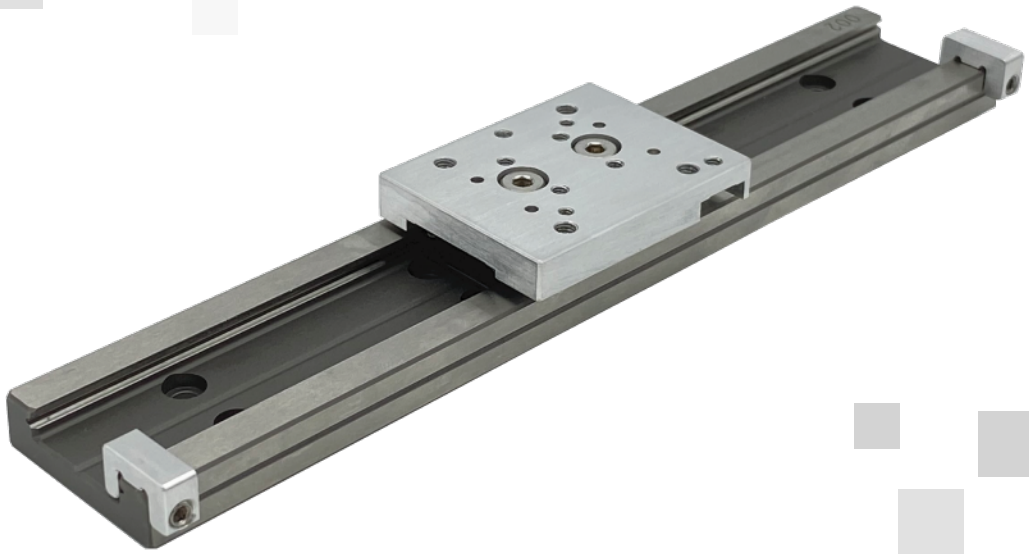
MLS-25 Series



Modular Linear Stage

Reference Manual

(Open and Closed Loop Versions)

MLS-25

Modular Linear Stage

Reference Manual

Rev 1.0

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Contents

1. Introduction

1.1 Product Description

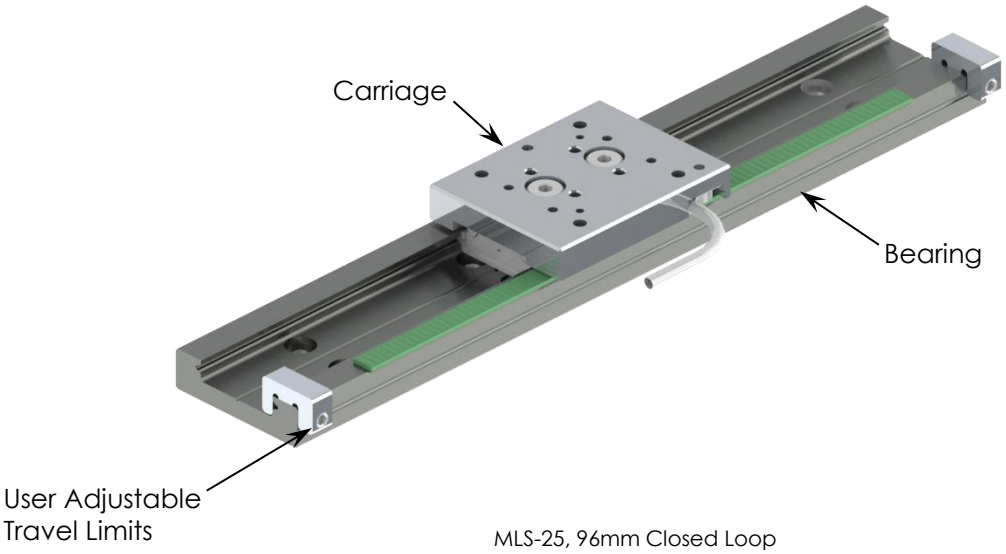
The modular linear stage (MLS-25) enables highly flexible and customizable motion system designs. X-Y, X-Y-Z mounting, easy creation of XY gantry systems, as well as two or more slides per bearing are possible.

The MLS-25 is fully integrated with our patented multi-phase piezo motor, and an incremental, high resolution encoder with <20nm resolution. The high precision stainless steel ball bearing can be factory cut to size if standard lengths are too long for the application. Travel adjustments are feasible with adjustable travel limits by the user. The MLS-25 can also be combined with our small rotary and gonio stages for the ultimate motion flexibility.

The MLS-25 is compatible with our MMC-10, MMC-100, MMC-110, and MMC-Ensemble motion controllers for plug-and-play motion system design.

Features:

- Travel range of up to 236 mm (up to 376mm available upon request)
- 20 nm closed loop encoder resolution
- High Load capacity stainless steel ball bearing (up to 2 kg)
- Low profile, 13mm height
- User adjustable travel limits



MLS-25, 96mm Closed Loop
(Shown in center position)

1.2 Recommended Controllers

The following controllers are available from MICRONIX USA for piezo stages:

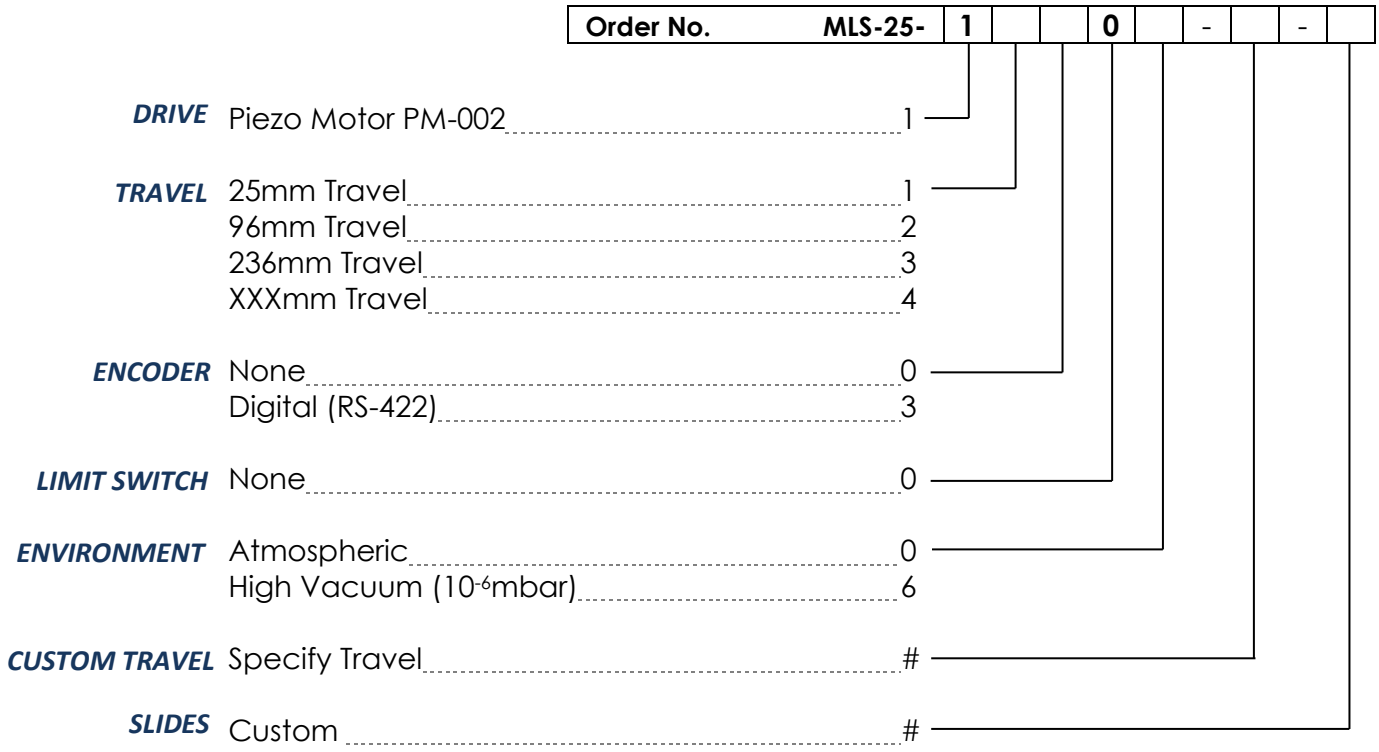
- MMC-10
- MMC-100
- MMC-110
- MMC-Ensemble

1.3 Technical Data

See datasheet.

2. Model Configurations

2.1 MLS-25 Order Numbers



Contact MICRONIX USA for custom applications and stacking configurations.

3. Preparing to Install the MLS-25

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 stage.

The stage is calibrated 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
- A clean indoor atmosphere free of corrosive gases, excessive dust, and condensation
- Temperature range of 10-40°C
- Relative humidity between 20-80%
- Wear clean latex gloves when handling vacuum products
- 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:

- MLS-25 Modular Linear Stage
- Reference Manual
- Any other previously agreed upon components such as a controller

4. Installing the MLS-25

The MLS-25 bearing rail mounting patterns require M2 screws with a maximum 1.5mm head height. Additional brackets and screws may be needed for custom applications.
Note: Stages assembled in factory do not require disassembly for base mounting.

Recommended mounting screw:

- 91200A0103 M2 Pan Head Slotted Screw (mcmaster.com)

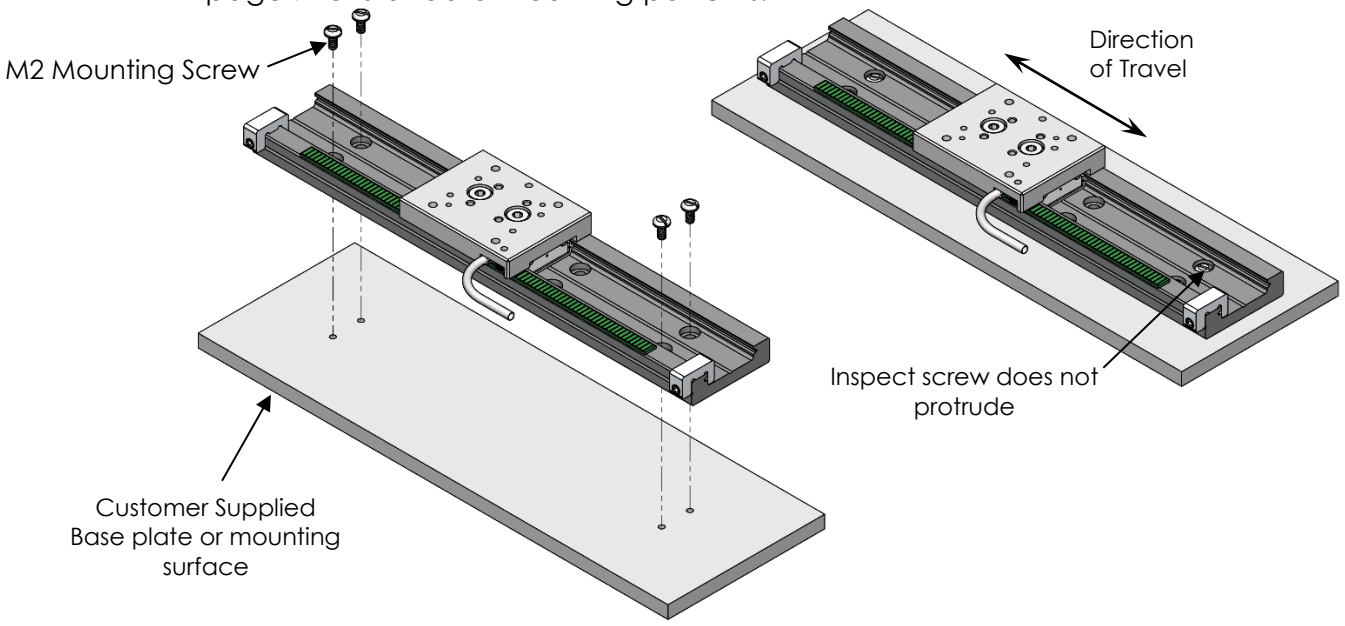
4.1 MLS-25 Installation

4.1.1 *General Mounting*

For general mounting, place and align the stage onto the mounting surface. Carefully move the carriage to access the mounting pattern if necessary. It is possible to move the carriage manually without damaging the stage.

Note: The stage does not include alignment dowel pins, it is recommended to use an alignment edge, a recessed edge or tangent dowel pins on the mounting surface that does not interfere with the travel of the carriage, see section 4.1.2 for mounting alignment illustration examples.

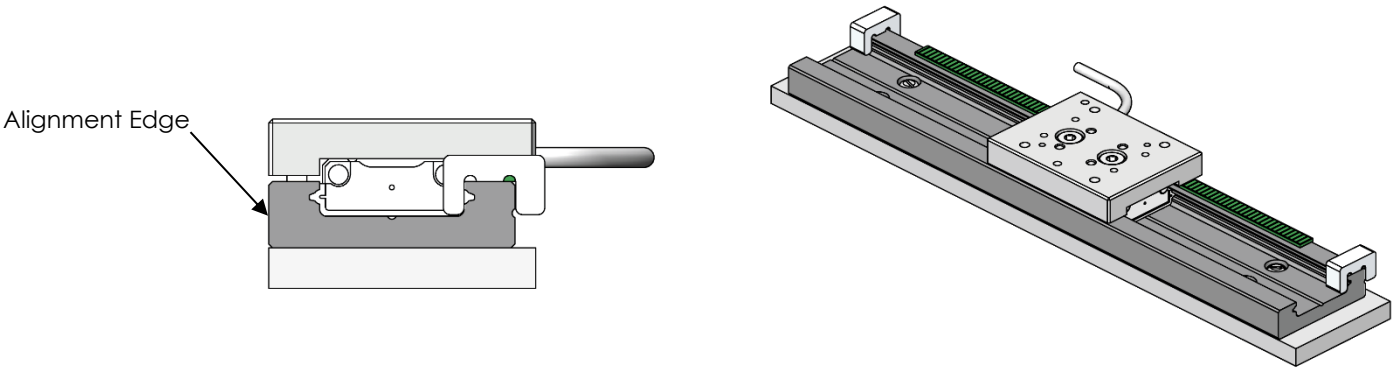
The MLS-25 requires a minimum of four mounting screws to secure the stage, or two mounting screws if setting up the stage as a cantilever beam (applicable to 25mm and 96mm stages only, longer stages need more than 2 screws to secure it). See page 7 for standard mounting patterns.



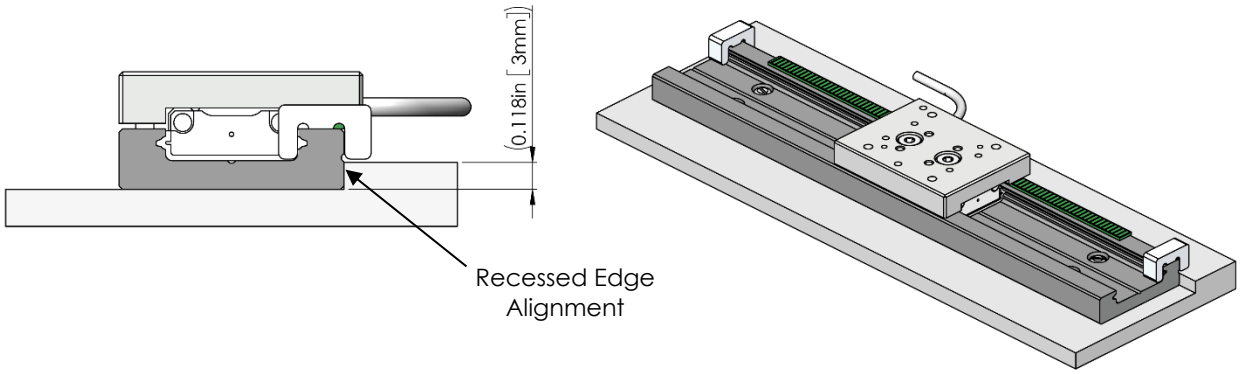
Instructions:
1. Secure the stage using M2 Pan Head Slotted Screws or mounting screws at 0.15 Nm (Recommended Torque)
2. Inspect the mounting screw does not protrude past the rail surface

4.1.2 *General Mounting Alignment Examples*

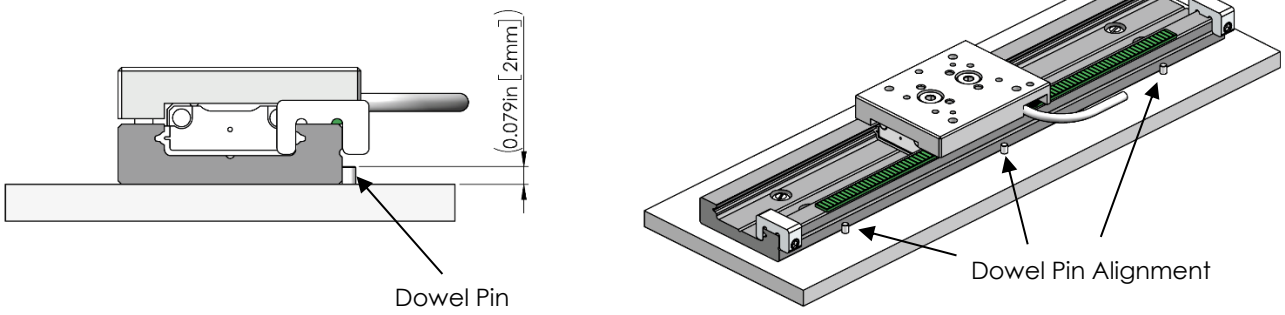
4.1.2.1 Alignment Edge



4.1.2.2 Recessed Edge Alignment



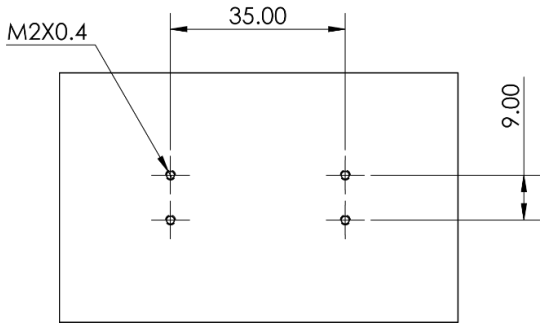
4.1.2.3 Tangent Dowel Pin Alignment



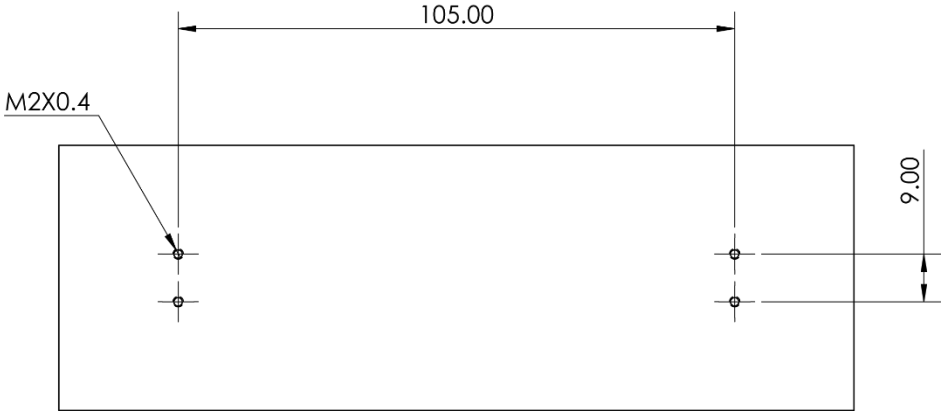
4.1.3 *General Mounting Patterns*

Note: See stage dimensions on Section 5.

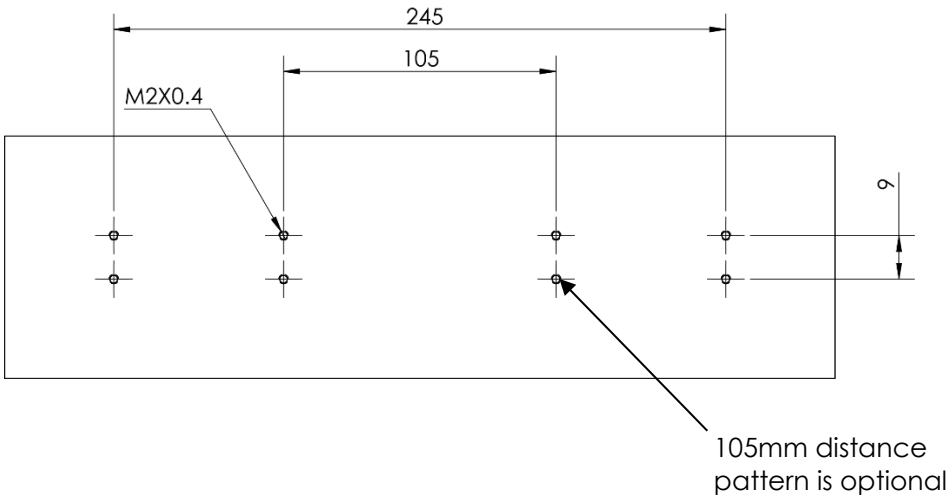
4.1.3.1 MLS-25 standard, 25mm travel mounting hole pattern:



4.1.3.2 MLS-25 standard 96mm travel mounting hole pattern:

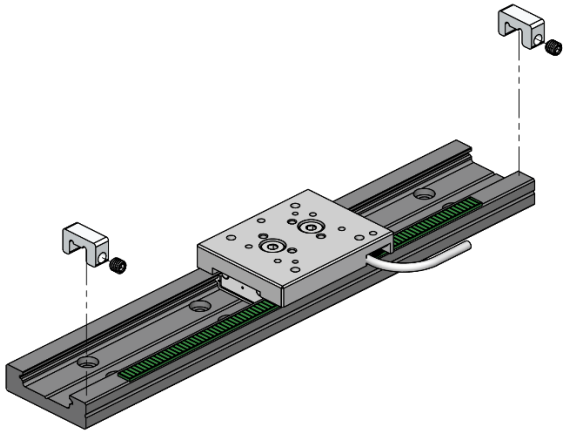


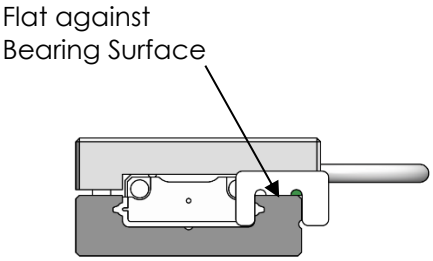
4.1.3.3 MLS-25 standard 236mm travel mounting hole pattern:



4.1.4 *User Adjustable Travel Limit*

Uses:
2x M3 x 3mm Cup Point Set Screw
2x 431538 Adjustable Travel Limits

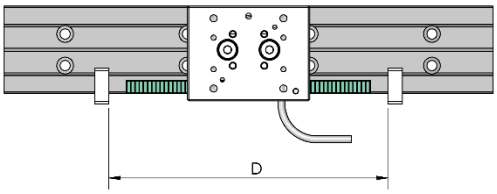




Instructions:

1. Determine the travel to be adjusted then find the distance between the travel limits needed, see equation and example below.
2. Preinstall the set screw into the clamp and insert the clamp into the bearing rail, make sure to place the travel limit clamp flat against the bearing or scale surface.
   Note: The adjustable travel limits may be placed over the scale if a longer scale has been previously installed. Careful to not damage the scale while adjusting.
3. Secure the position by tightening the setscrew manually using a 1.5mm hex key. Torque to a ¼ turn past set screw engagement. Do not over torque the set screw as this can damage the bearing rail.

Determining distance between limits (D):

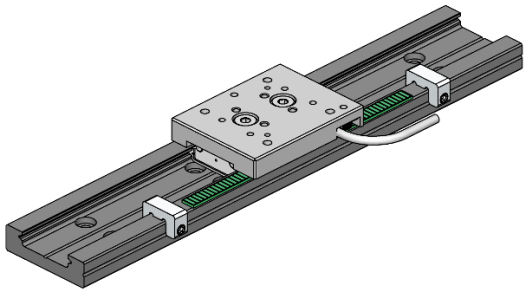


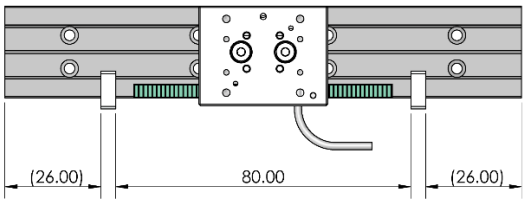
D = T + 35

where T is the travel required and distance range of:

- 70mm length: 35 < D ≤ 62
- 140mm length: 35 < D ≤ 132
- 280mm length: 35 < D ≤ 172
- Custom length: 35< D ≤ Custom Length

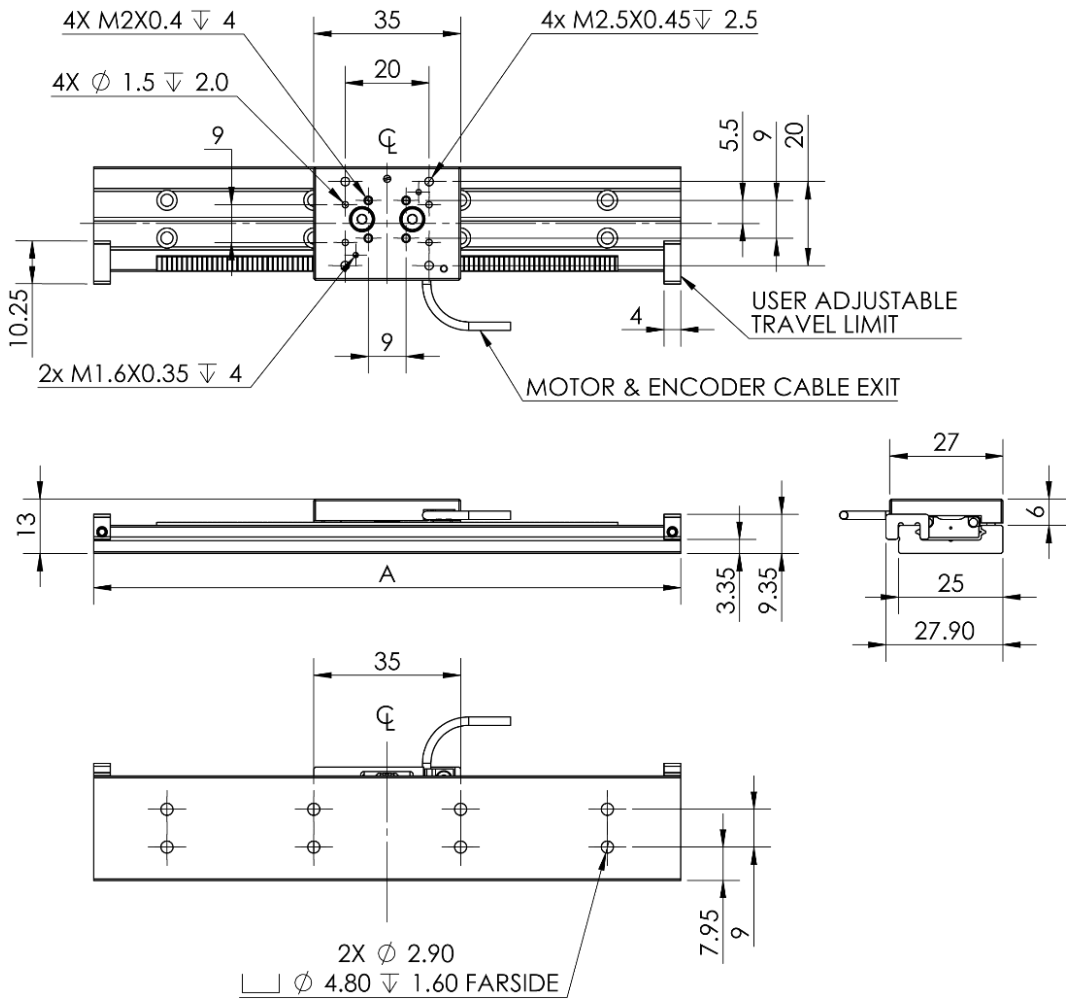
Example: To adjust a 140mm long stage to a 45mm travel, the distance between limits needs to be 80mm.





5. Dimensions

*96mm travel, closed loop version shown



Travel	A
25	70
96	140
236	280

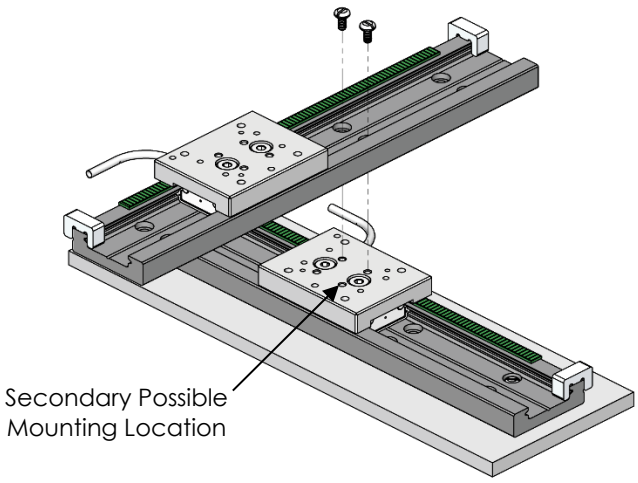
6. Stacking Configurations

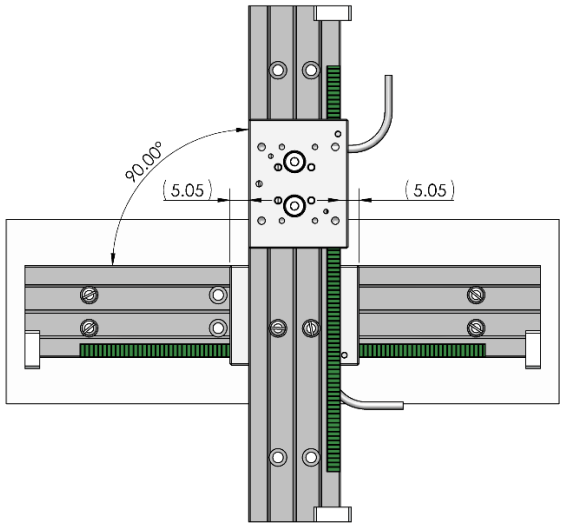
6.1 Configuration Examples (Additional Configurations available upon request)

6.1.1 *X-Y Mounting*

For X-Y mounting, follow the instructions for mounting the X-axis stage, outlined in section 4.1.1 *General Mounting,* then proceed to mount the Y-axis stage, as shown below. Please note, it is possible to move the carriage manually without damaging the stage.

Requires:
2x M2 x 4mm Pan Head Slotted Screw

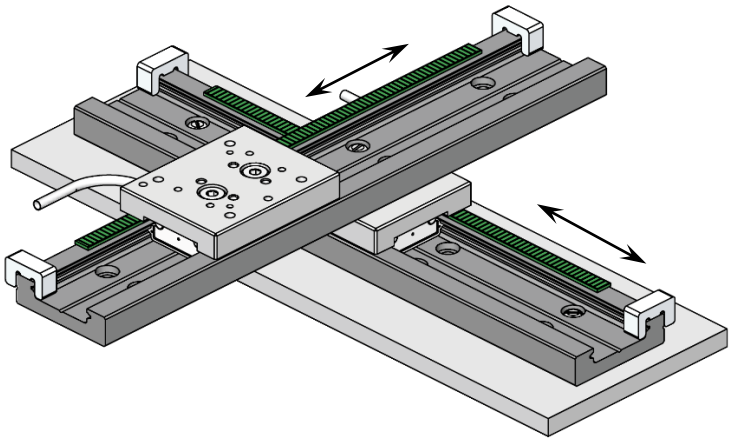




Instructions:

1. Install the second stage loosely onto the carriage using 2x M2x4mm Pan Head Slotted Screws.
2. Center the bearing rail of the stage along the length of the bottom stage carriage and align the stages as perpendicular as possible for optimal performance.
3. Secure the screws at 1.5 Nm (Recommended Torque).

XY Direction of Travel



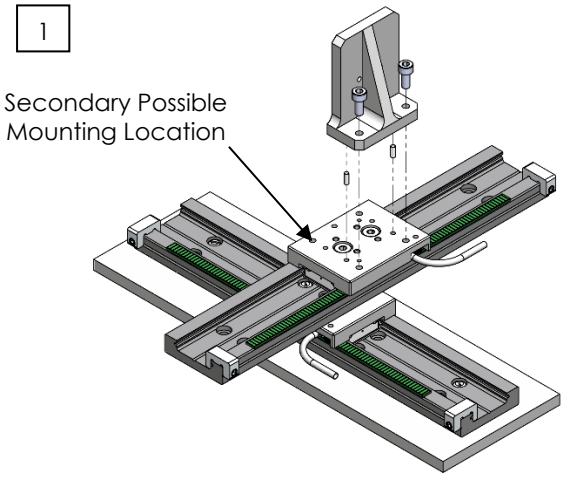
6.1.2 *X-Y-Z Mounting*

For X-Y-Z mounting, follow the instructions for mounting the X-Y configuration in section 6.1.1, then proceed to mount the Z-axis stage, as shown below. Please note, it is possible to move the carriage manually without damaging the stage.

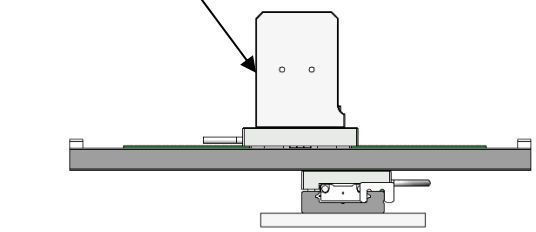
Note: The Z-Bracket could be rotated 90 and 180 degrees from the position shown below, installation procedure is the same.

Requires:
2x M2 x 4mm Pan Head Slotted Screw
2x M1.5 x 4mm Dowel Pin
2x M2.5 x 6mm Socket Head Cap Screw
431539 MLS-25 Z Bracket (Taller Bracket available to larger stages)

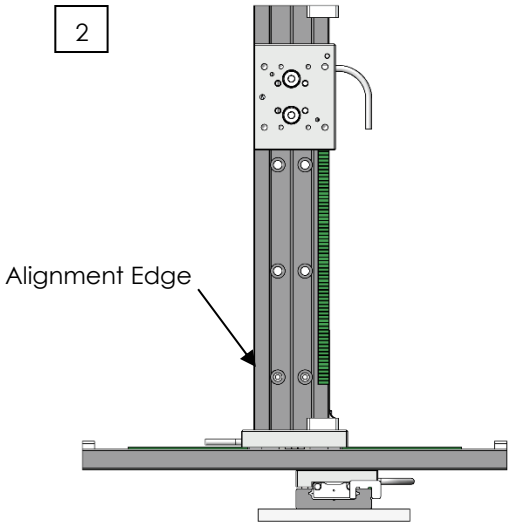
1



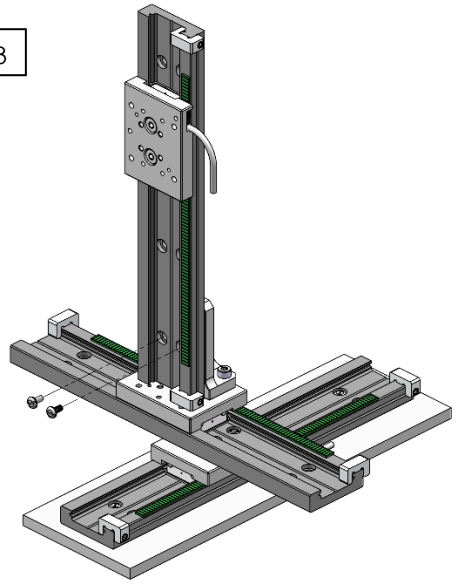
2



2



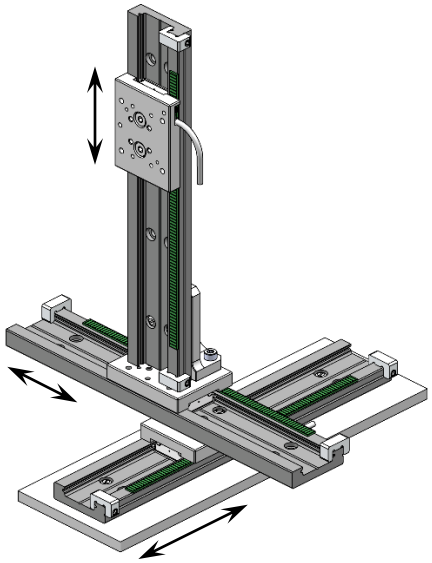
3



Instructions:

1. Install the Z Bracket (P/N: 431539) using M1.5x4mm dowel pins for alignment and secure using M2.5x6mm Socket Head Cap Screws at 2 Nm (Recommended Torque).
2. Align the Z stage to the bracket alignment edge.
3. Secure using 2x M2x4mm Pan Head Slotted Screws at 1.5 Nm (Recommended Torque).

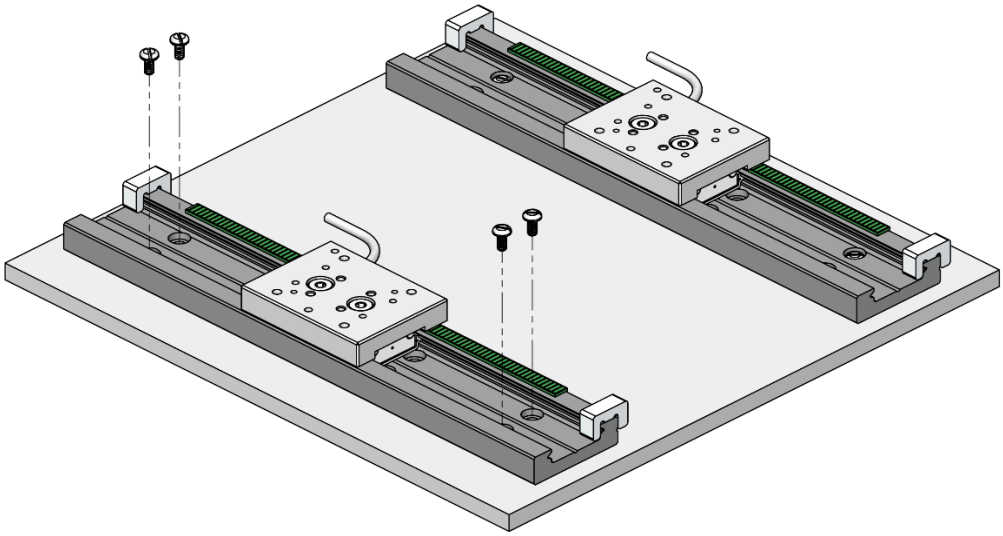
XYZ Direction of Travel



6.1.3 *X-Y Gantry*

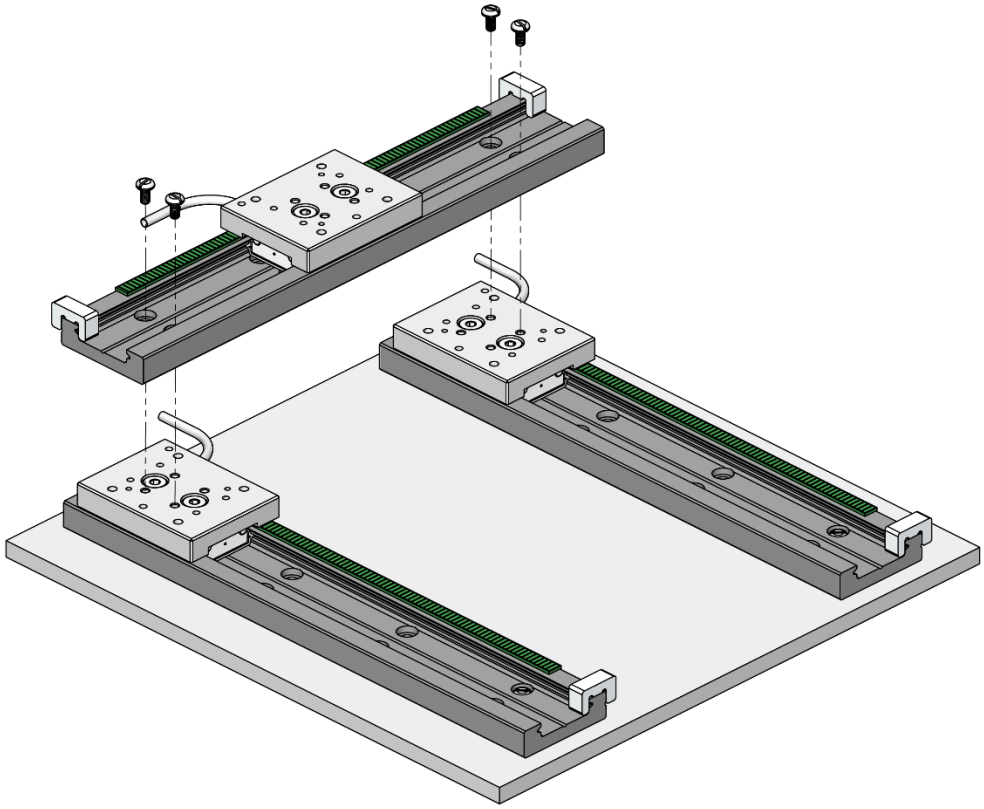
For an X-Y Gantry, mount the first bottom stage as outlined in section 4.1.1 *General Mounting,* then proceed to mount the second stage, as shown below to align both bearings in parallel. It is possible to move the carriage manually without damaging the stage.

Requires:
4x M2 Pan Head Slotted Screw for customer mounting surface
4x M2x4mm Pan Head Slotted Screw



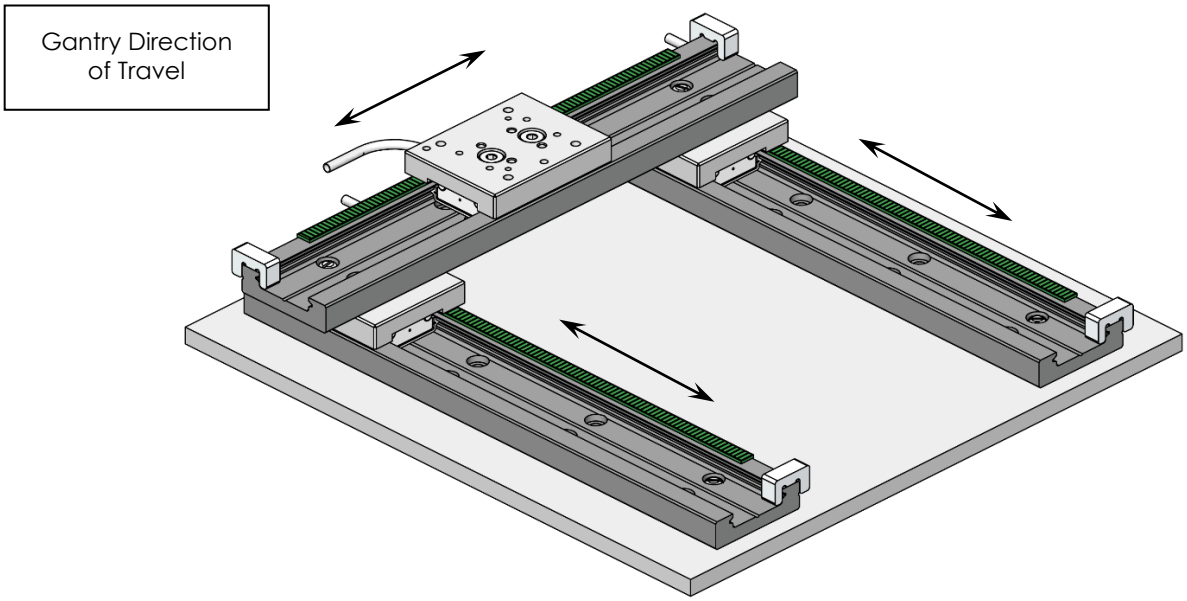
Instructions:

1. Loosely install the second stage onto the mounting surface using the M2 mounting screws.
2. Move both carriages to one limit and measure the distance between the carriages, measuring jaws must be parallel to both stages. Adjust the stage as necessary and secure by lightly tightening the mounting screws.
3. Move both carriages to the opposite limit and measure the distance again. Adjust the stage as necessary and secure by lightly tightening the mounting screws.
4. Repeat steps 2 and 3 until parallelism of <5µm is achieved. Then torque the mounting screws (1.5 Nm recommended torque).



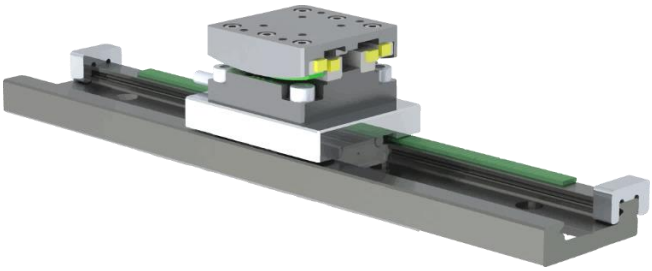
Instructions:

5. Carefully, move both carriages towards one of the limits to ensure the top stage is installed parallel from end to end.
6. Loosely install the stage using the M2x4mm mounting screws.
7. Align the stage equally on both carriages (see XY Mounting instructions for alignment) and lightly tighten the screws.
8. Repeat step 7 until alignment is achieved then torque the mounting screws at 1.5 Nm (recommended torque).

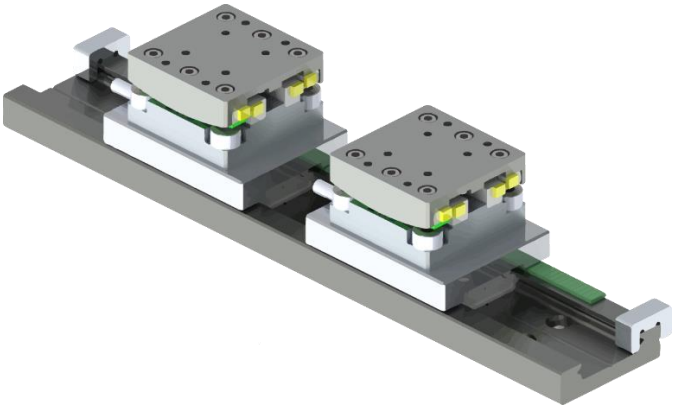


6.2 Configurations with other Micronix Stages

6.2.1.1 MLS-25 with PG-25, Gonio Stage

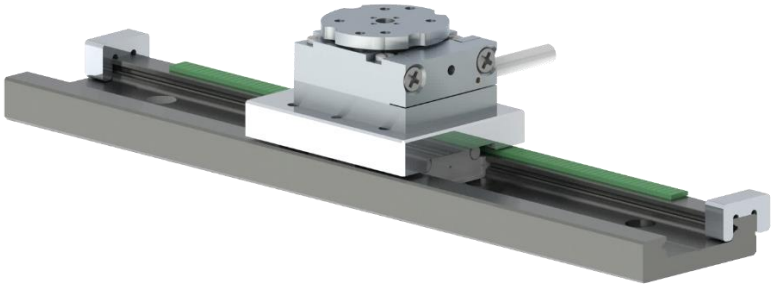


Single Slide

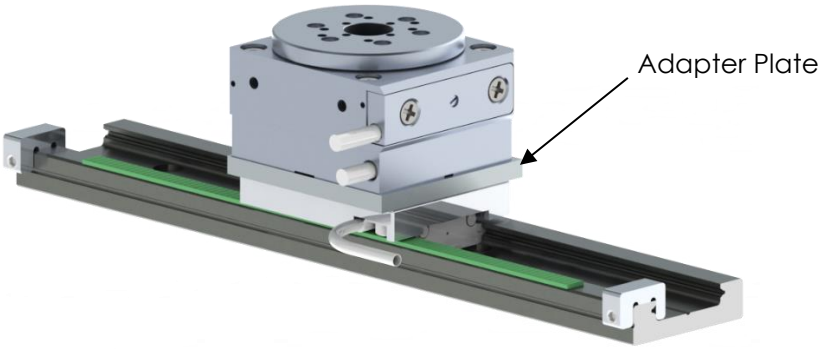


Two Slide

6.2.1.2 MLS-25 with PR-20, Rotational Stage



6.2.1.3 MLS-25 with PR-32L, Rotational Stage



7. Connecting the MLS-25

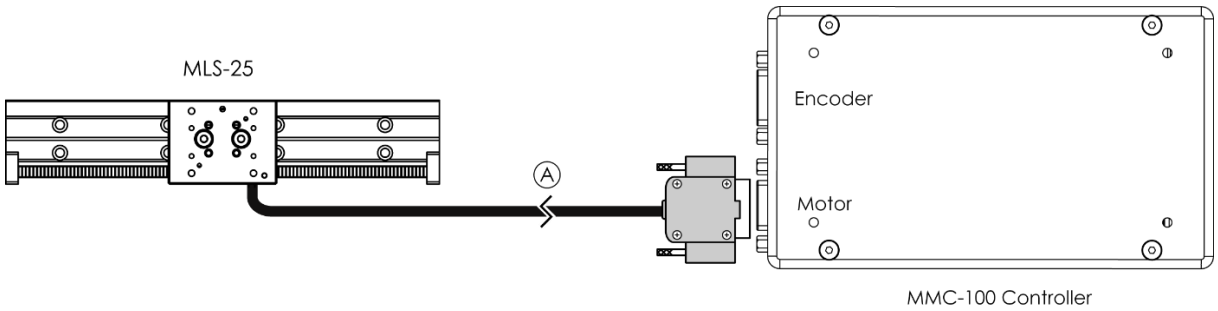
For controller information refer to the appropriate MMC controller manual.

7.1 Atmospheric Environments

7.1.1 *Open Loop Wiring Diagram*

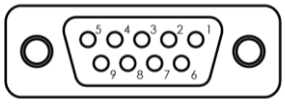
For MLS-25 open loop, connect the stage as shown below. This connection only requires that the Dsub 9 Pin Motor Cable is connected to a compatible controller. No other cables or components are needed.

Standard Cable Description:
A. Motor Cable (Male Dsub 9 Pin, 1.5m, Black Cable)



Motor Pinout

Pin	Description	Color
1	Phase 1	Red
2	Phase 2	White (Green TP)
5	Ground	Black / Green
Housing	Shield	-



Male Dsub9 Connector - Rear View

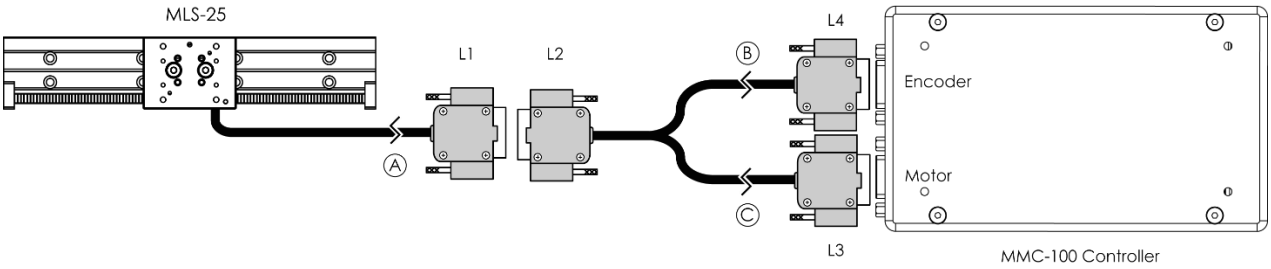
7.1.2 *Digital Encoder Wiring Diagram*

For MLS-25 with digital encoder, connect the stage as shown using the supplied 15 to 9 pin cable to connect the Encoder and motor module to the Controller.

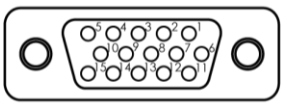
Standard Cable Description:

A. MLS-25 Cable (Male Dsub HD15 Pin Connector, 1.5m, Black Cable)
B. Motor Cable (Female Dsub HD15 Pin to Male Dsub 9 Pin, 1.5m, Black Cable)
C. Encoder Cable (Female Dsub HD15 Pin to Female Dsub 9 Pin, 1.5m, Black Cable)

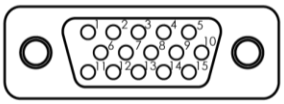
Wiring Diagram:



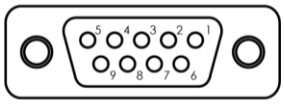
DSUB HD15 PINOUT				*ADAPTER CABLE PINOUT*	
DBHD15 Male (L1) Pin	***Description***	***Color***	***DBHD15 Female (L2) Pin***	***DB9 Male (L3) Pin***	***DB9 Female (L4) Pin***
1	Phase 1	Red	1	1	
2	Phase 2	White (Green TP)	2	2	
5	Ground	Black / Green	5	5	
Housing	Shield	-	Housing	Housing	
12	GND	Grey	12		4
8	A+	Brown	8		1
10	Index+	Violet	10		5
11	+5V	White (Grey TP)	11		6
15	Index-	White (Violet TP)	15		2
14	B-	White (Blue TP)	14		7
13	A-	White (Brown TP)	13		8
9	B+	Blue	9		3
Housing	Shield	-	Housing		Housing



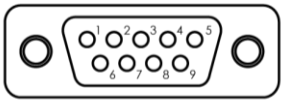
Male Dsub15HD Connector - Rear View



Female Dsub15HD Connector - Rear View



Male Dsub9 Connector - Rear View



Female Dsub9 Connector - Rear View

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.

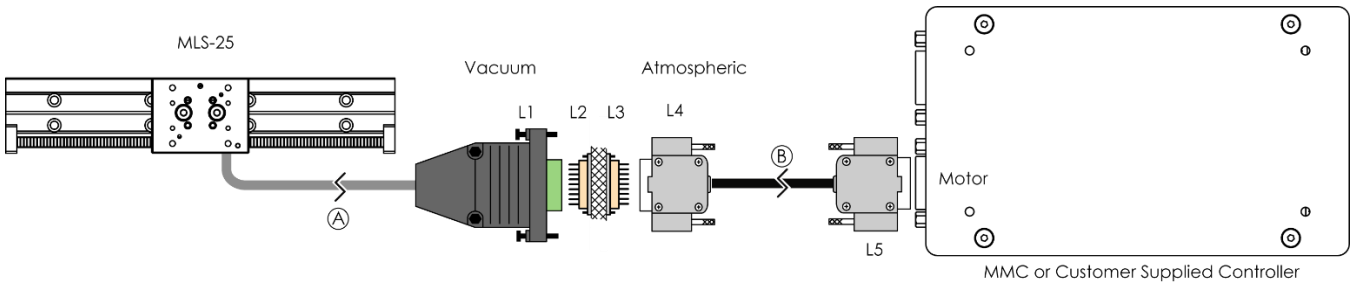
Connector Description	Connector Material	Contacts	Backshell
High Vacuum Glass- filled Dyiathilate D-Subminiature	DAP	T2 Female Crimps, Gold Pins (Accuglass P/N: 111652, 111653)	Nickle-plated Zinc Backshell Strain Relief

7.2.2 *Vacuum Open Loop Wiring Diagram*

Connecting the MLS-25 in a vacuum chamber requires the use of a feed-through connector at the vacuum chamber wall. The vacuum compatible MLS-25 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 functionality testing prior to installation in a vacuum chamber. Connect the stage as shown below.

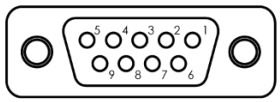
Standard Cable Description:

A. MLS-25 Motor Cable (Female Dsub 9 Pin DAP Connector, 1.5m, Silver Braided Cable)
B. Atmospheric Motor Cable (Female Dsub 9 to Male Dsub 9, 1.5m, Black Cable)

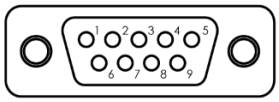


Pinout for Cables A & B

	Description:	Color	L1	L2	L3	L4	L5
Motor	Phase 1	Red	5	5	1	1	1
	Phase 2	White (Green TP)	4	4	2	2	2
	Ground	Black/Green	1	1	5	5	5
	Shield	-	6	6	9	9	Casing

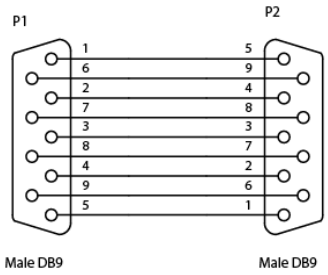


Male Dsub9 Connector - Rear View



Female Dsub9 Connector - Rear View

9 Pin Feed-through

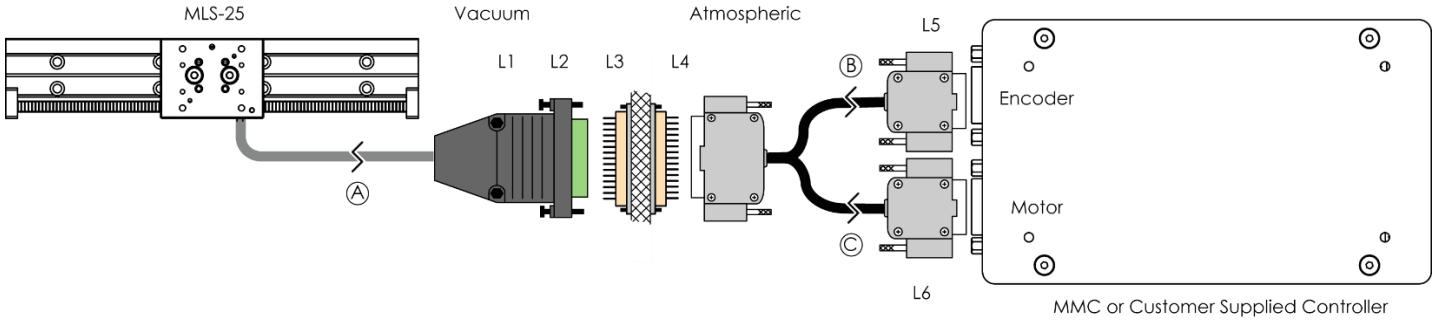


7.2.3 *Vacuum Closed Loop, Digital Wiring Diagram*

Connecting the MLS-25 in a vacuum chamber requires the use of a feed-through connector at the vacuum chamber wall. The vacuum compatible MLS-25 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 functionality testing prior to installation in a vacuum chamber. Connect the stage as shown below.

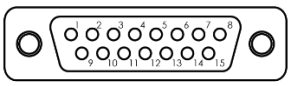
Standard Cable Description:

A. MLS-25 Cable (Female Dsub 15 Pin DAP Connector, 1.5m, Silver Braided Cable)
B. Atmospheric Encoder Cable (Female Dsub 15 to Female Dsub 9, 1.5m, Black Cable)
C. Atmospheric Motor Cable (Female Dsub 9 to Male Dsub 9, 1.5m, Black Cable)

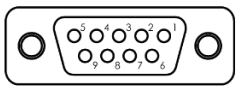


Pinout for Cables A, B, C

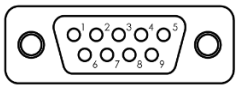
	Description:	Color	L1	L2	L3	Color	L4	L5	L6
Motor A	Phase 1	Red	1	1	8	Red	8		1
	Phase 2	White (Green TP)	2	2	7	White (Green TP)	7		2
	Ground	Black/Green	9	9	15	Black/Green	15		5
	Shield	-	10	10	14	-	14		Casing
Encoder A & B	GND	Grey	8	8	1	Grey	1	4	
	A+	Brown	7	7	2	Brown	2	1	
	+5V	White (Grey TP)	6	6	3	White (Grey TP)	3	5	
	A-	White (Brown TP)	5	5	4	White (Brown TP)	4	6	
	B+	Blue	4	4	5	Blue	5	2	
	B-	White (Blue TP)	12	12	12	White (Blue TP)	12	7	
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	8	
	Index+	Violet	14	14	10	Violet	10	3	
	Shield	-	-	-		-	Casing	Casing	



Female Dsub15 Connector - Rear View

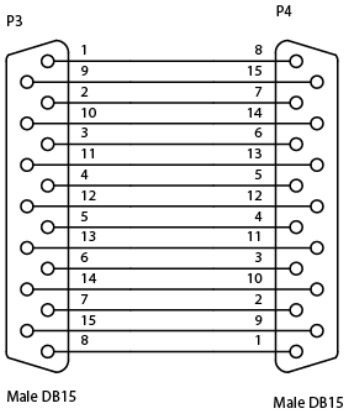


Male Dsub9 Connector - Rear View



Female Dsub9 Connector - Rear View

15 Pin Feed-through



8. Supplementary Information

8.1 Maintenance

- The MLS-25 series of modular linear stages utilizes a maintenance free design. Do not modify the stage or perform any maintenance unless specifically instructed to do so by MICRONIX USA personnel. If the stage is not performing up to the original specifications, please contact MICRONIX USA.
- The MLS-25 linear stage is a precision mechanical device and should be handled with care. Do not drop or mishandle the stage.
- Do not touch the bearing slide with bare hands to avoid contaminating the motor friction surface.
- Do not touch the ball bearing slide, as this will contaminate the lubrication and jeopardize the longevity of the stage.
- Do not de-rail the bearing as this will affect stage performance if re-installation is attempted. Please contact Micronix USA if this occurs.
- Follow the *Installation Preparation* requirements and use proper cable management to ensure a clean and safe operating environment.

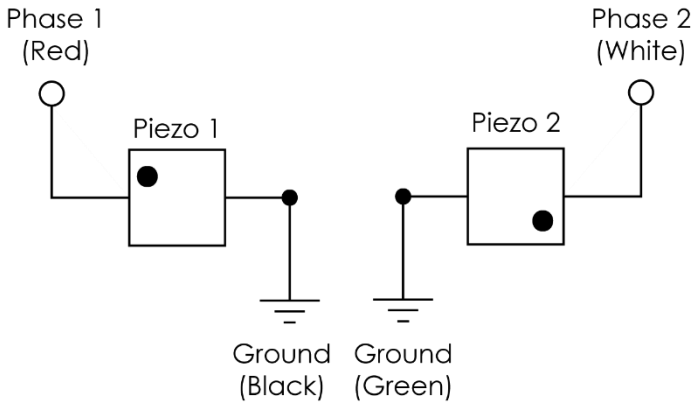
8.2 Units and Conversions

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

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

A. Appendix

A.1 2 Phase Piezo Motor Wiring Diagram

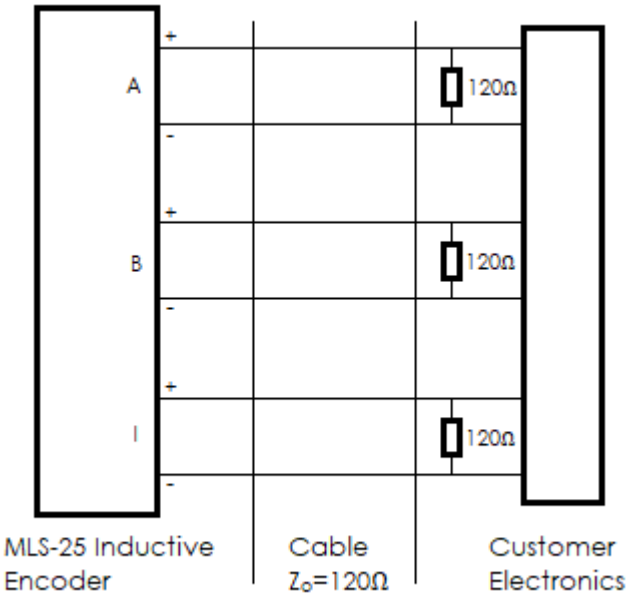


A.1.1 Piezo Operating and Electrical Specifications

Voltage	60V maximum
Capacitance	150nf ±15%
Operating Temperature	200°C maximum

A.2 Encoder Wiring Diagram

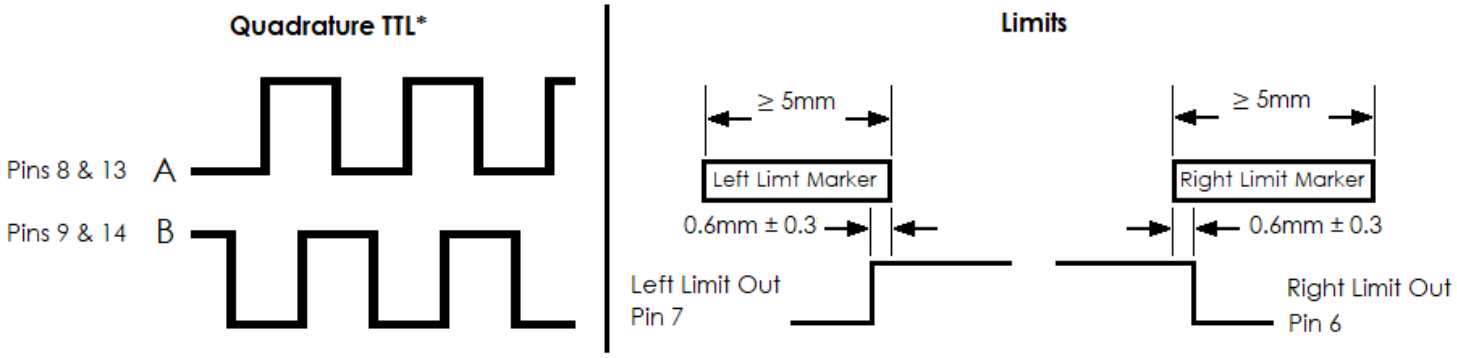
The MLS-25 will utilize an inductive encoder for position feedback, providing a robust solution free of possible light interference. Encoder resolution can be set as low as 18nm



A.2.1 Encoder and Limit Operating and Electrical Specifications

Power Supply	5VDC 5% @ 50mA (No outputs terminated) @80mA (A, B, I terminated) @20mA (sensor only)
Resolution	18nm to 150µm
Operating Temperature	-20 to 85°C
Humidity	10 – 90% RH non-condensing

A.2.2 Output Signals



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