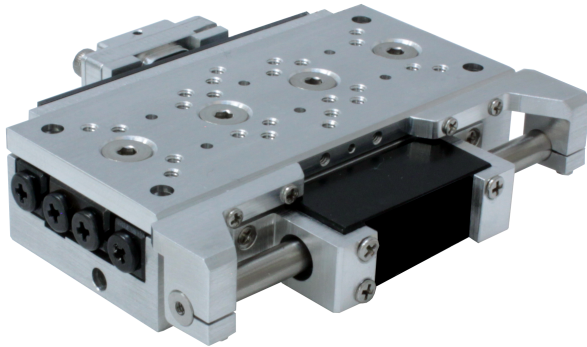
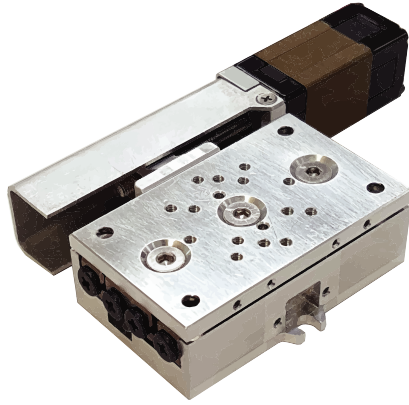


# PPS-28

## Series



## Precision Linear / Stepper Motor Stage Reference Manual (Open and Closed Loop Versions)

# **PPS-28**

## **Linear/Stepper Motor Positioner Stage**

### **Reference Manual**

Rev 3.2

**MICRONIX USA, LLC**  
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## 1. Introduction

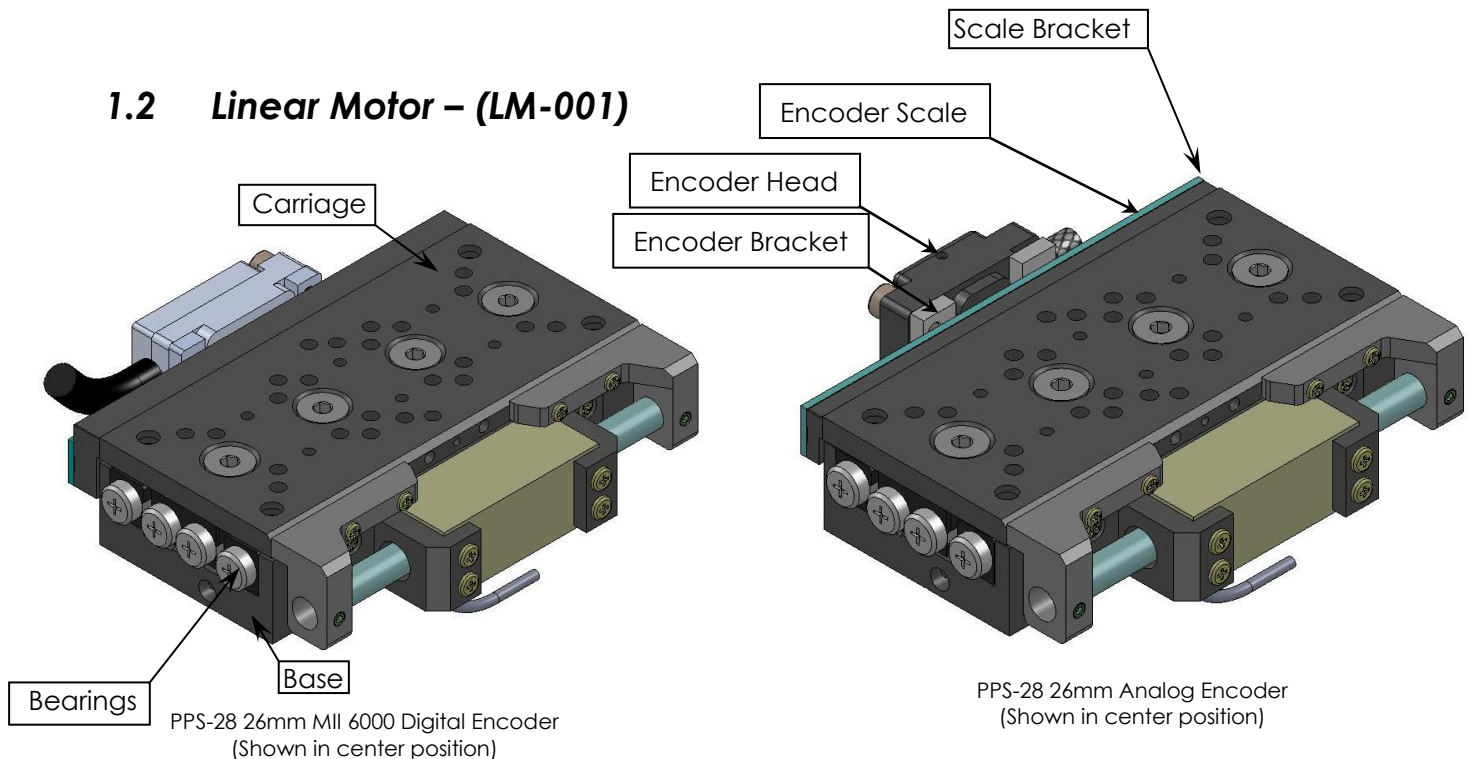
### 1.1 Product Description

The PPS-28 is a low profile, high-precision linear stage outfitted with a linear or stepper motor. Miniature cross-roller bearings assure high stiffness and guiding accuracy for loads up to 50N (horizontal orientation). The PPS-28 SMLM is available in travel lengths of up to 102mm, and an optional linear encoder provides submicron repeatability. High Vacuum ( $10^{-6}$  mbar) compatible versions are available.

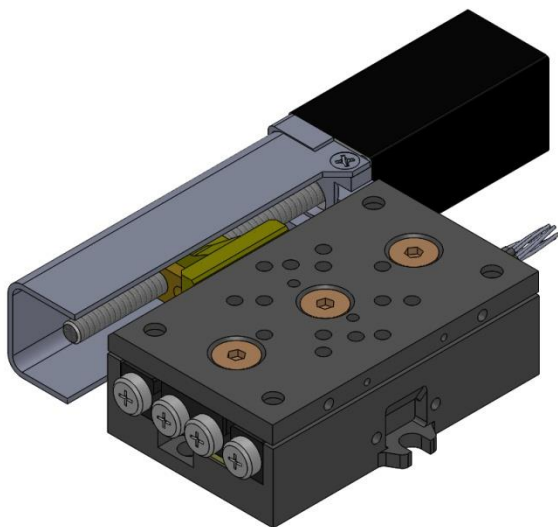
#### Features:

- Stepper Motor travel ranges of 26mm, 51mm, 76mm, and 102mm
- Linear Motor travel ranges of 26mm, 51mm, and 102mm
- Load capacity up to 5 kg (Stepper Motor)

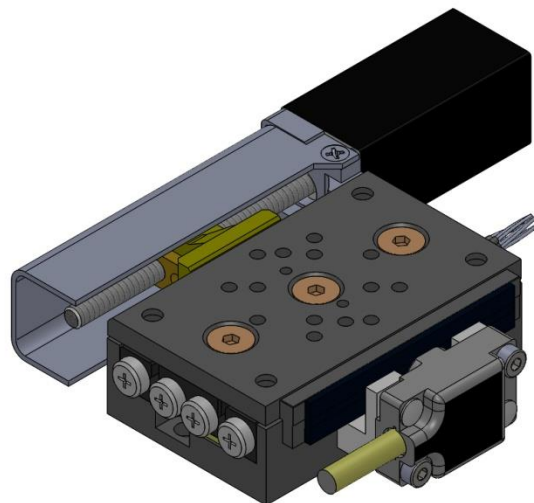
### 1.2 Linear Motor – (LM-001)



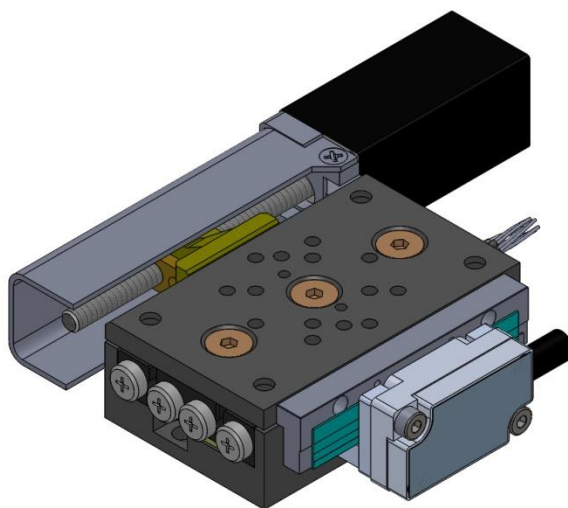
## 1.3 Stepper Motor – (SM-007)



PPS-28 26mm Open Loop  
(Shown in center position)



PPS-28 26mm Analog Encoder  
(Shown in center position)



PPS-28 26mm MII 6000 Digital Encoder  
(Shown in center position)

## 1.4 Recommended Controllers

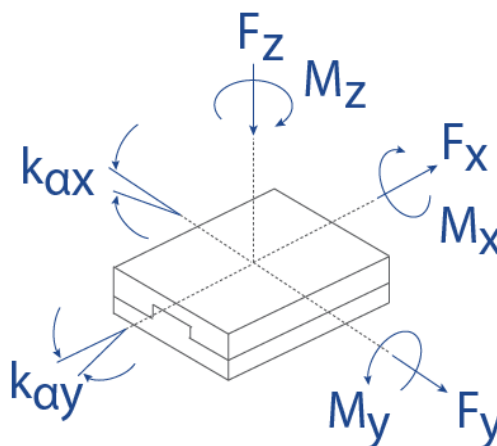
The following controllers are available from MICRONIX USA:

- MMC-200 [Stepper Motor Versions]
- MMC-300 [Linear Motor Versions]

## 1.5 Technical Data

Motor option	LM-001			SM-007			
Speed, max. [mm/sec]	100			5			
Encoder option	Analog (1 V <sub>pp</sub> )	Digital (RS-422)	Digital Low Cost	Open Loop	Analog (1 V <sub>pp</sub> )	Digital (RS-422)	Digital Low Cost
Resolution, typical [μm]	0.01	0.01	0.5	0.1	0.05	0.05	0.5
Repeatability, bi-directional [μm]	± 0.05	± 0.1	± 1	± 4	± 0.2	± 0.2	± 1
Repeatability, uni-directional [μm]	0.05	0.1	1	0.5	0.2	0.2	1

## 1.6 Load Characteristics



Load Characteristics	F <sub>x(N)</sub>	F <sub>y(N)</sub>	F <sub>z(N)</sub>	M <sub>x(Nm)</sub>	M <sub>y(Nm)</sub>	M <sub>z(Nm)</sub>	K <sub>ax</sub> [μrad/Nm]	K <sub>ay</sub> [μrad/Nm]
LM-001	2 peak	10	10	1	1	1	-	-
SM-007	5	50	50	1	1	1	-	-

## 2. Model Configurations

### 2.1 PPS-28 SM Order Numbers

Order No.	PPS-28-	2			1	
Stepper Motor, SM-007.....	2					
26mm Travel.....	1					
51mm Travel.....	3					
76mm Travel.....	4					
102mm Travel.....	5					
Open Loop.....	0					
Analog (1 V <sub>pp</sub> ).....	2					
Digital (RS-422).....	3					
Digital Low Cost.....	4					
Magnetic.....	1					
Atmospheric.....	0					
High vacuum, 10 <sup>-6</sup> mbar.....	6					

Contact MICRONIX USA for custom applications and stacking configurations.



Order No.	PPS-28	3				
Linear Motor, LM-001.....	3					
26mm Travel.....	1					
51mm Travel.....	3					
102mm Travel.....	5					
Analog (1V <sub>pp</sub> ).....	2					
Digital (RS-422).....	3					
Digital Low Cost.....	4					
None.....	0					
Magnetic.....	1					
Atmospheric.....	0					
High vacuum, 10 <sup>-6</sup> mbar.....	6					

Contact MICRONIX USA for custom applications and stacking configurations.

### 3. Preparing to Install the PPS-28

#### 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  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . 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
- 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-28 Linear Stage
- Reference Manual
- Any other previously agreed upon components such as a controller

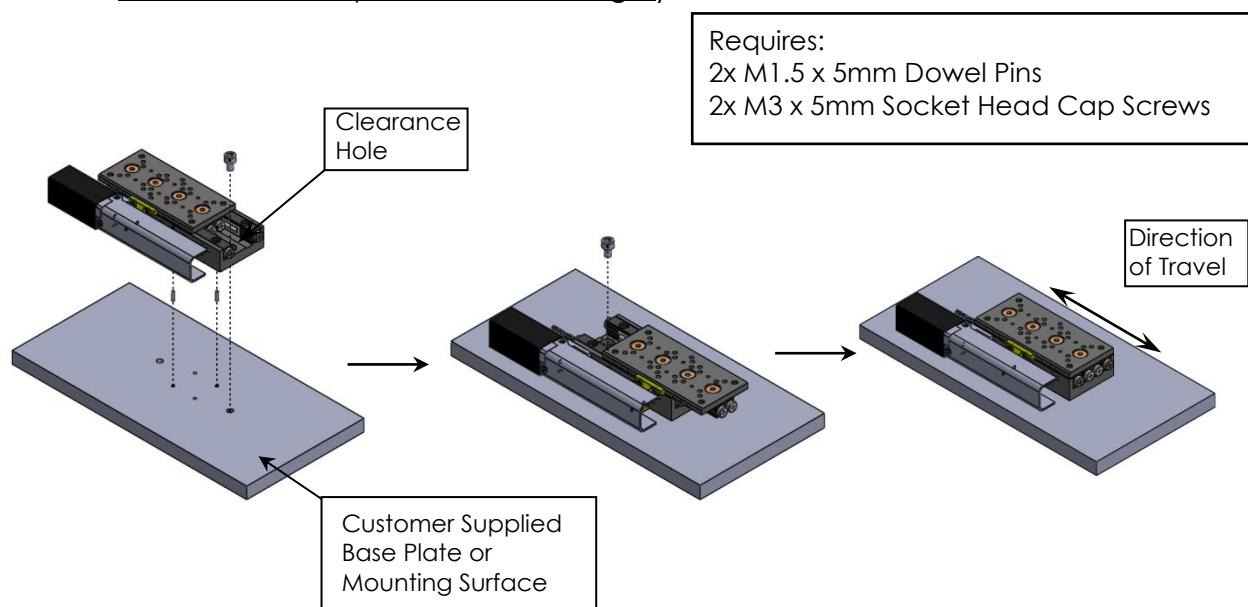
## 4. Installing the PPS-28

Mounting patterns require M3 or M2.5 screws for mounting and M1.5 x 5mm dowel pins for precision alignment. Additional brackets and screws may be needed for custom applications.

### 4.1 PPS-28 Installation

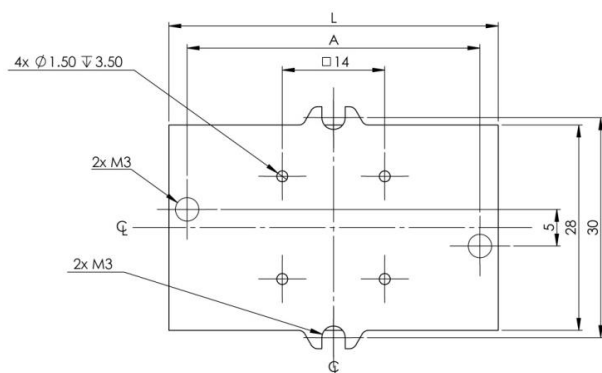
#### 4.1.1 General Mounting

For general mounting configurations, mount the base to the mounting surface. Move the carriage to access base mounting pattern. (Please note, it is possible to move the carriage of the linear motor configurations manually without damaging the stage, however, for \*stepper versions the motor must be driven by a controller to reposition the carriage.)



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

2. Move carriage via controller\*, if necessary, to access remaining mounting hole. Install M3 SHCS as shown.



Stepper Motor		
Travel	L	A
26mm	45	40
51mm	90	50
76mm	120	80
102mm	150	80

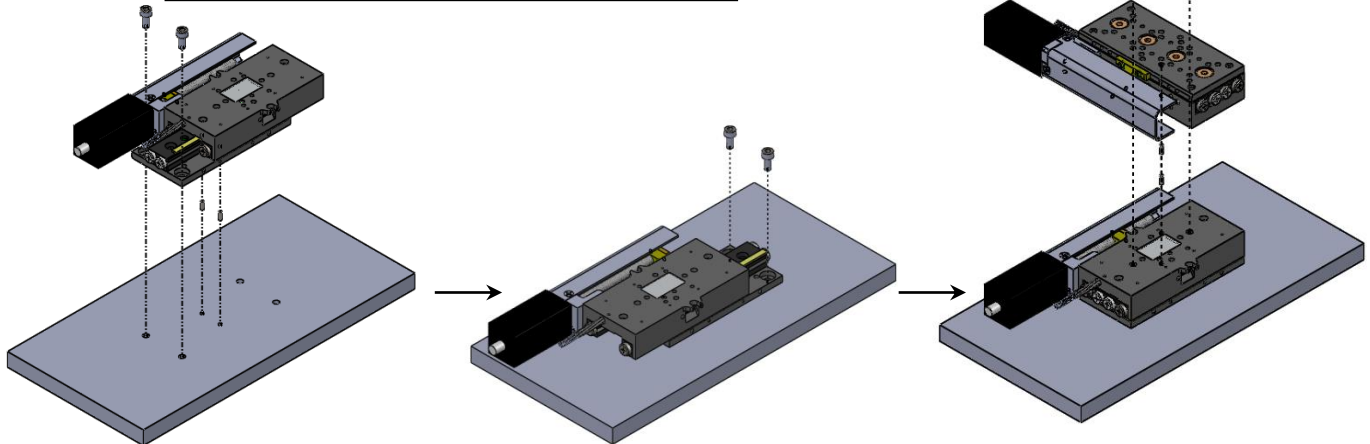
Linear Motor		
Travel	L	A
26mm	60	50
51mm	90	50
102mm	150	80

Top View  
Stage Mounting Pattern

### 4.1.2 X-Y Mounting

For X-Y mounting, follow the instructions outlined below (Please note, it is possible to move the carriage of the linear motor configurations manually without damaging the stage, however, for \*stepper versions the motor must be driven by a controller to reposition the carriage.):

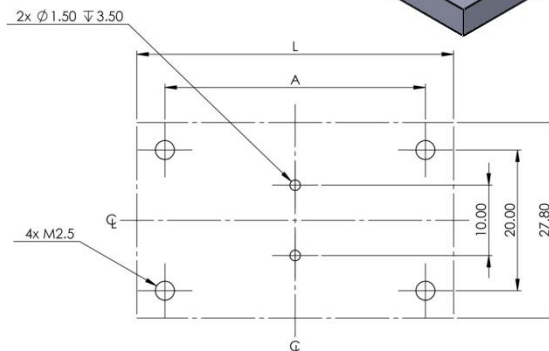
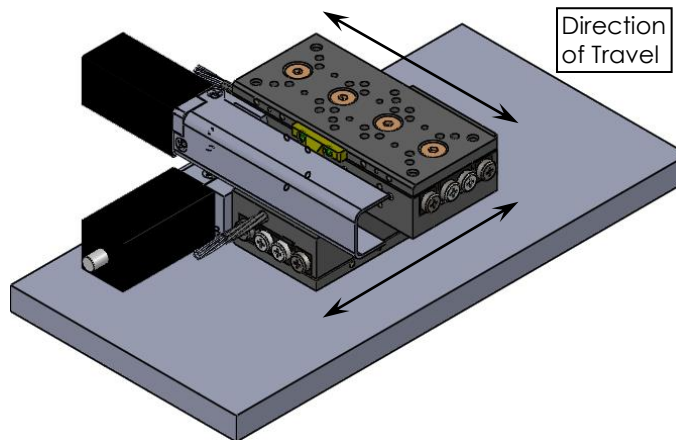
Requires:  
4x M1.5 x 4mm Dowel Pins  
6x M2.5 x 6mm Socket Head Cap Screws



1. Move Y-Axis Stage carriage via controller\*, if necessary, to access mounting holes. Install M2.5 SHCS and dowel pins as shown.

2. Move carriage via controller\*, if necessary, to access remaining mounting holes. Install M2.5 SHCS as shown.

3. Move carriage via controller\*, if necessary, to access ear mount holes. Install M2.5 SHCS and dowel pins as shown.



Stepper Motor

Travel	L	A
26mm	45	37
51mm	90	82
76mm	120	112
102mm	150	142

Linear Motor

Travel	L	A
26mm	60	52
51mm	90	82
102mm	150	142

Top View  
Stage Mounting Pattern

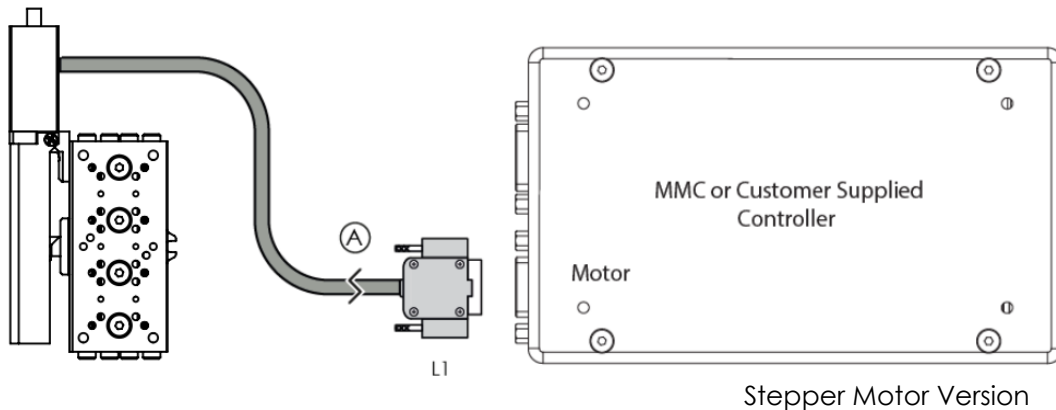
## 5. Connecting the PPS-28 LSM Stage

### 5.1 Atmospheric Environments

For controller information refer to the appropriate MMC controller manual.

#### 5.1.1 Open Loop Installation & Wiring Diagram

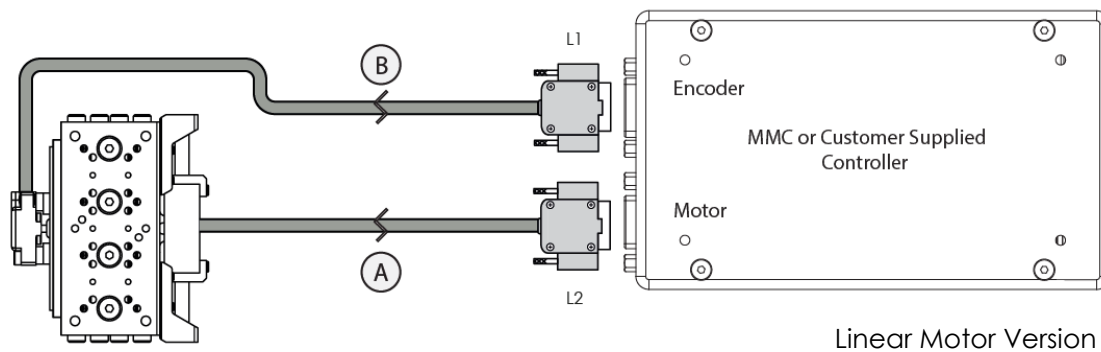
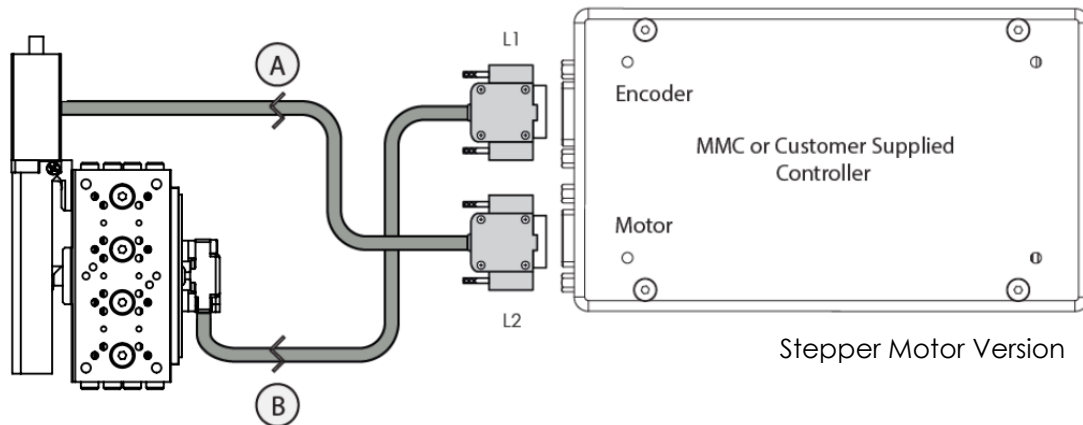
Connecting the PPS-28 LSM stage in an open loop configuration only requires that the D-sub 9 Pin male Motor Cable be connected to a compatible controller. No other cables or components are required. Note: Open loop configurations are not available for linear motor versions.



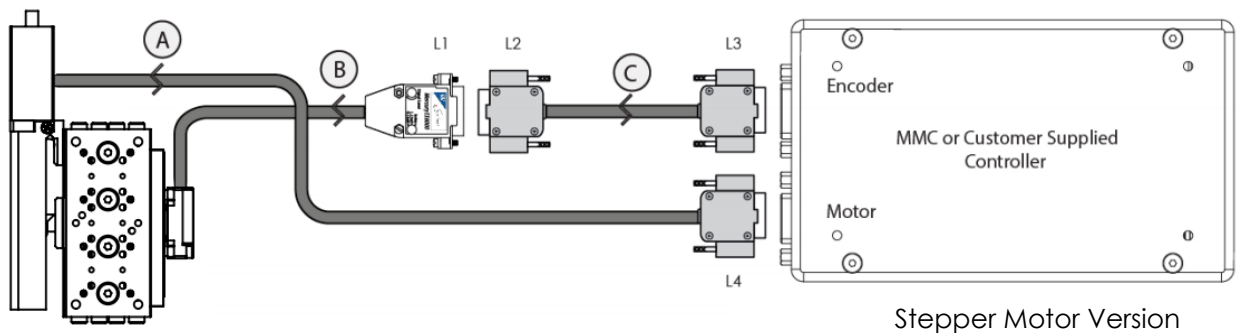
## 5.1.2 Closed Loop/Encoder Installation & Wiring Diagram

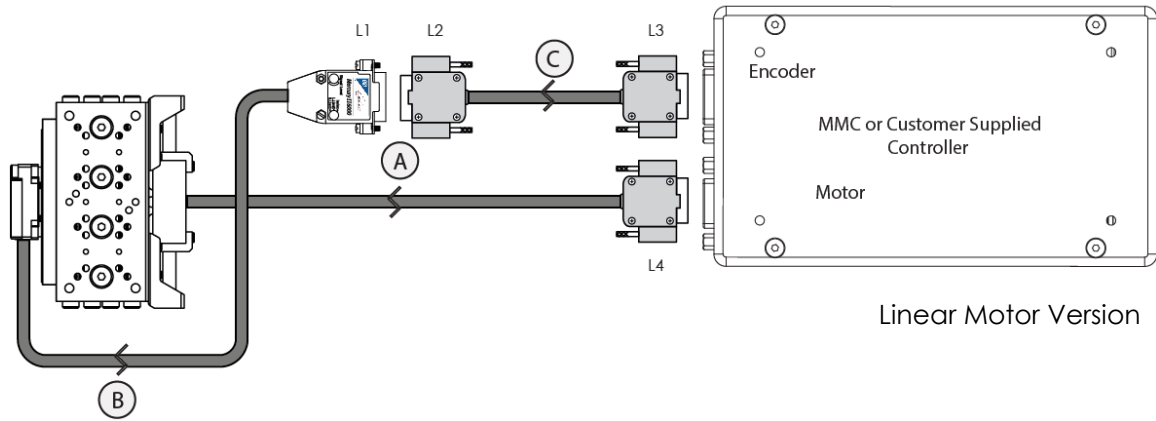
Using the PPS-28 LSM stage with an encoder requires a closed loop compatible controller that recognizes encoder feedback. Connect the stage as shown below.

### 5.1.2.1 Analog Encoder Wiring Diagram



### 5.1.2.2 MII 6000 Digital Encoder Wiring Diagram





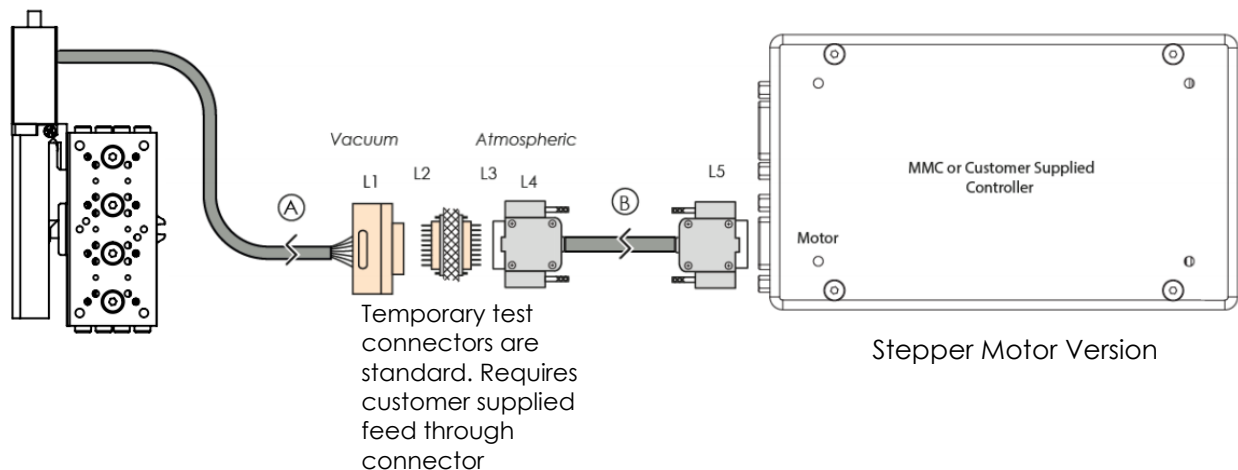
## 5.2 Vacuum Environments

### 5.2.1 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.

### 5.2.2 Open loop Installation & Wiring Diagram

Connecting an open loop PPS-28 LSM stage in a vacuum chamber requires the use of a feed through connector at the vacuum chamber wall. The vacuum compatible PPS-28 LSM 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 A.4. Note: Linear motor versions are not available for vacuum environments.



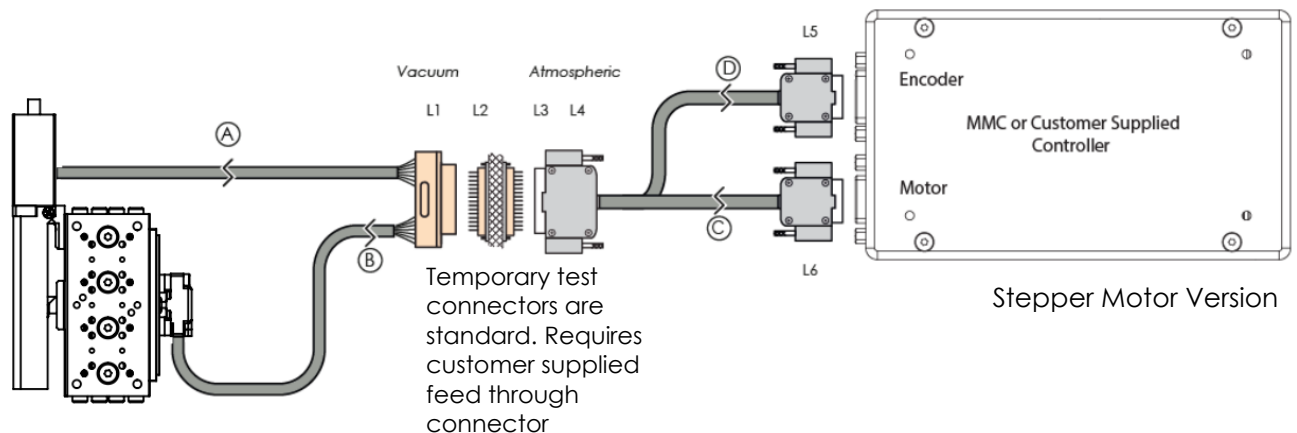


## 5.2.3 Closed Loop/Encoder Installation & Wiring Diagram

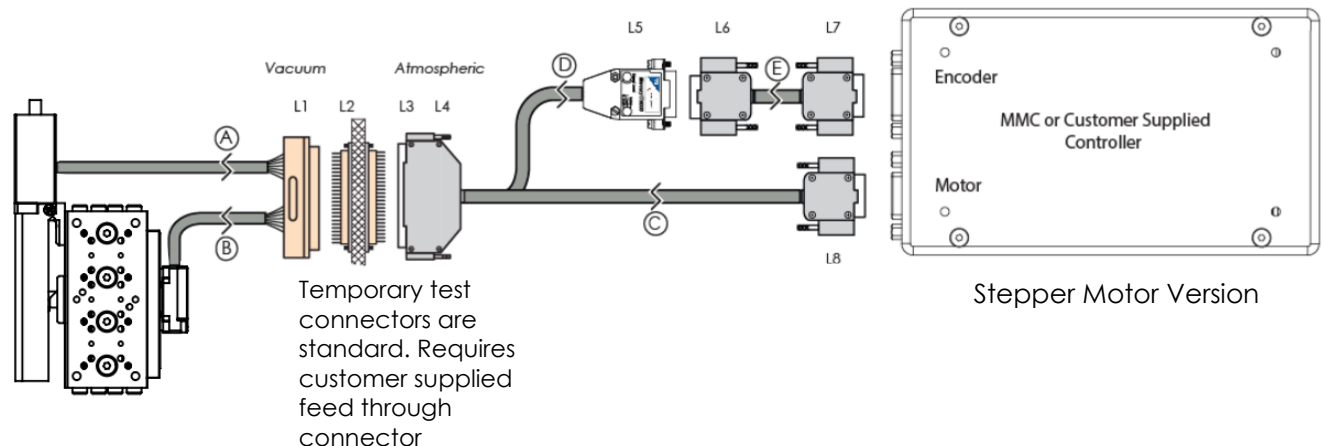
Closed loop installation of the PPS-28 LSM stage in vacuum environments requires an intermediate feed through connector at the vacuum chamber wall that can accommodate both the motor cable, and the encoder cable.

The vacuum compatible PPS-28 LSM stage 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 A.5.7, A.6.5.

### 5.2.3.1 Analog Encoder Wiring Diagram

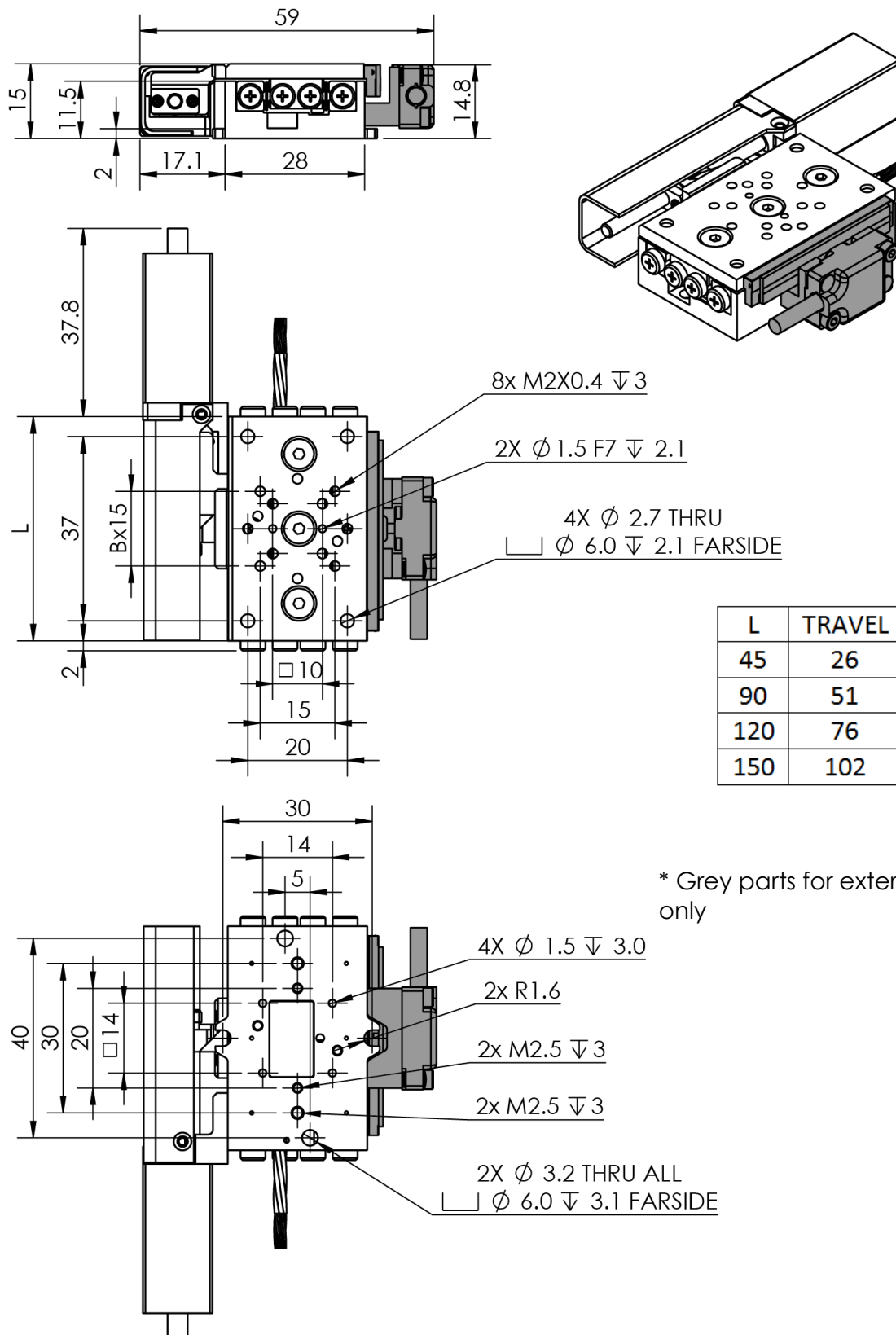


### 5.2.3.2 MII 6000 Digital Encoder Wiring Diagram



## 6. Dimensions

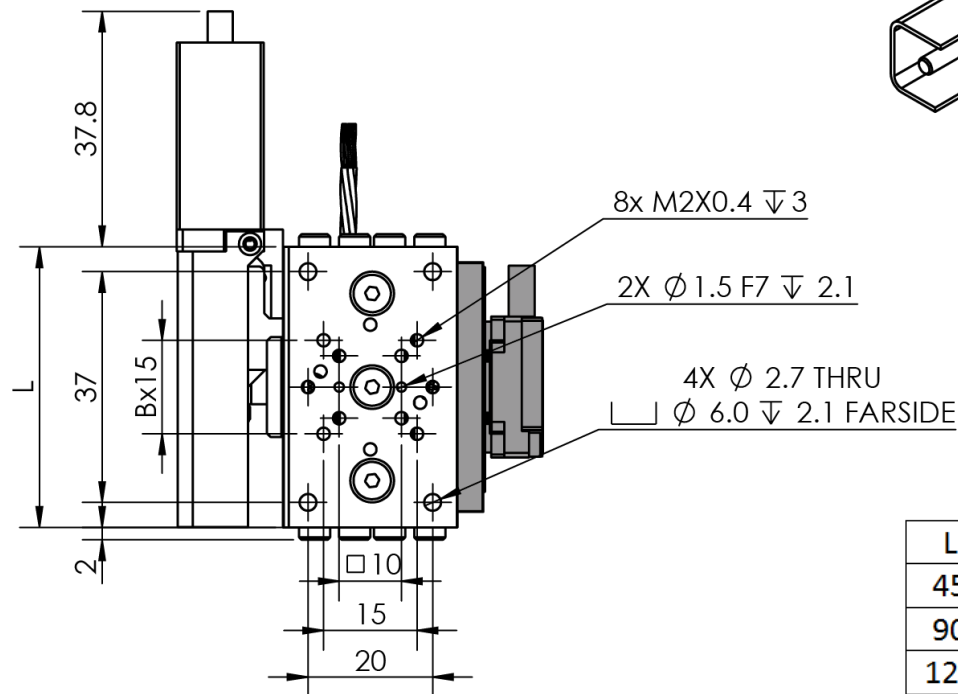
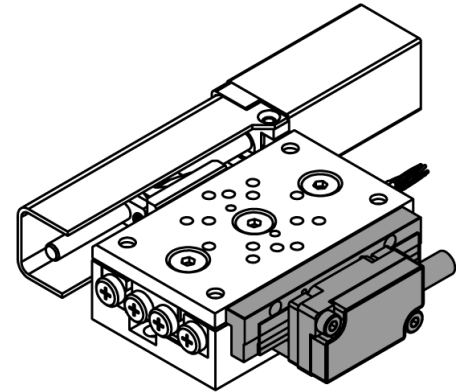
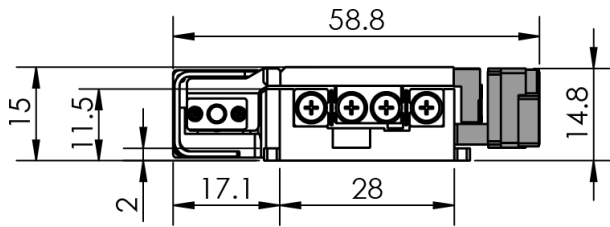
### 6.1.1 PPS-28 Stepper Motor Analog Encoder



L	TRAVEL	A	B	C
45	26	37	1	40
90	51	82	5	50
120	76	112	7	80
150	102	142	9	80

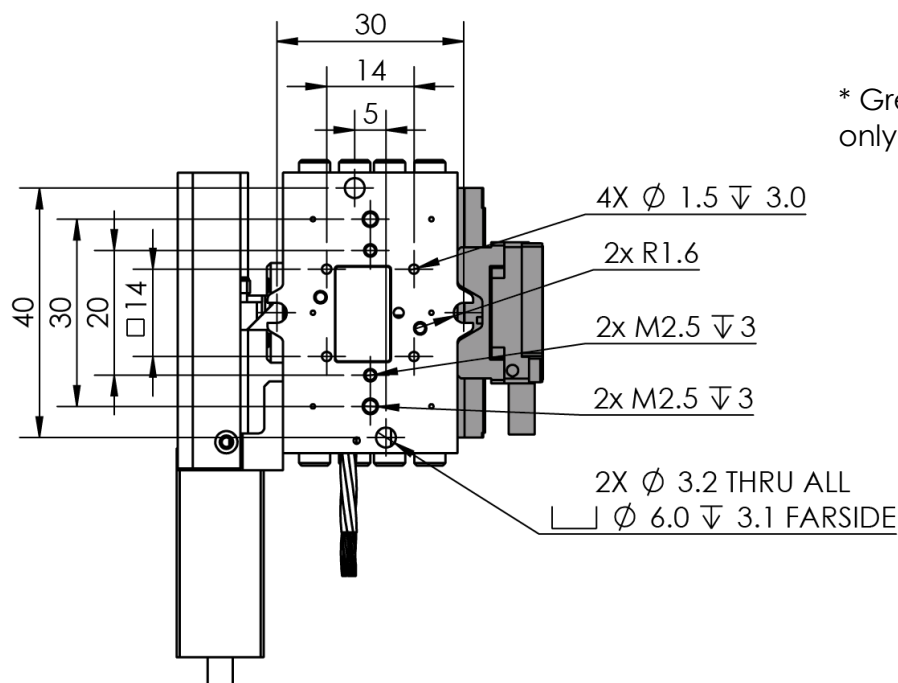
\* Grey parts for external closed loop only

## 6.1.2 PPS-28 Stepper Motor MII 6000 Digital Encoder

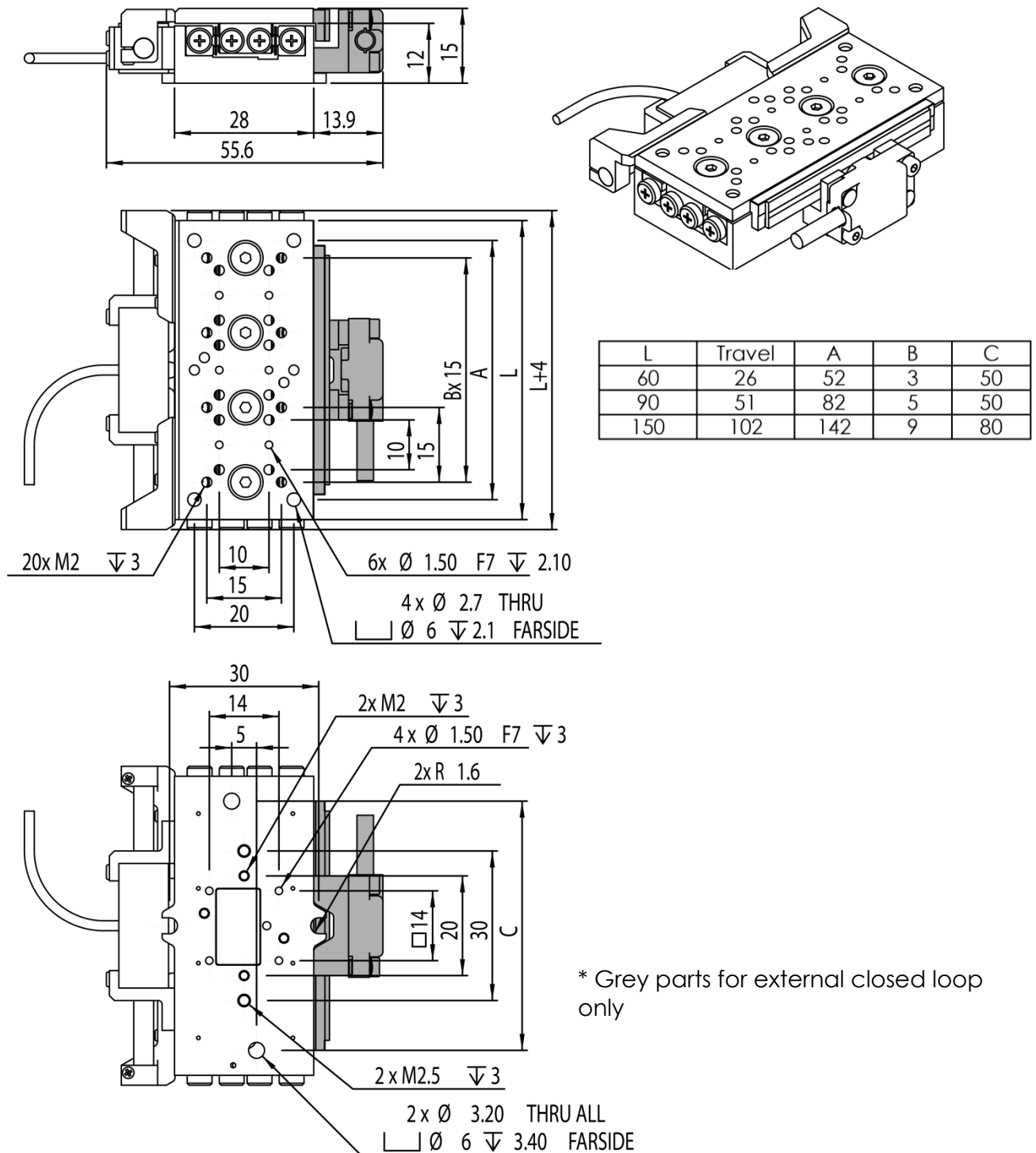


L	TRAVEL	A	B	C
45	26	37	1	40
90	51	82	5	50
120	76	112	7	80
150	102	142	9	80

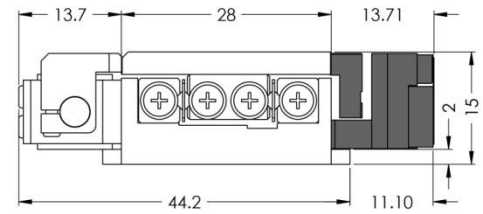
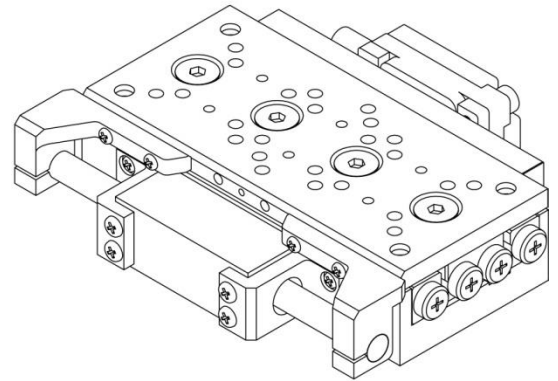
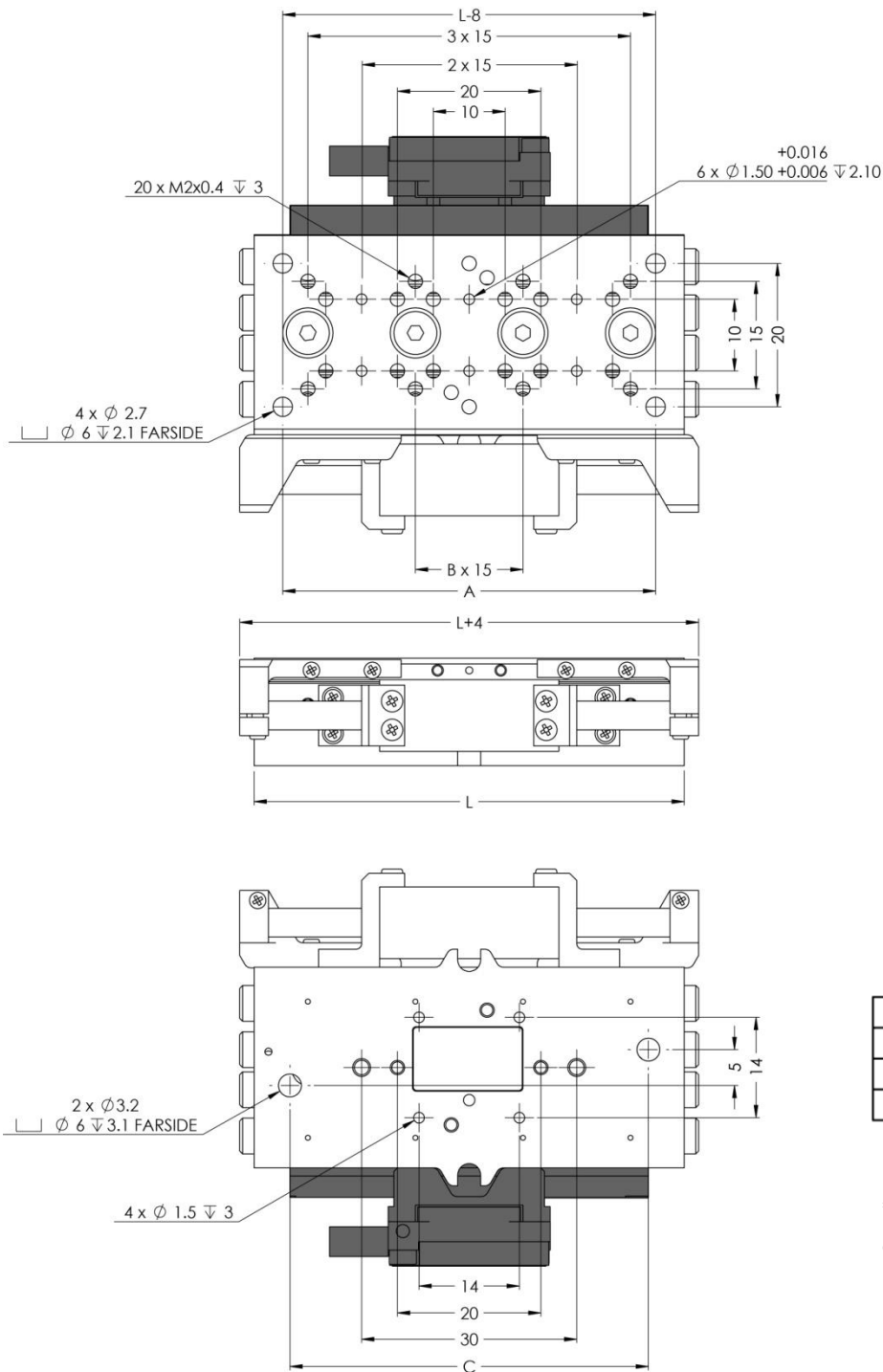
\* Grey parts for external closed loop only



### 6.1.3 PPS-28 Linear Motor Analog Encoder



### 6.1.4 PPS-28 Linear Motor MII 6000 Digital Encoder



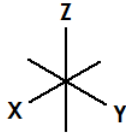
L	Travel	A	B	C
60	26	52	3	50
90	51	82	5	50
150	102	142	9	80

\* Grey parts for external closed loop only

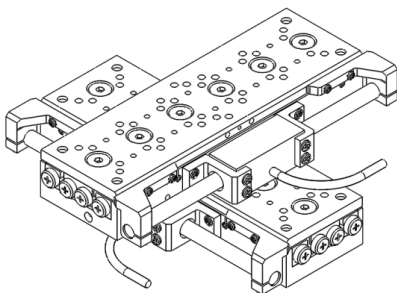
### 7. Stacking Configurations

#### 7.1 Configuration Examples (Additional Configurations available upon request)

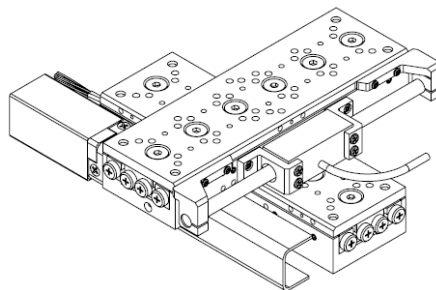
- Additional configurations available upon request
- Note: Stacking compatibility for all motor configurations.
- Positioning according to:



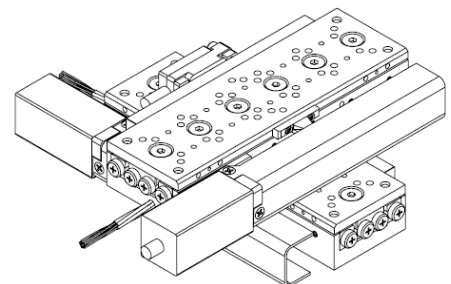
#### No Adapters



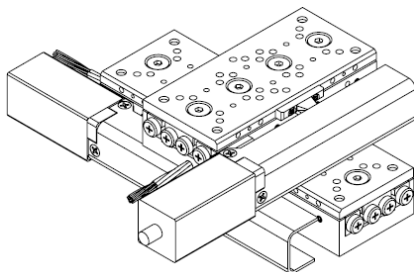
X-Y 51x51mm



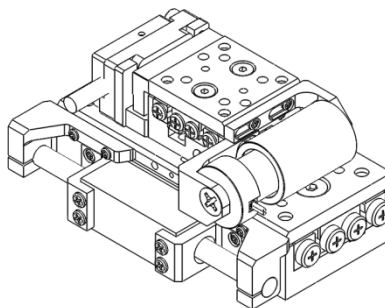
X-Y 51x51mm



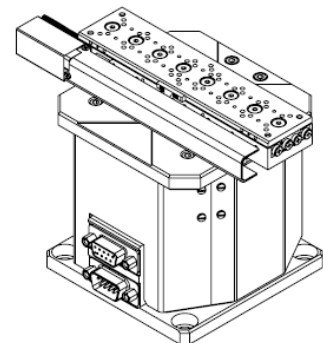
X-Y 51x51mm



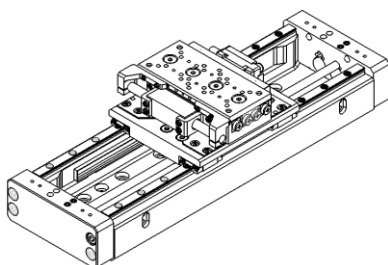
X-Y 51x35mm



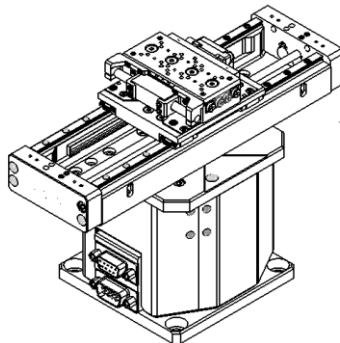
X-Y 26x11mm  
[with PPS-20 Linear Stage]



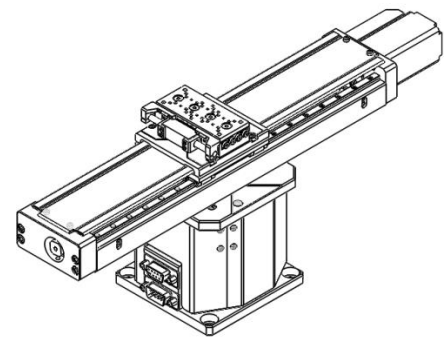
Y-Z 76x35mm  
[with PPS-90 Elevation Stage]



X-Y 100x26mm  
[with PPS-60 Linear Stage]



X-Y-Z 100x26x35mm  
[with PPS-60 Linear Stage  
& PPS-90 Elevation Stage]



X-Y-Z 200x26x35mm  
[with PPS-60 Linear Stage  
& PPS-90 Elevation Stage]

## 8. Supplementary Information

### 8.1 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.

### 8.2 Personal Safety

- The PPS-28 LMSM stage is a precision mechanical device and should be handled with care. Do not drop or mishandle the stage.
- Keep hands clear of all moving parts while the stage is in motion to avoid personal injury.
- 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.
- Allow for easy access to the stage in case of servicing.

### 8.3 Maintenance

The PPS-28 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.



## A. Appendix

### A.1 Stepper Motor

#### A.1.1 Standard Atmospheric DB-9 Male Motor Connector

Stepper Motor		
Pin	Function	Wire Color
1	Motor A+	Yellow
2	Motor A-	Green
3	Motor B+	Black
4	Motor B-	Red
5	N/A	N/A
6	Limit Switch-	Violet
7	Limit Switch+	Blue
8	+5V	Orange
9	Ground	Brown
♦ Solder shield to housing		

#### A.1.2 Stepper Motor Specifications

Stepper Motor	
Motor Type	2 Phase Bipolar
Phase Current	0.2 A
Step Angle	18°
Full steps per Rev	20
Coil-Resistance	13 Ohms
Coil-Inductance	3.5 mH
Holding Torque	2.4 mHm
Pitch	0.5 mm/rev
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	U	Red
2	V	Black
3	W	White*
4	N/C	N/C
5	N/C	N/C
6	Limit Switch+	Violet
7	Limit Switch-	Blue
8	+5V	Orange
9	Limit Switch GND	Brown
♦ Solder shield to housing		

### A.2.2 Linear Motor Specifications

#### S040D Linear Motor

Continuous Force	0.29 N
Continuous Current	0.3 Arms
Acceleration Force	1.2 N
Acceleration Current	1.1 Arms
Force Constant ( $K_f$ )	1.0 N/amp
Back EMF ( $K_e$ )	0.4 V/m/s
Resistance 25°C	11.2 $\Omega$
Inductance	0.5 mH
Electric Time Constant	0.045 ms
Fundamental Motor Constant ( $K_m$ )	0.31 $N\sqrt{W}$
Magnetic Pitch (North-North)	18mm

## A.3 Encoder Pinout

Pin	Function	Low Cost Digital	Analog
1	A+/Cos+	Brown	Brown
2	B+/Sin+	Grey	Yellow
3	Index+	Violet	Violet
4	GND	Black & Inside shield	Black & Inside shield
5	+5V	Red	Red
6	A-/Cos-	Orange	Orange
7	B-/Sin-	White	Green
8	Index-	Blue	Blue
9	N/A	N/A	N/A
Shield	GND	Outside Shield	Outside Shield

## A.4 Magnetic (Hall Effect) Limit Switches

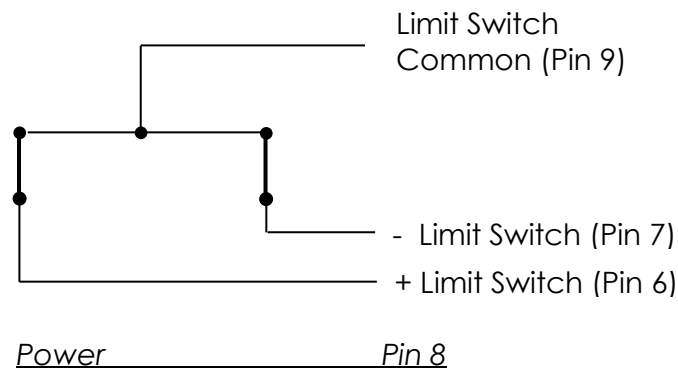
Hall Effect transistor switches are activated in the presence of a magnetic field. These switches feature a highly repeatable operation, remote sensing non-contacting operation, broad temperature range (-40 to +150°C), and exceptionally long life.

The hall effect limit switches are factory calibrated to ensure advertised travel length and cannot be adjusted by the customer.

### A.4.1 Hall Effect Limit Switches

Supply Voltage	3 - 12 VDC
Supply Current	< 5 mA
Output Configuration	Open Collector
Max Sink Current	20 mA
Contact Rating	100 mA @ 30 V
Contact Type	Open Collector (NPN) Normally Closed
Operating Temperature	-40 to +150 °C

### A.4.2 Limit Switch Schematic

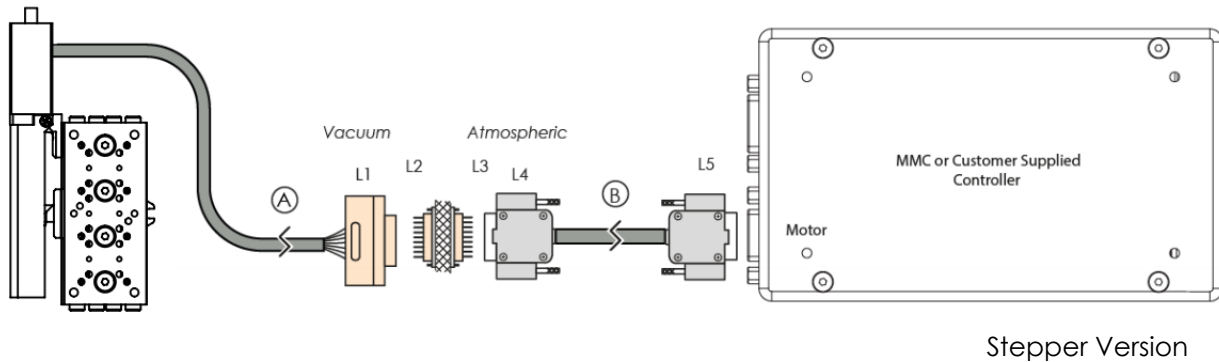


## A.5 Open Loop Vacuum Wiring Diagram

### Standard Cable Descriptions:

- A. PPS-28 Motor Cable - Vacuum Side (Female Dsub 9 Pin Peek Connector, 1.5m)
- B. Atmospheric Motor Cable (Female Dsub 9 Pin to Male Dsub 9 Pin, 1.5m)

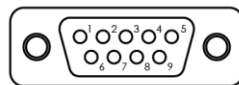
### Wiring Diagram:



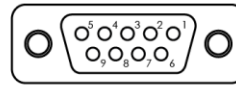
Stepper Motor Connector Pinout

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

-Motor

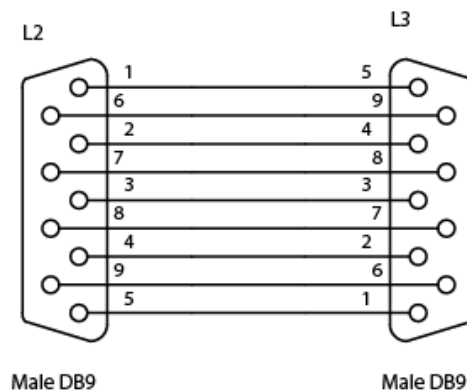


Female Dsub9 Connector - Rear View



Male Dsub9 Connector - Rear View

### A.5.1 Straight Through 9-Pin Feed Through



## A.6 Using an Analog Encoder

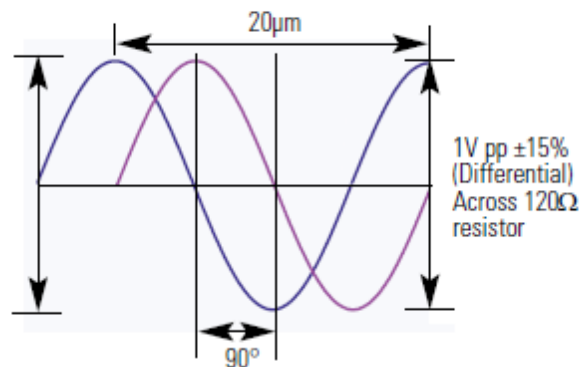
### A.6.1 Analog Encoder Overview

A PPS-28 LSM stage with Analog encoder will need to be paired with an appropriate controller. MMC controllers has an Analog option. The PPS-28 LSM stage with internal Analog encoder will be supplied with a 15-pin connector that incorporates both motor and encoder signals.

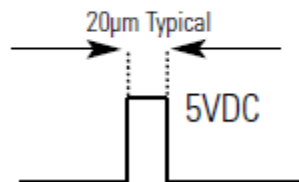
### A.6.2 Operating and Electrical Specifications

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

### A.6.3 Analog Output (Pins 1,2,6 and 7)



### A.6.4 Index Window (Pins 3)



### A.6.5 Resolution

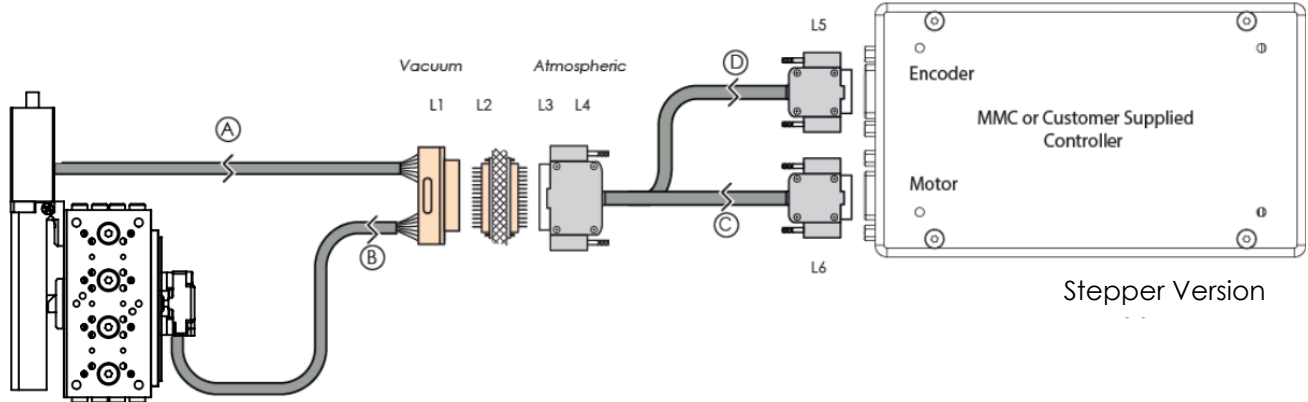
All closed loop stages are supplied with 20μm scales. The interpolation is done in an MMC controller to a higher resolution as specified in the order. With an analog encoder the MMC controller has an achievable resolution of 10nm.

### A.6.6 Analog Encoder Wiring Diagram

#### Standard Cable Descriptions:

- A. PPS-28 Motor Cable - Vacuum Side
- B. PPS-28 Encoder Cable - Vacuum Side
- C. Atmospheric Motor Breakout Cable (Female Dsub 25 Pin to Male Dsub 9 Pin, 1.5m)
- D. Atmospheric Encoder Breakout Cable (Female Dsub 25 Pin to Female Dsub 9 Pin, 0.5m)

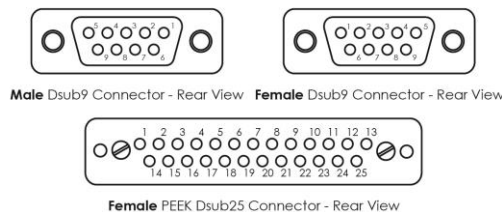
#### Wiring Diagram:



Stepper Motor Connector Pinout

Description	Color	L1	L2	L3	L4	L5	L6
Motor B-	Orange	1	1	13	13 (Brown)		4
Ground	Brown	14	14	25	25 (Black)		9
Motor B+	Blue	2	2	12	12 (White - Brown TP)		3
+5V	Orange	15	15	24	24 (Red)		8
Motor A-	Red	3	3	11	11 (Green)		2
Limit +	Blue	16	16	23	23 (White - Violet TP)		7
Motor A+	Yellow	4	4	10	10 (White - Green TP)		1
Limit -	Violet	17	17	22	22 (Violet)		6
Shield	-	5	5	9	9 (Shield)		Casing
Enc Shield	-	8	8	6	6 (Shield)	Casing	
+5V	Red	10	10	4	4 (Red)		5
Ground	Black	22	22	17	17 (Black)		4
Cos+	Brown	11	11	3	3 (Brown)		1
Cos-	Orange	23	23	16	16 (White - Brown TP)		6
Sin+	Yellow	12	12	2	2 (Yellow)		2
Sin-	Green	24	24	15	15 (White - Yellow TP)		7
Index+	Violet	13	13	1	1 (Violet)		3
Index-	Blue	25	25	14	14 (White - Violet TP)		8

-Encoder  
 -Motor



## 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.

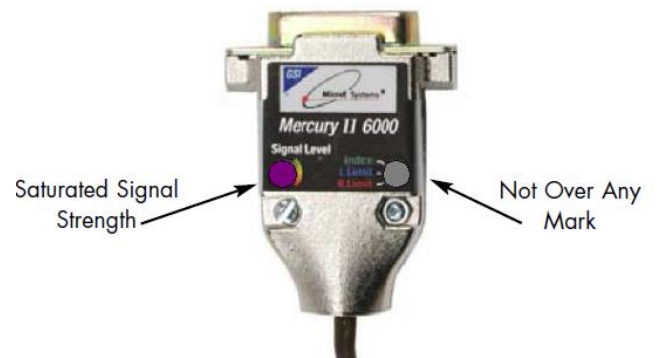
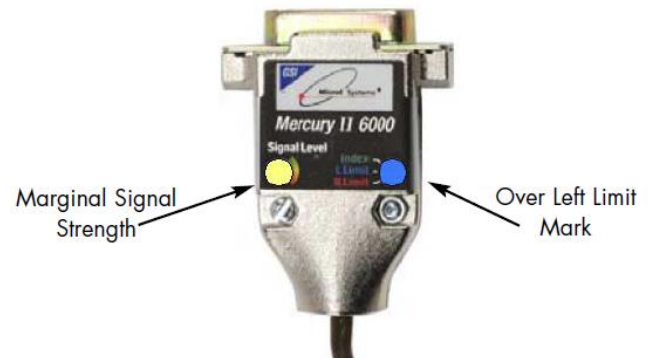
### A.7.1 Encoder Module Pin-out

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.

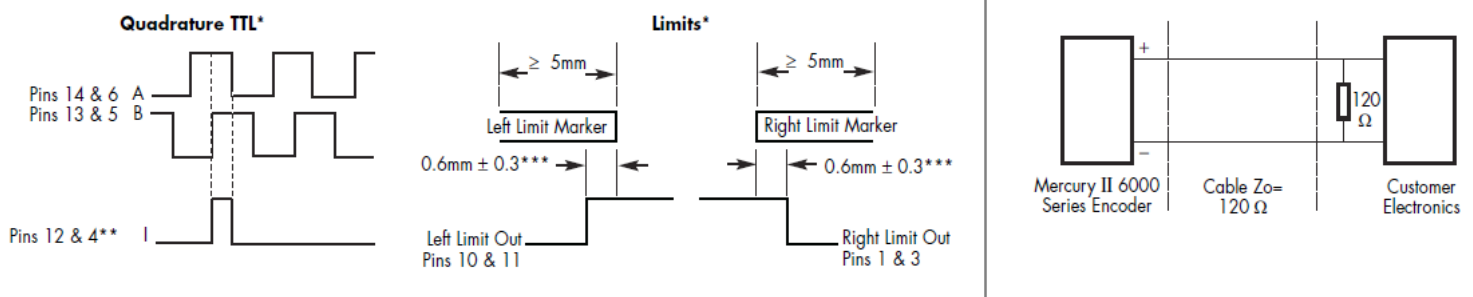
#### Normal Operation



### 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

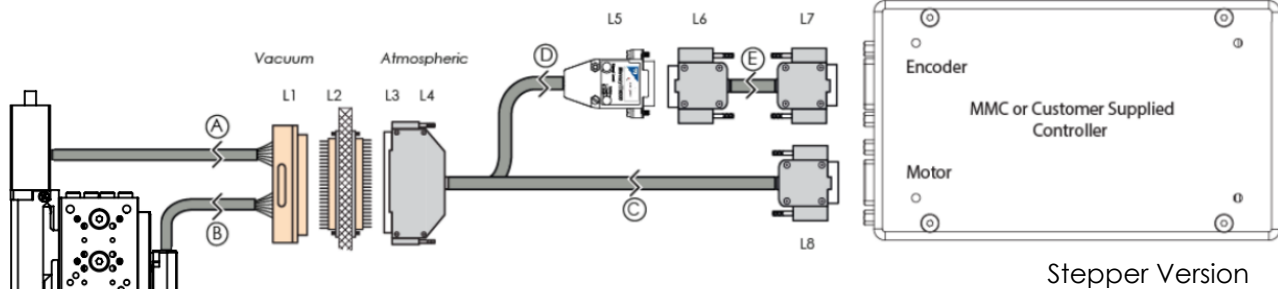
All closed loop stages are supplied with  $20\mu\text{m}$  scales. The digital encoder module interpolates to a higher resolution as specified in the order. With a digital encoder an MMC controller has an achievable resolution of  $2\text{nm}$ .

### A.7.5 MII 6000 Digital Encoder Wiring Diagram

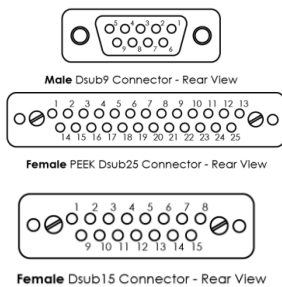
#### Standard Cable Descriptions:

- A. PPS-28 Motor Cable - Vacuum Side (Female Dsub 25 Pin Peek Connector, 1.5m)
- B. PPS-28 Encoder Cable - Vacuum Side
- C. Atmospheric Motor Breakout Cable (Female Dsub 25 Pin to Male Dsub 9 Pin, 1.5m)
- D. Atmospheric Encoder Module Breakout Cable (Female Dsub 25 Pin to MII 6000 Interpolator Module, 1m)
- E. Encoder Module Adapter Cable (Female Dsub 15 to Female Dsub 9 Pin, 0.5m)

#### Wiring Diagram:



Stepper Version



Description	Color	L1	L2	L3	L4	L8
Motor B-	Orange	1	1	13	13 (Brown)	4
Ground	Brown	14	14	25	25 (Black)	9
Motor B+	Blue	2	2	12	12 (White - Brown TP)	3
+5V	Orange	15	15	24	24 (Red)	8
Motor A-	Red	3	3	11	11 (Green)	2
Limit +	Blue	16	16	23	23 (White - Violet TP)	7
Motor A+	Yellow	4	4	10	10 (White - Green TP)	1
Limit -	Violet	17	17	22	22 (Violet)	6
Shield	-	5	5	9	9 (Shield)	Casing
+5V DC	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

