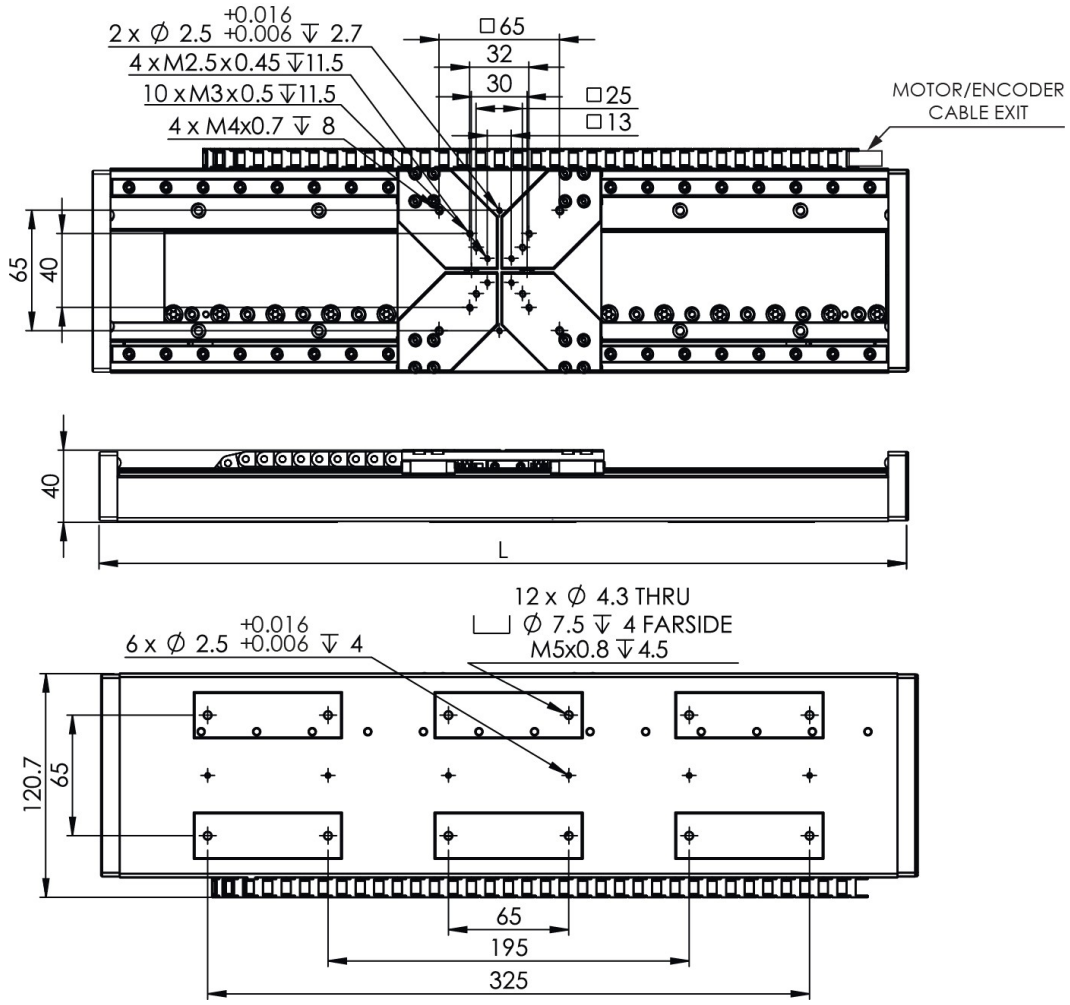


Figure 6. PPS-110 XY Installation

5. Dimensions

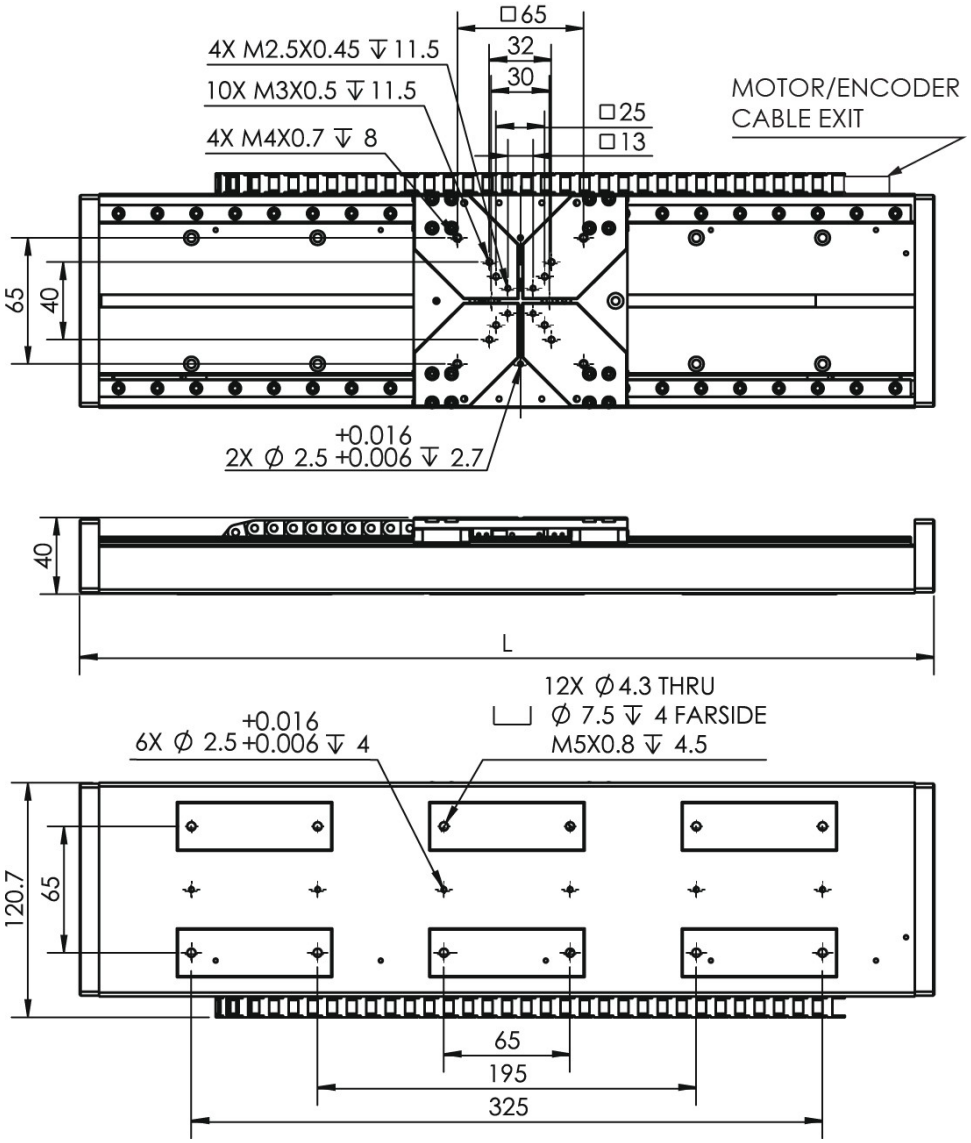
5.1 PPS-110 Internal Motor Versions (Linear and Piezo)

5.1.1 *Linear Motor Version*



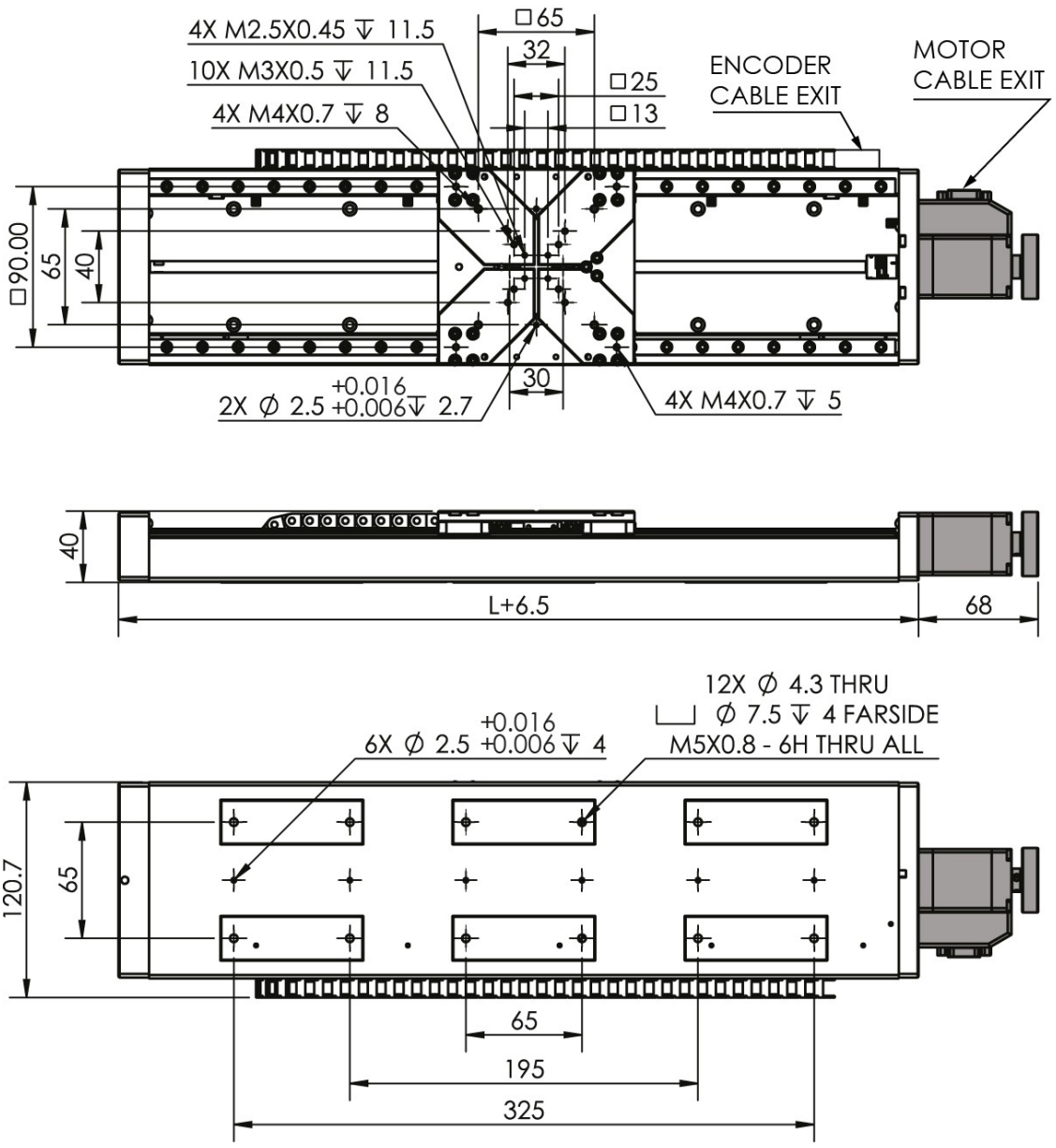
Travel [mm]	L [mm]
100	240
200	340
300	440
500	640
1000	1140

5.1.2 *Piezo Motor Version*



Travel [mm]	L [mm]
100	240
200	340
300	440
500	640
1000	1140

5.2 PPS-110 External Stepper Motor Version

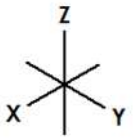


Travel [mm]	L [mm]
100	240
200	340
300	440
500	640
1000	1140

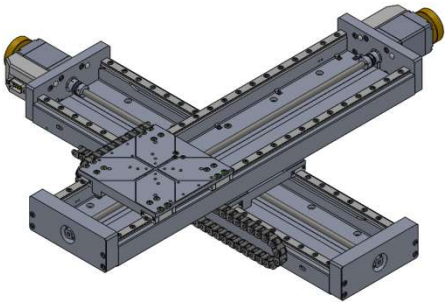
6. Stacking Configurations

6.1 Configuration Examples

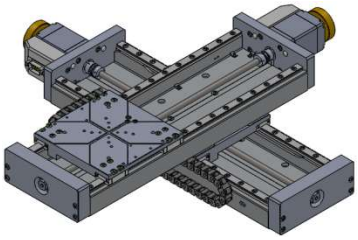
- Additional configurations available upon request
- Note: Stacking compatibility for all motor configurations.
- Positioning according to:



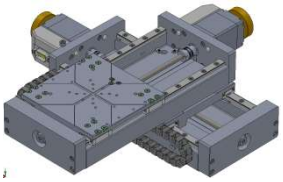
No Adapters



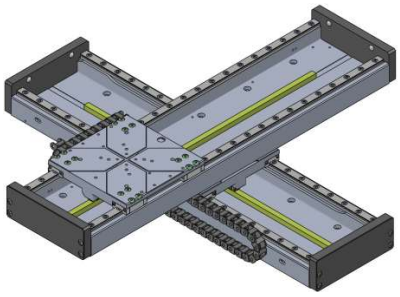
X-Y 300x300mm SM



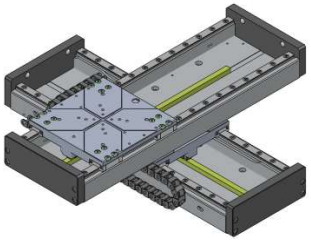
X-Y 200x200mm SM



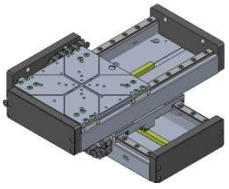
X-Y 100x100mm SM



X-Y 300x300mm PM



X-Y 200x200mm PM



X-Y 100x100mm PM

7. Connecting the PPS-110

7.1 Atmospheric Environments

For controller information refer to the appropriate MMC controller manual.
Wiring diagrams are consistent for all piezo, stepper, and linear motor assemblies.

7.1.1 *Open Loop Installation & Wiring Diagram*

Connecting the PPS-110 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 section A.5 for pinout configurations).
*PPS-110 Linear motor option is not available in open loop configuration.

Cable Descriptions:

A. Piezo Motor Cable (Male Dsub9 Pin, 1.5m PVC Black Cable)

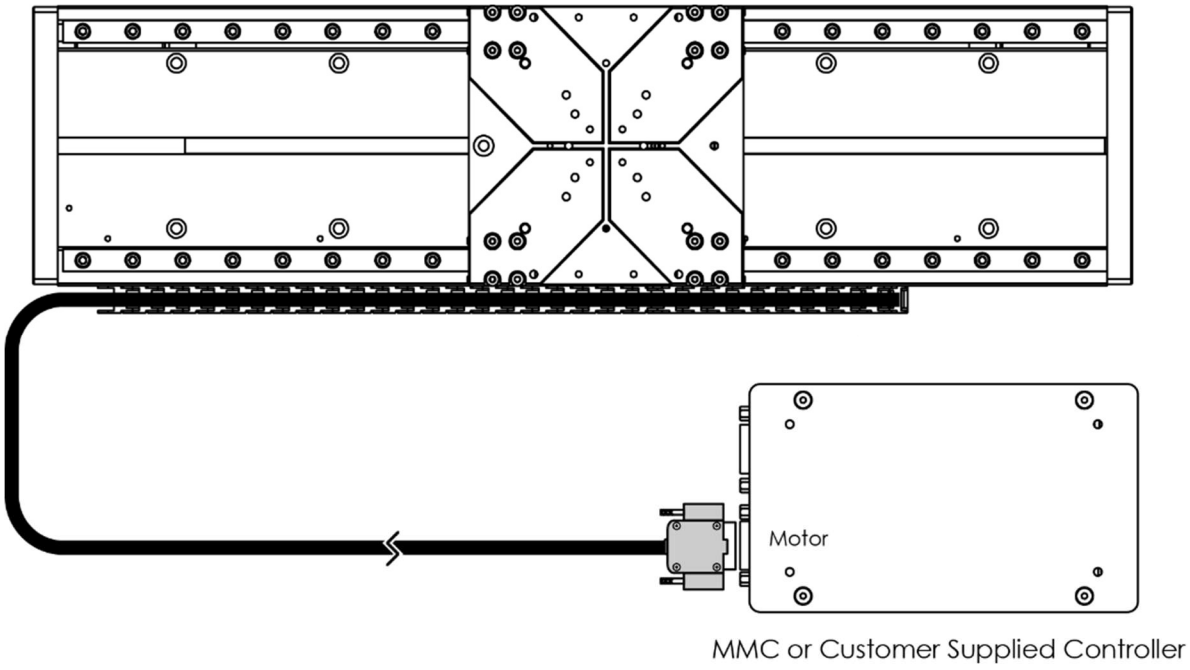


Figure 7. PPS-110 Piezo Motor Version Wiring Diagram

Cable Descriptions:

A. Stepper Motor Cable (Female Dsub9 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)

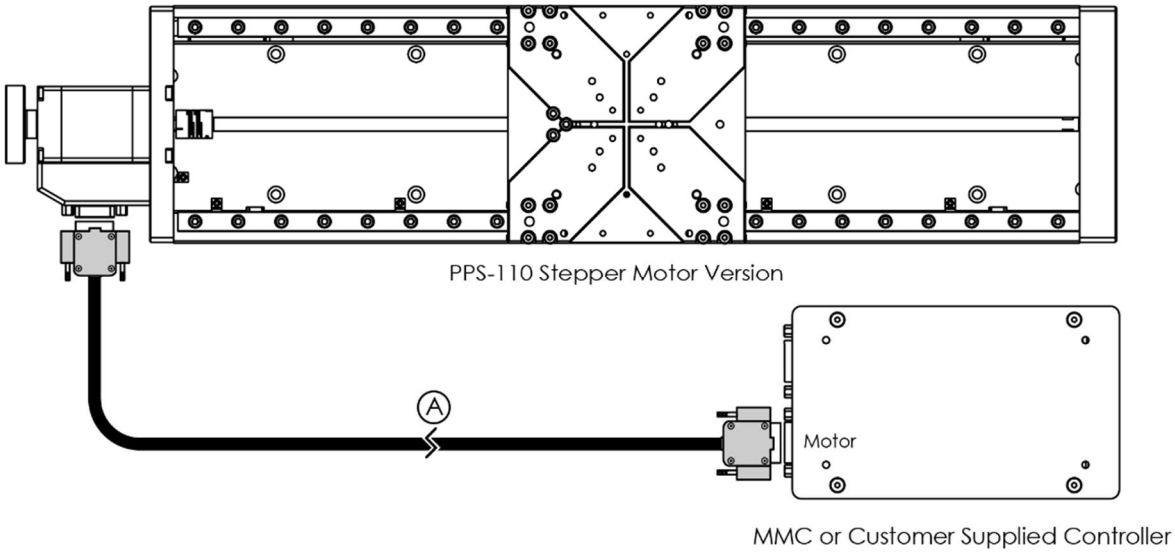


Figure 8 PPS-110 Stepper Motor Version Wiring Diagram

7.1.2 *Closed Loop/Encoder Installation & Wiring Diagram*

Using the PPS-110 stage with an encoder requires a closed loop compatible controller that recognizes the proper type of encoder feedback. Connect the stage as shown below.

7.1.2.1 Digital Encoder Wiring Diagram

Cable Descriptions:

A. Piezo Motor Cable (Male Dsub9 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)
B. Encoder Cable (Female Dsub9 Pin Module, 1.5m PVC Black Cable)

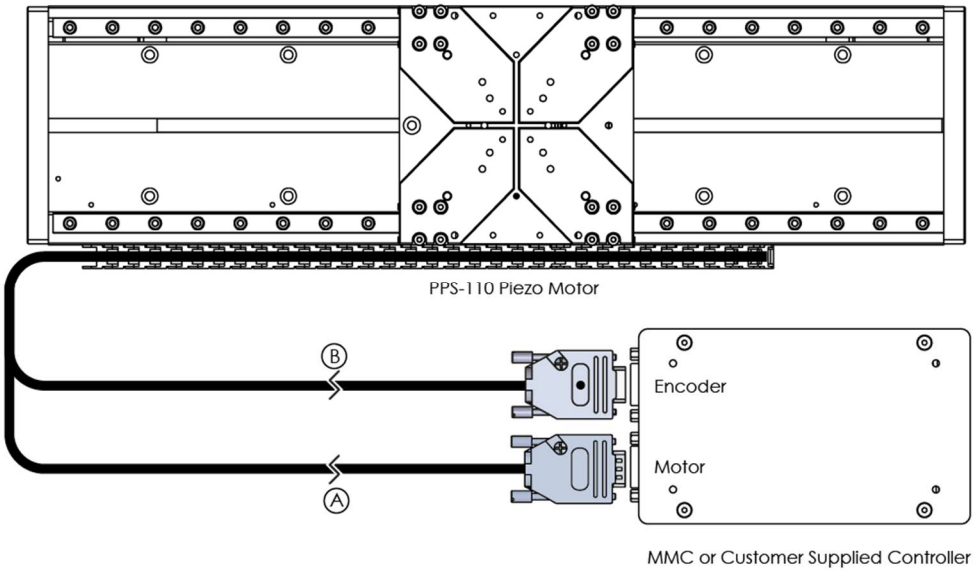


Figure 9. PPS-110, Piezo Motor Version, Digital Wiring Diagram

Cable Descriptions:

A. Motor & Limit Cable (Female Dsub9 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)
B. Encoder Cable (Male Dsub15 Pin Module, 1m PVC Black Cable)
C. Encoder Adapter Cable (Female Dsub15 Pin to Female Dsub9 Pin, 0.5m PVC Black Cable)

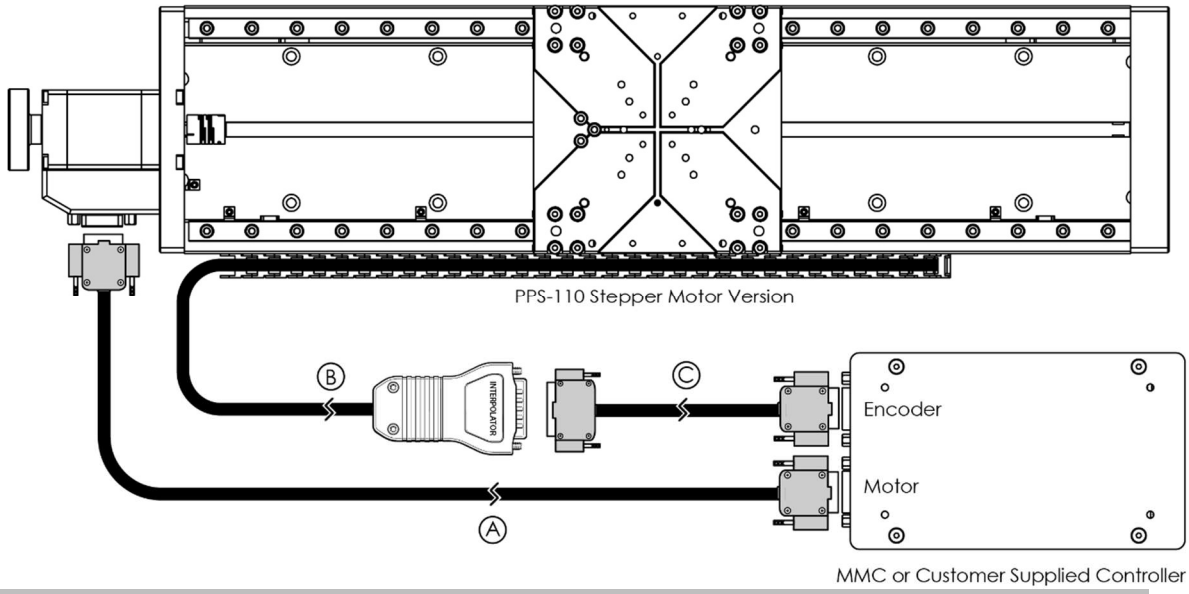


Figure 10. PPS-110, Stepper Motor, Digital Wiring Diagram

Cable Descriptions:

A. Motor & Limit Cable (Female Dsub9 Pin to Male Dsub9 Pin, 1.5m Black Sleeved Cable)
B. Encoder Cable (Female Dsub9 Pin Module, 1.5m PVC Black Cable)

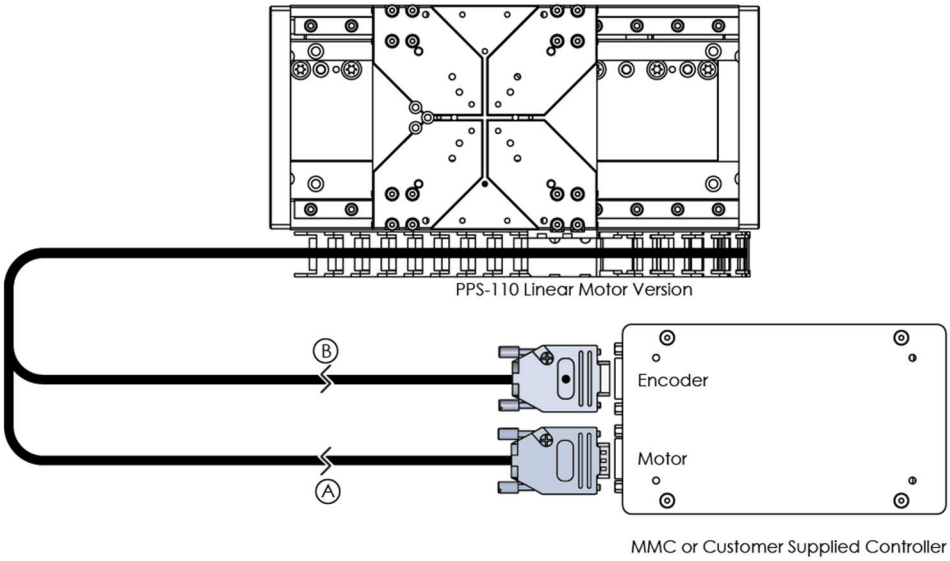


Figure 11. PPS-110, Linear Motor, Digital Wiring Diagram

7.2 Vacuum Environments

7.2.1 *Handling and Preparation*

When handling the stage for vacuum environments, take the necessary precautions when handling the stage, such as wearing clean 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

7.2.2 *Open loop Installation & Wiring Diagram*

Connecting an open loop PPS-110 in a vacuum chamber requires the use of a feed through connector at the vacuum chamber wall. The vacuum compatible PPS-110 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 are not available for vacuum environments. For details regarding the pin-out and feed-through specifications see the Appendix section A.5.

Cable Descriptions:

A. Motor Cable (Female Dsub9 Pin Peek or DAP, 1.5m Silver Braided Cable)
B. Atmospheric Motor Cable (Female Dsub9 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)

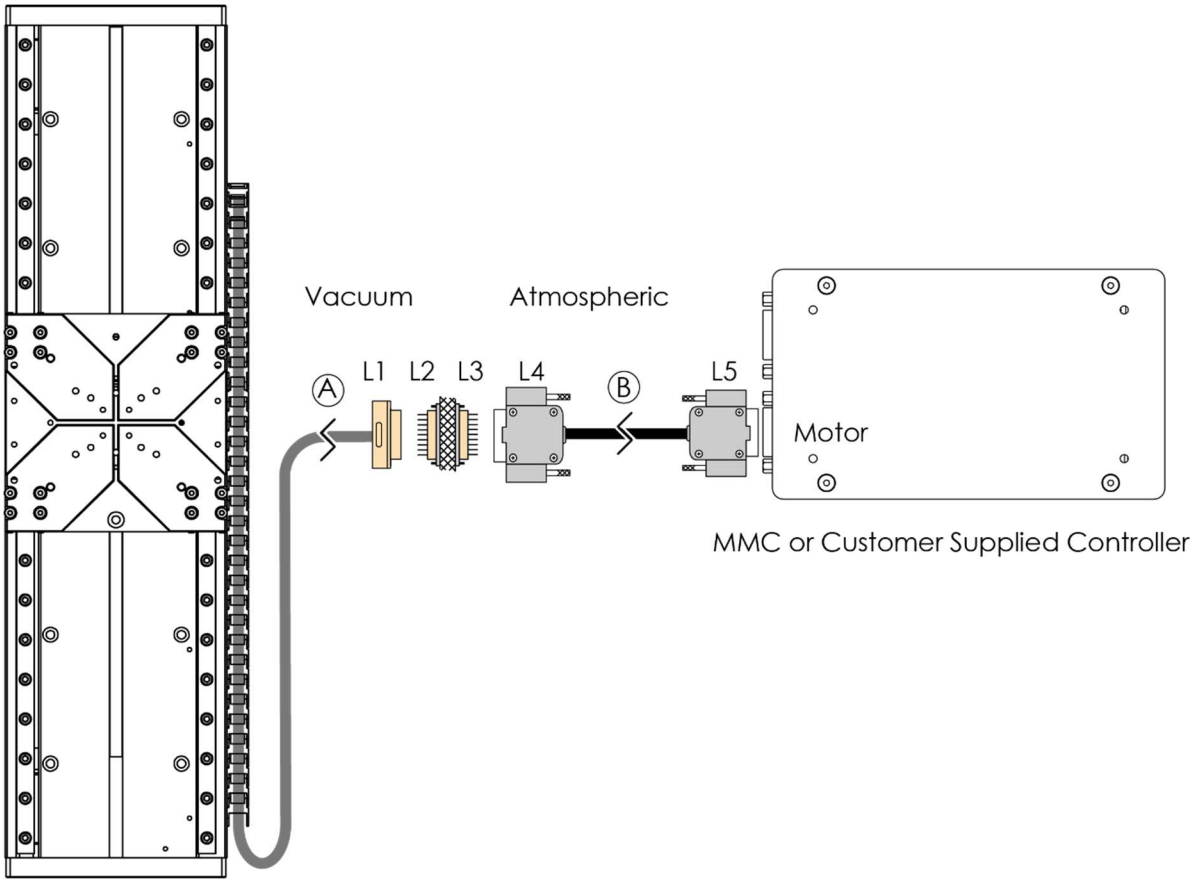


Figure 11. PPS-110, Piezo Motor Version, Wiring Diagram

Cable Descriptions:

A. Motor Cable (Female Dsub9 Pin Peek or DAP, 1.5m Silver Braided Cable)
B. Atmospheric Motor Cable (Female Dsub9 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)

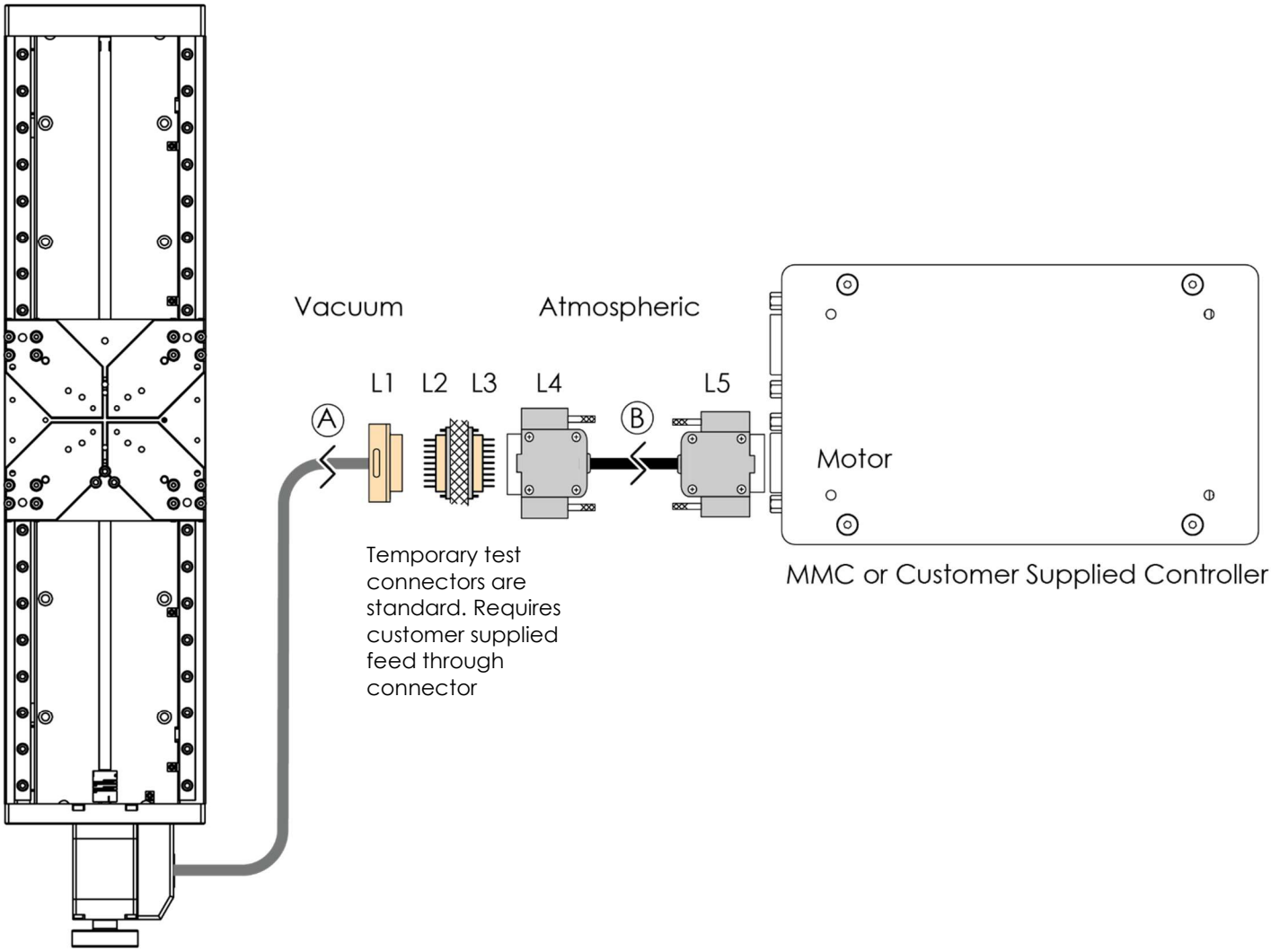


Figure 12. PPS-110SM, Open Loop, Vacuum Wiring Diagram

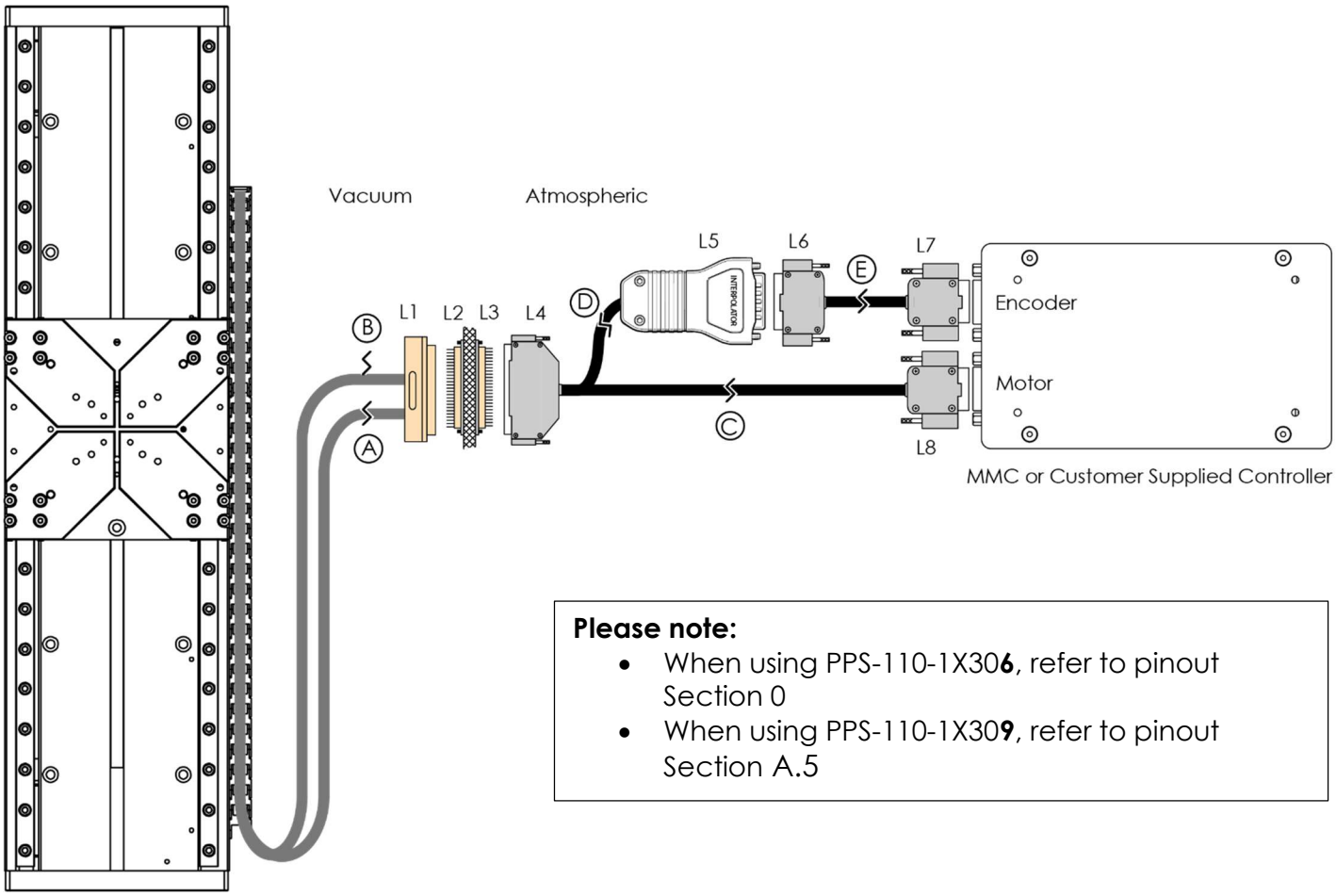
7.2.3 *Closed Loop/Encoder Installation & Wiring Diagram*

Closed loop installation of the PPS-110 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-110 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. For details regarding the pin-out and feed through specifications see the Appendix section A.5.

Cable Descriptions:

A. Motor Vacuum Cable (Female Dsub15 Pin Peek or DAP, 1.5m Silver Braided Cable)
B. Encoder Vacuum Cable (Female Dsub15 Pin Peek or DAP, 1.5m Silver Braided Cable)
C. Atmospheric Motor Cable (Female Dsub15 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)
D. Atmospheric Encoder Cable (Female Dsub15 Pin to Male Dsub15 Pin, 1m, PVC Black Cable)
E. Encoder Module Adapter Cable (Female Dsub15 Pin to Female Dsub9 Pin, 0.5m PVC Black Cable)



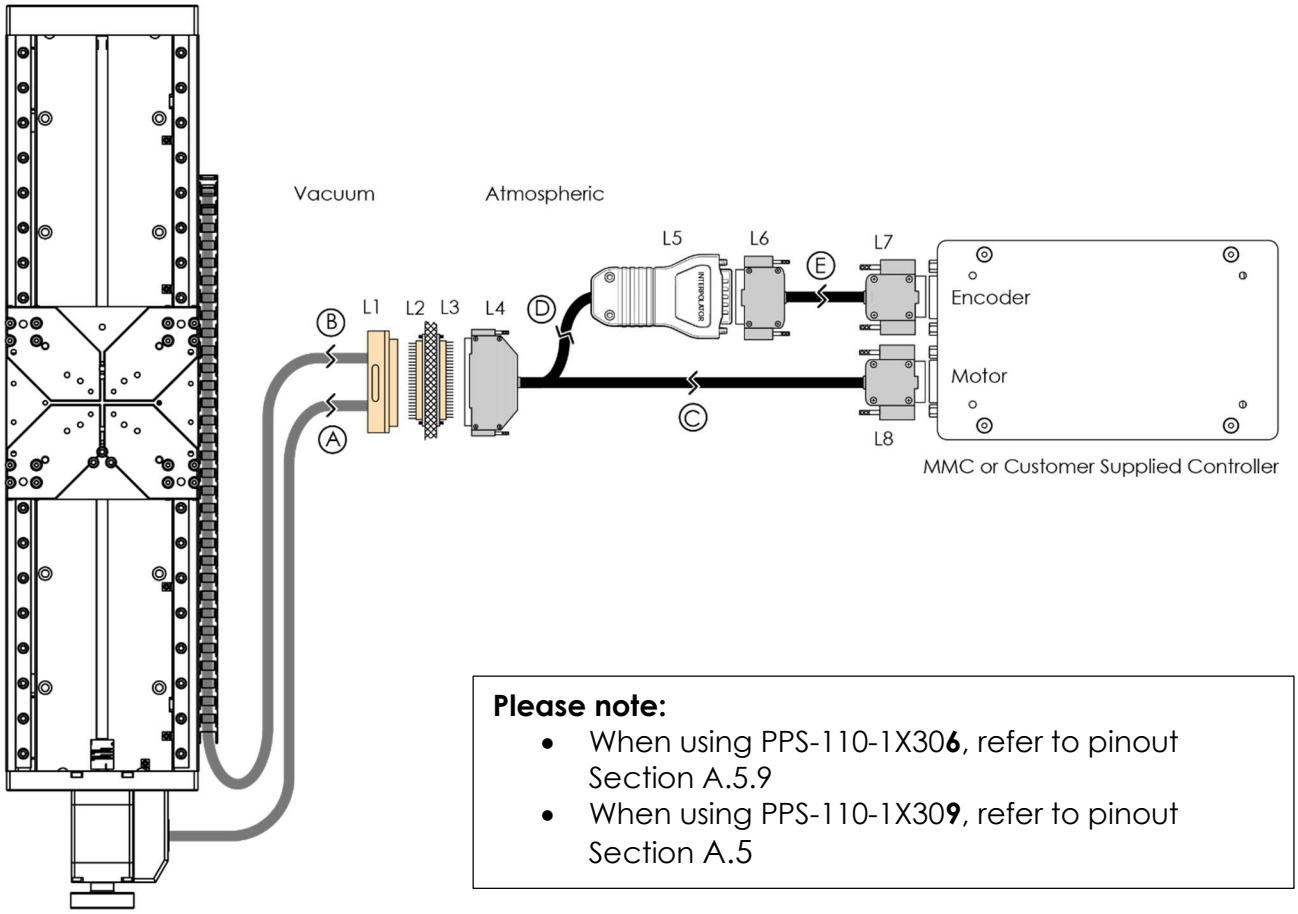
Please note:

- When using PPS-110-1X30**6**, refer to pinout Section 0
- When using PPS-110-1X30**9**, refer to pinout Section A.5

Figure 13. PPS-110 Piezo Motor Version, Digital Vacuum Wiring Diagram

Cable Descriptions:

A. Motor Vacuum Cable (Female Dsub15 Pin Peek or DAP, 1.5m Silver Braided Cable)
B. Encoder Vacuum Cable (Female Dsub15 Pin Peek or DAP, 1.5m Silver Braided Cable)
C. Atmospheric Motor Cable (Female Dsub15 Pin to Male Dsub9 Pin, 1.5m PVC Black Cable)
D. Atmospheric Encoder Cable (Female Dsub15 Pin to Male Dsub15 Pin, 1m, PVC Black Cable)
E. Encoder Module Adapter Cable (Female Dsub15 Pin to Female Dsub9 Pin, 0.5m PVC Black Cable)



Please note:

- When using PPS-110-1X30**6**, refer to pinout Section A.5.9
- When using PPS-110-1X30**9**, refer to pinout Section A.5

Figure 14. PPS-110, Stepper Motor, Digital, Vacuum Wiring Diagram

8. Supplementary Information

8.1 Maintenance

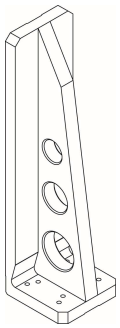
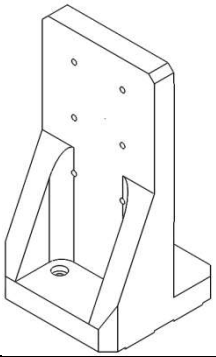
- The PPS-110 series of linear stages utilizes a maintenance free design. Do not modify the stage or perform any maintenance unless specifically instructed to do so by MICRONIX USA personnel. If the stage is not performing up to the original specifications, please contact MICRONIX USA.
- The PPS-110 series of linear stages are 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

430828 Z Bracket PPS-60	430613 Z Bracket PPS-60
	
Used to adapt the PPS-110 series to a perpendicular PPS-60 for XZ mounting configurations.	Used to adapt the PPS-110 series to a perpendicular PPS-60 for XZ mounting configurations.

A. Appendix

A.1 Stepper Motor

A.1.1 Standard Atmospheric DB-9 Male Motor Connector

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

- 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

Motor Type	2 Phase Bipolar
Phase Current	0.85 A_{RMS}
Step Angle	1.8°
Steps	200
Coil-Resistance	6.8 Ohms
Coil-Inductance	8.0 mH
Holding Torque	370 mNm
Pitch	1 mm/rev
Resolution/Full step	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

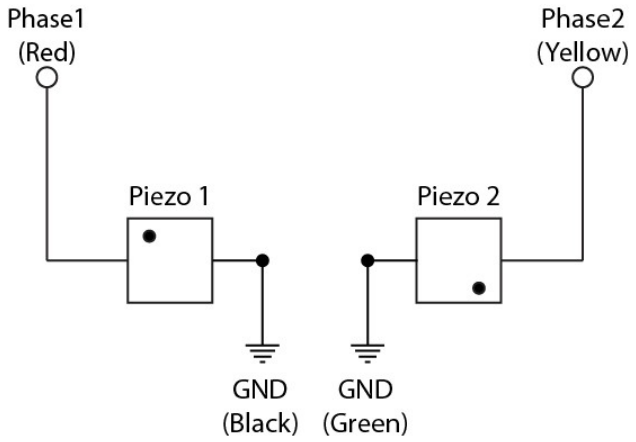
Continuous Force	29 N
Peak Force	100 N
Continuous Current	1.5 A_{RMS}
Peak Current	5.0 A_{RMS}
Force Constant (K_f)	19.9 N/A_{RMS}
Back EMF (K_e)	16 V/m/s
Resistance 25°C	5.5 Ohms
Inductance	1.8 mH
Electric Time Constant	0.35 ms
Rated Voltage (AC)	230 V_{RMS}
Fundamental Motor Constant (K_m)	4.90 N$\sqrt{W}$
Magnetic Pitch (North-North)	30 mm

A.3 Piezo Motor

A.3.1 Standard Atmospheric DB-9 Male Motor Connector

Piezo Motor		
Pin	***Function***	***Wire Color***
1	*Motor 1, Phase 1*	*Red*
2	*Motor 1, Phase 2*	*White (Green TP)*
3	*Motor 2, Phase 1*	*White (Grey TP)*
4	*Motor 2, Phase 2*	*White (Blue TP)*
5	*Motor 1 GND*	*Black* / *Green*
5	*Motor 2, GND*	*Grey* / *Blue*
6	*Limit +*	*White (Violet TP)*
7	*Limit -*	*Violet*
9	*Limit GND*	*Brown*

A.3.2 2 Phase Piezo Motor Wiring Connections



A.4 Limit Switches

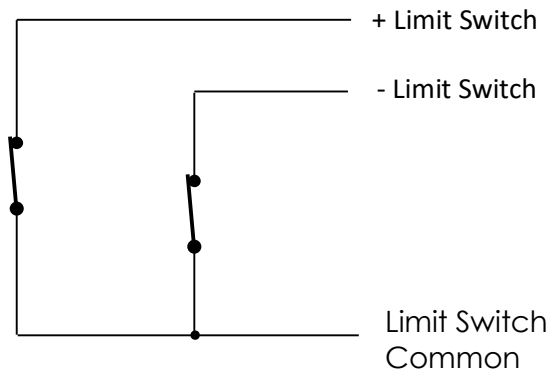
The limit switches are normally closed (when not activated) and should be connected to a compatible controller that recognizes these settings. A hard stop is designed into the PPS-110 body which will prevent the carriage from running away should the limit switches fail.

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.

9.4.1.1 Mechanical Limit Switches

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

9.4.1.2 Limit Switch Schematic



A.5 Pinouts

A.5.1 Piezo Motor Atmospheric Open Loop Pinout

See Figure 7

Pinout for PPS-110-1X000

Cable A
Dsub9M

	Description	Color	L1
Motor	Motor 1, Phase 1	Red	1
	Motor 1, Phase 2	White (Green TP)	2
	Motor 1 Ground	Black & Green	5
	Shield	-	Casing
2nd Motor Optional	Motor 2, Phase 1	White (Grey TP)	3
	Motor 2, Phase 2	White (Blue TP)	4
	Motor 2 Ground	Grey & Blue	5
PPS-110-1X010 Limit Switch (Optional)	Limit Switch +	White (Violet TP)	6
	Limit Switch -	Violet	7
	+5V	White (Brown)	8
	Limit GND	Brown	9

A.5.2 Stepper Motor Atmospheric Open Loop Pinout

See Figure 8

Pinout for PPS-110-2X010

Cable A
Dsub9F

Dsub9M

	Description	Color	L1	L2
Motor & Limits	Motor A+	Brown & White TP	1	1
	Motor A-	Green & White TP	2	2
	Motor B+	Violet & White TP	3	3
	Motor B-	Grey & White TP	4	4
	Limit GND	Black	5	5
	Limit Switch -	Blue	6	6
	Limit Switch +	White (Blue TP)	7	7
	Shield	-	Casing	Casing

A.5.3 Piezo Motor Atmospheric Closed Loop Digital Pinout

See Figure 9

Cable A
Dsub9M

Pinout for PPS-110-1X300

	Description	Color	L1
Motor	Motor 1, Phase 1	Red	1
	Motor 1, Phase 2	White (Green TP)	2
	Motor 1 Ground	Black & Green	5
	Shield	-	Casing
2nd Motor Optional	Motor 2, Phase 1	White (Grey TP)	3
	Motor 2, Phase 2	White (Blue TP)	4
	Motor 2 Ground	Grey & Blue	5
PPS-110-1X010 Limit Switch (Optional)	Limit Switch +	White (Violet TP)	6
	Limit Switch -	Violet	7
	+5V	White (Brown)	8
	Limit GND	Brown	9

Cable B
Dsub9F

Pinout for PPS-110-1X300

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

*For cable length other than the standard 1.5m, an encoder module (Dsub15) may be included along with an encoder adapter cable.

		Interpolator	Cable C	
Pinout for PPS-110-1X300		Dsub15M	Dsub15F	Dsub9F
Description	**Color**	**L5**	**L6**	**L7**
Encoder Ground	Black	2	2	4
Index-	White (Violet TP)	4	4	8
B-	White (Blue TP)	5	5	7
A-	White (Brown TP)	6	6	6
+5VDC	Red	7	7	5
Index+	Violet	12	12	3
B+	Blue	13	13	2
A+	Brown	14	14	1
Shield	-	Casing	Casing	Casing

A.5.4 Stepper Motor Atmospheric Closed Loop Digital Pinout

See Figure 10

	Pinout for PPS-110-2X310		Cable A Dsub9F	Dsub9M
	Description	**Color**	**L1**	**L2**
Motor & Limits	Motor A+	Brown & White TP	1	1
	Motor A-	Green & White TP	2	2
	Motor B+	Violet & White TP	3	3
	Motor B-	Grey & White TP	4	4
	Limit GND	Black	5	5
	Limit Switch -	Blue	6	6
	Limit Switch +	White (Blue TP)	7	7
	Shield	-	Casing	Casing

	Pinout for PPS-110-2X310		Cable B Dsub9F
	Description	**Color**	**L3**
Encoder	A+	Brown	1
	B+	Blue	2
	Index+	Violet	3
	Encoder GND	Grey	4
	+5VDC	White (Grey TP)	5
	A-	White (Brown TP)	6
	B-	White (Blue TP)	7
	Index-	White (Violet TP)	8
	Encoder Shield	-	Casing

*For cable length other than the standard 1.5m, an encoder module (Dsub15) may be included along with an encoder adapter cable.

			Interpolator	Cable C	
	Pinout for PPS-110-2X310		Dsub15M	Dsub15F	Dsub9F
	Description	**Color**	**L5**	**L6**	**L7**
Encoder	Ground	Black	2	2	4
	Index-	White (Violet TP)	4	4	8
	B-	White (Blue TP)	5	5	7
	A-	White (Brown TP)	6	6	6
	+5VDC	Red	7	7	5
	Index+	Violet	12	12	3
	B+	Blue	13	13	2
	A+	Brown	14	14	1
	Shield	-	Casing	Casing	Casing

A.5.5 Linear Motor Atmospheric Closed Loop Digital Pinout

See Figure 10

Cable A
Dsub9M

Pinout for PPS-110-3X310

	Description	Color	L1
Motor & Limits	Motor Phase A	Red	1
	Motor Phase B	Black	2
	Motor Phase C	White	3
	Limit GND	Brown	5
	Limit Switch -	White	6
	Limit Switch +	Violet	7
	Shield	-	Casing

Cable B
Dsub9F

Pinout for PPS-110-3X310

	Description	Color	L3
Encoder	A+	Brown	1
	B+	Blue	2
	Index+	Violet	3
	Encoder GND	Grey	4
	+5VDC	White (Grey TP)	5
	A-	White (Brown TP)	6
	B-	White (Blue TP)	7
	Index-	White (Violet TP)	8
	Encoder Shield	-	Casing

*For cable length other than the standard 1.5m, an encoder module (Dsub15) may be included along with an encoder adapter cable.

		Interpolator	Cable C	
Pinout for PPS-110-3X310		Dsub15M	Dsub15F	Dsub9F
Description	**Color**	**L5**	**L6**	**L7**
Ground	Black	2	2	4
Index-	White (Violet TP)	4	4	8
B-	White (Blue TP)	5	5	7
A-	White (Brown TP)	6	6	6
+5VDC	Red	7	7	5
Index+	Violet	12	12	3
B+	Blue	13	13	2
A+	Brown	14	14	1
Shield	-	Casing	Casing	Casing

Encoder

A.5.6 Piezo Motor Vacuum Open Loop Pinout

See Figure 11

	Pinout for PPS-110-1X306 or -1X309		Cable A Dsub9F	Dsub9M to Dsub9M Feedthrough		Cable B Dsub9F	Dsub9M
	Description	**Color**	**L1**	**L2**	**L3**	**L4**	**L5**
Motor	Motor 1, Phase 1	Red	5	5	1	1	1
	Motor 1, Phase 2	White (Green TP)	4	4	2	2	2
	Motor 1 Ground	Black & Green	1	1	5	5	5
	Shield	-	6	6	9	9	Casing
2nd Motor Optional	Motor 2, Phase 1	White (Grey TP)	3	3	3	3	3
	Motor 2, Phase 2	White (Blue TP)	2	2	4	4	4
	Motor 2 Ground	Grey & Blue	1	1	5	5	5
PPS-110-1X010 Limit Switch (Optional)	Limit Switch +	White (Violet TP)	9	9	6	6	6
	Limit Switch -	Violet	8	8	7	7	7
	+5V	White (Brown)	7	7	8	8	8
	Limit GND	Brown	6	6	9	9	9

A.5.7 Stepper Motor Vacuum Open Loop Pinout

See Figure 12

	Pinout for PPS-110-2X016		Cable A Dsub9F	Dsub9M to Dsub9M Feedthrough		Cable B Dsub9F	Dsub9M
	Description	**Color**	**L1**	**L2**	**L3**	**L4**	**L5**
Motor & Limits	Motor A+	Brown & White TP	5	5	1	1	1
	Motor A-	Green & White TP	4	4	2	2	2
	Motor B+	Violet & White TP	3	3	3	3	3
	Motor B-	Grey & White TP	2	2	4	4	4
	Limit GND	Black	1	1	5	5	5
	Limit Switch -	Blue	9	9	6	6	6
	Limit Switch +	White (Blue TP)	8	8	7	7	7
	Shield	-	6	6	9	9	Casing

A.5.8 Piezo HV/UHV Closed Loop Digital Pinout

See Figure 13

	Pinout for PPS-110-1X306		Cable A&B Dsub15F	Feedthrough Dsub15M			Dsub15F	Cable C Dsub9M
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L8**
Motor A & C	Motor 1, Phase 1	Red	1	1	8	Red	8	1
	Motor 1, Phase 2	White (Green TP)	2	2	7	White (Green TP)	7	2
	Motor 1 GND	Black & Green	9	9	15	Black & Green	6	5
	Motor 2, Phase 1	White (Grey TP)	3	3	6	Grey/White (Grey TP)	15	3
	Motor 2, Phase 2	White (Blue TP)	10	10	14	Black	14	4
	Motor 2 GND	Grey & Blue	9	9	15	Blue	13	5
	Motor Shield	-	11	11	13	White (Blue TP)	12	Casing
Encoder B & D	Encoder Shield	-	4	4	5	-	5	*To interpolator L5 (Cable D)*
	+5V	White (Grey TP)	5	5	4	White (Grey TP)	4	
	Encoder GND	Grey	12	12	12	Grey	12	
	Index+	Violet	6	6	3	Violet	3	
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	
	B+	Brown	7	7	2	Brown	2	
	B-	White (Brown TP)	14	14	10	White (Brown TP)	10	
	A+	Blue	8	8	1	Blue	1	
	A-	White (Blue TP)	15	15	9	White (Blue TP)	9	
	Setup*	White (Green TP)	N.C.	N.C	N.C.	White (Green TP)	-	
	CAL*	Green	N.C.	N.C	N.C.	Green	-	

	Pinout for PPS-110-1X306		Interpolator Dsub15M	Cable E Dsub15F	Cable E Dsub9F
	Description	**Color**	**L5**	**L6**	**L7**
Encoder	Ground	Grey	2	2	4
	Index-	White (Violet TP)	4	4	8
	B-	White (Blue TP)	5	5	7
	A-	White (Brown TP)	6	6	6
	+5VDC	White (Grey TP)	7	7	5
	Index+	Violet	12	12	3
	B+	Blue	13	13	2
	A+	Brown	14	14	1
	Shield	-	Casing	Casing	Casing

A.5.9 Stepper HV/UHV Closed Loop Digital Pinout

See Figure 14

	Pinout for PPS-110-2X316		Cable A&B Dsub15F	Feedthrough Dsub15M			Dsub15F	Cable C Dsub9M
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L8**
Motor A & C	Motor Phase A+	Red	1	1	8	Brown/White (Brown TP)	8	1
	Motor Phase B+	Green	2	2	7	Green/White (Green TP)	7	3
	Limit Switch -	White	3	3	6	Violet/White (Violet TP)	6	6
	Motor Phase A-	Blue	9	9	15	Grey/White (Grey TP)	15	2
	Motor Phase B-	Black	10	10	14	Black	14	4
	Limit Switch +	Violet	11	11	13	Blue	13	7
	Limit Ground	Brown	12	12	12	White (Blue TP)	12	5
Encoder B & D	Encoder Shield	-	4	4	5	-	5	*To interpolator L5 (Cable D)*
	+5V	White (Grey TP)	5	5	4	White (Grey TP)	4	
	Index+	Violet	6	6	3	Violet	3	
	Cos+	Brown	7	7	2	Brown	2	
	Sin-	White (Blue TP)	8	8	1	White (Blue TP)	1	
	Enc Ground	Grey	12	12	12	Grey	12	
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	
	Cos-	White (Brown TP)	14	14	10	White (Brown TP)	10	
	Sin+	Blue	15	15	9	Blue	9	
	Setup*	White (Green TP)	N.C.	-	-	White (Green TP)	-	
	CAL*	Green	N.C.	-	-	Green	-	

	Pinout for PPS-110-2X316		Interpolator Dsub15M	Cable E Dsub15F	Dsub9F
	Description	**Color**	**L5**	**L6**	**L7**
Encoder	Ground	Black	2	2	4
	Index-	White (Violet TP)	4	4	8
	B-	White (Blue TP)	5	5	7
	A-	White (Brown TP)	6	6	6
	+5VDC	Red	7	7	5
	Index+	Violet	12	12	3
	B+	Blue	13	13	2
	A+	Brown	14	14	1
	Shield	-	Casing	Casing	Casing

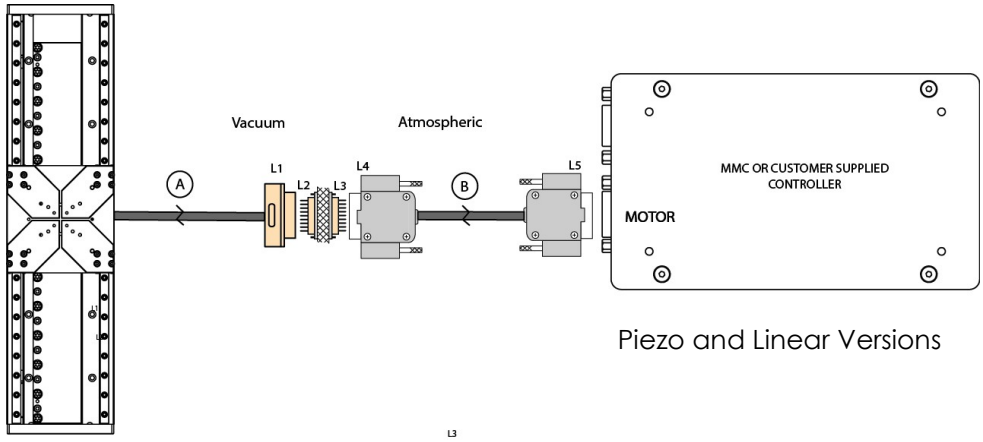
A.6 Legacy

A.6.1 Legacy Open Loop Vacuum Wiring Diagram

Standard Cable Descriptions:

A. PPS-110 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:

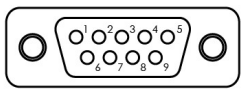


Piezo and Linear Versions

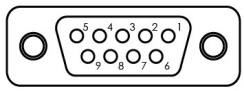
Piezo Motor Connector Pinout

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

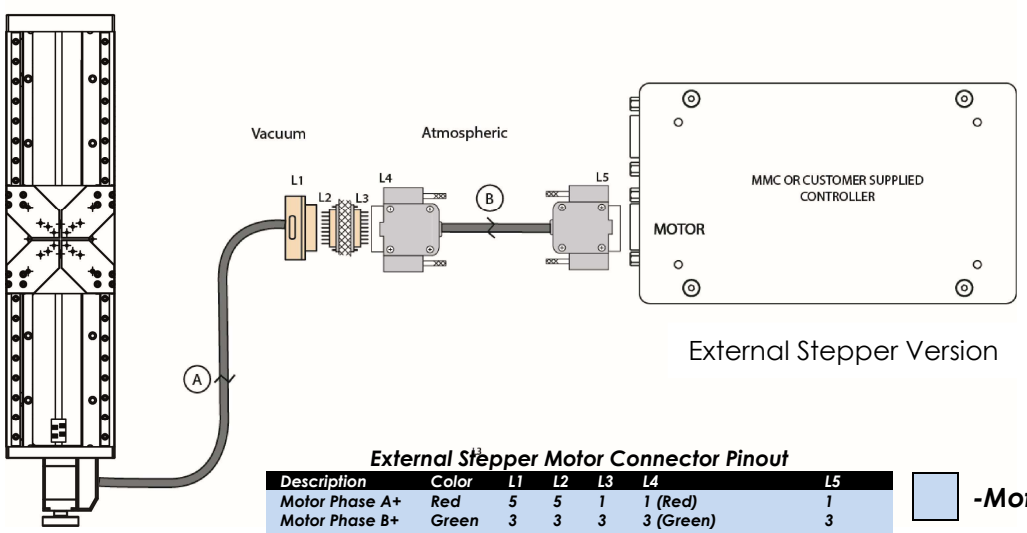
-Motor



Female Dsub9 Connector - Rear View



Male Dsub9 Connector - Rear View

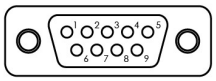


External Stepper Version

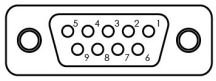
External Stepper Motor Connector Pinout

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

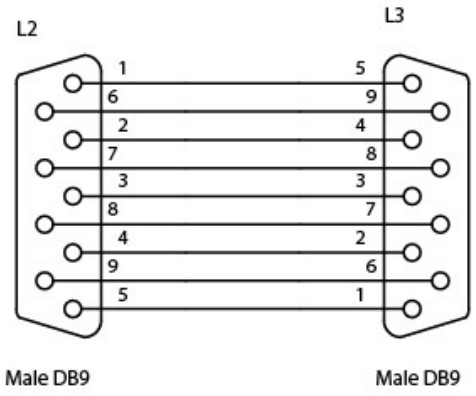


Female Dsub9 Connector - Rear View



Male Dsub9 Connector - Rear View

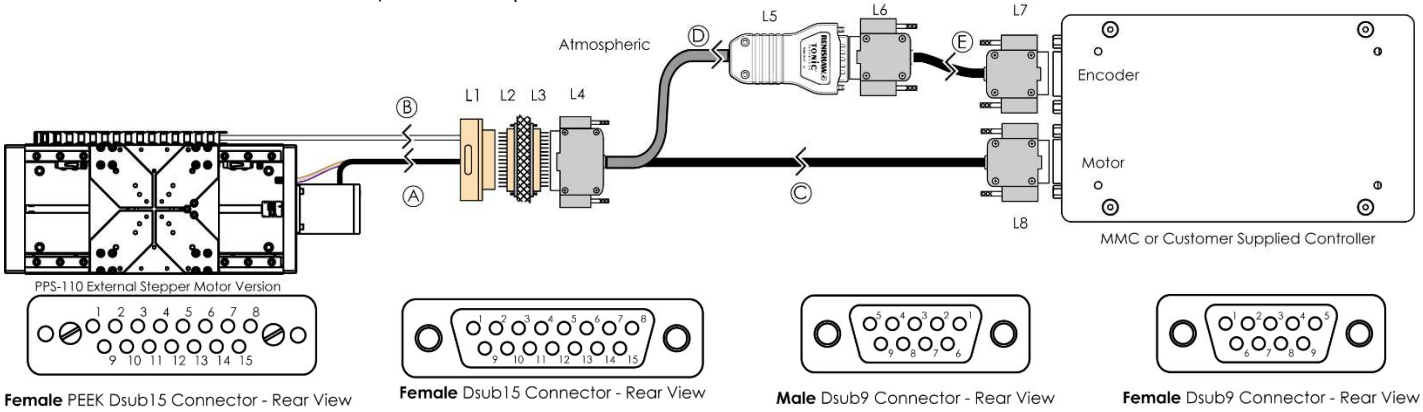
A.6.2 Straight Through 9-Pin Feed Through



A.6.3 *Legacy Closed Loop Vacuum Wiring Diagram*

Standard Cable Descriptions:

A. PPS-110 Motor Cable - Vacuum Side (Female Dsub 15 Pin Connector, Silver Braided Sleeving)
B. PPS-110 Encoder Cable - Vacuum Side (Female Dsub 15 Pin Connector, Silver Braided Cable)
C. Atmospheric Motor Cable (Female Dsub 15 pin to Male Dsub 9 Pin, Black Cable)
D. Atmospheric Encoder Module Cable (Female Dsub 15 Pin to Interpolator Module, Silver Braided Cable)
E. Encoder Module Adapter Cable (Female Dsub 15 Pin to Female Dsub 9 Pin, Black Cable



	Pinout for PPS-110-2X316		Cable A&B Dsub15F	Feedthrough Dsub15M			Cable C Dsub15F	Cable C Dsub9M
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L8**
Motor A&C	Motor Phase A+	Red	1	1	8	Brown/White (Brown TP)	8	1
	Motor Phase B+	Green	2	2	7	Green/White (Green TP)	7	3
	Limit Switch -	White	3	3	6	Violet/White (Violet TP)	6	6
	Motor Phase A-	Blue	9	9	15	Grey/White (Grey TP)	15	2
	Motor Phase B-	Black	10	10	14	Black	14	4
	Limit Switch +	Violet	11	11	13	Blue	13	7
	Limit Ground	Brown	12	12	12	White (Blue TP)	12	5
Encoder B&D	Encoder Shield	-	4	4	5	-	5	*To Interpolator L5 (Cable D)*
	+5V	White (Grey TP)	5	5	4	White (Grey TP)	4	
	Index+	Violet	6	6	3	Violet	3	
	Cos+	Brown	7	7	2	Brown	2	
	Sin-	White (Blue TP)	8	8	1	White (Blue TP)	1	
	Enc Ground	Grey	12	12	12	Grey	12	
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	
	Cos-	White (Brown TP)	14	14	10	White (Brown TP)	10	
	Sin+	Blue	15	15	9	Blue	9	
	Setup*	White (Green TP)	N.C.	-	-	White (Green TP)	-	
	CAL*	Green	N.C.	-	-	Green	-	

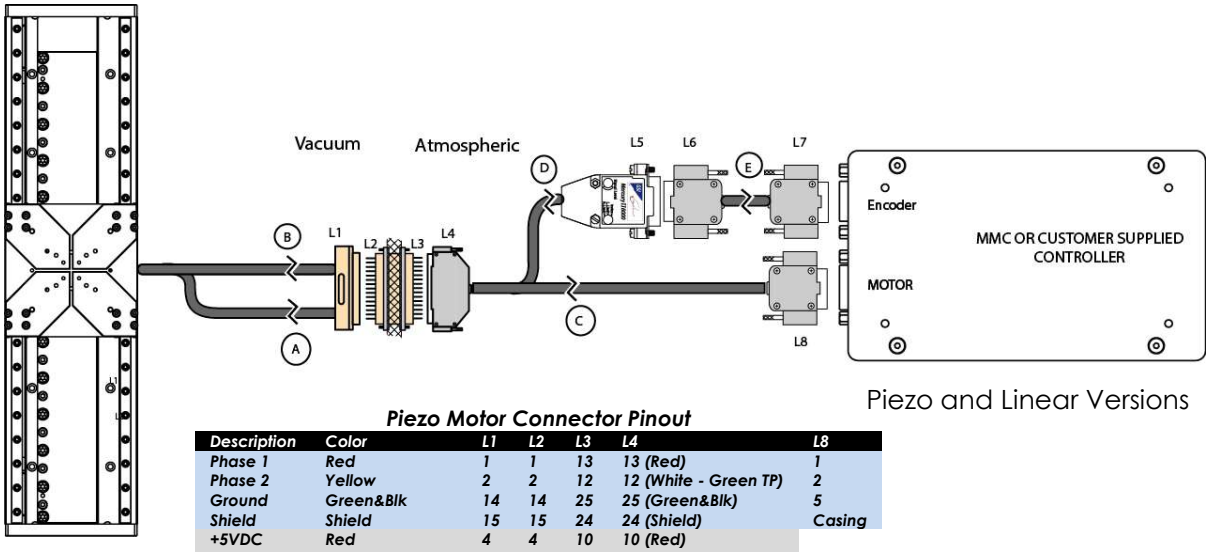
	Pinout for PPS-110-2X316		Interpolator Dsub15M	Cable E Dsub15F	Cable E Dsub9F
	Description	**Color**	**L5**	**L6**	**L7**
Encoder	Ground	Black	2	2	4
	Index-	White (Violet TP)	4	4	8
	B-	White (Blue TP)	5	5	7
	A-	White (Brown TP)	6	6	6
	+5VDC	Red	7	7	5
	Index+	Violet	12	12	3
	B+	Blue	13	13	2
	A+	Brown	14	14	1
	Shield	-	Casing	Casing	Casing

A.6.4 Legacy MII 6000 Digital Wiring Diagram

Standard Cable Descriptions:

A. PPS-110 Motor Cable - Vacuum Side
B. PPS-110 Encoder Cable - Vacuum Side
(Female Dsub 25 Pin Peek Connector)
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:



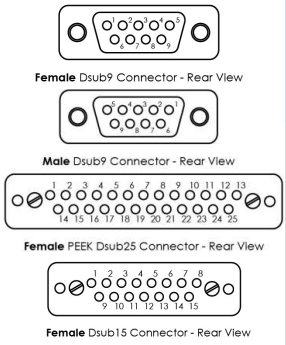
Piezo and Linear Versions

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	

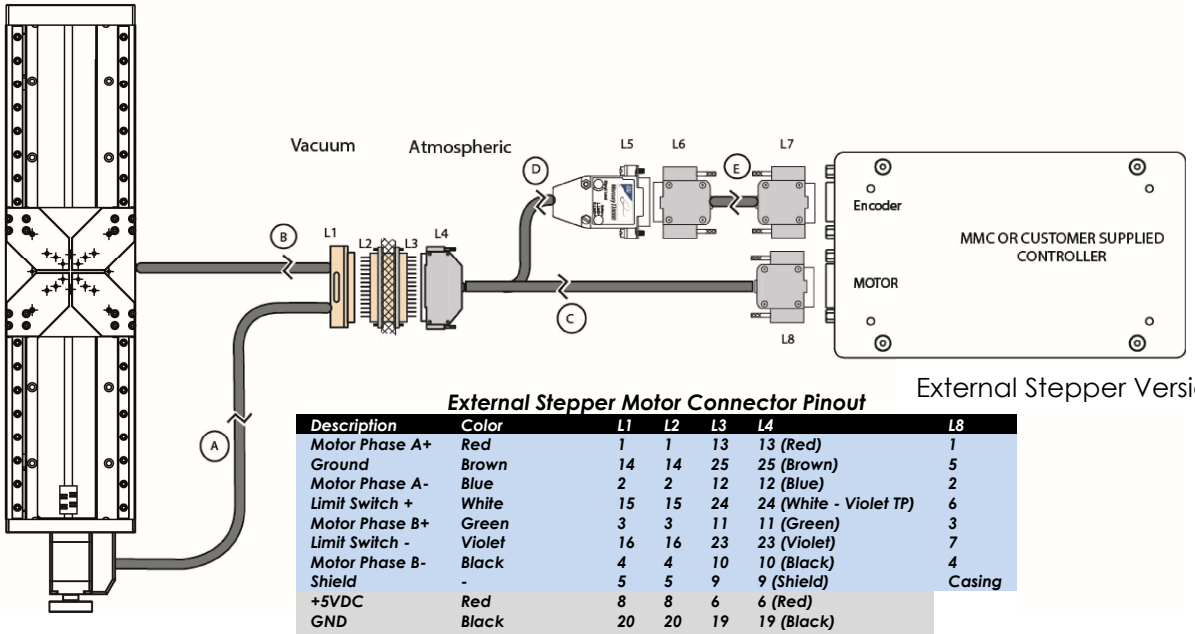
Internal Stepper Motor Connector Pinout

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)	



-Encoder
-Motor

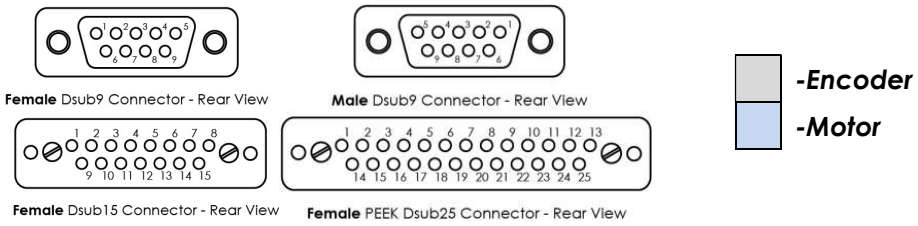
- ***Note: For the pinout of cable E, refer to the appropriate MMC manual.***



External Stepper Version

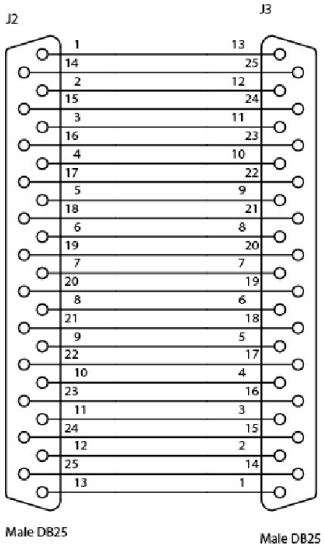
External Stepper Motor Connector Pinout

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.6.5 Straight Through 25-pin Feed Through



A.6.6 *Legacy UHV Digital Encoder Module*

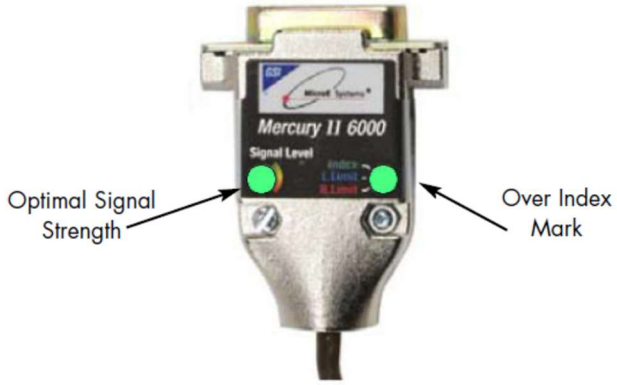
When using the digital external encoder configuration, the Encoder Module should display two green LED's indicating a power source and proper encoder alignment. A Red or Yellow Signal Level LED indicates misalignment of the Encoder Head, if this occurs contact MICRONIX USA. Do not adjust the Encoder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

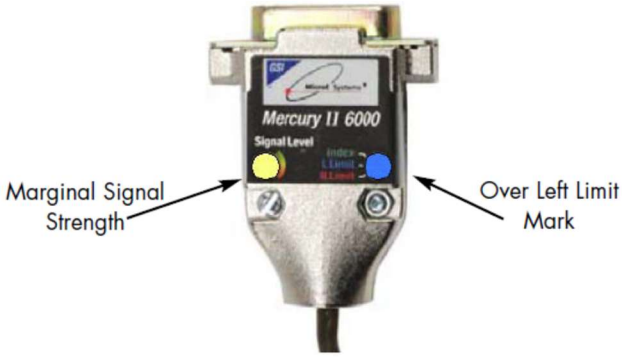
A.6.7 *Legacy UHV Encoder Module Pin-out*

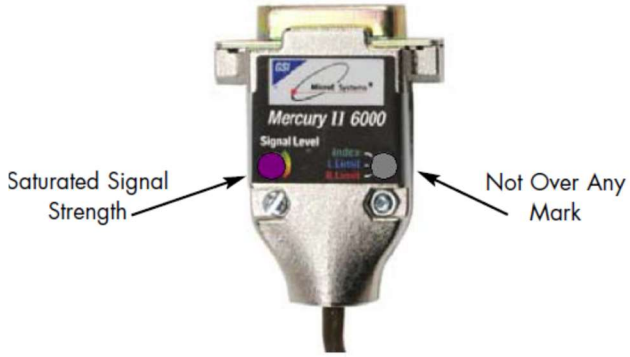
Pin	Description	Pin	Description
1	*Right Limit+	9	Ground
2	Ground	10	*Left Limit+
3	*Right Limit-	11	*Left Limit-
4	Index-	12	Index+
5	B-	13	B+
6	A-	14	A+
7	+5V	15	(not used)
8	+5V		

*-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



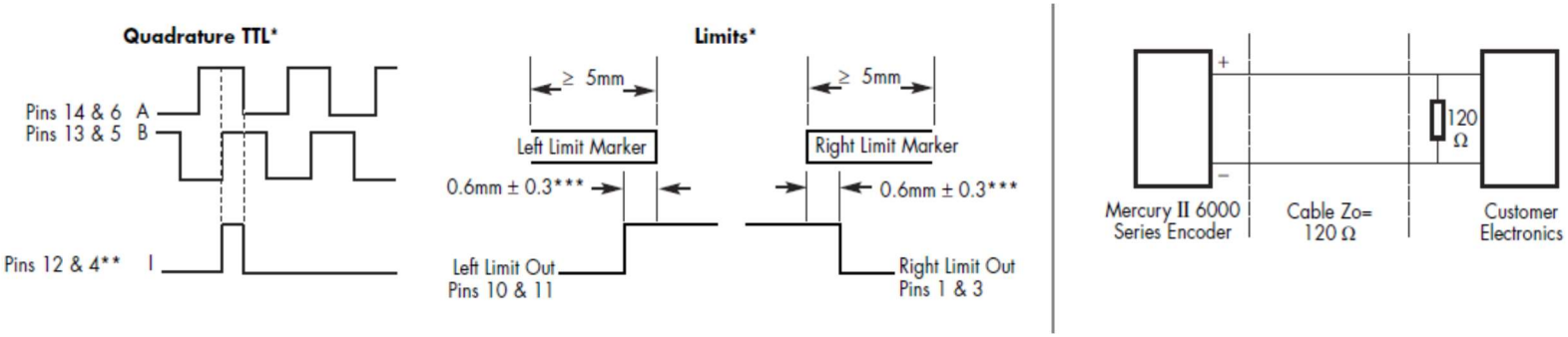




A.6.8 Operating and Electrical Specifications

Power Supply	5VDC ±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.6.9 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.6.10 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 for Piezo Motor version, 10nm for Linear Motor version, and 50nm for Stepper Motor version.